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Reconstruction of the International Information Technology Standardisation Process within a Component-based Design Framework:

A Component based project development setting perspective

Thesis submitted for the degree of
Doctor of Philosophy

by

Theodora N. Ngosi

City University of London
School of Informatics
Department of Computing
Northampton Square
London EC1V 0HB
United Kingdom

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Researcher's prayer of wisdom

Keepers of the gates of wisdom, please let me in
to contribute lessons to leave for the learning;
that might learn from my research experiences & results.
Without blocking any blessings already granted from God,
I ask you for just one small miracle;
that I perform to the best of my capabilities in the time that God has given to me.
Amen.

Special Dedications

This thesis is dedicated with love and in recognition of the late Dr. John O. Jenkins, formerly of City University of London for his persistent encouragement, support and understanding. It was a pleasure working with a gentle dedicated scholar when everyone around me was creating unnecessary chaos. John's commitment and diplomacy to secure permission to study the projects examined in this research laid the foundation for the high quality results that this thesis presents.

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- JTC 1 SC 2, Character sets (project ISO 10646-1).
- JTC 1 SC 7, Software engineering (project ISO 12207).
- JTC 1 SC 29, Multimedia & hypermedia (projects ISO 10918 and ISO 11172)

I have a special indulgent acknowledgement of the standards organisations that generously allowed me to conduct this research, and showed great interest by providing me with information or contact points that supported my work in one way or another.

British Standard Institute (BSI).
European Workshop for Open Systems and Workgroups.
International Organisation for Standardisation (ISO)
International Electro-technical Commission (IEC).
ISO Joint Technical Committee for International IT Standards Development (JTC 1).
JTC 1 SC 2 administrative staff in the Secretariat in Geneva.
JTC 1 SC 7 administrative staff in the Secretariat in Canada (SCC).
JTC 1 SC 29 administrative staff in the secretariat in Japan (JISC).
JTC 1 SC 29 WG 11, administrative staff in the Secretariat in Italy (CELT).
Organisation Commune Europeenne de Normalisation (CEN and CENELEC).
Software Engineering Standards Committee of the IEEE Computer Society.

Declaration Statement

Abbreviations

AFDs	Activity Flow Diagrams
AFNOR	Association Francaise de Normalisation
ANSI	American National Standards Institute
BDDs	Business Dynamics Diagrams
BPR	Business Process Re-design
BSI	British Standards Institute
CBD	Component-based design
CEC	Commission for the European Communities
CEN	Comite Europeenne de Normalisation
CENELEC	Comite Europeenne de Normalisation Electrique
DFD	Data Flow Diagram
DTI	Department of Trade and Industry, UK
ECMA	European Computer Manufacturers' Association
EIA	Electrical Industries Association
EWOS	European Workshop for Open Systems
GATT	General Agreement of Tariffs and Trade
GIITS	Generic International Information Technology Standards
HTML	Hypertext Markup Language
ICT	Information and Communication Technology
IEEE	Institute of Electrical, Electronic and Engineering
IEC	International Electro-technical Commission
IISD	International Institute for Sustainable Development
IS	Information Systems
ISO	International Organisation for Standardisation
ISO LRPG	International Organisation for Standardisation-Long Range Planning Group
IT	Information Technology
IITS	International Information Technology Standardisation
ITSSR	Information Technology Standards and Standardization Research
ITU	International Telecommunications Union
ITU-R	International Telecommunications Union - Telecommunications Standards Sector of International Radio Communications
ITU-T	International Telecommunications Union -Telecommunications Standards Sector of the International Telecommunications Union
JBIG	Joint Bi-level Image Experts Group, ISO/IEC JTC 1/SC 29/WG 1
JTC 1	Joint Technical Committee, 1 of ISO IEC
JPEG	Photographic Experts Group, ISO IEC JTC 1/SC 29/WG 10
LAN	Local Area Network
MHEG	Multimedia and Hypermedia Expert Group, ISO IEC JTC 1/ SC 29/WG 12
MIS	Management Information Systems Quarterly
MITI	Ministry of International Trade and Industry
MK-I	(Mark-I) Intermediate Models-I
MK-II	(Mark-II) Intermediate Models-II
MPEG	Moving Pictures Expert Group, ISO IEC JTC 1/SC 29/WG 11

Abbreviations *(continued)*

NSB	National Standards Body
OIPT	Organization information processing theory
PDS	Project development setting (s)
PMI	Project Management Institute
SC	Sub-committee
SDO	Standards Development Organisations
SDLCP	Software Development Life Cycle Processes
SDS	Standards Development Setting (reconstructed project development setting of extant IITS process)
SE	Software Engineering
SES	Software Engineering Standardisation
SGFS	Special Group of Functional Standardisation
SLCP	Software Life Cycle Processes
SSM	Soft Systems Methodology
SUPRA	Scottish Universities Policy Research and Advice
TC	Technical Committee
WG	Working Group
XML	Extensible Mark-up Language

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Abstract

This thesis critically examines the international information technology standardisation (IITS) process. The core substance of this process is projects that develop or revise one or a cluster of related published international standards. Projects span several years embracing construction of technical concepts; discussions; writing of draft standards and negotiations to establish international agreements on common solutions or requirements. An IIT standard, once published, is a binding technical specification on organisations and industries.

Complexity of the IITS process is the phenomenon of interest. The argument is that, without reconstruction, complexity impedes successful project development. An open layered component-based design (CBD) approach lays the foundations of the reconstruction of the IITS process. This approach ensures reduction in sources of complexity to then, create solution options that can leverage performance capabilities.

Prior theoretical and empirical research has excluded the IITS process. A theory-driven empirical research grounded in organization information processing theory (OIPT) therefore strengthens theoretical and methodological foundations to analytically challenge IITS process complexity. Five empirically examined projects yield a definition of the IITS process. Customised as a lens, OIPT provides an integrative study of the IITS process through four levels: environment, content, performance and reconstruction. OIPT criteria strengthen the theoretical explication of complexity, ambiguity, dynamism, variety and uncertainty. OIPT dimensions influence methodological assessment of solution options, reconstruction actions and design of an autonomous component-based project development setting.

This thesis presents four contributions to the information systems (IS) community. First, Standards Documentation Setting (SDS) is the test case demonstrating the development of draft standards within an integrated CBD framework. Second, a life cycle of the reconstructed IITS process illustrates performance expectations. Third, an integrative solution framework demonstrates the reconstructed IITS process. Fourth, the evaluated research methodology addresses issues of inconsistency and dichotomy raised in IS literatures.

Key words: International IT standardisation process, project development, theory-driven empirical research, organization information processing theory lens, qualitative longitudinal case study, multiple case study approach, open layered component-based approach, process reconstruction, information systems, component-based project development settings

Chapter 1

Introduction to Thesis and Results

1.0 Chapter Synopsis

This thesis is original empirical work providing a comprehensive analysis and reconstruction of the international information technology standardisation (IITS) process. The research coincides with enduring debates to improve the IITS process. Very little empirical research exists on the IITS process. Virtually no prior theoretical or empirical research has been carried out to reconstruct this process. There is a large body of standards body of literature (such as King and Lyytinen, 2003; Rada, 1999; Severance, 1995) criticising the IITS process widely for lengthy time scales to produce IIT standards and because the process is considered inefficient

The thesis addresses these debates by providing an empirical definition of the current IITS process from five examined projects. Complexity of the IITS process is the phenomenon of interest. The defined IITS process is critically examined through an analytic framework grounded in organisational information processing theory (OIPT) as a lens. This analytic framework strengthens theoretical and methodological foundations to challenge IITS process complexity across four levels: its environment, content, performance and reconstruction. OIPT criteria strengthen explication of complexity, ambiguity, dynamism, variety and uncertainty of the variety of phenomena emerging from divergent IITS process practices.

The current IITS process has become too complex and entrenched for any conventional solutions to be effective. It is argued therefore that, open layered component-based design (CBD) is a proven approach that can capture the best solutions no other method can match. This researcher customises this CBD approach to develop **an open layered CBD framework** providing powerful reconstruction actions of the IITS process that can reduce sources of its complexity. Moreover, IITS process project development needs efficient practices. This CBD framework supports integrated functional and technical solutions. Consequently, the reconstruction actions also lay the foundation for creating solution options placed in the context of project development. This combination can be expected to enhance IITS process performance toward successful project development. This includes any embedded IITS process content features, performance contexts and practices.

This research fits into the information systems (IS) community by its use of IS research methods; by relevance of its subject matters and by its credibility to develop implementable results linking process functions to IS. It has, however, a connection to IT standards research, by its response to address criticisms evolving rapidly in the body of literature on this subject matter.

Figure 1-1 gives a summary of four important aspects underpinning this thesis: One, the IITS process and IITS project development are the focal aspects of study. Two, OIPT as a lens is applied to develop a theory-driven empirical research. Its qualities in this research share similar guidelines to those in Pettigrew (1997) and Weick (1995) involving grounding in theory which strengthens theoretical focus, theorising and explication of epistemological assumptions underpinning the research process and of the study of IITS process. Three, concepts adopted from CBD approach are customised to develop an open layered CBD framework within which the current IITS process is reconstructed and new designs are developed. Four, two main design results are, an autonomous component-based project development setting (PDS) and an integrative solution framework of the reconstructed IITS process. Both the PDS and the new IITS process operate in a distributed computing environment, thereby leveraging integrated solutions.

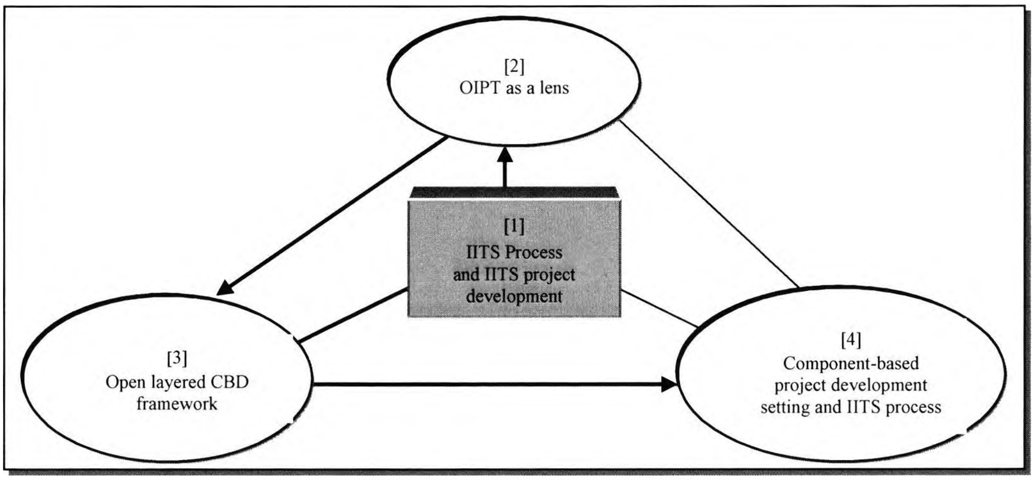


Figure 1-1: Main aspects of thesis
(Source: compiled by author)

This introductory chapter consolidates important aspects of the chosen area of research, methodology, treatment of the findings and their integration in this thesis. It discusses the core subject matters of this thesis (§1.1), followed by terms, definitions and concepts relevant to the investigation of the IITS process (§1.2). Current research on IITS is discussed (§1.3). Next, it gives separate outlines of the research (§1.4), scope of the thesis (§1.5), treatment of thesis questions (§1.6), main findings (§1.7) and contributions (§1.8). The thesis structure is defined (§1.9) and concluding with a summation link of this chapter (§1.10).

1.1 Thesis Subject Matters

1.1.1 Background

Extant IT market climate is one of globalisation of firms to create and to gain sustainable competitive advantage; to be the best in the world, rather than just control or expand markets over rivals (cf. Porter, 1998). The utilisation of IT systems as products or for services in a given context, can present the risk of competing requirements, solutions and problems. Standards are developed where there is this potential systemic risk.

David (1995:22) argues that, having dependable standards is one way to make it simpler for all parties to recognise what is being dealt with. The basic principle of standards is, therefore, to represent the best possible solution to a problem in a given context. For example, ensuring a level of uniformity in many products, providing binding regulations on issues emerging from IT market segments are some of the core elements of solutions for the development of technology that delivers real results.

The reasoning of IT market dynamics propels many IITS efforts. Technology and market scenarios pull together arguments of the implementation value of the standards that are perceived in the IITS process. Standardised methods, for example, have become 'the benchmark of excellence' in digital multimedia (Gibson *et al.* 1998; Pennebaker and Mitchell, 1993) and electronic data interchange applications (Chiu, 2002).

An IIT standard would offer guidelines, as to how standardised methods can be applied, because it deals with varieties of industry needs or legislative matters. Standardised methods address not only simplification of data compression, but also the need for combining techniques that can provide common repeatable solutions expressed in business terminology. When applied in different sectors, standardised methods become more innovative. Different manufacturers can customise these methods to create supersets of applications. The benefits may be realised in the manufacturing process as measurable quality in the products produced and product differentiation which increases consumer choices presented in the marketplace hence.

At present, standards development organisations (SDOs) such as the International Electro-technical Commission (IEC) and International Standards Organization (ISO) provide a forum for the development of IIT standards within the Joint Technical Committee (JTC 1). These SDOs have the *societal responsibility* to respond to demands from various interested parties (often labelled standards stakeholders) that bring their products, requirements or solutions to be standardised. SDOs are regulated through acts of governing bodies and policies. The standards, however, are free from the political interests of the SDOs, governing bodies or parties that have vested interest in the standards.

Standards stakeholders have direct or indirect relationship with diverse IT market sectors globally. As such, they pursue their aims in the IITS process to examine technology problems and to define common solutions. Major stakeholders cover IT firms (manufacturers and vendors), user groups of associated industries, government agencies, and professional and research organisations (De Vries and Verheul, 2003; Jakobs, 2000). By participating in the IITS process, these stakeholders stand to gain from the development and eventual implementation of the published IIT standard.

While this is 'what the IITS process is concerned with', it has no particular framework that has been defined in the extant literatures. There are topical debates in the standards and IS communities that the IITS process needs to be more agile, so that it can respond to the growing technology issues from global IT markets, and to also attend to the dynamics of IT standardisation (cf. Blind, 2005, Jakobs, 2000; Rada, 1999).

The complexity of the IITS process is another topical concern debated widely. This complexity has become a **liability** to the strategic challenges faced by SDOs. Enduring challenges for SDOs are to produce not only timely standards, but also to make provision for information and technology that can deliver real value in IITS process performance. Standards developers (known hereafter as developers) face the difficulty of how to develop any particular project in a synergistic or cost-effective manner. Keen (1997:16) makes an important point relevant to summarise these implications of IITS process complexity:

> Processes that return more money to the firm than they cost in terms of capital are assets; processes that cost more than they return are liabilities.

1.1.2 Scope of Subject Matters

As a holistic appreciation, the overall aim of this research has been to empirically establish how IITS projects are developed. Five projects are examined which are selected from two separate domains, namely GIITS and SES. The projects, ISO 10646-1, ISO 10918 (JPEG-1), ISO 11172 (MPEG-1), IEEE 1074 and ISO 12207-1 satisfied well-considered criteria involving solution proposal; topical and critical, intensity, deviant, contrast and convenience (see §3.6.3).

This thesis focuses on five subject matters carried forward from the empirical findings and reviewed literatures. They are IIT standards; IITS process analysis and reconstruction; project development; and, design of solutions and IS. In brief, the IITS process is defined from the similarities located in the empirical case evidence of the five projects. The thesis critically examines an empirically defined IITS process, followed by its reconstruction within a CBD framework. The results include specifications of a component-based PDS and of the reconstructed IITS process. Solutions for the reconstructed IITS process are described in great detail. Capabilities for the success of project development and for the enhancement of IITS process performance are defined.

1.1.3 Thesis Topic

In pulling together these introductory issues, the main topic of this thesis is the reconstruction of core aspects of the IITS process within a component-based design (CBD) framework.

1.1.4 Problem Statement

The question posed with reference to the thesis topic is: 'Why reconstruct the IITS process? The response is an empirically determined problem statement that includes its details and extended implications:

> The complexity of the current IITS process is out control to appreciate a specifiable phenomenon. It is beyond the use of conventional solution approaches, because there are several evolving sets of interlocking issues, constraints and consequences requiring radical attention for developing imperative solutions.

In keeping with Simon (1996: 184) a complex system is made up a large number of parts that interact in a non-simple way. Simon further connects complexity to behaviour over time, and of the environment in which a system might be connected to. Against this definition, the empirical evidence suggests that the complexity of the IITS process is associated with its ubiquitous features, practices and multi-dimensional performance contexts. This process is embedded in the functioning of the IITS environment consisting of SDOs, NSBs, committees and stakeholders.

During project development, organisations, people, practices, processes and changes interact in a dynamic and non-linear fashion (cf. Cilliers, 1998). More so, the IITS process has prominent constraints resting on its performance: such as, SDO policies, demands from stakeholders, information, scientific methods used in project development and obligations to global concerns.

Over time, these elements form evolving sets of inter-linked issues and consequences that may be unintended. Rittel and Webber (1984) came up with the concept that design problems are *wicked problems* and fundamentally different from the well-defined problems of science. Potentially, an implication of the complexity of the IITS process accords to *wicked problems* described as contradictory and messy. Solutions to them are often difficult to recognise (cf. Conklin and Weil, 1997, Conklin, 2006; Rittel and Webber, 1984). For now, IITS process performance can be summarised as difficult to describe, predict, manage or verify because of complex interdependencies among its features.

1.1.5 Solution Proposal

The position taken in this thesis is to define a solution proposal that places into perspective, the central arguments for dealing with IITS process complexity. A relevant premise that Rittel and Webber (1973) use in dealing with *wicked problems* is that, 'you don't understand the problem until you have developed a solution'. There are sufficient grounds to suggest that IITS process the complexity conceals cross cutting issues. In this introductory chapter, this researcher prefers not to give a detailed breakdown of these concerns, because the specific challenges of this complexity have yet to be defined.

Furthermore, solutions are possible if the right kind of approach is defined to understand and to address how IITS process complexity could be resolved. The solution proposal should also fit in the context of IITS process. Based upon this judgement, open layered CBD representation is the choice of solution proposal (see Figure 1-2).

With this solution proposal, the focus is on explicating, through analytical mechanisms, why how reconstruction would be a solution to resolve IITS process complexity, leading to a component-based PDS. The fully defined intentions of this solution proposal (Figure 3-4) added depth to the to selection of the five projects examined in the empirical case study (see §3.6.3). Two notable intentions were defined as:

[a] To develop project development that can give special prominence to the core aspects of the IITS process.

[b] To harness solutions that will be part of the practices to which the five projects would be referenced.

1.1.6 Thesis Goals

There are two integrative goals:

Goal #1: To reconstruct the IITS process and create a component-based project development setting.

To demonstrate this goal, **the Standards Documentation Setting (SDS)** is created as a test case. In brief, the SDS will function as a self-contained autonomous component-based PDS. Core functions of the SDS are the development of draft standards and any other relevant IITS process deliverable items. It addresses specific issues of independent life cycles for each draft standard, intensive information gathering, communication, collaboration of actions and technical development of projects (Chapters 6, 7).

Goal #2: To define an integrative solution framework of the reconstructed IITS process.

In this goal, **an integrative solution framework** completes the features of the reconstructed IITS process. This goal aligns with the fact that this research has a CBD framework, as a solution proposal guiding the investigation toward component-based PDS.

Once reconstruction is carried out to create the SDS, this leaves *a gap* in the content of the IITS process. The potential risks can be unconnected features and inconsistency in the delivering performance results. Consequently, this integrative solution framework is a resolution of the reconstructed IITS process. It attempts to unify different concepts of the expected operational performance of the reconstructed IITS process. It enhances explication of the discussion of solutions, and their expectations in the new IITS process (Chapter 8).

1.2 Terms, Definitions and Concepts

1.2.1 Summary

The reconstruction of the IITS process utilising a CBD framework is a challenging one. Key terms are defined covering IITS process, project development, IIT standards, reconstruction and CBD approach. The definitions help to construct major concepts underpinning treatment of these subject matters, and terminology relevant to this thesis.

1.2.2 Terminology for IITS Process

SDOs and NSBs are co-operative organisations that guide the development of IITS projects and approve IIT standards according to formal agreements. Because of this reference to organisations, in this thesis the IITS process is examined as an organisation process. This decision gives a more appropriate focus to define the IITS process from different perspectives of the functioning of organisations, which may also, address highly critical concerns. Three perspectives are purpose, content, performance and functional.

Purpose perspective: The core substance of the IITS process is projects that develop or revise one or a cluster of related IIT standards (cf. Cargill, 1989; De Vries and Verheul, 2003). This thesis shows that, a process engaged in project development can create entwined purposes. It becomes difficult to distinguish between the process and project development. Scholarly works by Archibald (1992, 2003), Bessant and Francis (1997) and Gelès *et al.* (2000), for example, offer insights into what constitutes project development, product-development programs and teams that develop projects. In this perspective, understanding the purpose of the IITS process describes what it does or why it exists.

Content perspective: A wide range of literatures describe the general content of a process as a collection of activities performed across groups of people or organisation functions (cf. Davenport, 1993; Humphrey, 1989, Johann, 1995). For many organisations, process content includes its broad range of assets. IITS process assets cover information, management responsibilities, projects, stakeholders, technology and standards as products. Examining the process content perspective therefore aims to describe details linking purpose (what the process does) and unique features (what the process has) which combined bring continuity the execution of its defined performance strategy.

Performance perspective: This looks at the IITS process through the lens of a project development. Typically, a project development cycle depicts the dynamic interplay of executed human actions, changes, interactions, practices and processes for transforming certain inputs into a desired result. These elements are akin to performance characteristics upon the purpose of the IITS process would be referenced in the accomplishment of an overall goal, over time (cf. Dorfman and Thayer, 1990).

Functional perspective: This is the status of a process akin to how it performs in relationship with other components in the organisation. Clark (1999), Ostroff (1999) and, Rummler and Brache (1995) describe an organisation process as one that cuts across the hierarchy of functional structures or levels. The IITS process especially, executes its actions through clearly identifiable functional levels. These are SDOs (strategic), NSBs (operational and tactical) and committees (technical). This perspective is therefore important to pull together core elements of the typology of organisational issues, such as practices that might impact on project development and delivery of results.

1.2.3 Project Development

Scholarly works such as Archibald (1992), Project Management Institute Standards Committee (1996), Kerzner (1998) and Mankin *et al.* (1996) seem to agree on a similar definition:

> A project is unique to a company or organisation. It can be integrated into certain business or organisation processes as an endeavour carried out under definable objectives, resources, time, cost and quality constraints.

Drawing upon this definition, the IITS process develops projects that have the uniqueness to respond to technology and legislation issues evolving from business, industry and IT market, globally. Within this cope of issues, constraints bearing on each project are several. Important items that encourage framing of IITS process project development are expertise, stages, stakeholders and procedures.

Expertise: Each project approved by SDOs is assigned to a committee with collective expertise of a specified subject matter relating to its development. Individual developers come from business, core sciences, industry, management and research backgrounds.

Stages and outcomes: Project go through development stages that span several years. Each stage yields a draft standard as an interim result that is evaluated through ballots to establish consensus agreements among participating parties.

Stakeholders: IITS creates a multi-stakeholder environment. Without stakeholders or their contributions IITS projects can not be developed. Influential stakeholders can direct the development of the project, in favour of the objectives that their firms pursue in the IT market (cf. Axelrod *et al.* 1997).

Procedures: Committees observe SDO procedures specified as directives (http://www.iso.org/directives). In addition, scientific methods offer underpinning procedures and practices associated with the project problem space, as well as, how the project is developed. Each project yields an IIT standard that has to pass certain rules specified in the ISO IEC directives (2004:11-12), for example:

> **Homogeneity:** Uniformity of structure, of style and of terminology shall be maintained not only within each document, but also within a series of associated documents.
> **Consistency:** clear and accurate documents in standardised terminology, principles and methods of terminology, conformity and quality.
> **Fitness** for implementation as a regional or national standard.

1.2.4 Terms for IIT Standard

Terminology for IIT standard covers its development, specification and implementation.

Development: An IITS process project is designed to examine actual or potential problems and requirements for very complex IT systems. A project is completed when an IIT standard is published.

Specification: An IIT standard is a publicly available technical document or specification recommended by the consensus of experts and interested parties. It describes common criteria for physical and technical characteristics of computing systems or best practice for a process. It can include essential requirements, model solutions for implementation or performance conditions (cf. Hawkins, 1995:1).

Internationalised regulations are specified in the standard as binding criteria to be adhered to by a producer, either tacitly or as a result of a formal agreement (David, 1995: 4). Such regulations ensure that IT products or services available to global markets have characteristics of cultural and linguistic adaptability, dependability of performance, interoperability and portability (David, 1995; ISO IEC, 2004; Katsoulakos, 1993). If relevant, binding criteria involving compatibility of systems products or conformity to commonly perceived requirements is specified in the IIT standard.

Implementation: The implication of an IIT standard is its implementation value in business, industry and organisations that develop IT products or services. In recent years, standards involving ISO 10918, JPEG-1 (1994) and ISO 11172, MPEG-1 (1993) raised the bar by creating highly commercial and competitive global IT market segments for multimedia technologies. Their successes are linked to areas, such as broadcasting, communication, education, entertainment and, digital library and Internet technologies (Furht, 1998; Chiariglione, 1998; Lesk, 1998).

An empirical definition of IITS process from this research that highlights its important theme underpinning its content is as follows:

> The IITS process relies on the unique knowledge and skills of various parties to develop highly technical projects resulting in specifications that can be expected to guide the development of technology products, services and market segments. The process can be delineated into a series of stages evolving over time in response to inputs, practices and procedures for the execution of well-established tasks. Each completed stage yields a draft standard requiring consensus agreements among the parties that develop the project, leading to an IIT standard maintained through an accredited SDO.
>
> (Source: author's definition)

1.2.5 Concepts and Terms of Process Reconstruction

This researcher proposed reconstruction on specified core aspects of the IITS process. A core aspect can now be established as a concept of the IITS process that is exclusive to its performance. This concept strongly encourages close attention to project development issues, in terms of content, context, practices and their relationship to outcomes. In this thesis, documentation of draft standards and consensus seeking ballots have been identified as core aspects.

The core aspects have specifiable features and complete cycles of performance. This suggests that they are capable of functioning exclusively. With specifiable features, therefore, it is possible for such core aspects to be reconstructed. By using a CBD framework in the reconstruction exercise, the core aspects can be autonomous PDS that also reduce the complexity of IITS process across its spectrum of performance. Moreover, an autonomous component-based PDS is self-contained with an individualised content (such as actors, users, inputs, objectives and needs), IS resources and operational scope (such as processes, practices, procedures and outcomes). Defined as such, a PDS fulfils only the requirements of one aspect of the IITS process, and not a combination of several ones.

Against this, scholarly works on process improvement approaches provide motivation for defining terms that apply to the reconstruction of the IITS process. The base concepts are taken from reengineering, redesign and team designs, as follows:

Reengineering employs an 'obliteration approach' or complete reconfiguration a process (Davenport, 1993, 1998; Hammer and Champy, 1994). **Redesign** says, address process problems, drive change rapidly by creating solutions, ensuring improvement in those areas that can deliver measurable results to the business (cf. Braganza, 2001, Johann, 1995; Kock and Murphy, 2001). Another approach is to **design processes and teams around projects**, as key to organisational success. Galbraith (1994), Mohrman *et al.* (1995) and Stewart (1997) argue that, when teams are organised around resources they can increase their focus to co-ordinate and to integrate complex geographically dispersed activities.

Empirical evidence from this research suggests IITS process as possessing far greater complexity challenges yet to overcome (see §1.1.4). Reconstruction is taken on its own merit as a pro-active approach to address untamed challenges. In addition, a CBD is in its own right an approach. Together, reconstruction of core aspects of the IITS process within a CBD framework develops stronger focus on how to create the content of an autonomous component-based PDS, and how to reason solution options for its operational scope. Thus, exclusive definitions for reconstruction and project development setting described next illustrate these important themes of this thesis:

> [1] Reconstruction is the means to reduce sources of complexity and uncertainty in order to adequately address critical issues in the problem space of IITS process performance. A CBD framework helps with reasoning the reconstruction actions, to include design creation of the project development setting; extensive elimination of excessive features and definition of the functional intent necessary to harness solutions that can bring valuable performance capabilities.
>
> (Source: author's definition).

> [2] A project development setting is an autonomous component-based unit representing a reconstructed core aspect of the IITS process. It fulfils only its stated objectives, operational content and requirements, and not several others. It has as its primary significance, greater transparency of project development to the committees; lateral management and integrated functions.
>
> (Source: author's definition).

1.2.6 Concepts and Terms of CDB Approach

Component-based design approaches are solidly founded on mature on mature, evolutionary and revolutionary concepts in computing technologies. Exclusive areas of their application cover component-based or aspect orientated software development (Szyperski, 1998; 2000), programming (Booch 1987) and software architectures (Bass *et al.* 1997; Malan and Bredemeyer, 2002). More recently, however, CBD approaches have been extended and customised to business processes. Three definitions taken from Allen (2001), Herzum and Sims (2000) and Veryard (2000) support business application contexts:

> [1] Business component A particular type of component that offers services that provide business capability through its interfaces (Allen, 2001:8).

[2] A business component represents and implements a business concept or business process. It doesn't represent just any business concept, but those concepts that are relatively autonomous in the problem space..."Autonomous" does not mean isolated. As business concepts in the problem space relate to other concepts, for example an order by a certain customer for one or more items, so business components mainly provide useful functionalities through collaboration with other business components (Herzum and Sims, 2000: 41).

[3] Component-based business means creating a business operation or process by connecting "components" together from different sources (Veryard, 2000: 16).

In these definitions, the results of component-based designs in business processes can bring enhanced capability to deliver a number of solutions to identifiable performance problems. The variety of other business areas using these CBD approaches include e-commerce enterprises for sets of services (Allen, 2001; Fingar *et al.* 2000); distributed process workflow (Kammer, 2000); systems integration (Adler, 1995; Davenport, 1998; Krieger and Adler, 1998) and finance sector (Sprott, 2000).

Drawing upon these reviewed literatures, the approaches are being divided into design and development of components from scratch for specific. In design and development 'component-based' has been defined as:

> It involves a range of a range of provisioning strategies of which development is one. There is emphasis on market awareness of available components (Allen, 2001:9).

On similar lines, Whitehead (2002:186) explicates component-based development as:

> It is the process of building and delivering applications that are built using components through a combination of purchase, reuse, reengineering, and new development of components, followed by their assembly into applications. CBD requires a planned development strategy to ensure that the components used will fit together successfully.

In software and systems areas, however, the trend is toward deployment of components. This may evolve from design or from adaptation of purchased components to organisation implementations and integration (Allen and Frost, 1997; Brown, 2000; Szyperski, 2000). According to Szyperski (2000: 1-3), if the choice is component-based design or component-based development approach, the arguments that motivate their use need to be make clear.

1.2.7 Arguments for IITS Process CBD Approach

Findings of the analytic evaluation of the extant IITS process suggest that, it embraces multidimensional contexts of complexity imposing a great variety of other phenomena (see §7.3). Simplifying traditional process contexts and implementing layers of sophisticated systems to automate the past are soft options that can no longer be considered. Using a CBD approach to reconstruct the IITS process is the solution.

However, this researcher realises the danger to fall for the hype of CBD approaches that are adopted in dimensionally different area such as business, software and systems literatures mentioned above. It is argued hence, the decision to adopt a CBD approach to reconstruct the IITS process requires relevant concepts or principles, and setting boundaries in which they can be applied. Sensitising of concepts (Blumer, 1986) is applied here to conceptualise features (concepts or principles) that can be customised effectively to create a CBD framework for the IITS process. This sensitising of concepts is delineated from three key arguments described by Szyperski (2000: 1-3) as baseline, enterprise and dynamic computing. Szyperski (2000) applies three key arguments described in the section that follows this: **baseline** (component-based solutions), **enterprise** (creating a systems infrastructure) and **dynamic computing** (systems challenges).

[1] Baseline argument

Szyperski suggests that component-based solutions can combine acquired and purpose-created components. This argument applies to the IITS process for the explicit aim is to reconstruct its core aspects within a CBD framework so as to create a component-based project development setting. This is, in itself a solution, because the CBD framework draws attention to an array of well-established concepts for reducing different kinds of evaluated contexts of IITS process complexity. Typically, autonomy of the project development setting has the advantage to introduce transparency of project development. This is because the setting is designed for a specific purpose, with features highlighting its functions in this respect.

[2] Enterprise argument

This argument embodies configuring a core set of components or integrating systems products (hardware and software) within an enterprise setting (cf. Szyperski, 2000:3). In general, enterprise is widely associated with types of organisations involving business or corporations (Allen, 2001; Cleland, 1996; Porter, 1998), government bodies and non-profit institutions (Bryson *et al.* 2001). Organisations purchase systems products manufactured by different kinds of vendors (cf. Davenport, 1998). A requirement for the use of the systems is that they adhere to a consistent fit into the organisation's components, such as functions, processes and customer interfaces.

For the IITS process, this researcher finds that this enterprise argument has two other meanings: functional and IS infrastructure.

One, **functionally,** environment is a fitting term for the IITS process. This is from the fact that the functioning of the extant IITS process greatly relies on co-operation between SDOs, NSBs, committees and stakeholders, together forming its environment (see §5.3). Reconstructing the IITS process within a CBD framework creates autonomous functionality for a specified component-based PDS. At the same time, each component-based PDS will continue its association with the reconstructed IITS process. By this association, it can be expected to keep some key elements of the IITS environment and IITS process. This ensures a level of certainty to align the PDS to relevant perspectives, such as purpose, content, functions and performance perspectives (see §1.2.2).

Two, a CBD approach also creates an **IS infrastructure** for the reconstructed IITS process. An empirical study on Web Service adoption (Hackney *et al.* 2006) provide insightful operationalisation of an IS infrastructure in the reconstruction of the IITS process. The considerations are the different contexts in which the IITS process functions, such as: external environment, organisation's internal environment and technological (see §3.5.4, Hackney *et al.* 2006). On the one hand, the reconstruction of the IITS process with a CBD framework takes on *'environment and organisation contexts'* to organise required functionality of its new features. On the other hand, functionality of the new features can only be addressed in the *technological context* that, they are enabled to perform effectively.

To operationalise an IS infrastructure hence, a CBD approach has the capability to increase the use of IS resources for integration of independent features and for 'fit' of function. Both integration and 'fit' of function is the degree to which characteristics of an innovation match the current technological setting or IS infrastructure of an organisation (cf. Doty *et al.* 1993; Hackney *et al.* 2006).

In the enterprise argument for functionality and IS infrastructure, these connections clearly suggest that, there are many challenges to be considered in reconstructing the IITS process. Attention is given to the appropriateness of the choice of CBD approach that can effectively address the perceived phenomena of IITS process complexity to which the reconstruction actions can be referenced. Two example questions to be addressed here are:

Which type of CBD concepts *fit* its performance contexts?

Which *views* of the IITS process *fit* its purpose and scope of functioning?

Views that respond to these questions are illustrated in Table 3:4 (Contexts and views of CBD solution proposal), such as structural, functional and management. These views in Table 3:4 suggest the need to understand contexts in which the reconstructed IITS process and autonomous component-based PDS are expected to function, when sources of complexity has been dealt with. In this respect, the reasoning of the reconstruction actions would demonstrate the *'fit' to function,* by the representation of a proposed solution, and by defined contexts drawn from the CBD framework.

[3] Dynamic computing argument

In this final argument, the scope and content of use of IS resources can be dynamically extended to meet new requirements on demand (cf. Szyperski, 2000:3). The IITS process depends upon collaborative activities that embody communication, co-ordination and flow of information in various operations. A CBD approach offers scalable capability to expand the use of different types of IS resources.

The Internet used a core technology, for example, can be extended to scalable interface approaches in the form of data or information repositories (Adler, 1995; Kock and McQueen, 1996). Through these repositories, committees can resolve multiple project development actions that they perform as a matter-of-fact, such as communication, co-ordination, processing, information management and exchange. In this respect, a CBD approach offers the following capabilities:

> ...implement protocols to connecting participating components and enforce some of the policies governing the use of mechanisms that are used by the framework itself are not necessarily fixed. Instead, they are left to higher-level architectures (cf. Szyperski, 2000:15).

1.2.8 Terms for CBD Framework for IITS Process

The arguments described above show that CBD approach applied in a process context is itself complicated. It can include various other considerations, such as business goals; and methods for modelling and designing of process concepts, functions features and IS architectures. This researcher therefore takes sensitised concepts, to place the CBD arguments described in the context of the IITS process. This is how *a CBD framework* has been developed for the reconstruction of the IITS process.

Scholarly works on design methods (such as Adler, 1995; Lee, 1997; Moran and Carroll, 1995; Starkey 1992) encouraging clarity of the dominating concepts and terms of reference to fit into this CBD framework. They are design representation, design choice, design rationale, reconstruction and solutions. Furthermore, design factors bearing on the 'enterprise and dynamic arguments,' such as functional contexts and views require greater judgement and interpretation. These factors address the challenges of the IITS process. They ensure appropriate representation of the proposed IITS process component-based PDS, drawing upon assessed functional contexts and views.

[1] Design representation

To reconstruct the IITS process is to unravel its various features, performance contexts and other items that support it. Creating a new design from scratch is high risk, because of the complex nature of the IITS process. In design terms, the approach is to adopt the *baseline argument* (Szyperski, 2000). A CBD approach provides a baseline design strategy, which encourages representation for defining the structure and content creation of the core aspects of the IITS process to be reconstructed. For example, how different types of features can be put together to create a project development setting and to add depth in defining functional concepts and intentions (cf. Lee, 1997).

[2] Design choice

The perceived phenomena of IITS process complexity suggests considerations for the enterprise and dynamic computing arguments (Szyperski, 2000). An open layered CBD approach is an appropriate design choice (cf. Herzum and Sims, 2000: 176-168). **Figure 1-2** that follows next, gives a simplified representation of how the Standards Development Setting (SDS), as an example project development setting, can be structured within an open layered CBD framework.

Primarily, layering addresses a *structural view* supporting the *content creation* of the component-based project development setting. Two or more layers can be used to frame levels of abstraction of the desired structure and content of the design. Another design factor is the *emergent contexts* (Hackney *et al.* 2006) from the dynamic interplay of IITS process content elements and performance contexts, over time.

As Figure 1-2 shows, the *contexts* in which a draft standard is developed in the SDS can be represented *as layers* of distinctive *functions* aligned with committee actions: such as, information gathering, document processing and project editor's draft collation tasks. Layering helps to parameterise key content features and function categories shaping the design representation hence.

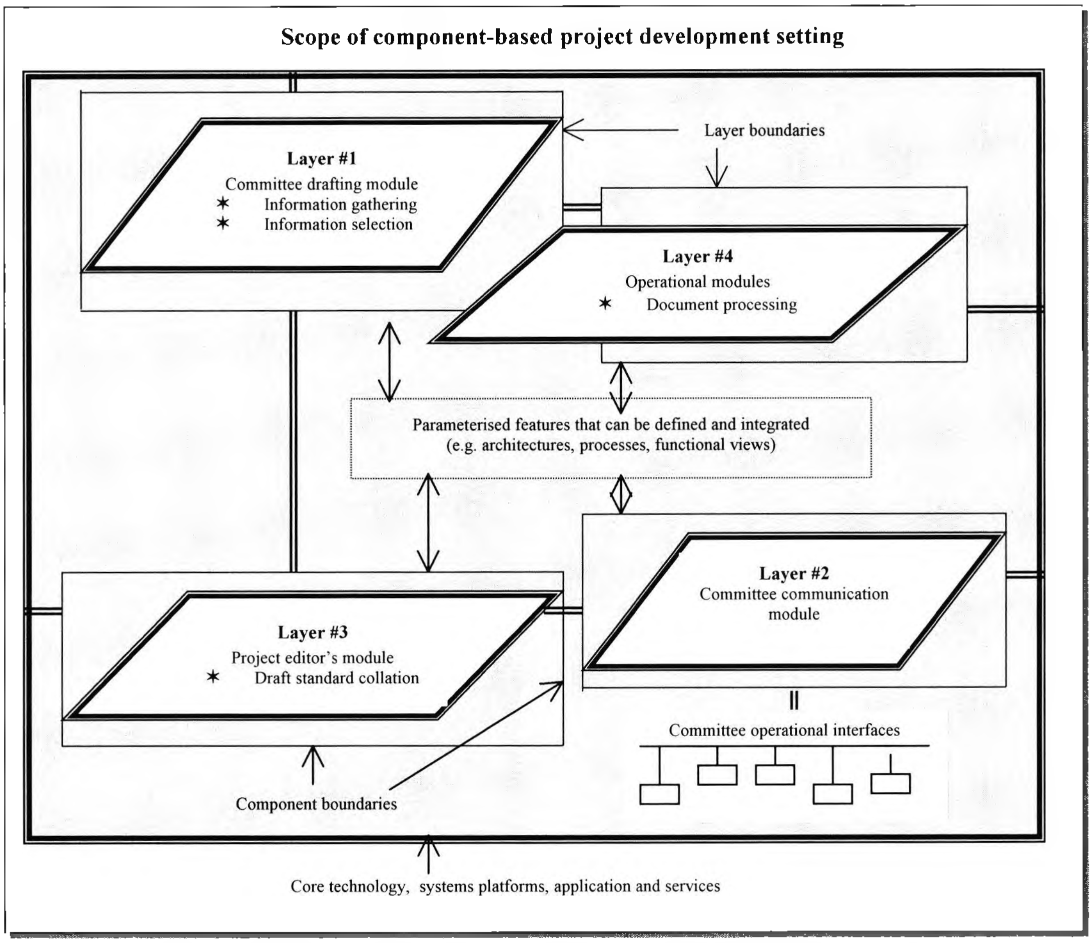


Figure 1-2: Representation of Open-Layered CBD Framework
(Source: compiled by author)

[3] Design rationale

In this thesis design rationale helps to reason the purpose of the intended design. It lays the foundation for defining the design structure, its content features and functional factors. As in Figure 1-2, when working with an open-layered CBD representation, the design rationale utilises the **partitioning principle** (cf. Adler, 1995; Herzum and Sims, 2000). This means, the design can be partitioned so that it is possible to assign influential features and contexts that must be included in the open-layered CBD framework.

While dynamic features may not all be captured in a static design or 'paper-based' design, the required layers are. Once the partitioning principle is chosen, design rationale makes transparent the functional intent of the design. Solution options can be developed for the design structure strategy, basic requirements for its content and performance contexts. Moreover, rationale includes managing decisions that can influence the development of the relationships required in the design, for example: interdependencies between different layers, their features and contextual constraints for the use of IS resource (cf. Lee, 1997; Moran and Carroll. 1995).

[4] Reconstruction

Design representation and rationale enhance reasoning of the reconstruction actions. The definition of the content of a PDS is achieved through structured analysis: eliminating redundant features and clarifying operational details simultaneously (see §1.6.3).

[5] Solutions

Working with a CBD representation supports baseline argument for deciding solution choices (Szyperski, 2000). Content assignments are developed in the design. They take into account dimensions within which solutions must fit (cf. Starkey, 1992), together with functional views in which to identify solutions that are possible. Especially, IITS process project development has unique details where the solutions need to be parameterised in the CBD design alongside content features and IS integration.

1.3 Research on IITS

1.3.1 Current Topics

This research is embedded in the body of knowledge on IT standardisation by reference to IITS process as the object of study. The starting point is to draw upon the literature review about IT standardisation. Research on IIIT standards is being carried out in four areas: economics, ICT, ITSSR and IS.

The economics domain has had its focus on applying the economic theory to the adoption of published IT standards in business, organisation or industry context for which they are designed. There is a reasonably large body of literature (such as Besen and Johnson, 1986; Besen and Farrell, 1994; David and Greenstein, 1990; Katz and Shapiro, 1985, 1994; Farrell, 1985; Gandal, 2002).

The interpretation of adoption or eventual implementation of the standard, judged upon its network effects: a positive correlation between the number of users of a standard, its utility function, market and economic impacts (Farrell and Saloner, 1986; Katz and Shapiro, 1985). However, the development of IT standards is not connected directly to implementation nor is it purely based on economic impacts. Indeed, Cargill (1989: 4-5) makes this point:

> True, a set of literature examines the economic justification for standards, and for that matter, this justification is used increasingly to spur the rush to standards. But the economic model describes one attribute of the standards process and discipline, not the thing itself. Indeed, very few standards decisions are made from a purely rational economic viewpoint-while it is pleasant to claim that standards are the fruit of quantitative economic roots, it is also highly suspect and more than a little naive.

The development and implementation of IT standards have accelerated over the past twenty years. This has opened up research studies on IT standards and a wide range of growing literatures across the four areas. Topical issues that have received much attention are institutional frameworks of IITS, which are central to the forms of complexity that exist with project development.

This covers *SDO structures and operations* (Cargill, 1989; Jakobs, 2000; Ngosi and Jenkins, 1993; Zhao *et al.* 2005); *committees* (Cargill, 1989; Foray, 1995); *process of standardisation* (Cargill, 1989,1995; Baron, 1995) Berg and Schummy, 1990; Chiesa *et al.* 2002) and *stakeholders* (Brunsson *et al.* 2002; De Vries and Verheul, 2003; Jacobs *et al.* 2001; Leiss, 1995). Jakobs (2000: 8) summaries one of the reasons for discussing these features of the IITS institutional framework:

> The process of standardization cannot be regarded as a simple, one-dimensional activity to lay down technical rules and guidelines, taking place in a removed world of its own. Rather, it must be considered in conjunction with the environment within which it takes place. Very different facets need to be taken into account when trying to actually understand this process.

1.3.2 Current Topical Debates

Evolving research studies mention a number of criticisms that encumber the creation of IIT standards. These criticisms can be categorised into implementers (industry), practitioners and researchers.

In the first category, the implementers of IT standards are industry and organisations. Industry argues that IIT standards bring sustained value to expand trade and markets. The changes in technology and IT markets need to be comparable to effective standardisation, in order to meet their needs to implement IT standards. Compared to the rapid rate of technical progress in areas, such as web services where the underlying technologies are still evolving, SDOs are slow to react to technological changes (cf. Gosain, 2003: 12).

In the second category, the implementers of IT standards often are practitioners that take part in the development of the projects either as committee members, stakeholders or other interested parties. Practitioners also criticise the IITS process as being slow and inefficient. Weiss and Cargill (1992) and Farrell (1996) indicate how SDOs are perceived as slow to produce solutions that go against the interests of some members, because they necessarily include groups with divergent interests. It has been suggested that SDOs are also less responsive to IT market needs compared to industry-based consortia, because of excessive formalities (cf. Mähönen, 2000; Rada, 1999; Sherif, 2003). Other enduring criticisms rest on time-wasting procedures, politics and policies, instead of the task of creating standards that the users need (cf. Severance, 1995).

In the third category, are researchers. Because of diversity in IITS subject matters and their selection for study a number of provocative issues are emerging. Three examples are from MISQ and Standards Colloquium.

One, in the aims and scope of the MISQ Special Issue on Standard Making, King Lyytinen (2003: iii) highlight that:

> Firms that create successful standards can seize significant competitive advantage, while firms that are locked out of standardization process, or remain laggards in utilizing the standards face difficulties. Standard choice and the implementation of standards have also become a critical part of managing the IS function and developing software. At the same time traditional institutional forms of standardizing (standard developing organizations, SDOs) have become rife with problems, and the scope, pace and success rate of standardization processes has changed drastically rendering uncertainty and new opportunities for different stakeholders.

Two, a separate Standards Colloquium reports on concerns raised by Cargill. The criticism being, the existing standardisation regimes are old and not prepared to address today's IT problems and that a more innovative approach to standardisation is required (Krechmer, 2005: 87).

Three, in MISQ Special Issues, Jacucci *et al.* (2003) and Hanseth *et al.* (2006), on a similar topic, describe in some detail, the complexity of the standardisation effort for an electronic patient record systems. They perceive the standardisation effort from technical and social perspectives that include the complexity standards development processes in general.

1.3.3 Rebuttal to Current Debates

Categorically, IT standards researchers are producing varied criticisms that may be valid. These criticisms must be treated respectfully in the area in which they apply. The reason for highlighting this is from the fact that research on IITS is covering a number of subdivisions, each one with different problems to be examined.

Three prominent subdivisions in the reviewed body of literature are studies on open, sector and vertical standards (Table 2-3: Literature classifications of IT standards). The studies address business problems unique to particular industries. They are concerned with how a specific technology is applied to solve problems identified within a business context or a sector. The standards are developed through consortia forums.

Typically, Internet or Web technology uses open standards that would be developed and ratified through the World Wide Web Consortium, W3C (http://www.w3.org/Consortium/; W3C, 2002). Sector studies such as those in the area of ICT, develop individual empirical cases that can lead to proprietary or *de facto* standards to translate what a specific sector believes are the solutions to its problems. The sector can position agreed proprietary standards to prospective adopters for implementation. At the same time, it assesses the impacts of specified solutions (cf. Weiss and Cargill, 1992). Vertical standards focus on data and business processes, such as business-to-business e-commerce that requires common standards (Zhao *et al.* 2005).

By making these divisions understandable, it is clear that not all cases evolving from the standards body of knowledge belong to the main stream of IITS examined in this thesis. Yes, there are similarities. Consortia-based empirical cases (open, sector and vertical) need recognition for offering a platform for developing IT standards, and upon which to build the standards body of knowledge.

When the study is not carried out in the IITS arena, however, it would be questionable to qualify it as 'main stream IITS'. The case is more likely to be a consortia-based case with central research issues of that area. More recent examples are banking and insurance (Markus *et al.* 2006; Michels and Morelli, 2001); e-business (Kotinurmi *et al.* 2003; Zhao *et al.* 2005) and health informatics (Jacucci *et al.* 2003; Hanseth *et al.* 2006).

This intermixture of various studies suggests generalisation of the phenomena of IITS. Trying to cover all the concerns of say, industry or sector standards under the 'same umbrella' as IITS leads to equivocality: multiple interpretations of the same thing (Daft and Lengel, 1986). Each interpretation from any study is individually unambiguous, but collectively they differ and may be mutually exclusive or in conflict (Zack, 2004). Thus far, there are multiple interpretations of what the problems of the IITS are, or otherwise. IITS is a unique area of study with cross cutting concerns from the internationalisation of the community. Therefore, dimensions of how IITS projects are developed and how the IITS process performs must be treated exclusively.

1.3.4 Gaps in Knowledge

The gap in knowledge in reviewed standards literature is illustrative of some the challenges this thesis aims to deal with.

First, reviewed literature show very little empirical research defining the IITS process. No prior theoretical or empirical research has been carried out to study the development of IITS process projects or to reconstruct this process. It declared that the process of standardisation that Cargill (1989: 230) described nearly two decades ago still stands as written:

> The standards process, in its present form, is a curious combination of naiveté and sophistication. The process depends on the goodwill of a large population for the successful creation of standards and on enlightened self-interest for the successful completion of the process (that is, the use of the standards produced). Both of these attributes are potentially unreliable and, in terms of human behaviour, entirely unnatural. However, the process works and seems to work well. But for how much longer?

Second, it is also well known in extant standards literatures that there is an IITS process. This is from the fact that models exist that help to interpret the process of standardisation (Baron, 1995; Cargill, 1989, 1995; Mansell and Hawkins, 1992; Reilly, 1994). Each model is very descriptive and bearing mostly on industry-based pursuits (see Table 2-5: Example IT standardisation models and stages). However, these models have not gained recognised approval for use widely in the IITS environment itself. The exception is the Reilly (1994) model, which has been applied at national level, within the ANSI X3 committee.

Third, these IT standardisation models mentioned above seem to fill a gap regarding 'what the IITS process could be or might be'. This researcher posits that, the lack of an agreeable definition which helps to understand such a high profile international process that is debated widely is a gap in knowledge. Its definition is a necessity for its analysis, evaluation and for changing it from separate research perspectives. It can be argued that there are other areas covering business, software engineering and manufacturing embracing highly technical, procedural and practice-oriented processes akin to the IITS process. In these areas, complicated process features do not prevent creating a formal process definition or life cycle that can be used as a measure to guide actions.

Fourth, on evolving studies, De Vries and West (2005) acknowledge the need to strengthen empirical research on the creation of IT standards. What seems to be clear from the reviewed literatures is that the four areas covering IITS studies (economics, ICT, ITSSR and IS) have now intersected. This helps IT standardisation to become a recognised field, thereby encouraging mapping of studies that develop knowledge.
One the one hand, what is happening is a gap in knowledge from various debates regarding the effectiveness of IITS process. Provocative criticisms will endure, because perceived IITS problems debated widely have not been dealt with empirically. On the other hand, there is this intersection that various IITS studies create. This simply points to several epistemological questions yet to be answered, and have been identified in this research as a gap in knowledge for empirical study, such as:

[a] How are IITS projects developed?
[b] What is the definition of the IITS process?
[c] What solutions would enhance IITS process performance?

1.3.5 Response to Gaps in Knowledge

This response aims to link current IT standardisation research issues to the empirical study and findings that this thesis describes. This approach helps to decide relevant thesis topic (§1.1.2), problem statement (§1.1.4), scope of the thesis (§1.5) and treatment of questions (§1.6).

The first is a response to make the distinction of the focus of this thesis. The study of the IITS process is concerned with standards that are often referred to as consensus or voluntary (Baron, 1995; Cargill, 1989; David, 1987). In view of the emerging studies (§1.3.4), the body of standards literatures has a tendency to make the assumption that, voluntary, open, sector or vertical IT standardisation efforts have similar features. The scope of the development of IIT standards is interpreted from these similarities. It is important, therefore, to differentiate IITS process matters from the rest. In doing so, describe the accurate representation of the area of study with analytic mechanisms that apply to it.

The second link is a response to the views on current criticisms of IITS (§1.3.2). The criticisms in standards research studies illustrate some topics yet to be examined empirically. One such topic is the heterogeneity of IITS dynamics as one of the sources of IITS process complexity. Typical IITS dynamics involve committees with stakeholders of standards, formalities of procedures and practices (Axelrod *et al.* 1995; De Vries and Verheul, 2003, Foray, 1994; Fomin *et al.* 2003; Jakobs, 2003).

In this link, it is argued that the decision to examine IITS process complexity as a problem statement (§1.1.4) has other entwined provocative and topical issues to be answered through empirical case study. In particular, solutions for practice that could help to resolve some of these criticisms have thus far remained under explored. This thesis gets to the root of IITS efforts, which is the IITS process. This is the step toward unravelling what the IITS process represents, how it functions and what its concerns are.

The reconstruction of the IITS process utilising CBD framework addresses effective solutions so that its embrace the challenges that IITS projects bring. By these actions, this thesis contributes timely to the enduring 'calls' to change current IT standardisation practices (De Vries and West, 2005), with innovative approaches (Krechmer, 2005).

The third link is a response to the process of IT standardisation from models presented in §1.3.4. Given the limited theoretical or empirical research on the IITS process, this thesis addresses this gap in knowledge from an empirical case study of IITS project development. This gap in knowledge suggests that example models have not adequately covered the scope of the IITS process.

Pettigrew (1997: 347), for example, suggests the types of questions that can be examined: What is the content of projects and the contexts in which they are developed? What are the dynamic qualities of committee performance that shape project development practices in the various layers of context in the IITS process? Only through empirical study of understanding project development can a valid model of the IITS process be defined (see Figure 6-4: Features of IITS process: Life cycle models). An empirical model closes this gap in knowledge, because it provides greater focus of the epistemological explanations and definition of the IITS process. It does not, however, nullify other existing models that are not connected to how IITS projects are developed.

1.3.6 Theory

This research has four main segments: complexity of IITS process as phenomenon of interest; empirical case study of IITS project development; analytical study and reconstruction of the IITS process; and, design of solution options. Each segment is structured along four themes of analytical fact finding embodying questioning, description, explanation and interpretation.

The OIPT as the suitable *theory* has been customised as a lens. This in line with suggestions from a number of scholarly works, such as: DiMaggio (1995), Goodman (1978, 1985), Pettigrew (1997, 2000) and Weick (1995). These scholarly works advocate the use of a theory that gives approaches to theorising, theoretical focus, meanings of description and explanation. Weick (1995: 388-390) suggests that in order to be receptive to grounding there is then a need for trade-off between *the theory* of choice and theorising.

In applying OIPT as a lens, this researcher places emphasis on **a theory-driven research methodology.** This is representative of interpretative analysis. It is argued that, the rich phenomena of IITS are attributed to the social construction and heterogeneity of IITS process features. Such rich phenomena are not patterned to distinguish their unique characteristics by methods thought to be adaptable to this analysis. Emphasis of this theory-driven research methodology is **essential unified grounding** of the specified segments of the research process. Each segment has stages of aggregation, reconciliation and explication of the findings.

Grounding in theory as suggested in Weick (1995) provides a basis for linking the process of knowledge production in the different segments, to findings and to interpretation. It encourages this researcher's understanding of the details underpinning explication of meaning developed in the findings. In the absence of a lens hence, analysis of such rich phenomena generates uncertainty such as difficulties of consistency and repeatability of any particular method applied (Chapter 9). The OIPT as a lens thus becomes an important tool to model the research process, so as to develop relevant analytical mechanisms and knowledge that is based upon the essential unity that grounding in theory offers (Chapters 2, 3, 4 and 5).

As described in the section that follows next, this research is qualitative. It adopts an interpretive stance. Clearly, justification of a theory-driven research methodology is the match between the qualities of the research and those of the OIPT as a lens. Extensive work has been carried to adopt and customise OIPT qualitative features involving guidelines, principles and decision parameters (see §2.8, §3.3). These qualitative features, together with the theoretical representation of OIPT offer an interpretive framework of its use as a lens. This interpretive framework fits across the four segments of this research. This customisation of OIPT as a lens for this research also closes a gap in theory in the study of IITS.

In keeping with theory constructs from DiMaggio (1995), Pettigrew (1997, 2000) and Weick (1995), it is important to mention that the OIPT interpretive framework, rather than its customised features, help to develop stronger theoretical focus and explication. Customised features provide methodological specificity covering the different segments of analysis from different angles for data gathering, theorising and interpretation of finding. Moreover, specificity requires the clarity of essential elements underpinning the research process and sensitivity of the treatment of evolving themes, for creating meaning in the findings to help decide on a course of actions.

1.4 Overview of the Research

1.4.1 Research Goals

Primarily, an exploratory study was carried out to gather information regarding the IITS environment defined in this thesis as SDOs, NSBs, professional standards bodies and committees. A survey conducted with individuals from each of these groups and an intensive literature search supported this exploratory study. Through selection of relevant issues, three principal goals were defined that are integrative of the design of the research approach and intentions, as follows:

[1] To examine the environment in which IIT standards are developed and describing critically, its representations of functioning.

[2] To define a solution proposal framework that encourages framing of the theoretical focus for solving critical issues and challenges impacting on project development and IITS process performance.

[3] To examine selected projects that demonstrate the reality of how IIT standards are developed and the set of phenomena they represent with regard to the solution proposal.

1.4.2 Operational Objectives

Figure 1-3 describes five operational objectives regarding how the research actions have been executed, for the accomplishment of the goals described above.

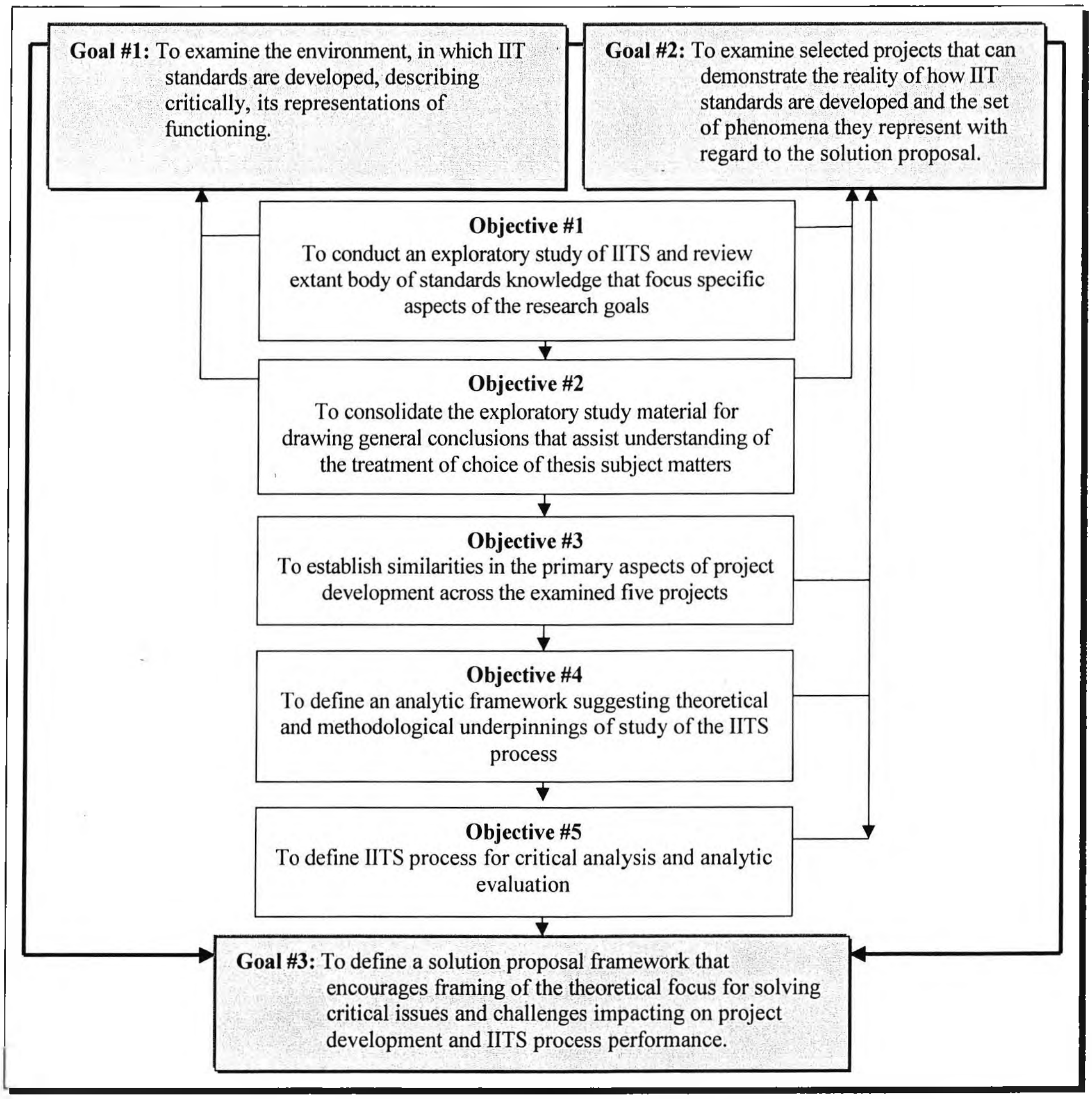


Figure 1-3: Chart Linking Research Goals and Operational Objectives
(Source: compiled by the author)

1.4.3 Research Methodology

This research is carried out as a qualitative systematic analysis of the contexts of IITS process and project development. These contexts embody social construction elements and rich phenomena. The investigation draws upon methodological pluralism illustrated in **Table 1-1.** From this Table, three main features of this methodology are described next, namely: qualitative systematic analysis, positivist paradigmatic perspective and theory-driven empirical research.

One, **qualitative systematic analysis** is supported with an interpretive analytic stance using three principles from Klein and Myers (1999) for conducting and evaluating interpretive field studies in IS.

Table 1-1: Research methodology perspectives (Source: compiled by the author from adapted concepts: Bechhofer and Paterson, 2000; Eisenhardt, 1989; Klein and Myers, 1999)		
Interpretive analytic stance	[1] Principle of Hermeneutic process:	Examining how IITS process projects are developed through committee actions: define various layers of context; understanding interplay between various project development elements and considering their interdependent constructed meanings that they form.
	[2] Principle of Contextualisation:	Critical reflection of the historical and technical backgrounds of the projects as case descriptions of the research setting.
	[3] Principle of interaction between the researchers and the subjects:	How the research material is gathered through the interaction between the researchers and focus groups.
Interpretive framework of OIPT as a lens [e.g. essential unified grounding in theory, theoretical focus about theorising, epistemological underpinnings of analytic rigour and explication of meaning].		
Positivist paradigmatic perspective	[1] Evidence building:	The research methodology is theory-directed: OIPT is applied as lens from the inception of the research task, instead of starting from an unknown set of theories and testing them.
	[2] Theory-building:	Interpretation of research hypothesis from empirical evidence allows the development of a detailed theoretical account of the phenomena.

Two, there is a **positivist paradigmatic perspective** of evidence building adopted from other scholarly works on qualitative research (such as Bechhofer and Paterson, 2000; Eisenhardt, 1989). This perspective adds depth in constructing the meaning of the findings from the different research segments.

Three, this methodology supports **a theory-driven empirical research** in line with the treatment of the research goals and operational objectives for *evidence building* leading to *theory building*. In this methodology the process of knowledge production can change these paradigmatic views. At some stage of the investigation, an interpretive or a positivist paradigmatic view is applied. OIPT as a lens develops stronger theoretical focus also linking qualitative approaches, interpretive analytic stance and paradigmatic views as they arise hence. Its criteria such as ambiguity and complexity encourage depth across or between levels of the investigation. Its interpretive framework helps to transform *the meaning* of identified themes underpinning the interpretations of evidence.

Meaning is translated from located evidence: for example, how IITS projects are developed and the phenomena attributed to project development. *Evidence building* has, as its essential aspects, investigation and processes of knowledge production. This evidence defining the meaning of the findings is the basis from which to answer case study questions and for determining the research hypothesis (Eisenhardt 1989; Galliers, 1992; Strauss and Corbin, 1990, 1998).

1.4.4 Stages of the Research Methodology

The research methodology consisted of six distinct stages for accomplishing the goals and operational objectives.

[1] Exploratory study:	Of the environment in which IIT standards development occurs. Policy Delphi survey approach through questionnaires to develop research material on projects, organisations, structures, committees and classifications of stakeholder profiles.
[2] Case descriptions:	For organising the case study and for facilitating the collection of relevant data and case narration.
[3] Empirical case study:	Five projects examined to build up case evidence and to answer specified research questions.
[4] Explanations:	Constructing the empirical reality of the findings to form a basis for developing research theory of identified phenomena.
[5] Interpretations of research outcomes:	Defining specific items and thesis core subject matters from the underlying framework of the explanations of the empirical evidence.
[6] Writing up:	Case study reports, key findings for further analysis and thesis outline.

1.5. Scope of the Thesis

1.5.1 Main Strands

This thesis embodies three interconnected strands. They are associated with the treatment of the interpretation of the empirical evidence of project development, and analysis and reconstruction of the IITS process.

Strand #1:	The research hypothesis and IITS process are defined from similarities in the empirical evidence of the five projects. The definition of the IITS process closes the research gap between the creation and adoption of IT standards (§1.2.1).
Strand #2:	The defined IITS process is examined to understand various representations of its qualities, to evaluate its performance and contexts of its complexity. The focus on IITS process performance is the foundation to explicating its critical issues and for determining actions necessary to deal with them.
Strand #3:	The IITS process is reconstructed within the design framework of an open layered CBD approach. This is the proactive action aimed at creating PDS. Solutions are determined and described from specified results of the reconstructed IITS process.

1.5.2 Research Hypothesis

In strand 1, the research hypothesis is established from the empirical findings in line with Eisenhardt (1989), Galliers (1992) and Orlikowski (1993). This hypothesis described (Chapter 4, Box 4-1) is interpretative because it presents the empirically derived challenges of the IITS process as the phenomena of interest. The hypothesis is then set out as explanatory constructs or propositions that frame dominant assumptions allowing systematic analysis and reconstruction of the IITS process for dealing with the complexity, as follows:

[Action #1] Reconstruct IITS process	**[assumption consequence1-1]** Reduce excessive features, complexity and uncertainty that cause of problems in performance.
[Action #2] Utilise CBD approach	**[assumption consequence 2-1]** Demonstrate a cohesive set of functionality required by specified core aspects of the IITS process.
	[assumption consequence 2-2] Create combinations of functionality and operational capabilities that match IS requirements.

In framing these critical terms hence, the study of the IITS process involves the operationalisation of the research hypothesis through integrated focal tasks of problem solving. In keeping with Jackson (1994) operationalisation aims to encourage clarity of developing dimensions of the results that form the basis for defining desired solutions, instead of epistemological clarification of the IITS process (see §5.1.2). Formal testing of an interpretive hypothesis is not envisaged (cf. Checkland, 1987; Walsham, 1995).

1.5.3 Empirical Definition of IITS Process

The investigation of Strands 1 and 2, hinge on the definition of the IITS process for in-depth analysis and reconstruction. An empirical definition is in Figure 6-4 indicates that the IITS process has two main features that are examined mutually: a core process and a project development cycle (Ngosi and Jenkins, 1993; Ngosi and Braganza, 2006).

1.5.4 Empirical IITS Process Practices

An important theme underpinning the IITS process is its practices involving: co-operation, participation, subject matters, collaboration and consensus.

Co-operation: IITS efforts are achieved through the *co-operation* of SDOs, NSBs, professional standards organisations and affiliated forums. SDOs involving ISO and IEC provide direction to strategies, functioning and social responsibility (ISO Horizon, 2004; ISO Strategic Plan, 2004; IISD, 2004).

Participation: Membership is the formality for involvement in IITS efforts. International committee members that develop various IITS process projects are accredited through NSBs. These committees cover TCs, SCs and WGs (cf. Cargill, 1989; Jakobs, 2000; Weiss and Sirbu 1990). Membership accreditation though NSBs strengthens collaboration of national and international standardisation efforts.

Project subject matters: They are central to the containment of project development. Each TC and SC is assigned to develop projects of specifiable subject matters, such as character sets, software engineering and multimedia.

Collaboration: This parallelism of national and international is the co-operation that promotes collaboration of activities, information exchange and functional communication across the IITS process.

Consensus: This is a central goal of participation and representation in the IITS environment. In particular, the specification of a draft standard requires recommendations determined through consensus views of committee members, stakeholders' and groups representing the general public.

1.5.5 IITS Process Complexity Frame of Reference

Corning (1998:1) suggests that, 'the degree of complexity that might be imputed to a phenomenon can depend upon our frame of reference for viewing it'. Central to the problem statement mentioned in §1.1.4 is how to analytically define the contexts of ITS process complexity. As demonstrated in Chapter 7, it is important adhere to the representative use the OIPT. Its principles are adaptable as criteria for making distinctions in the contexts of complexity and its implications. These criteria are complexity, ambiguity, dynamism, uncertainty and relationships between them (cf. Daft and Lengel, 1986; Galbraith, 1973, 1977; Weick, 1969).

[1]	Complexity:	Of the environment in which the IITS process exists and, content of IITS process and project development strategy.
		Of the contexts of complexity in specified areas of IITS process: such as, committee actions, project development practices, information, information processing and management of projects.
[2]	Ambiguity:	Presented in specified situations during IITS process performance: such as, competing sub-processes in project development.
[3]	Dynamism:	Located in the meaning of IITS process performance , in the relationships between its elements.
		Located in the meaning in contexts: such as, various layers of context that in which project development and practices occur.
[4]	Variety:	In the content of IITS process and project development strategy: such as information processing, project development scenarios and project tasks.
[5]	Uncertainty:	Presented in specified characteristics, such as environment functions, information, process events and project tasks.

1.5.6 Thesis Arguments

There are three principal arguments abridged to the implications of the problem statement and to the aims of the thesis investigations:

Argument #1:	Successful project development and timely delivery of IIT standards are critical strategic aims of IITS process. Project development needs clarity and transparency, to establish dimensions of requirements for success.
Argument #2:	Reconstructing specified core aspects of IITS process can reduce sources of complexity, uncertainty and implications.
Argument #3:	Creating autonomous component-based PDS introduces clarity, transparency and combinations of capabilities for the enhancement of IITS process performance through IS.

1.5.7 Thesis Questions

These questions involve the key aspects of the problem statement (§1.1.4), strands #2 and #3 of the thesis (§1.5.1).

Question #1: How can the IITS process be analysed to demonstrate how the projects are developed and to address the critical issue of its complexity?

Question #2: Which core aspects of the IITS process can be reconstructed to deal with specified critical issues and to create a test case project development setting?

Question #3: Which solutions are fundamentally effective to enhance IITS process performance and leverage successful project development?

1.5.8 Features of Thesis Question Formats

A theory-driven empirical research involves processual investigations involving: for example, grounding in theory, challenging analytically particular assumptions and epistemological underpinning explications. Such an investigation can become ingrained in the processes of knowledge production and interpretation of findings. In the interest of coherence, thesis questions complement processual investigations for evidence building. The thesis questions utilise two main formats: 'how' and 'which'.

The *'how question'* identifies with processual analysis (cf. Pettigrew, 1997, 2000). It has been intentionally designed for working within and across the IITS process to underpin the logic of the explication of its features, and performance contexts.

The *'which question'* focuses on the explication of problem-solving tasks (Newel and Simon, 1972; Wilson, 1984). First, this question format will draw upon epistemological interpretations of the findings of processual analysis and thesis arguments to add depth in defining reconstruction actions. Second, this format is used once again, in a prescriptive sense. It encourages the assessment of solution options for the reconstruction actions (Galbraith, 1973, 1987; Lee, 1997; Starkey, 1992) and for synthesis of the results (Lawson, 1997; McGraw-Hill, 2003).

1.6 Treatment of Thesis Questions

In this section is a summary of the scope of the thesis and its theoretical and methodological foundations.

1.6.1 Analytic Framework

This analytic framework Figure 5-2 is a central feature, designed in this thesis, to integrate the levels of analysis and reconstruction of the IITS process through OIPT as a lens. This framework shares similar guidelines such as those outlined in Pettigrew (1997), Galbraith (1973, 1977) and Weick (1969), as follows:

Environment: This is the study of the IITS process from the perspective of the environment in which it performs (cf. Galbraith, 1973, 1977; Weick, 1969). The IITS environment, in particular has different types of issues upon which IITS process performance depends: such as, SDO direction, strategies, functions and procedures.

Embeddedness: The IITS process is examined from different angles and across various layers of context in which it performs (cf. Pettigrew, 1997). The framework takes the IITS process as dynamic, non-linear and with deeply embedded elements. While defining the IITS process, its features, complexity, critical issues, challenges and requirements are considered as embedded elements for explication.

Interconnectedness: Pettigrew (1997) suggests understanding of the study the process in past, present and future time. In this analytical framework, interconnectedness is achieved by using **analytical contrasts** involving static and dynamic analysis (Born, 1994; Dorfman and Thayer, 1990 and Kruchten, 2004). Without due attention to these contrasts as part of the focus of analysis, the findings can distort the true nature of the details of the IITS process, as well as, the phenomena being studied.

Alternatives/Actions: OIPT as a lens provides the levels through which findings from the analysis of the IITS process can be linked to the reconstruction actions. This is achieved in distinctive sub-levels of the search of specific solution options for dealing with the specified contexts of complexity, as well as, framing the dimensions in which the solution must fit (cf. Galbraith, 1973, 1977).

1.6.2 Treatment of Thesis Question #1

> How can the IITS process be analysed to demonstrate how the projects are developed, and to address critical issues of its complexity?

This question draws upon the analytic framework to concentrate on contrast analysis of the extant IITS process with regards to project development (Chapters 6). An analytical evaluation of IITS process performance describes contexts of complexity through OIPT lens criteria (see §1.5.5). Critical issues embody needs and concerns attributed to the IITS process.

1.6.3 Treatment of Thesis Question #2

> Which core aspects of the IITS process can be reconstructed to deal with specified critical issues and to create a test case project development setting?

This question is answered in Chapter 7, which integrates the operationalisation of the research hypothesis and reconstruction of IITS process. Core aspects of the IITS process are examined exclusively from a defined process framework to determine their merit of importance. Drawing upon assessed features, the SDS is defined as a core aspect. This involves combining relevant features from different areas creating a robust structure of the SDS to fit a defined CBD representation.

Reconstruction using the open layered CBD approach takes a conceptualised SDS. Working through a number of steps covering content creation, design representation, design rationale, simplification and construction of functional intent requires structured methods (see §1.2.5, §1.2.6). Process modelling procedures involving BDDs and AFDs (Rock-Evans, 1992) proved useful to define the created SDS features and its functional content. Other advantages of these procedures include reasoning the reconstruction actions through multiple levels of refinement and evaluation of the design rationale. Intermediate models follow reconstruction and design refinement, through to the construction of the functional design of the SDS as a component-based PDS.

1.6.4 Treatment of Thesis Question #3

Which solutions are fundamentally effective to enhance IITS process performance and leverage successful project development?

This question is answered in Chapter 8. It deals with a synthesis of results from the SDS design specification and integrated solution framework of the reconstructed IITS process. A result specification framework (Figure 8-1) is designed specifically to define this synthesis procedure. It adds depth to the decision-making processes necessary to develop specific details of the results that answer this question #3.

1.7 Main Findings

1.7.1 Categorisation of Results

In line with the result specification framework mentioned above, two main categories of items are declared as research results, namely: functional and technical-IS. This framework delineate these two categories into explicit results, functional and technical solutions, and tacit, as follows:

Category #1, explicit results: They reflect on how the extant IITS process has been reconstructed within a CBD framework. In this category are three declared results, namely, a new IITS process life cycle framework (§8.2), SDS design specification (§8.3) and integrative solution framework of the reconstructed IITS process (§8.4). These results are explicit, because they impress on central aims of the research effort. Notably, to reduce the complexity of the IITS process; to develop component-based PDS and to establish sets of solutions.

Category #2, functional and technical solutions: In reference to the thesis arguments (§1.5.6) these solutions are sets of specifications that can make significant contributions to the effectiveness of IITS process performance and successful project development. The main reference is the integrative solution framework defining the expected operational performance of the reconstructed IITS process. The specifications logically demonstrate both functional and technical solutions (see §8.5).

Category #3, tacit items: To stress the importance of the CBD framework on the declared results, tacit items incorporate 'strategies' addressing the types of operational capability that can be expected to enhance the performance of the reconstructed IITS process, and to align it to project development. The tacit items cover information processing capability, operational capacity, performance capabilities and IS capability (see §8.6). Separately, these results are consolidated to answer thesis question #3 (see §1.6.4). Three other component-based PDS recommended to complete the reconstruction of the IITS process in the future are summarised hence.

1.8 Key Contributions

1.8.1 Summary

In the final Chapter 9, reflexivity is the approach taken to review the research effort in terms of its goals, methodology and results. Reflexivity is the basis for reasoning the conclusions of the research.

The basis of judgement to derive conclusions cover credibility of the research, epistemological justifications and transferability of declared results (cf. Lincoln and Guba, 1985). This judgement also helps to identify and address gap in practice to which the research methodology is referenced, in line with current issues in reviewed literatures. Example issues of gap in practice addressed in the conclusions of this thesis cover theory-practice (Bhaskar, 2002; Gregor, 2002, 2006), philosophical and methodological paradigmatic knowledge (Khazanchi and Munkvold, 2002, Weber, 2003). Through reflexivity, judgement of the contributions and conclusions, it can be argued that epistemological justifications of the research effort become clearer in their impacts on how the research goals have been accomplished.

1.8.2 Contributions of Declared Research Results

In this section, is a summary of the contributions, and reserving key conclusions to be addressed explicitly as a result of understanding important aspects of the 'truth value'. The contributions are categorised as declared results, IS and standards bodies of knowledge, and theory.

Three items in Category #1, explicit results (§1.7.1, §8.3) qualify as contributions of this research. The focus of their collective contribution is the implications for practice in the IITS environment. By implementing these results, the IITS environment can actualise their meaning in harnessing solutions that contribute to the enhancement of the IITS process and project development.

1.8.3 Contribution IS Body of Knowledge

In this category, the domain of reference of this research is identified as the IS community, by relevance of the core subject matters and methods applied (see §2.2.2). A major contribution is to the IS body of knowledge is an integrated research methodology (see §9.5.2). This contribution makes two essential impacts.

One, the study the IITS process which is under-explored in the IS community. The credibility of this methodology is based upon the fact that it applied IS research methods adequately. It takes different positions to differentiate comprehension and explication of various levels of the study of the IITS process consistently, and to ensure that the declared results have credible implications for practice in their targeted environment.

Two, this theory-driven empirical research methodology makes a significant contribution by addressing inconsistency and dichotomy that are current and enduring issues raised in a number of scholarly works (Fitzgerald and Howcroft, 1998;

Khazanchi and Munkvold, 2002; Mingers, 2001;Weber, 2003). It demonstrates how the use of OIPT as a lens can encourage the essential unity that underlies the different segments of this research process. This methodology makes another contribution for further development in process studies requiring the use of multiple methods and paradigmatic views.

1.8.4 Contribution to Theory

The OIPT has been applied as a lens for description and explanation (Gregor, 2002, 2006; Goodman, 1978, 1985; Neuman, 2000). Its use for grounding the research methodology in theory produced integrated empirical findings. Its principles and dimensions offered substantive concepts to develop an analytic framework linking different parts of the analysis and reconstruction of the IITS process.

In keeping with Goodman (1978, 1985) the use of OIPT in this research gives an extension of the use of the original theory. The contribution to theory is discussed as the extended context of use of OIPT, because it has been customised for this research. This extension embraces four other dimensions: grounding in theory, analytic mechanisms, interpretation and prescriptive actions (§9.5.4). This extension changes the dominant paradigm of OIPT and not, its original representation.

1.8.5 Contribution to IT Standards Body of Knowledge

The core subject matters of this research (§2.2) are embedded in standards body of literature. Three main items identified as the gaps in knowledge in the standards body of literature have received very little empirical attention. They are definition of IITS process, empirical study about IITS project development and solutions for practice to resolve criticisms about IITS process (§1.3.4). The contributions are as follows:

[1] This research establishes an accurate empirical definition of the IITS process. As a breakthrough, this definition gives the IITS process its exclusive identity for future reference in other studies.

[2] Virtually no prior theoretical or empirical research exists on the IITS project development. The five projects examined in this research generated constructed empirical reality of IITS project development, from which the IITS process has been defined. This means there is a particular relationship between IITS process and project development that can be verified empirically. This relationship is a fundamental one for explaining why a CDB framework is the solution option that might enhance performance.

[3] Reconstruction of the IITS process has been carried out within a CBD framework. This approach to reconstructing the IITS process is an incisive method that effectively deals with contexts of the complexity of IITS process that have been linked to a number of theoretical criticisms. For example, SDO inefficiencies and uncertainty (King and Lyytinen, 2003) and slowness to respond to IT market needs (Rada, 1999; Gosain, 2003; Sherif, 2003). This methodological treatment of the critical issues of the complexity of the IITS process, together with reconstruction actions make a contribution by developing results upon which to build solutions for practice.

1.9 Thesis Presentation

This thesis contains an abstract and nine chapters. The structure is presented in **Figure 1-4** that follows next.

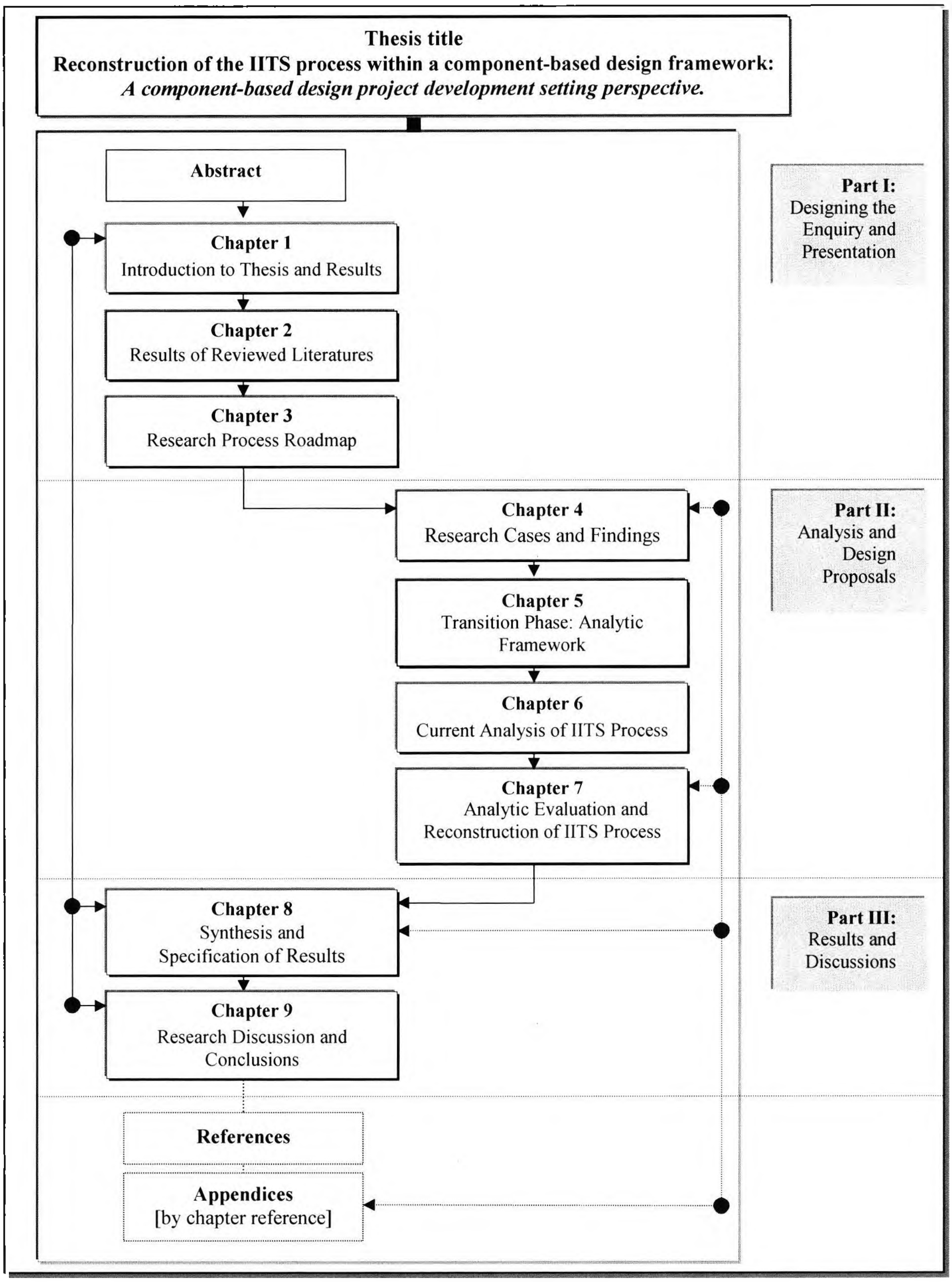


Figure 1-4: Thesis Structure
(Source: compiled by the author)

1. 10 Chapter Summation Link

This introductory chapter served to provide a comprehensive description of the core subject matters of this thesis. It has covered epistemological requirements of the treatment of these core subject matters, phenomena of interest, methodology, theory, contribution of results and depth of the investigations ahead. The next chapter takes a retrospective approach to describe the research body of literatures.

Chapter 2
Results of Reviewed Literatures

2.0 Chapter Introduction

This chapter presents results of the reviewed body of literatures. Five core subject matters of this research guide this review to develop central concepts for their treatment in the research process and highlighting limiting concerns in the body of literatures. The chapter starts with a selection approach of the area of research (§2.1), followed by core subject matters (§2.2). Results of reviewed literatures are discussed covering: international IT standards development (§2.3), IITS Process (§2.4), project development (§2.5), design solutions (§2.6), research methods (§2.7), theory considerations (§2.8), theoretical framework (§2.9) and chapter summation (§2.10).

2.1 Selection Approach: Area of Research and Subject Matters

2.1.1 Motivation of Approach

The researcher was employed full time in a NSB covering the development of IT standards at National, European and International levels. Choosing an area of research based on this work experience was likely to be a pitfall when certain constraints were introduced into controlled investigations. A methodical selection approach was paramount to initiate this research on evaluated issues, instead of just work experience.

2.1.2 Preliminary Research Survey

This survey was conducted primarily, to exclude biased influences from this work experience and then, to determine a relevant area of research and subject matters. This survey was carried out through a single questionnaire. It was mailed to 500 candidates randomly chosen from the researcher's assigned areas of work. The candidates were requested to describe how IIT standards were developed, to include the problems they experienced. Views from 425 (85%) of evaluated questionnaire responses suggested that individuals representing SDOs, NSBs and international committees expected this research to make changes to IIT standards development processes and current practices.

Drawing on the results of survey, this researcher realised one downside for examining all-compassing IITS issues covering organisations, committee, activities and processes. The downside was the dominance of IITS operational matters, over the social and technical contexts in which the standards were developed. Reviewed literatures (such as

Berg and Schummy, 1990; Cargill, 1989; Gabel, 1987; 1991; David and Greenstein, 1990; Hemenway, 1975; Weiss and Sirbu, 1990) offered conceptualisation to delineate central issues of IT standardisation. Reviewed SDO operational documents, such as IEEE *Standards Board Annual Activities Reports,* ISO IEC *vision for the future* (ISO IEC, 1990) and ISO-*LRPG items* (ISO, 1991) provided judgement for supporting relevant actions determined from the results of this survey, and for setting attainable research expectations.

2.1.3 Selection Criteria and Choice of Items

Criteria involving international perspective, specific area and target audience provided judgement for choice.

An international perspective to the conduct of the research was fundamental to the analysis of the development of IT standards and problematic issues that were expected to be worldly in nature. Practical thinking suggested that, solutions developed to deal with worldly issues would have better implications for practice if the investigations were conducted from an international perspective.

Reviewed literatures (Berg and Schummy, 1990; Cargill, 1990; David, 1987; Rankine, 1990) suggest international IT standards projects to be unique on several dimensions: such as, organisations; processes; practices; committees; collaboration; scientific approaches and stakeholders. Because of the uniqueness to each of these dimensions, the study of project development as a **specific area** would present a richer mix of elements to demonstrate how international evolves and to explain the phenomena of interest.

Keen (1991:28) states: "relevance of research implies a particular style of Rigor, suited to the aim of influence on a **target audience**." Views from the preliminary survey suggested SDOs, NSBs and committees as the target audience affected by this research, and could benefit from the results. Their views became key points for answering three questions to influence the choice of subject matters:
[a] What does the target audience expect from this research and its results?
[b] Why are solutions important to this target audience?
[c] What types of solutions are they likely to accept or reject?

Example views presented in the preliminary survey results and ranked on merit, attempt to answer these questions as follows:
[a] Distinguish IT standardisation processes from others, according to importance.
[b] Separate SDO operations from IT standards development process.
[c] Create visibility of the content of project development.
[d] There is a need to exploit IS applications in the provision of technical information and communication in committee processes.

2.2 Core Subject Matters

2.2.1 Classifications and Content

In keeping with Benbasat (2001) and, Benbasat and Zmud (2003) core subject matters give an identity to underlying set of phenomena of interest that is unique to the chosen area. The selection approach led to five core subject matters: scope of international IT standards development, project development, IITS process, design of solutions and research methods.

International IT standards development is the focal area of the research. The scope of the development of IT standards is the subject matter, because it aids identification of major concepts upon which this area can be questioned and, described in greater detail. Subject matters involving **project development, IITS process and design of solutions** represent the contexts in which this area of research and its concerns can be examined. A further breakdown yields *sub-items* encouraging depth in the treatment of the core subject matters to generate knowledge for defining purposive investigation actions. Two example sub-items demonstrate this.

[a] **The environment** in which international IT standards are developed gives a frame of reference attributed to the area of research. This sub-item is fundamental to the choice of solution proposal to be examined (§3.5.4) and to creating meaning of the research results.

[b] **Analysis and reconstruction of the IITS process** pay close attention to the focal tasks of the investigation. Focal tasks demonstrate the 'how to' examine core subject matters using an appropriate approach and constructive arguments, in order to fully understand the nature of the desired solutions.

Table 2-1 associates the area of research to its core subject matters and sub-items to be reviewed exclusively. 'Commitments' give a summary of the treatment of the review of the assembled body of literatures regarding the core subject matters.

Table 2-1: Core subject matters and sub-items
(Source: compiled by author)

Area of research	Core subject matters	Sub-items	Commitments
International IT standards development.	[1] Scope of international IT standardisation activities	[a] IIT standards development environment [b] IT standardisation practices	- Descriptions of the environment e. g: organisations.
	[2] IITS process	[a] Process analysis [b] Analysis of specific items	- Methodological considerations
	[3] Project development.	[a] Trends in project development	- Representation of project development aspects
	[4] Design and solutions	[a] Process reconstruction [b] Design strategy [c] Information systems	- Approaches of reconstruction - Evaluation of results
	[5] Research methods	[a] Empirical practices	- Case study - Theory, theory lens - Evaluation of methods

2.2.2 Presentation of Area of Research-IIT Standardisation

Garcia and Quek (1997:450) pose two important questions to point out the difficulties in defining the actual object of IS research:

Question #1: Is the object of research in information systems of a technological or social nature?

Question #2: Is it the organisation, an information system or a social system?

This research posits that, these two questions bring into consideration the decisions to choose a domain of reference of research. Methods for examining the core subject matters (Table 2-1) are likely to be derived from areas. Posing these two questions helps to differentiate understanding of overlaps (see §2.2.3). These overlaps are no easily identifiable. A process of exclusion is applied to reason how IT standardisation is presented in various standards literatures. It discusses issues impinging on the core to develop justifications of the actual object of research and choice of the domain of reference. The decisions rest attention on meaning in the identified overlaps and their relationships to the object of research.

First is the scope of IIT standards which is being studied in four areas: economics, ICT, ITSSR and IS (see §1.2). The areas of economics and ICT can be excluded as domains of reference for two reasons: Economics of standards does not include the creation of IT standards (Fomin *et al.* 2003). ICT has been more closely addressed in the area of IIT standards, because both areas deal with perspectives of IT technologies.

As communication networks continue to become part of a more general information infrastructure, the need for standardised ICT together with generic and specific technology increase. ICT standardisation has a linear progression from basic research to product design, to the creation of the technical specification of an ICT system, implementation and introduction of innovation processes (cf. David and Greenstein, 1990; Miller and Morris, 1999). It has been associated with domain specific technologies focusing on information infrastructures, networks, Internet technology and telecommunications all underpinning e-business systems (cf. Egyedi, 2000; Jakobs, 2004). International IT standardisation deals with most areas concerned with IT applications, apart from public communications.

Second is the area of ITSSR evolving within the IS community. It is examining various themes exclusive to IT standardisation: such as, organisational and industry impacts of standards, creation of standards, implementations and standardisation directions (Blind and Thumm, 2004; Krechmer, 2005).

Putting these four areas together, **Table 2-2** contains subject matters assembled from the standards body of literature. Clearly there is a diversity of subject matters with potential overlaps into this research. Hence, the necessity to make decisions based upon a process of elimination of those subject matters that do not add to the goals of this research depicted earlier in Figure1-3.

Table 2-2: Literature summary of IITS subject matters
(Source: compiled by author)

Subject matters	Summary
Culture:	Of IT standardisation to include providers of IT systems, their users and forum of activities.
Economics:	Of impacts of technology development, implementation of IT standards, and creating business value, growth of markets and international trade.
Human factors and usability:	Of instructive manuals for the application or design of IT systems, and business activities through use of standards.
Education and training	Academic institutions now use standards as teaching tools e.g.: the University of Technology of Compiégne (France) and AFNOR created the first Masters graduate programmes in the EU covering standardisation and quality matters (ISO 1994).
Policy and politics:	Of developing IIT standards based upon SDO, government and legislative regulations; competition on different IT standards in the market and public policy implications.
Sociology:	Of social shaping of technology; understanding and defining the environment in which IT standards are developed.
Social-technical:	Of the relationship between the development of the standard and its succession for implementation; market forces of the standards.
Societal:	Impacts of standardisation activities aimed at improving the quality of life and promoting public understanding of the applications of standards
Strategies:	Of understanding organisation or industry needs for IT standards; for guiding firms through standards in its search for an optimal fit between the external and the internal environment.
Technical: [computer science, engineering, IS]	Of understanding and defining how IT standards are developed; of the interplay between IT systems, scientific methods and standards that are developed; of the use of IS applications.

2.2.3 Research Domain of Reference

Through this process of exclusion of subject matters mentioned above, IT standardisation does not have methods that fit into the central aims of this research. Abiding to IT standardisation means the choice of research methods would cover this diversity of subject matters about IITS. This would create arguments that are constructed around the theme of accountability to the methods that do not challenge the analytically assumptions of the research intentions.

The core subject matters in Table 2-1 fit into the central research aims of the IS community. According to Orlikowski and Iacono (2001:121), the core subject matter of the IS field is the 'IT artefact' viewed as part of the components of the organisation and people involved in the use of a computer-based artefact. This research does not, however, make a particular kind of 'IT artefact' a central theme. The contexts in which IIT standards are developed raises questions about organisations, human actions, practices and their implications on how the IITS process currently functions. Reconstruction of the IITS process on the other hand, assigns explanatory primacy on expected functionality and desired solutions. The use of IS resources is complementary to help integrate various reconstructed features for harnessing solutions of functionality and enhanced practices (cf. Markus and Keil, 1994; Venkatesh *et al.* 2003).

To summarise, domain of reference of this thesis focuses on the IS community, as the targeted audience. This choice is based upon the identity of the object of the research and choice of methods (cf. Keen, 1991). By virtue of studying the IITS process within the IS community, a link has been created. Convergence on content (Markus, 1997) and trans-disciplinary (Galliers, 2003) perspectives are adopted hence:

Convergence on content helps to strengthen the epistemological assumptions underpinning the link of the IS community to the IITS in the context of the treatment of the research process toward set goals (see §9.1).

Trans-disciplinary perspective helps to focus the methodological relevance of this research. In particular, contributions from reviewed literatures offering approaches that can strengthen the treatment of the core subject matters of this thesis (§2.2.2).

Epistemologically, both these perspectives complement each other. However, the approaches taken in this research are in line with Keen (1991:27-39), whereby well-established methods available in the IS community provide a yardstick of effectiveness for conducting the investigation at hand.

2.2.4 Overlapping and Emergent Issues

This research is conducted in two phases: The first, is the execution of the *research process* through case studies, which yields empirical evidence (Chapter 4). Second, is the *transition* phase from research process to the treatment of the empirical evidence covering analysis and reconstruction of the IITS process (Chapters 6, 7). The connection of these two phases necessitates the identification of overlaps and emergent issues likely to affect the outcome of any course of action taken in the investigation. The identification ensures that the core subject matters (Table 2-1) are given adequate treatment within their correct context, together with a body of knowledge upon which to build relevant concepts. Identified overlaps and emergent issues follow next:

Methods employed in the research process belong to the area of Information Systems Research (ISR), which is mutually exclusive to the IS community. Literatures on research process and methodological practices are discussed later in §2.7.

In the transition phase, the IITS process is established from the empirical findings and is critically examined (Chapter 6). The literature review that follows this, shows that the treatment of the IITS process as a core subject matter of this thesis, has sub-items involving process analysis, reconstruction and design of solutions. These sub-items expand the boundaries within which the IS community can be used as a domain of reference. To further demonstrate how convergence on content and trans-disciplinary perspectives relate to the study of IITS process, these sub-items lead to the question:

What are the implications of overlapping and emergent issues in this research?

There are quite a few answers to this question. The important answer is that, well-considered **complementary subject matters** (Table 2-1) develop focal tasks ensuring greater *analytic rigour* for working across the thesis core subject matters (Table 2-1). Relevant areas with *few overlaps*, but convergence on emerging themes can be used for examining unique items. For example, IITS process project development approaches have some *overlaps* in the areas of product development and collaborative practices. Other examples are the reconstruction of IITS process and design of solutions. These subject matters have convergence on content with other areas, such as business process changes (Braganza, 2001; Davenport, 1993; Harrington *et al.* 1998); design science (Hevner *et al.* 2002; Markus *et al.* 2002) and organisation design studies (Galbraith, 2005, Ostroff, 1999). As such, an investigation with these far-reaching overlaps into other areas has to be defined in such a way that the examined subject matters complement each other to resolve overlaps and any inconsistencies.

Respectfully, this where analytic rigour encourages close attention to epistemological requirements. It helps to develop themes emerging from the investigation that complement the treatment of each core subject matter. An investigation evolving with analytic rigour influences greater depth and detail for explication of the meaning of the core subject matters. An added advantage in this research is the use of the OIPT as a lens to strengthen both theoretical and methodological mechanisms, so that complementary subject matters are treated on the same basis. Besides its other qualities described as description and explication, this lens has been customised to diffuse unnecessary convergence on content on subject matters that overlap.

Methodological mechanisms for this research draw upon concepts developed for the core subject matters in the areas in which they are embedded. This is because research subject matters that have both few and wider overlaps present the difficulty of integrating different methods. Analytic challenge of any assumptions and unique items underpinning the investigation becomes mercurial. Methodological mechanisms devised from well-established concepts, in which the core subject matters or sub-items are embedded, are therefore instrumental to resolve dilemmas that arise in the investigation (cf. Keen, 1991; Lee, 2000).

As an epistemological requirement, concepts from other related areas help to harness special meanings of content in the treatment of the core subject matters with specific needs. Areas such as ITSSR or SES, offer direct reference as a yardstick for determining how the empirical case evidence can be used to define the IITS process. Empirical case evidence would provide meaning of constructed reality of the project development. The reference would help to add detail of interpretation, in line with the practices that apply to the empirical case evidence.

Contribution to a domain of reference bearing on convergence on content and trans-disciplinary perspectives draws upon insights gained from the investigations. The contributions of this research are addressed primarily to the IS community, to builds upon its extant body of knowledge (see §1.8; §9.5). The IITS environment, on the other hand, is a secondary targeted user. The research results are expected to offer implementation value for practice to the IITS environment, albeit the body of knowledge that enhance the investigation.

Four points are used here to summarise this section.

[1] The intention of this research is to produce results. In this section it has been identified that, the body of knowledge guiding this research falls into IS and standards literatures. There are two issues resting on the core subject matters described in Table 2-1. One, their treatment within the IS body of literatures bears on the research process and contribution to knowledge. Two, the gap in knowledge identified in the standards body of literature focuses on criticisms about the IITS process. These two issues together create significant convergence on content or trans-disciplinary perspectives that might affect the investigations and the research outcomes.

[2] Convergence on content generates uncertainty factors identified as embeddedness of the research subject matters in other areas that might affect decisions on outcomes and contributions. The framing of the investigation adequately dealt with convergence on content or trans-disciplinary perspectives. In doing so, this researcher developed combined judgements of the treatment the chosen subject matters and resolution of uncertainty factors.

[3] The judgements were carried over to define the research process hence. They enriched understanding of the research purpose, namely the goals, operational objectives and their relationship (see Figure 1-3). Moreover, the research purpose both determines, and is determined by the methods applied to then define their significant influences, such as theory lens, methodological mechanisms and paradigmatic views.

2.3 Literatures on International IT Standardisation

2.3.1 Framework of Discussion

The study of the IITS process greatly depends upon an in-depth understanding of what IITS is about and how it is judged in the body of literatures. As the chosen area of this research, IITS covers multi-dimensional aspects with several other items that have only recently, become the focus of attention in main stream IS journals, such as MISQ and JIT.

Figure 2-1 is used hence, to provide far greater structuring of the subject matters associated with IITS. More so, delineate the area of study within the scope of reviewed literatures so that the chosen subject matters can be discussed adequately, in separate areas. The results of the IITS reviewed literatures are divided into: [1] institutional perspective. [2] Current practices. [3] Contributions and concerns from body of literatures.

2.3.2 Institutional Perspective

The IITS institutional framework has been given a great deal of attention in a number of literatures, such as Cargill (1989); Hawkins (1999); Jakobs (2000); Ngosi and Jenkins (1993); Weiss and Sirbu, (1990) and Zhao *et al.* (2005). This framework is often described as institutional, because of its range of properties that propel IITS efforts: such as subject matters, structure and co-operation.

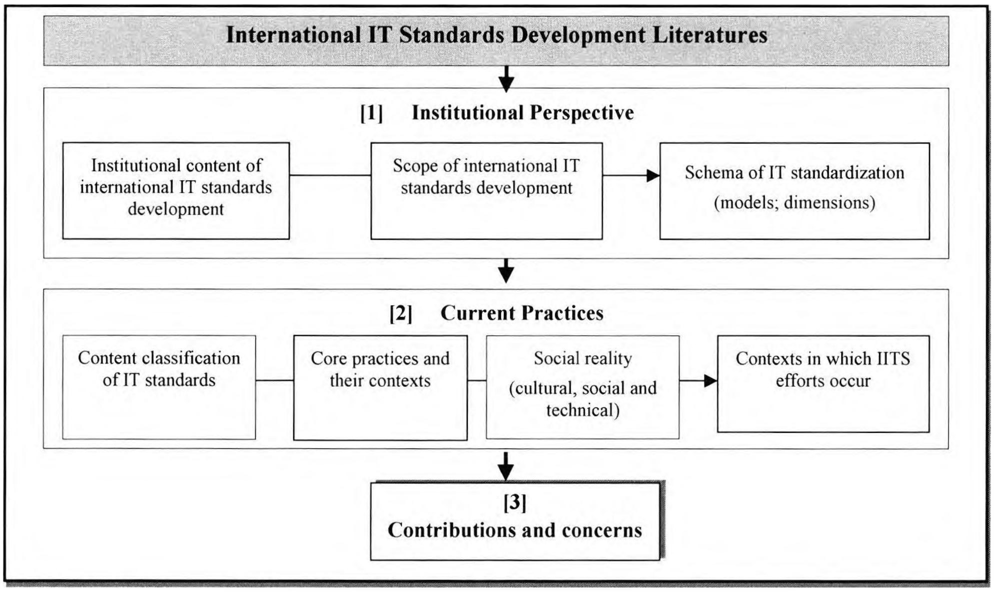


Figure 2-1: International IT Standards Items
(Sources: complied by author)

International IT standards cover **interrelated subject matters** of computing technologies mainly hardware, software, telecommunications, electro-technology, interfaces and platforms for evolving applications and services (cf. Berg and Schumny, 1990 and Jakobs, 2000). To some extent, certification is an emerging subject. It incorporates the evaluation of essential requirements from project development, which must be satisfied before an IIT standard is approved for publication and implementation, subsequently.

The overall structure of this institutional framework is formed through alliance of nations represented by NSBs. Traditionally, governance of international IT standardisation is through three principal representative non-governmental SDOs that oversee different subject areas: The ITU deals with telecommunications (ITU-T) and radio-communications (ITU-R). The IEC has electrical and electronic engineering, and interfaces are its main standards domains. ISO is responsible for the federation of nations specialising in all fields of standards development, except those covered by ITU and IEC.

In this structure, the **co-operation** of independent standards organisations and agencies propels IITS efforts. Professional Standards Organisations (such as The IEEE, User Groups (such as ECMA) and government agencies (such as the DTI in the UK and MITI in Japan). To conceptualise this institutional framework, Brunsson and Olsen, (1993: 4) give an appropriate definition:

> Organisations can be said to be institutionalised insofar as their behaviour is determined by culturally conditioned rules which manifest themselves in certain routines for action and which give meaning to those actions.

With this definition, it is argued that standards scholarly works that give some interpretation of this institutional framework of IT standardisation are still quite limited. Researchers using the *institutional theory* as a lens in IS research (DiMaggio and Powell 1991; Scott, 1995) find that there is a need to develop detailed models, based on other theories of the social view of the organisations and critical reflections upon observed behaviour. Models to aid *theorising* of IITS issues are still being developed. Fomin *et al.* (2003), for example, are refining their 'design, sense-making and negotiation' (D-S-N) model in the investigation of ICT standardisation processes.

On the other hand, literatures covering organisational design (Brooks and Weatherston, 1999; Clark, 1999; Galbraith, 2002; Ostroff 1999) mention that due to the growing complexities of the functioning of each organisation, institutional frameworks no longer work in many cases. The trend is toward integrated components with an emphasis on specialising concepts of organisation functions (Galbraith, 2002), team-based designs (Mohrman *et al.* 1995; Neufield *et al.* 2001) together with horizontal and cross-functional activities (Ostroff 1999).

In other scholarly works (Burton and Obel, 2004; Fenton and Pettigrew, 2000) arguments continue for organisation structures. The researchers indicate that, despite the pursuit for structures perceived as 'intelligent team-based environments'; fundamental design principles must underlie the functioning of an organisation. There is still a need therefore, for a formal design that accommodates an organisation's decision-making channels and may be another that structures communication and boundaries management.

The institutionalisation of the IITS environment has been identified as of primary value to its ideology of functioning that also shapes standardisation practices (cf. Egyedi, 2000; Schmidt and Werle, 1998). While this is the case, the body of reviewed standards literature thus far, does not promote universality in the characterisation of this institutional framework. Because of the growing trend toward studies on consortia-based IT standardisation, established definitions are becoming more stylised to account for phenomena associated with this institutional framework. This leaves inconsistencies in the conceptualisation of the same framework hence.

In combining these enduring arguments for organisation structures, functioning or the shaping of practices for that matter, the standards body of literature still has more questions than answers attempting to unravel this IITS institutional framework, for example:

What is the accurate representation of the IITS environment?
What other types of features are there besides the formal structures?
What kinds of practices are exclusive only to IITS, and not other standardisation efforts?

Standards researchers (such as Cargill, 1989; Jakobs, 2000) have given representations of the some of the IITS environment structures covering committees and SDOs. This researcher applied these three questions to shape the empirical considerations for dealing with the variety of phenomena attributed to the IITS process and IITS environment structures. By virtue of the abstruse interactions of IITS process interaction with the IITS environment, a schematic model was developed defining representations for empirical consideration (see Figure 3-3).

2.3.3 Literature on International IT standards Development Committees

A number of literatures (Cargill, 1989; Foray, 1994; De Vries and Verheul, 2003; Hallström, 2000; Jakobs, 2000) describe standards committees as memberships of individual standards developers (known hereafter as developers).

Membership meets criteria of expertise and representation of sponsored interests (De Vries and Verheul, 2003; Hallström, 2000). The committees fall into three categories: TCs, SCs and WGs (Cargill, 1989; Foray, 1995; Ngosi and Jenkins, 1993). The ISO IEC JTC 1 is an exception; it currently provides a forum for the development of international IT standards (http://www.isotc.org/).

Besides these characterisations, very few textbooks and scholarly articles distinguish standards committees from others or describe their technical practices in detail. While committees develop assigned projects, they can be viewed as part of the constitution of other structures, such as SDOs and NSBs. In project development, committees are the central entity of IITS process performance and practice.

Extant literatures continuously redefine participation in committees. For example, stakeholder alliances (Axelrod *et al.* 1997); identification of stakeholders (De Vries and Verheul, 2003); and user involvement in committees (Foray, 1994; Jakobs, 1998). The technical practices however, are under-explored. A framework of understanding IITS ought to link project development to committee performance and to practices. This link would show the dynamic complement of relationships between them, such as: how committee performances (in the social context of human dynamics) play an important role in project development as the technical core of the IITS process.

There is however, a large collection of literatures from group study research that impress upon international IT standards development. Concepts on group task performance and group practices (Baron *et al.* 1992; Hackman, 1976, 1977; McGrath, 1984; 1990) can offer critical reflections on how committee practices evolve. Other scholarly works (Kaplan and Martin, 1999; McGrath *et al.* 1993) have argued that, group or team-based activities incorporate 'norms' that evolve from practices or other contexts of performance. 'Norms' that already co-exist with standards committee practices cover collaboration, co-operation, consensus, decision-making and role differentiation. Overall, scholarly works on standards lack these exclusive representations of committee practices and their significance in project development.

2.3.4 Scope of International IT Standardisation

Historically, standardisation of IT technologies is regarded as scientific in nature. In this context, the standard serves as a *technical reference* to designers or manufacturers defining physical characteristics of products, such as weights, measurement and performance (Hemenway, 1975).

Studies on IT standardisation moved on to economic dimensions described focusing on IT firms market strategies and differentiation of technology (Bonino and Spring, 1999); product creation (Fichman and Kemerer, 1993; West and Dedrick, 2000) and industrial co-ordination involving networked partnerships (Shapiro and Varian, 1999). In these examples, the scope of IT standardisation is assimilated in the functioning of technology systems and market prestige that IT firms might gain by participating in the IITS process or through implementing IT standards. The other parts in the scope of IT standardisation are scientific and technological development, social benefits and environmental protection. Together, these dimensions place demands on IITS efforts to address issues emerging from the utilisation of IT systems in global markets or legislation, as well as developing anticipatory standards covering future technologies.

Findings from this research reveal that the scope of IITS is that of methodical action for determining technical decisions, when there are divergent problems and requirements for different systems. Committees attempt to harmonise competing requirements to recommend universally acceptable solutions for interoperability of different types of IT systems (cf. David, 1995: 22; Hawkins, 1995:1). The solutions can reduce ambiguity in the interpretation of practices and processes for the development or use of IT systems. Potential advantages of the application of a chosen technology or its development practice are examined, according to scientific paradigms and methods. According to Gabel (1991: 3):

> Standardization is a particular way of making products go together. Standardised products go together because they have been designed in conformance with a common specification-the standard. Groups of products which have been designed to go together by common reference to a design stand, are said to belong to a the same network.

Example *networks* that impact on our daily lives are computers in geographically distant locations that can work with one another using telephone line and communication software to exchange information. Television can now be distributed through communication satellite networks providing a wider range of broadcasting channels and digital services, to include electronic mail and telephony.

Such standardised solutions make a contribution to compatibility and portability of the applications of technology in permitting exchangeable functions and, cultural and linguistic adaptability. ISO describes the general scope of international IT standardisation as:

> ...the activity of establishing, with regard to actual or potential problems, provisions for common and repeated use, aimed at the achievement of the optimum degree of order in a given context (ISO IEC Guide 2, 2004).

2.3.5 Classifications of Practice of International IT Standards

International IT standards are classified according to their development practices and information conveyed in the published specifications. Three main classifications from reviewed standards literatures are openness, consensus and voluntary. Although the extant literatures mention these classifications repeatedly, the underpinning concepts and their implications receive little attention.

SDOs exercise **'openness'** for participation and representation of interest as core practices (and central aims) of all international standards development activities (Cargill, 1989; Hallström, 2002). Individuals or parties with interest to contribute to the activities or in implementing a published standard can participate, and contribute freely, as members of any standards-making body. Openness is extended to the general public, whereby it can express its views through representative user groups or societies (ISO, 2004, Cargill, 1989; Jakobs, 2000). Often, when an IIT standard is published it is categorised as a **publicly available specification** that conveys **open access** of information to those who develop it, the stakeholders and society at large (cf. Gabel 1991).

The underpinning practice of standardisation is open participation. Indeed, contradiction, conflict and misunderstanding evolve among participating parties, especially the concentration of power in the contribution of technology or methods to which standards projects are referenced. **Consensus** is therefore fundamental to the dynamics of reasoning any identified conflicting views, leading to resolution and agreement among participating parties. The published international IT standard is also known as a **consensus standard.** Moreover, well-established principles of consensus cover goal, timeliness, voting, procedures and agreement.

Consensus is a goal pursued in all aspects of international standards development. This goal has implications on SDOs. They have the entrusted responsibility to ensure that views of all represented parties are included in controlled conditions to aid decision-making, in the interest of all. The standards must be developed fairly and constructively, in terms of impartial judgement of documented concepts.

Another under-stated principle is of consensus as a goal of **timeliness** in dealing with issues contributing to project development or processing the standard for publication (cf. Baron, 1995). SDOs are expected to exercise timeliness in their operational strategies: such as using efficient ballot mechanisms, providing information and using procedures that expedite consensus practices (cf. Baron, 1995; ISO *Code of Ethics,* 2004).

Voting or ballot practices (known as 'due process' of standardisation) are applied. SDOs use voting rights associated with distributing the size of power among memberships of the SDO (such as nations, societies or user groups), or the type of membership of interested parties for inclusion in the 'due process'. Within ISO and IEC, nations have a single vote, with equal voting rights. Rules applied to collect votes and comments have significant impacts on the evaluation of draft standards and decision-making process of the final results (Chiao *et al.* 2005). Consortia-based voting, however, assigns only to paying memberships, such as individuals or groups (Updegrove, 1993).

Technical procedures are measures exercised in the review of draft standards through ballots. Attaining consensus in the development of the project and resolution of draft standards can yield technically complex issues. Relevant technical procedures would be employed, ensuring that common parameters determined from technology perspectives being examined are documented correctly in the intended IIT standard.

Agreement in standardisation practices accommodates specific needs and views of committees that develop the projects, and across multiple stakeholder groups that are impacted by the standard (cf. ANSI, 1995; De Vries and Verheul, 2003). Establishing common agreement rests attention on SDO voting practices, to include procedures that committees defined to guide technical negotiation and decision-making.

[a] **Negotiation procedures**, for example, offer methodical harmonisation of material presented in a draft standard (Cargill, 1989; Repussard, 1995). Objections identified in the votes and comments presented are discussed and resolved to achieve the most acceptable conclusion (cf. Easterbrook, 1993; 1994).

[b] **Decision-making** procedures establish common sets of parameters that are in compliance with contractual agreed industry practices, governmental regulations and technical requirements. The standard is recommended hence, through consensus negotiations on the issues that the developers, interested parties and representations of the public domain agree upon (cf. Cargill, 1989; ISO IEC, 2004).

The origin of **voluntary** standards described in LeCraw (1984) and Link (1983) is that of a technical industry standard specification that is formulated through consensus. The specification is intended to facilitate communication within industry and to convey proprietary information openly, in the interest of all. Because of the open participation and consensus-based contexts in which international IT standards are developed, the term voluntary has come to be associated with these efforts.
Predominantly, the role of the developers is voluntary, internationally, and without financial compensation. SDOs presuppose the developers' voluntary efforts: such as, willingness, time, expertise, experience and representation of the interest of all, permit the successful completion of the standardisation process. Furthermore, in the due process, openness and voluntary have particular meaning regarding participation. Both incorporate the right of any participating individuals to express a position; have the position considered and appeal the decision, if they are adversely affected by it (cf. Baron, 1995: 411).

2.3.6 Content Classifications

The reviewed literature presents classifications of IT standards. The full in **Table 2-3** that follows this has two main classes: technology and application.

First, IIT standards are primarily **technical specifications** that establish base line criteria for the creation of a product that uses the technology (Hawkins, 1999). Technical specifications can **describe** core technology, applications, engineering principles, test methods, perceptions about problems to be solved or requirements derived from standardisation. They can **prescribe** distinctive physical and performance qualities of tangible systems products, components or services (cf. Hawkins, 1995:1). Prescriptive specification can incorporate criteria of compatibility, conformity or compliance. Three of the projects examined in this research in the case study, namely ISO 10646, ISO 10918 (JPEG) and ISO 11172 (MPEG-1) fall into this category as *technical standards* (see §3.6.3).

Table 2-3: Literature classifications of IT standards
(Sources: adapted from Coallier and Azuma (SC 7 Spice Project); Gabel, 1991; Krechmer, 2005)

Standard	Sub-types	Key features	Impact
International (consensus or voluntary) *Professional*	- Technical (product) - Application (process)	- Developed at international levels, in the public domain, through Committees consisting of NSB memberships. - Standards developed by e.g. IEEE. - Consensus and collaborative efforts often prevent dominance of interested parties. - Intellectual property rights (IPR), inventions and payments for patents are acknowledged by SDOs.	- Used on a global business and industry basis - Prolonged market impact (acceptability & usefulness). - Market opportunities can be realised, encouraging IT innovations.
De facto	Technical (product); industry	- Strictly commercial and private to a firm or industry sector. - They are part of a firm's core technology incorporating IPR, patents & copyright licenses.	- Developed for their competitive advantage. - Can be adopted in a sector and voluntary domains.
De jure	- Technical (product) - Application (process)	- These standards have regulatory interpretations. Regulatory interpretations & compliance to the standard are mandatory (e.g. in telecommunications).	- Can support fundamentals of research to improve the relationships of science, technology-innovation, market & industry systems. - Can provide for anticipatory technology & create market-oriented opportunities.
[a] Market standards		- Standards established through market-mediated needs (e.g. Microsoft Windows Application Programming Interface; VHS videotape standards).	
[b] Open	- Application (process) - General and policy	- The standards support common agreements to enable communications open to all within a specific domain.	- Can create anticipatory technology or service requirements. - Can create market-oriented opportunities.
[c] Vertical	- Application (process)	- Define how a specific technology is applied to solve different types of problems identified within a business context or a sector.	- Designed for technology and market-oriented opportunities. - Effective for cross-industry co-ordination of requirements and solutions.
Mandatory	- Technical (product) - Application (process) - General and policy	- These standards have regulatory issues in environment, heath, and public communications. - Standards must have policy and, or government endorsements.	- Can promote policy-making for encouraging technology development and focus environmental requirements.

Second, is an **application standard,** also known as process standard. It provides recommendations for the **implementation** of IT systems, applications, product development process or services. IEEE Standard 1074 (1997) examined in this research is an example that describes generic guidelines of requirements and best practices an organisation might follow in defining its software development life cycles, to include project planning and management.

Relationships between the requirements specified in an application standard and those of products or process derived from using such a standard are not always straightforward. The developers have to resolve whether or not there is a case for the inclusion of specific requirements, such as systems implementation or criteria for compliance and compatibility. As illustrated in Table 2-2, IIT project development would draw upon the classification of both domain and consortia-based through specified adoption procedures. Three main reasons are:

[a] Adoption allows **open developmen**t in the IITS process, and to enforce international agreements or legislative issues (ISO, 2004).

[b] Adoption offers **a shorter project development method**. Otherwise, many of these techniques or requirements would normally take several years to be established and validated, before an IITS project is initiated.

[c] According to Updegrove (1995: 324-325), one factor that complicates standardisation is the fact that one kind of standard will often be dependent upon another. Thus, adoption can **reduce the risk of incompatible solutions** brought on by the interdependence of different standards in the IT market.

2.3.7 Current Practices of International IT Standardisation

Much of the reviewed standards literature focuses on consortia-based practices, such as alliance of networks (Shapiro and Varian, 1999), role of government and national practices (Mazza, 1995; Updegrove, 1995). Only a few authors (Cargill, 1989; Jakobs, 2000; Mazza, 1995) have mentioned, as views, the strategic, technical and operational outlook of IITS practices. Because of the scanty descriptions, it was necessary to review organisational literatures to develop theoretical depth in the meanings of current IITS practices. The meanings are summarised as strategy, technical practices, operational views.

First, an organisation's **strategy** puts into effect the actions intended to achieve a set of goals and plans (Scholes *et al.* 2004; Watson, 1993). Practices guide how a strategy is transformed into reality to yield desired results. To operationalise this broad definition, **Table 2-4** following next shows SDO strategic views, side by side: Mazza (1995: 528-530) offers strategic discussions that apply to SDO responsibilities of ANSI. The ISO Strategic Plan for 2005 to 2010 (ISO 2004) describes key objectives and actions pursued as part of its practices.

Second, **technical practices** of international IT standardisation exist in the framework of the development of the projects.

Third, **operational views** are associated with the practices employed in SDOs, NSBs and committees in supporting various activities (cf. Cargill, 1989). NSBs are required to have authoritative involvement in their own country that allows them to be called upon to act as secretariats to deal with operational activities bearing on international IT standards development. Information processing, communication, co-ordination of work and feedback are ongoing operational practices. Another aspect that leans on operational practices is that of Certification Bodies, Registration Authorities and Recognised Operating Agencies (see Table 6-2).

Table 2-4: Sample SDO-based strategic practices (Source: compiled by author from Mazza (1995) and ISO (2004))	
Mazza (1995)	**ISO Strategic Plan (2004)**
[1] The SDO give direction for the development of international standards in relevant subject areas. [2] Identifying work within the SDO that is responsive to National Information Infrastructure's needs and making this visible in useful ways to interested parties. [3] Providing a forum for liaison with other groups, including those that are identifying requirements, developing specifications, engaged in actual implementation experience or seeking reference specifications. [4] To utilise electronic tools whenever applicable to improve the effectiveness of collaboration and communication.	[1] Developing a consistent and multi set collection of globally relevant International Standards. [2] Being the recognised provider of International Standards. [3] Promoting the use of voluntary standards as an alternative or as a support to technology regulations. [4] Being open to partnerships for the efficient development of International Standards and guides relating to conformity assessment.

2.3.8 Contexts of Practice

An IIT standard is likely to turn out to be a result of the dichotomous contexts in which it is developed, as well as, its utility functions through implementation. In this review four types of contexts all-too frequently omitted from the standards literatures are summarised: intellectual input, standards professionals, professionalism and social responsibility.

Intellectual input is central to IITS practices. Committees can be associated with what Tidd and Hull (2002) describe as 'professional bureaucracy'. Individual developers are often referred to as experts with specialisation in a particular area (cf. Baron, 1995; Cargill, 1989). Developers come from core sciences, industry, research, management and business backgrounds. In particular, companies engaged in R & D projects, product development and service sectors contribute expertise to gain collective knowledge through collaboration with others. Information, expertise, knowledge and industry practices are exchanged through participation across a number of projects.

Overall, the implication of intellectual input is that, expertise gives developers specialised authority to develop the projects and to make decisions concerning technical content of the international standard. The developers are expected to understand subject matters of the project, to perceive problems they examine and to translate them in the IITS process in recommending solutions sought after in global markets. SDOs have the authority to endorse international standards that are agreed though consensus and specified procedures. They can intervene in technical discussions to give direction.

SDOs are not always prepared with the knowledge to resolve matters that arise in project development. Intellectual input is extended to a few selected **standards professionals**: experienced developers, SDO and NSB senior managers and executives, and industry consultants. Standards professionals can be found in SDO strategic, management and advisory forums. They identify practice requirements and contribute to the documentation of strategies, policies and procedures implemented in the IITS process.

Intellectual input brings awareness of **ethical and professional obligations** on the part of the developers. Parnas (1995) gives a definition of software engineering professionalism as that, developers of computing systems and of the standards should consider how to deliver solutions that will be acceptable to clients. He stresses that, standards developers are expected to appreciate practical-world problems experienced in implementing software systems. They need to be aware of their responsibilities as experts. These obligations are also imposed on participant nations in the ISO Code of Ethics (ISO 2004).

Social responsibility (SR) introduced earlier in §1.1, is binding on IITS efforts and on the strategies that standards bodies engage in. SR bears on the challenges to understand society's expectations of standards. Usually, these expectations are channelled to SDOs or NSBs through government agencies and user groups. Societal expectations can cover services that formally meet criteria specified by the standard, such as ease of use and safety for consumers. The implementation of any standards that delivers these expectations becomes the responsibility of SDOs (cf. ISO Horizon, 2004; IISD, 2004). In response, SDOs have the social and ethical obligations to develop globally relevant international standards in a constructive, fair, responsive and efficient manner, as well as to promulgate the activities and results that benefit society at large. Other binding guidelines of SR can be found in the '1979 GATT Standards Code' (CEC DGXIII, 1990). In brief, the GATT agreement suggests that international standards must provide effective mechanisms to eliminate unfair market practices, so as to allow sustainable economic, social and technological development, and environmental protection.

2.3.9 Contributions of Standards Literatures

The main contributions of the reviewed standards literatures to this research cover: research areas, dissertation records and contributions.

[1] Literatures

Much of the body of literature on IITS is still relatively scanty, because this topic is evolving to gain recognition within the IS Community. In many respects, IT standardisation activities are discussed 'behind closed doors' in committees, societies and independent consortia of user groups where invitation is by expertise or contribution. The IEEE Computer Society, for example, holds annual SES symposia and Workshops (http://www.ieee.org). These conferences are the only means for developers and research groups to present first-hand experiences by exchanging information and project development practices. Those studying IITS as a topic can 'tap into' the Proceedings to assemble well-established project development practices not found in public literatures (refer to Jakobs, 2005: ii).

[2] Research areas

Table 2-2 shows a summary of IITS subject matters. Much of the research claiming to cover IITS in the IS community is also offering topics evolving from empirical consortia-based activities (see §1.3.3). Social science is another area, which tends to examine IT standardisation in the scope of alliance formation, co-operation and co-ordination (Axelrod *et al.* 1997; Farrell, 1996). Policy-orientated studies examine stakeholders in IT standardisation (Aram *et al.* 1992; Axelrod *et al.* 1997). While this variety in the studies exists on the same subject matters, relatively little work has focused on voluntary IT standards as an exclusive topic. In many of these scholarly works, 'voluntary' is applied in industry standards that have the underpinnings of openness and consensus translated in the adoption of concepts or implementation as a publicly available specification (cf. Hemenway, 1975; LeCraw, 1984; Link, 1983).

[3] Doctoral dissertation records

There are very few dissertations covering some aspect of IT standards, and they are restricted to a particular problem. According to bibliographic statistics of the British Library dissertation records for all UK universities, no prior doctoral dissertations have examined international IT standards development especially the IITS process or standards project development. Out of a search of 395 information technology and standards topics, only two doctoral dissertations mention the term `standards'. Notably, in information science bibliographic library studies (Al-humood, 1998; Li, 1992). Outside the UK, Egyedi (1996) focuses on standards processes and policies in the area of telematic services. Evans (1997) describes standards in developing infrastructures for sharing geographic information.

[4] Literature contributions

As a major breakthrough in an area that is barely given academic attention, empirical IT standardisation studies are offering a platform for questioning the best approaches for developing IT standards and upon which to build the standardisation body of knowledge. This inter-disciplinary nature of the standards material makes a contribution to the challenges that need to be presented in a topic on international IT standards development hence.

[5] Concerns

One of the assumptions made in standards boy of literature is that voluntary and sector IT standardisation efforts have similar features: such as, actors, practices, technical approaches and market impacts. The framework within which international IT standards are developed is interpreted from these similarities.

The generalisation of an area of research that spans converging issues will always be difficult. Attention to overlaps or shared concepts in the areas do not however, aid explanation of how IIT standards are developed or what problems manifest in the IITS process. The challenges faced in the IITS process are therefore more likely to be unique such that they demand exclusive empirical analysis. Where necessary, findings from sector standards for example, can make a contribution to verify identified empirical generalisation from this research.

2.4 Literature on IITS Process

2.4.1 Content of Review

This literature review takes two views: One, the presentation of the content of IT standardisation. Two, the underlying concepts and approaches, which can help shape the study of a process.

2.4.2 Conceptual Schema of IT Standardisation

The IITS process has thus far, not been defined in the extant standards literatures. There are, however, a number of scholarly works that have offered models depicted in **Table 2-5** for the conceptual representation the development of IT standards. The models are distinctively different from each other in their perspectives. This review therefore offers an interpretative schema of IT standardisation associated with the contexts of the models. This conceptual schema also ties together the content classifications of international IT standards (§2.2.5) and domain IT standards (§2.2.6).

Cargill (1989) has the first known model depicting five-stages of IT standardisation. The model leans more on an industry perspective that has come to be applicable to voluntary IT standards. Cargill suggest that his model is 'split into two camps-one polarised around the users and their interests in implementation and the other around the providers and their global concerns' (Cargill, 1989:48).
Providers of IT products and services define a *reference model* (Stage 1) of the qualities of an *industry standard* (Stage 2), including how one set of the functions would occur from a defined technology. The generalisation of a *functional profile* (Stage 3) offers common parameters necessary to accomplish a function or sets of functions matched to providers needs. *Systems profile* (Stage 4) is defined to aggregate a set of implementation applications for a *class of user and requirements* that IT provides need to meet to implement a solution. *Application implementation* (Stage 5) is the solution that responds an assessed user problem.

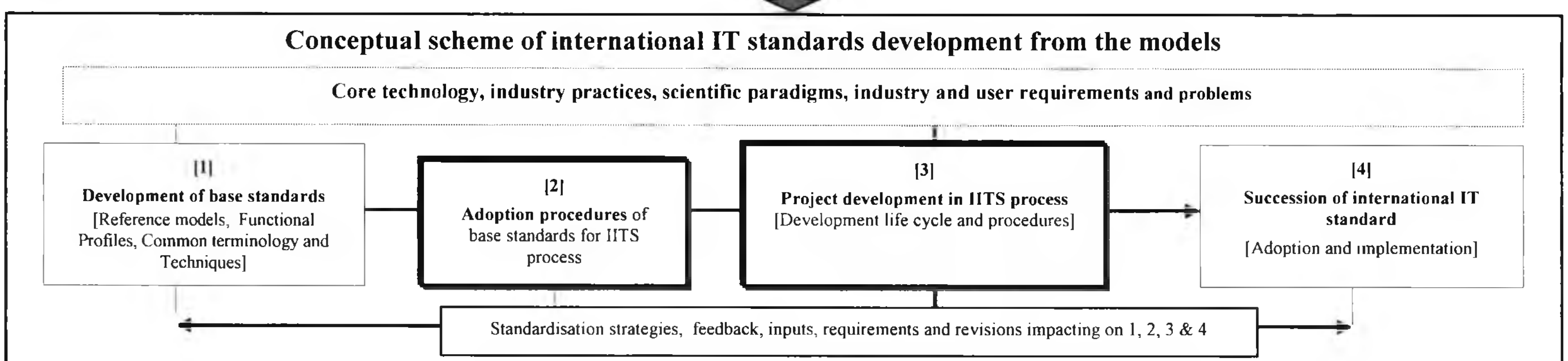
Bonino and Spring (1991:102) propose a three-stage model: Reference Model, Design stage of the standard and Implementation. Their view is that IT standards can be traditional, based upon products that have been implemented in the marketplace. They can be anticipatory to guide future development of tangible systems products or service platforms. A Reference Model (Stage 1) places the focus of the intention of the standard (Stage 2). They emphasise that strategic planners, scientists and users need to be involved in the design and formulating the scope of the standard, and its subsequent implementation.

Mansell and Hawkins (1992: 45) offer another three-stage model: *Planning and priorities* (Stage 1); *Standards development processes and Negotiation* (Stage 2) as exclusive to the definition of the intended standard. These two stages take into account technical factors and priorities of the development of the standard contributing to consensus issues. (Stage 3) is the context in which a published IT standard is *implemented,* which can produce non-technical factors.

Ngosi and Jenkins (1993: 83) describe an empirical five-stage conceptual model. This model is derived from a survey of the development of software standards within ISO JIC 1 SC 7 and IEEE Working Groups. The model outlines the content of a core process that guides the development of international standards and time scales of stage.

Table 2-5: Example IT standardisation models and stages
(Source: compiled by author from listed literatures)

Authors	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5	Stage 6
Cargill (1989)	Reference model	Industry standard	Functional profiles and base standards	Systems profile	Application implementation	
Cargill (1995)	Pre-conceptualisation	The formal standards process	Conceptualisation	Discussion	Writing of the standard	Implementing the standard
Bonino and Spring (1991)	Reference Model	Design stage of the standard	Implementation			
Mansell and Hawkins (1992)	Planning and priorities	Standards development processes and Negotiation	Implementation			
Ngosi and Jenkins (1993)	Project Proposal	Study and Discussion	Writing of the Standard	Consensus-seeking	Publication of International Standard	Revision and Maintenance
Reilly (1994)	Initial requirements	Development of base standard	Development of functional profile, including, product or service tester development	Testing	Deployment of standard for implementation and user feedback	
Baron (1995)	Determination of a need for the standard	Discovery (information acquisition of the information necessary to develop the standard)	Development of the standards document	Public review of draft standard for comments prior to approval	Determination of consensus, which includes resolution of issues	Publication and distribution of standard for public use



Reilly (1994) provides a five-stage model that has been adopted and refined for use as a life cycle in the X3 committee of the American National Standards Institute (ANSI). This model is the first to suggest that model by Cargill (1989) and Bonino and Spring (1991) can lead to base standards describing abstract technical information developed from an adopted industry standard. A base standard can only provide reference, as needed, when developing specific international or professional standard. Two arguments have been raised regarding the Reilly (1994) model.

Cargill (1995: 80) mentions his contention with this life cycle model (presented in X3 committee study document-SD2) that, the actual process of standards creation begins much earlier, and it consists of five steps: Pre-conceptualisation; The formal standards process; Conceptualisation; Discussion; Writing the Standard and Implementing the standard. Jakobs (2000: 20) argues on time scales that, three years is the minimum period for standards production within ISO, which is roughly equivalent to Stage 2 (Development of base standard) of the refined Reilly Model used in ANSI X3 committee. Sherif (2002) has points out that SDOs have considerably streamlined their processes. She gives ITU-T as an example that, it is now capable of passing a recommendation within 18 months.

On these time scale argument, this researcher agrees with Jakobs (2000), because this assumed time reduction does not take into account the true nature of IITS project development. It does not consider the analytic rigour required in each project stage that includes: developing technical concepts; writing the draft standard and time consuming practices required for establishing consensus agreements to publish the standards.

2.4.3 Literature Streams of Process Analysis

Process analysis literatures can be divided into three streams: business process improvement (BPI) and business process change (BPC); software process improvement (SPI) and organisational process studies. In these literatures, there is an absence of a definition of process analysis on which to effectively apply well-tried frameworks. A close definition is by Pettigrew (1997:342) in his discussion on process research in organisational settings:

> ...the major contribution of process research...is to catch reality in flight, to explore the dynamic qualities of human conduct and organisational life and to embed such dynamics over time in the various layers of context in which streams of activity occur...

The areas of BPI and BPC often are interchangeable in terminology and practice. They comprise a large of body of literature that has developed many of the propositions for process improvement. In both these areas, process analysis takes a broad view of understanding an existing process to shape the concepts of its definition through models. More so, the analysis and definition tends to be organised around the principles of defining the functionality of a current process for modification either through redesign or reengineering (Born, 1994; Davenport, 1993, 1998; Harrington *et al.,* 1998; Johann, 1995; Kock and Murphy, 2001).

SPI is an approach to systematic and continuous improvement of a software development organisation's ability to produce and deliver quality software within time and budget constraints (http://www.sei.cmu.edu). It is mentioned in this review for its illustrative process analysis, from which relevant concepts can be adopted optionally. The Software Engineering Institute's Capability Maturity Model, SPI-CMM for example has been adopted widely (Caputo, 1998; Humphrey, 1989; Paulk *et al.* 1995). It is a tool for organisations seeking to evaluate the process performance based on measurable improvements, such as reductions in product defects, time and costs.

Organisational process studies concentrate on two dimensions: Analysis of the hierarchy of organisational functions, such as strategic, operational and tactical (Clark, 1999; Galbraith, 2002; 2005; Ostroff, 1999; Robey and Sales, 1999). The characterisation of a process based on organisational functionality (Rossett, 1992, 1999); embedded contexts, such as teams, information and environmental influences (Clark, 1999; Galbraith, 2002; 2005; Ostroff, 1999 Pettigrew 1997).

Reviewed works by Ostroff (1999) and Pettigrew (1997, 2000) mention a number of concerns. In particular, organisational processes are hierarchically organised around complex functional issues, such as activities, product development and performance practices that may be divided among a range of sub-units. Often, only key organisational processes become the predominant focus of analysis. The analysis leads to the reconfiguration of specialised functionality or use of IS.

2.4.4 Process Analysis Approaches

In these three areas mentioned earlier, the body of literature on business and organisations lack universality in the process analysis approaches. In organisational studies descriptive analysis suggested in Pettigrew (1997) and, Yammarino and Dansereau (2004) is often preferred. The descriptions tend to cover macro and micro perspectives of process performance, in line with other organisational units.

The macro perspective has underpinnings of propositions by Galbraith (1973, 1977) and Weick (1969) to study of an organisation's functions taking into account environmental factors and their influences upon performance.

This is because at macro level, an *organisation's environment* provides sources of information, the customer and resources. **The micro perspective** of an organisation, on the other hand, informs on *how the content of processes* can be portrayed: such as, inputs, execution of activities and influences of their results upon set strategies.

There are a number methods and methodologies that illuminate how a process can be analysed. The soft systems methodology, SSM (Checkland and Scholes, 1991) incorporates a systems thinking approach in the analysis of an organisation; its processes, under set conditions that influence human actions. Kock and Murphy (2001) created 'InfoDesign methodology' combining process analysis with definition re-design of specific functions involving knowledge and information flow through IS resources.

Another category is methods utilising different modelling paradigms upon which to build requirements or desired changes. Examples are BDDs (Rock-Evans, 1992), DFDs (Avison and Fitzgerald, 2002) and object relationships (Dietz, 1994). And explicit aim of these methods is to combine description and structured representation of a process, as a building block to the design of IS.

When addressing multi-dimensional processes, any form of modelling is less forgiving on errors. The meaning of the process can be lost, because the analysis has to match criteria of the original method. If not more so, data gathered on performance has to match constructs of the examined reality. The models go through validation of data gathered and refinement to define actual or desired performance. Then there is the difficulty of modelling the meaning of social contexts or issue-based process performances. The results become constructional interpretations, instead of explication that might help us to differentiate understanding of process, its performance contexts or problems to be solved.

2.4.5 Specific Items of Process Analysis

Processes span across an entire organisation from the different kinds of functions it performs (Clark, 1999; Ostroff, 1999). Cross-functionality requires process analysis for critical understanding of three specific items: performance, problems and requirements.

An analysis of process performance establishes understanding of features and factors influencing functionality. Rossett (1992) mentions that, the goal of performance analysis is to measure the gap between the desired and actual performance. In this regard, the macro and micro perspectives mentioned earlier could be differentiated further to focus on angles for explaining specific items of process performance: such as content, operational challenges, dynamic interplay of human interactions, practices and outcomes. By linking the features established from these levels, *actual* performance can be defined.

Process analysis must address **how problems occur in performance**. In BPI and BPC, a process associated with the most critical problems is given priority in the selection for redesign or re-engineering (Davenport, 1993; Kock and Murphy, 2001). Definition of problems is fundamental to the intent of *desired performance*. This would be qualified through detailed **requirements analysis.** An organisation would therefore, make a careful assessment of say, customer needs, capabilities and resources to develop requirements for its processes. These requirements determine the desired performance.

In issue-based approaches for IS development and process design (such as Avison and Fitzgerald, 1999, 2005; Easterbrook, 1993, 1994) the resolution of requirements depends upon consensus among diverse groups of stakeholders' being achieved, even when a solution is understood. There are arguments that, achieving consensus on stakeholder wishes offers no purpose on the realities of the actual problem or requirements (cf. Easterbrook, 1993, 1994). This consensus reassures the stakeholders that all issues they presented for consideration have been dealt with, without compromising their views.

2.4.6 Critique of Process Analysis Literature

There are three main criticisms from this review regarding specificity of process analysis and the approaches.

The appropriateness of a process analysis approach rests on the **specificity of the chosen analytical criteria** for describing and for explicating the process. For example, process dimensions to examine and reasons for examining them. A number of the reviewed literatures do not offer specificity criteria in process analysis. Only a few scholarly works (Born, 1994; Dorfman and Thayer, 1990; Krutchen, 2005; Pettigrew, 1997) recommend levels of analysis that can give the 'reality' of the actual dimensions of process analysis.

In this thesis, **understanding a process** is a prerequisite for its reconstruction and designing desired functionality. It is important therefore, to link process analysis to the location and explanation of outcomes of the study (cf. Pettigrew, 1997: 340). While there are several well-established methods and methodologies, the descriptions of the process can not be linked adequately to *how* process reconstruction can be achieved or *which* requirements are to be satisfied in the design actions.

Literatures on BPI, BPC and organisation studies place emphasis on **'problem recognition'**, questioning how an organisation performs its business or processes. Problem recognition, as opposed to problem analysis lacks criticism and factual judgement about the problems that can considered in process reconstruction exercises. If the problems are not stated implicitly or explicitly, the result is a final process design that fails to meet the organisation's objectives of correct functionality.

The analysis of requirements, as input to the process design exercises, is under-explored in BPI and organisation studies. Process modelling approaches often applied in BPI fail to give sufficient attention to the requirements that can be met in design actions. Organisation studies on the other hand, present all-important factors in the contexts of organisational and process functionality. All to-frequently, they do not present detailed requirements analysis to account for the examined contexts and desired performance. Inevitably, there is a need to cross over to other areas for explication of analyses of problems and requirements.

In the context of **problem analysis,** solutions are the logical next step. Literatures in the areas of soft systems analysis (Checkland and Scholes, 1991) and software processes (Dorfman and Thayer, 1990; Humphrey, 1989) draw attention to specific context of problem-solving analysis. Example details are problem definition, causes, severity and implications (Checkland and Scholes, 1991; Humphrey, 1989). Details of causes or severity would be judged upon all-inclusive organisational factors of how examined problems are defined in order to solve them. They are forms of verification that can not be ignored in devising approaches and solutions that are specific to the problem context.

Process requirements are determined on the basis of desired performance, not a gap of actual and desired performance which needs criteria of items that can be measured (cf. Rossett, 1992). Exclusively, process requirements will address the functions a process is expected to perform to execute a project, to produce a certain result, based on actual or measurable inputs, activities and use of IS resources (Humphrey, 1989; Sawyer *et al.* 1997).

Looking at interconnected items strengthens the argument for using a theory lens. The analytic framework in Figure 5-2 demonstrates how OIPT as a lens becomes vital to link all these core elements described in this section: One, this lens helps to develop greater analytic rigour underpinning the understanding of a process. Two, it links core elements that include process performance, evaluation of complexity, requirements and design of solutions all examined within the same theory base (Chapter 5).

2.5 Project Development

2.5.1 Reviewed Body of Literatures

Standards literatures barely give any attention to project development, albeit the fact that this is a central theme of IT standardisation. This researcher reviewed a selected body of literature that illustrated concepts of project development to draw upon current insights into issues that impact on IITS. The results of this review produced seven categories shown in **Table 2-6**.

Table 2-6: Project development literature streams
(Source: compiled by author)

Streams of literature topics	Literatures
[1] Organisation-based project and product development	Archibald (1992); Gelès *et al.* (2000); Leonard-Barton (1992); Orlikowski (2002); Souder *et al.* (1998); Tidd, (2001)
[2] Challenges and dynamics of project development that cross over areas of organisational functionality	Galbraith (1977, 1994); Matheson and Matheson (1998), Mankin, et al. (1996); Ostroff, (1999); Sherman *et al.* (2000); Smith and Reinertsen (1998); Tidd (2001)
→ [3] Project development team-based activities	Evaristo and Fenema (1999); Faraj and Sproull (2000) Galbraith (1977, 1994); Humphrey (2000); Hauptman and Hirji (1999); Neufield *et al.* (2001); Mohrman *et al.* (1995)
[4] Technical project and product development (e.g. Project approaches)	Carlile (2002); Clark and Wheelwright (1997); IEEE Computer Society standards Proceedings (selected topics); Fischer (1979); Griffin (1997); Tushman (1978)
→ [5] Intellectual input, information and performance in project development	Bennis and Biederman (1997); Fischer (1979); Lesser and Storck (2001); Quinn (1997);
→ [6] Project-oriented practices and capabilities	Bennis and Biederman (1997); Blackler (1995); Faraj and Sproull (2000); Lesser and Storck (2001); Mankin et al. (1996); Orlikowski (2002); Wenger. and Snyder (2000)
→ [7] Group and team-based practices; group performance	- *Communication practices:* Evaristo (2003); Faraj and Sproull (2000); Kaplan and Martin (1999); Ocker et al (1998). - *Practices:* Baron et al. (1992); Brown (2000); Gersick and Hackman (1990); Hoffman (1979); Hackman (1976, 1977); McGrath (1984; 1990); Mohrman et al. (1995); IEEE Computer Society standards Proceedings (selected topics); Wenger (2000) - *Content of performance*: Kaplan and Martin (1999); McGrath *et al.* (1993); Orlikowski, (2002)

2.5.2 Definition of Projects

The PMI Standards Committee describes a project as a temporary endeavour undertaken to create a unique product or service (PMI. 1996:4). A project is considered to be unique to an organisation program of work. It has a definite start and finish point, with specific schedule, cost and technical objectives.

2.5.3 Dimensions of Project Development

Figure 2-2 gives predominant project development trends from reviewed literatures. Five dimensions relevant to these trends are described next: [1] Organisation. [2] Functional Integration Strategies. [3] Project Development. [4] Innovation and Interventionist Strategies. [5] Results and Issues.

2.5.4 Review of Project Development Dimensions

[1] Organisation

The premise here is that, project development takes place in an organisation. Project-based organisations tend to integrate project development in *key processes* to deliver products or services to customers (cf. Cleland, 1996; Ostroff, 1999). There can be a mutual relationship between an organisation's processes and the projects it chooses to develop.

[2] Functional Integration Strategies

Processes assigned with project development fit into the organisation's overall strategy of functioning. Functional integration strategies advance an organisation's goals. An organisation strategy and projects would therefore, be placed in the context of an integrated development program to move toward the realisation of a particular organisational goal (cf. Matheson and Matheson, 1998). Functional integration would incorporate all the items shown in Figure 2-2 [2] focusing on the alignment of organisational strategies to project development.

[3] Project Development

Organisational project development has very little consistency of definition. It has been associated with different typologies: projects as organisational programs of work (Gelès *et al.* 2000); project-product development (Bessant and Francis, 1997), team-based projects and programs (Archibald, 1992, 2003; Mohrman *et al.* 1995; Quinn *et al.* 1997) and product design and development (Baxter, 1995). This list is endless.

Nevertheless, the main purpose is to execute projects and deliver tangible products, designs, information or services, depending on an organisation's chosen strategy. In contrast, IITS project development is about responding to assessed technology and regulation issues to deliver standards that can be tangible products or technology requirements or solutions (see §1.2.3). Committees as teams, SDO, NSBs and the dynamic interplay of information, practices, processes add to the core elements underpinning the framework of project development.

What evolves from the reviewed body of literatures and reality of IITS is that project development embodies methodologies and dynamic human mechanisms. *Methodologies* can include strategy; R & D activity; process engineering; operational measures; business philosophy or policy orientations (cf. Gelès *et al.* 2000; Matheson and Matheson 1998). As illustrated in Figure 2-2, [3], *mechanisms* on the other hand evolve as project and people-oriented practices for executing particular activities. Project development will then, yield interim and final results, in the interests of attainment set goals (Archibald, 1992, 2003; Gelès, 2000; Tidd, 2001).

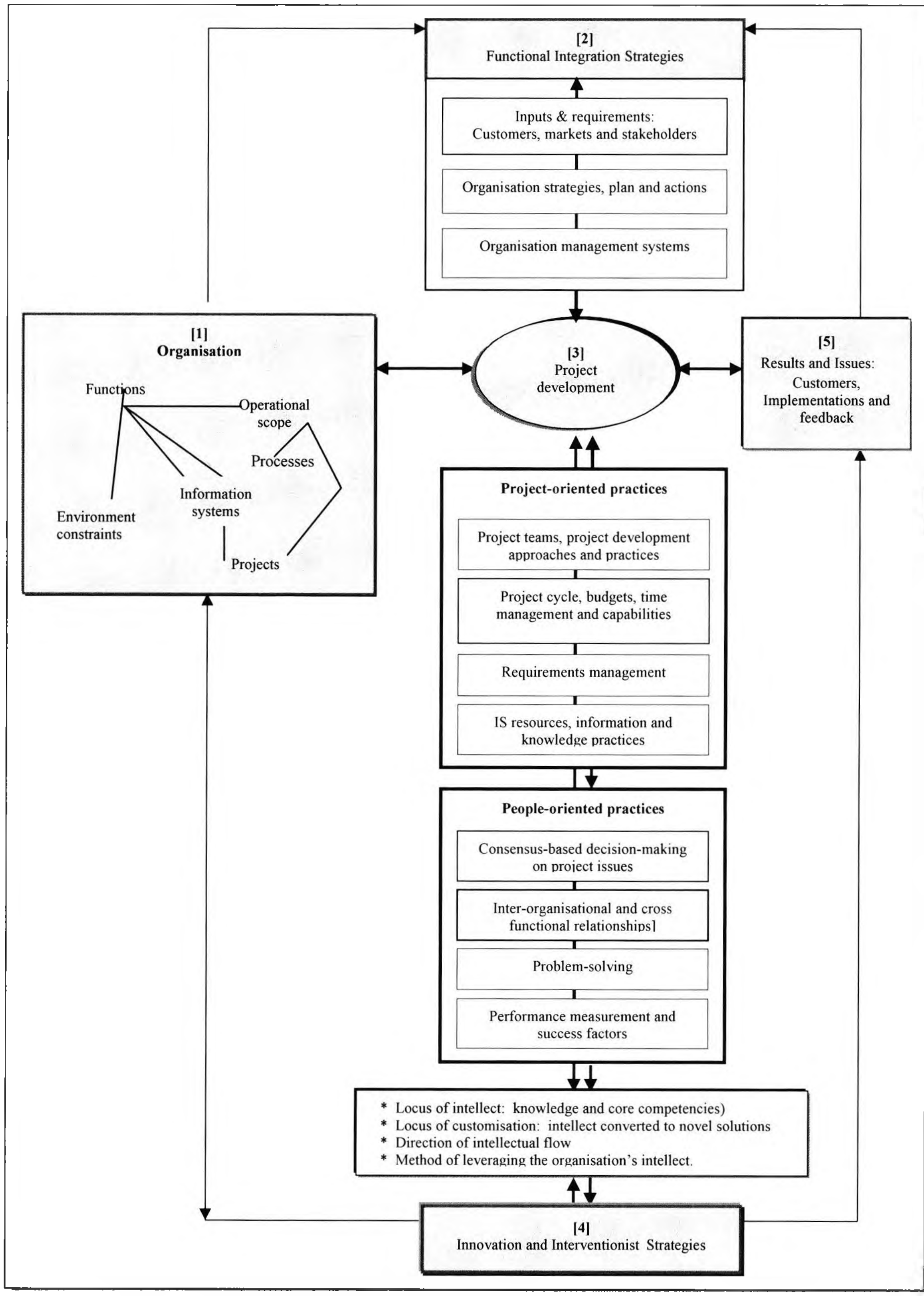


Figure 2-2: Literature Dimensions of Project Development
(Source: compiled by author)

[4] Innovation Strategies

They are **implemented through** IS resources to promote performance, in terms of efficient information processing, information management and communications management (Tidd, 2001). **Interventionist strategies** increase managerial roles in examining the dynamic interplay of project development elements. *Intervention* points to testable propositions of problem solving with an organisation's fact based approaches or proven methodologies. Problem solving *strategies* will cover design of solutions supported with best practice, performance measurement and success factors.

[5] Results

Results of project development lead to customer implementations. Feedback of implemented results can bring informed challenges to the organisation. The implementation of IIT standards, for example, can make a contribution to the information and evaluation strategies employed in project development for other projects in the same subject area.

2.6 Design and Solutions

2.6.1 Literature Streams

Three core subject matters of this thesis guide this literature search and review: process reconstruction, project development and design of solutions (see Table 2-1). A summary of the reviewed literatures is given only for the items central to the aims of process reconstruction, to include design strategy and IS. As illustrated in **Table 2-7,** this search yields four areas located in the body of literature that also has identifiable overlaps from the items connected to them.

Table 2-7: Literature streams for process design and solutions
(Source: compiled by author)

Area	Key concepts	Body of literature
[1] Process reconstruction	- Redesign; reengineering, change - Process restructuring for distinctive issues e.g.: collaboration; information flow; workflow.	Braganza (2001); Davenport (1993, 1998); Johann (1995); Kock and Murphy (2001); Hunt (1996); Kock and Nosek (2005); Nezlek et al. 1999
[2] Design strategies	- Process functionality - IS integration	Adler (1995); Allen (2001); Davenport (1998; 2000); Johann (1995); Herzum and Sims (2000); Kammer (2000)
[3] Design for process capabilities	- Technology-based solutions supporting value and competitive advantage	Hamel and Prahalad (1989, 1993, 1994)
	- Customer-centric processes and horizontal designs	Galbraith (2005); Hutchings and Knox (1995; Ostroff (1999)
	- Cross-functional operational solutions through integrated IS e.g.: for co-ordination, information sharing, inter-process collaboration and e-services. - IS integration and infrastructure for overall process performance	Adler (1995); Davenport (1998); Herzum and Sims (2000); Krieger and Adler (1998); Sauer et al. (1997)
[4] Organisation design including process and project issues:	- Project-product development process functionality. - Design of project-based teams and settings. - Design of team practices (knowledge, information)	Clark and Wheelwright (1993); Galbraith (1973, 1994; 2002, 2005); Mohrman et al. (1995); Neufield et al. (2001); Braganza (2004); Kerzner (1998); Wenger et al. (2002)

2.6.2 Process Reconstruction

In reviewed literatures process reconstruction has a number of meanings stemming from BPC, BPI and process modelling concepts. Lind and Goldkuhl (1997), for example, use a theory-driven approach for reconstruction of business processes. Different ways for performing a particular process are described in detailed levels through action and process diagrams. However, concepts such those used in re-design are applied to design new process features, which form a basis for determining desired changes, such as new functions and flow of information.

Depending on the focus of the method applied, reconstruction has been used after redesign actions. This is in the cases where there is a need to establish a coherent design structure of the new process; to integrate IS resources or new operational matters such as team settings (cf. Davenport, 1993; Tapscott and Caston 1993). This form of process reconstruction falls into the category of radical re-design and re-engineering approaches such as those in Davenport (1993), Harrington (1991) and, Kock and Murphy (2001). The reconstructed process needs reconfiguration of new features and functionality.

2.6.3 Design Strategy

Propositions raised in literatures (such as Galbraith, 1994; 2005 Veryard, 2000) suggest that an organisation's success in solving complex process problems depends largely on managing design issues of required functionality. Designing a complex process has the major challenge of trade-offs between content features and interdependencies of the various functional issues that may need separate solutions. The absence of a good design strategy is an invitation to failure of performance expectations hence. The body of literature on process design strategies argues for reduction of complex facets, process definition and process integration.

Business and organisation processes tend to build up **complex facets** underlying their content, functionality, strategies and services. Herzum and Sims (2000) and Veryard (2000) mention that business processes need a component-based approach because it can potentially provide a potent design strategy to effectively resolve identifiable complex facets and dynamic functionality.

Process definition the main trends in large businesses that want to pursue propositions for performance capability, customer-centric designs or managing various functions more effectively (cf. Galbraith, 2002; Veryard. 2000). A component-based design strategy utilises autonomy and partitioning principles. Complex processes performing at different levels of the organisation can be designed in . According to Herzum and Sims (2000), this partitioning principle helps to redefine the process, so that it can perform a specialised business concept or function Redefined process features can then be tailored to support an organisation's strategy for that particular concept: for example, project development and service provision.

Literatures such as Alder (1995), Krieger and Adler (1998), Herzum and Sims (2000) and Veryard (2000) argue that, a component-based design strategy is more effective in leveraging performance capabilities through **integrated systems**. The basic principle begins with the design strategy that provides a good fit for creating autonomous units that are unconstrained by an organisation's functions. Each component-based unit can be designed to handle business concepts, functions, operations and IS resources. A variety of process representations (content, control elements and performance contexts) can be integrated to operate in a distributed computing environment. More so, integration of processes and their representations can help to maximise the application of infrastructures that use communication technologies in all areas of co-ordination of work, information sharing, services and teamwork.

In arguing that the extant IITS process can be reconstructed in a CBD framework, the design strategy and its key principles, such as autonomous units, partitioning and integration systems become more attractive as potential solutions. IITS process project development produces various sub-processes that make their definition and performance evaluation difficult. Specific IITS process facets such as writing of draft standards, can be partitioned and customised as concepts, so that their unique needs can be addressed more effectively. A component-based design strategy would also help to deal with fewer IITS process concepts and performance contexts. Claims of reducing complexity, simplicity of process representations, resolution redefined functions and leveraging performance capabilities, however, will depend on evaluated solutions from the implementations, instead of design issues.

2.6.4 Literatures on Information Systems

The review is based on the argument in this thesis, which is to utilise IS resources as facilitator for creating effective functionality of the reconstructed IITS process (see §1.4.4, §2.2.2). From a diverse range of literatures on the use of IS in organisational contexts, a relevant definition for the aims of this thesis is taken from Land (1992:6):

> Information systems need to be considered just as artefacts but from the perspective of the people who may wish to use those artefacts to support their activities and decisions in a more formal manner.

A more recent conceptualisation to add to this definition is that process approaches stress emphasis on technology capabilities necessary to bring about competent performance (Davenport, 1998; 2000; Keen, 1997). Capability is a measurable dimension to be used in conjunction with specifiable process practices. This will determine how well it a process is functioning to fulfil stated requirements, compared to: input, skills to perform tasks and utilisation of IS (Humphrey, 1989; Holdsworth, 1994; Prahalad and Hamel, 1996). Another convenient definition taken from Cobb and Mills (1990: 44) helps to link process reconstruction to expected functional solutions and to context of use of IS:

> ...problems are symptoms of a process that is not yet under intellectual control. An activity is under intellectual control when the people performing it use a theoretically sound process that gives each of them a high probability of obtaining a commonly accepted answer. ...Intellectual control is achieved when theories are developed, implementation practices are defined, and people are taught the process.

2.6.5 Gap in Design and Solutions Literature

This section has described *design* and *solutions* in view of the reconstruction of the IITS process. Scholarly works (such as Avison and Fitzgerald, 1999, 2005; Hevner *et al.* 2003; Hirschheim *et al.* 1995; Maxwell *et al.* 2002) focus on design issues and design methods to develop IT artefacts. The identified gap in knowledge on these literatures focuses particularly on design and contexts of the interpretations of solutions.

In general, design and solution apply to different types of phenomena. According to Simon (1996) and Weber (2003) **design** combines the expressiveness of analytical contexts and problems being considered, and representing them to explicate a solution that can meet certain needs. The term **design solution** as used in Hevner *et al.* (2003) and Weber (2003) has other entwined meanings. Their suggestion is of one particular style of design (or a specified design strategy). The design strategy helps to represent a problem, so that **solution options** can be defined. The design strategy can also present how a chosen solution can be implemented. Thus, solution option, the problem and implementation considerations are considered together, perhaps until, the 'ideal solution' is determined through practice.

Literatures covering organisation process issues (such as Galbraith, 1973, 1977, 2002; Ostroff, 1999) suggest that the design demands well-established framing concepts. For one reason, the organisation and organisation process may have separate types of problems embedded in other issues. On the hand, the design of an organisation places emphasis on structures, management of functions and customer relationship (cf. Galbraith, 2002). If appropriate, an organisational design enables an organisation to execute better, learn faster and change more easily (Mohrman *et al.* 1995:7).

An organisation process, on the other hand, can include multidimensional elements: for example, content of work, functions, tasks systems, teams and structures of communication. These elements would have other interdependencies to embedded items that are differentially shaped by performance. An important argument revisited here to address the gap in design and solution terminology is that a design and a solution are separate items. They have explanatory interconnectedness determined in this thesis as, follows:

In keeping with Simon (1996) and Weber (2003), a relevant **design strategy** seeks to define the problem being considered. The design strategy helps to capture the reasoning of **workable solution options**. When the terms of the problem have been reasonably delineated, the design strategy ensures a level of certainty to address the right process issues bearing on the solution options, and to also match identifiable needs. Defined process elements can then be tailored according to **design decisions** supporting the representation of the problem and solutions of choice in design strategy and (cf. Starkey, 1992; Maxwell *et al.* 2002).

Criteria for evaluating competing designs have been suggested in a variety of literatures. Depending on the aims the study, the most common evaluation methods are: the value-based in which a design must feasible if its meets criteria for 'Technical, Economic, Legal, Operational, Schedule feasibility factors, TELOS' (Burch, 1992). Another is the function-based involving criteria for 'Maintainability, Usability, Reusability, Extendibility factors, MURRE' (Burch, 1992). These criteria require excessive qualitative and quantitative data collection on each competing design, accompanied by data from implementation trials.

Markus and Keil (1993) suggest that, it is more important to define the *quality of the solutions* sought, instead of providing mechanisms for managing diverse matters. Solutions that are evaluated from a design would be *complete* in their definition stated in view of:

[a] Their quality to meet the aims of proposed process changes.

[b] Solutions of quality are likely to be adopted and implemented in the area for which they are designed. They will qualify, perhaps as implementable because they accomplish the goal of the study. They are expected to bring about positive implications, such as value creation in function or to the organisation as whole.

[c] Quality and completeness of the solutions has emphasis on the *'fit'* between an organisation's strategy; process performance and technology matched to requirements (cf. Doty *et al.* 1993; Galbraith, 1977; Sauer and Willcocks, 2003). Whereas, *incomplete solutions* do not satisfy stated requirements. They do not offer 'fit' or promise of implementability.

2.7 Research Methods

2.7.1 Body of Literature

The area of ISR deals with methodological practices employed in empirical IS research. Among the dominating ISR scholarly works are Galliers (1991, 1997); Klein and Myers (1999); Lee *et al.* (1997); Mingers (2001); Mingers and Willcocks (2004); Myers and Avison (2002); Nissen *et al.* (1991); Trauth (2001) and Walsham (1993). These collective scholarly works offer different types of typologies of shared practices within the IS community. A predominant argument is that, scientific interests in studying human beings in organisation contexts and the use of IS increases the need for appropriate methodological practices. Empirical enquiry supported by research methods, paradigms, theory and questions are some of the methodological practices that have a crucial role in designing and executing the research process.

2.7.2 Typology of Research Process

Extant literatures offer two main perspectives of an IS research process: qualitative and quantitative.

The qualitative perspective has been clearly identified for its applicability to investigate wider context of the social construction of IITS, and weaving together understanding of actions governed by human behaviour (cf. Kaplan and Maxwell, 1994). **The quantitative perspective** focuses on investigation of measurable variables to establish statistical significance of their properties or relationships between variables (cf. Straub *et al.* 2004).

As it stands today, IS research is not strictly qualitative. It has interaction between technology and humans as significant factors that lead to borrowing several strengths in the methods that complement the dynamic nature of doing research in this field. According to Guba and Lincoln (1994), qualitative comes from the fact that the approaches that apply to IS research frequently tend to balance its underlying influences in the light of tacit philosophical assumptions. More specifically, the strengths and weaknesses in the methods that have been developed in IS research adopt other distinctions. This is from the need to refine those underlying influences of qualitative research, and to deal with the emergent discourse in the use and value of various methods.

Three prominent distinctions are positivist, interpretive and critical. They are described as *philosophies* as part of Galliers' framework of orthogonal relationship between research philosophy and method (Galliers, 1997: 153). *Epistemology* is applied in Orlikowski and Baroudi (1991) to make these three distinctions. Other terms applied for the same distinctions are *paradigms* (Chen and Hirschheim, 2004; Hirschheim, 1985; Hammersley, 1992) and *theoretical perspectives* (Goles and Hirschheim, 2000).

Crucial points of interest are from studies carried out by Orlikowski and Baroudi (1991) of 155 IS research articles, followed by Chen and Hirschheim (2004) of 1893 articles published in US journals and European journals. These studies determined the frequency of the use of positivist, interpretive and critical paradigms across the journal articles. General consensus from these studies suggests that positivist and interpretive paradigm dominate IS research, with very little attention given to the critical paradigm.

Table 2-8 contains a summary of a typology of a qualitative research process developed from these three dominant paradigms. One topic that seems ignored in IS research is that, depending on the subject matters, an investigation can link these paradigms interchangeably: for example, positivist and interpretive or critical and interpretive. A number of researchers (such as Brewer and Hunter, 1989; McGrath, 1984; Mingers, 2001) support methods pluralism due to the fact that qualitative research tends to investigate complex social phenomena. Brewer and Hunter (1989), and McGrath (1984) also advocate combining qualitative and quantitative methods originating from different paradigms. Critics of methods pluralism (Guba and Lincoln, 1994; Lincoln and Guba, 2000) have argued that, the use of different methods can create irreconcilable positions in the research process. This is because of the methods also have different paradigms, such as positivist or interpretive.

These debates do not, however, discuss combining paradigms underpinning epistemological, methodological and philosophical *logic* of explaining phenomena of interest. Paradigms such as positivist and interpretive are easily integrated in an investigation, because of their shared dimensions and extendible influences (see §2.7.8). The question here is, does this research, because of its unique convergence on content or embeddedness of its subject matters in other areas require unique paradigms?

The contra pluralist position described in Mingers (2001: 247) gives a partial answer to this question. By encouraging methodological pluralism, both methods and paradigm dichotomies can be overcome. This researcher answers this question arguing that a theory-driven research methodology is more likely to support the relationship of combining methods, paradigms and epistemological assumptions in one investigation, thereby resolving dichotomies (see §9.5).

Table 2-8: Typology of guidelines of qualitative IS research process
(Sources: Benbasat *et al.* 1987Galliers, 1991, 1997; compiled from Yin, 1989, 1994)

	Paradigms		
	Positivist	**Interpretivist**	**Critical**
[1] Ontological basis:	Objectivity	Subjectivity<>inter-subjectivity	Subjectivity<>inter-subjectivity
	Realism	Social realism<>order of phenomena of interest	Realism<> understanding of social construction
[2] Stance	Predictive understanding of phenomena of interest	Descriptive<>explanation:	Descriptive<>explanation theory development
[3] Goal:	Predicting or explaining causal relationships	Generalisation of details revealed in the interpretation of non-specific phenomena of interest	Explanation of contexts of phenomena of interest
[4] Theoretical basis	Formal propositions<> problem	Derived propositions from exploratory study<>literatures	Logical challenges of generally accepted assumptions
[5] Data collection:	Laboratory and field experiments Case studies	Traditional ethnography<> case studies	Critical and traditional ethnography<> case studies
[6] Methodology:	Measurement	Case study participant observation Textual analysis <> Document analysis Constructed meanings: hermeneutic process	Case study participant observation Narrative discussion
[7] Instruments:	Measurement<> validity	Questionnaires Interviews Formal documentation	Questionnaires Interviews Formal documentation
[8] Data types:	Quantitative<>quantified surveys	Textual	Textual
[9] Data analysis	Quantitative	Qualitative: coding paradigms, comparisons; relationships and patterns in data collected	Qualitative: critical analysis of the qualities of setting, social meanings, relationships and changes, over time
[10] Research outcomes:	Grounded theory and Improvement on existing theory Theorem proofs	Theory development Models<>frameworks<>Method Solution proposals to phenomena of interest	[Inexact] <> change in the situation

2.7.3 Content of IS Research Process

Keen (1980) offers four recommendations underpinning the elements of a research process in IS.

[1] A research process should have *some framework* to guide how it is executed to successful completion. Some of the core inputs of a research process are, research design, goals, objectives, actions and analysis approaches.

[2] *Relevant body of knowledge* (such as well-established literatures) aid in explaining how to examine phenomena of interest.

[3] *The 'meaning' of the research* is developed through an interpretative process that examines and, translates stated actions into desired results.

[4] *Research methods* (and methods of science) should serve as a focal point for the investigation.

Keen's recommendations have remained consistent in the IS body of knowledge. Nevertheless, much progress has been made in IS research that add other crucial more up-to-date guidelines covered in the typology in Table 2-8 above. Against this typology, a qualitative IS research process has key features covering perspectives, philosophical assumptions, ontological basis, theory lens, research outcomes and practical importance.

Perspectives: A research process embraces perspectives such as qualitative or quantitative. They are prescriptive for the approach underpinning a chosen research process.

Philosophical assumptions: A number of scholarly works (such as Galliers, 1997; Walsham, 1993) recommend the use of philosophical assumptions, which shape the underpinning methodological and paradigmatic aspects of a IS research process (see §2.7.8).

Ontological basis: The relationship between methods and paradigms is one that draws upon the ontological basis of the meanings of reality that exist in the phenomena of interest. Ontology involves the philosophy of reality that epistemology addresses. Epistemology being the philosophy of knowledge (Greco, 1999) is closely connected to the research ontology basis and its methodology hence.

Theory lens: The need for a theory lens is being addressed in a number of scholarly works (Garcia and Quek, 1997; Gregor, 2002; Trauth, 2001; Watson, 2001). The central argument is that, judgement as to whether a research process or choice of method is of the right type depends upon stating from the beginning, a *theory lens* of choice and its *position* in the study (see §2.8).

Relevance: Benbasat and Zmud (1999) redress the practice of relevance in IS research, which is also discussed in Keen (1991). Recommendation 4 in Benbasat and Zmud (1999: 9) places focus on research outcomes: 'When deciding whether or not to begin a new research project or a manuscript, IS researchers should focus on the likely outcomes, rather than the inputs, of such efforts'.

Practical importance: In Trist (1976) and Benbasat and Zmud (1999), the outcome of the research is the focus of the investigation that offers critical thinking about practical importance and implementability. According to Trist (1976) an empirical study makes access to real life settings, such as investigating IITS process project development in committee settings. The premise to guide the research purpose would be the *implementability* the results and the benefits to be cultivated in IITS practice.

Overall, practice helps to improve theory and knowledge on the topic examined. Therefore, emphasis on the *practical importance* of research results is not only for answering examined research questions. Taken as part of the contribution to knowledge, it adds value to the intended adoption of the research results and a broader view of the impacts of specifiable issues. These are arguments for implementability that are well-supported in techno-change studies. For example, Majchrzak (1991) and Markus (2003) suggest that solutions need to be designed with the goals of their 'practical use value' for adoption in a targeted environment.

2.7.4 Instruments of IS Research Process

In the reviewed literatures, a qualitative research process presents four sub-items: research design, exploratory, case study and research questions. The last three items are often regarded as key instruments of a research design.

A number of models (such as Jarvenpaa, 1988; Galliers and Land, 1988; Remenyi and Williams, 1995) are suitable for **a qualitative IS research design** (see Figure 3-1). The perspective relevant to the chosen topic determines how the research can be designed. For example, if the primary interest of the research topic is in understanding a phenomenon, the stance can be grounded theory (Strauss and Corbin, 1990, 1998) or interpretive research design (Boland, 1985; Galliers, 1992; Walsham, 1993).

Qualitative IS research can be **exploratory** in the cases where a problem or theory is not clearly identifiable or where the existing body of knowledge is insufficient to permit the posing of questions (cf. Benbasat *et al.* 1987; Galliers, 1992). Data is collected and analysed to form the basis for identification of the object of the research and an approach that would be most suitable. This process can lead to theory building (Galliers, 1992: 161). Keil (1995), for example, employs of an inductive version of exploratory study. He applies a longitudinal single-case study to examine unexplored phenomena of patterns of failure of systems projects. He then builds a theory indicating the 'why' or 'how' project failures occur and to test this.

A case study is a main strategy that aids the analysis the potential aspects of a particular case. Yin (2003: 13) revised these features to define the scope of a case study as:

> an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.

Benbasat *et al.* (1987: 371) mention eleven features of case studies, which are also part of Yin's works (1989, 1994). Four of the features are guidelines for designing the case study approach:

[a] Case studies involve the intense examination of a small number of entities, when a phenomenon cannot be studied outside the context in which it occurs.

[b] A case study examines a set of phenomenon of interest, in natural setting, given a set of objectives to be attained.

[c] The study is guided by 'why' and 'how' questions. A small number of entities aid generalisation of some phenomenon of a particular set of circumstances, from which to generate to theory.

[d] A case study provides a systematic way of studying events through data collection from a number of sources, by multiple means, and analysing information.

2.7.5 Components of Case Study

The main components of a case study identified in the reviewed literatures are research question, case, selection criteria, unit of analysis and case strategy.

To make clear distinctions, a qualitative research process has constraints focusing on the type of research question posed; control needed in the investigation and focus on events in the study (Lofland and Lofland, 1995; Patton, 2002; Straus and Corbin, 1998). The importance of a research question would therefore, rest on how it is formulated:

[a] In the first constraint, Yin (1994, 2003) indicates that a case study is conducted within an explicit framework of **research questions** to be answered. Patton (1990, 2002) and Robson (2002) place the basic question of research within the problem statement that clarifies a concept to be investigated. These two versions of a research question have similarities, as they are different kinds of focus. This can result in variations in how the research question might be examined, or how data collection and analysis, and write-up of the thesis can be carried out.

[b] In the second and third constraints, the research question can be broken down to observe certain **conditions and needs** at different stages in the investigation. The scope of these questions is set in the case study to guide detailed observation and to build adequate case evidence (Yin, 1994). Conceptualisation, description, clarification, explanation-generation and control can be comprised otherwise. According to Lofland and Lofland (1984), the schema of formulating research and case study question bearing on these constrains accounts for: the central concept of the research; the iterative investigation of data collection and analytic process of applying the research questions.

A 'case' is an issue or subject matter requiring in-depth examination. In the area of international IT standards, project development is an example case to be examined as a whole and in its own context, not as a population of others (cf. Yin,1994). Exclusiveness in this study of a case increases focus on the quality of the treatment of items to be investigated, in order to build evidence to answer set questions correctly.

In general, IS literatures (such as Benbasat *et al.* 1987; Lee, 1989; Eisenhardt, 1989; Yin, 2003) suggest that case study researchers should provide detail of the **case selection criteria**. However, the literatures do not present the selection criteria: The assertion is that, case selection fit into the choice of topics, research question and knowledge building of the investigation process. Patton (1990, 2002) may be one of few exceptions to recommend case selection criteria for designing the case study. **Table 2-9** next, describes these criteria: intensity and information-rich, critical, sensitive and convenience.

Table 2-9: Case selection criteria drawing upon sampling strategies (Source: adapted from Patton, 1990, 2002)	
Selection criteria/ sampling strategy	**Descriptions**
[1] Criterion	Involves the study of cases that meet some predetermined criterion of importance. In addition, all cases must meet some criterion; useful for quality assurance and for criterion sampling.
[2] Critical case	It has relations to be studied or has issues to be evaluated, so as to make them clear. This type of case can have strategic importance in relationship to a problem that is perceived by others widely in the same area. If used as a sampling strategy it permits logical generalisation and maximum application of information to other cases.
[3] Convenience	Easy access to issues under given conditions: it may be necessary to use cases that offer access to the actors, to study their activities, as they occur. Cost and time real consideration when the case is intense data sampling needs.
[4] Extreme or deviant case	Usually are information-rich or special in some way that it can present highly unusual manifestations of the phenomenon of interest.
[5] Intense case	Involves information-rich cases that also have interesting features of central importance to the purpose of the research. An intense case provides purposeful data sampling and rich examples of the phenomenon of interest.
[6] Sensitive case	Might be of importance, politically or strategically, to an organisation.
[7] Typical	Illustrate or highlight what is typical, normal or average about phenomenon of interest.

A unit of analysis characterises a case study, because it is unique to the research question, not the topic of investigation (cf. Yin, 1994, 2003). Furthermore, Miles and Huberman (1994) note that a case a might not be monolithic; there might be 'sub-cases' embedded within it. The 'embeddedness' of a case (or items presented in a case) can sometimes yield other studies. This is because individual units of analysis yield arguments, and interpretations of issues towards the identification of relevant information.

Guha *et al.* (1997), for example, selected a case to examine broad and complex phenomenon of BPC. They specified three units of analysis: the firm, BPC team and BPC project examined concurrently, over time. This case later presented other embedded cases of BPC with multiple units of analysis, each with different sets of issues and propositions.

Yin (1994) suggests that evidence from **multiple-case strategy** is often considered more compelling and the overall study to be more robust than that of a single case. Flick (1998) and Patton (1990, 2002) argue for maximal variation. Especially when an information-rich investigation has been identified, multiple cases are often the choice of approach. Maximal variation means, the selected multiple cases need to be as different from each other as possible to adequately cover the analysis of chosen items and to ensure robust evidence. Decisions, as to how to make use of the material from the different cases would be determined through comparisons to construct relevant explanations.

2.7.6 Qualitative Data Collection

To make sense of the reviewed literatures the data collection approaches utilised widely in IS research are summarised. They are content of approaches, focus groups and relevant information and interpretations.

Boudreau *et al.* (2001), Flick (1998), Patton (1990, 2002) and Walsham (1993) are in agreement that the **content of qualitative data collection approaches** can include: analysis of documents and texts; participant observation; systematic surveys through questionnaires and interviews; and, and the researcher's impressions of the investigation. As central aims qualitative research in IS demands cases involving systemic study of a chosen setting, data gathering, analysis and interpretation.

Hancock (2002) applies the term **'focus group'** (or the participants of the study), because of their uniqueness as part of a particular context of study and as a data source. A focused group aids *focused sampling*, which enhances the chance that data collection is from the same source. It offers an *epistemological stance*, whereby data gathered from individuals ultimately becomes collective knowledge that helps understanding of examined items. In this epistemological stance, data collection from a specified focus group offers a step towards *triangulation* to strengthen the grounding of the evidence. Denzin (1978) and, Denzin and Lincoln (1994) give distinctions of triangulation as by data source, by method, by researcher, or, by theory.

Collecting qualitative data samples rich in relevant information is an approach that serves to interpret relationships or patterns in items under investigation. Arrow and McGrath (1993), Hayes (2001), Pettigrew (1990), Vaast and Walsham (2005) use a combined *ethnography approach:* fieldwork and participant observation are applied as the *lens* through which qualitative data samples are interpreted. They structure the fieldwork as a longitudinal case study that combines various sources of qualitative data. Their participant observation is the means to empirically examine the dynamics of people, as individuals and representations of their practices.
On the other hand, 'rich in relevant information' is from the fact that, a longitudinal case study allows the researcher to perform simultaneous data collection, analysis, and interpretations, over time. The data gathered is judged and refined through reflection at different stages of the study. As in Arrow and McGrath (1993) and Pettigrew (1990), the interpretations from simultaneous data collection and analysis build up accurate details. The interpretations, in turn form the basis for defining the properties of examined contexts, patterns and relationships among items and embedded factors, and to categorise them against concepts that are developed in the investigation process.

2.7.7 Review of Qualitative Data Analysis

Qualitative data requires **inductive analysis** to serve four main purposes:

[a] To reduce variety in the data presented for evaluation.

[b] To aid the identification of the central issues of phenomena and how it can be explained (Flick, 1998; Miles and Huberman, 1994). Identification can include any mix of quantitative and qualitative data analysis overarching theoretical

perspectives taken in the investigation, so as to categorise elements in the examined data.

[c] To structure relevant information for answering research questions: Miles and Huberman (1994) and Strauss and Corbin (1990, 1998), for example, use coding paradigms. Sets of questions are formulated and applied on collected material. The codes are used to sort categories then, to associate them to developed concepts identified in the interpretations. The codes, however, can be based on any mix of quantitative and qualitative evidence.

Qualitative research lacks testability and objective realism, because its focus is on explanation of social construction and of phenomena of interest identifiable in the data gathered. Often, in settings of social construction its meaning has to be de-contextualised or reduced to analysable contexts, until some interpretation is established through data collection and analysis processes. The ontology basis of a research process is elaborated through **constructed empirical reality**, thereby emphasising the *interpretive focus* to which *meanings* aid explanation (cf. Bruner , 1993; Flick, 1998; Orlikowski and Baroudi, 1991; Robson, 2002).

Bruner (1993: 1) points out that **meaning** is radically plural, open or both. The view taken in constructing meaning depends on the perspectives that help interpret the collected data set or to answer questions regarding a solution to the phenomenon of interest.

[1] When constructed reality is plural, this can take the form of **common meanings**, as a generalised interpretation of dominant elements in the setting examined. For example, to explain *what* IITS projects development is concerned with can describe committees, stakeholders and SDOs as dominant elements.

[2] The other is the **unique meaning** attached to specific aspects of IITS projects development. This takes the form of explaining *how* the projects are developed, so that meanings are connected to *why* certain events or practices occur or *which* solutions are needed for a particular problem. When '*unique meaning*' can be constructed, this suggests that the presence of an identifiable phenomenon attributed to the examined settings and their contexts.

[3] Common and unique meanings together, build upon the **interconnectedness** of issues or patterns in the empirical data, and from which narrative generalisations are drawn.

[4] Constructed explanations of meaning are **open** to the researcher's analytical mechanisms and interpretive focus. The explanations provide decisions for articulating hypothesis, as research theory to be examined and reasons for its analysis (cf. Eisenhardt, 1989, 1991; Yin, 2003).

2.7.8 Paradigmatic Viewpoints

Drawing from selected literatures (Burrell and Morgan, 1979; Guba and Lincoln, 1994; Garcia and Quek, 1997; Greco, 1999; Mingers, 2001; Myers, 1997; Walsham, 1995), qualitative empirical research in IS applies paradigms as a patterned set of philosophical assumptions.

This body of IS literatures presents paradigm variations within the qualitative research paradigm itself. Walsham (1995: 80), for example, encourages case study researchers to define the philosophical position (such as positivist or interpretive), from which they derive the basis for conducting an investigation and for reporting of their work. The other version is the assumption that particular methods have in part, their own paradigms linked to how they are applied. Reflecting on the typology of research process (§2.7.2), this researcher takes the central paradigmatic viewpoint based upon their applications: stance and theory of knowledge

Stance: The use of paradigm presents a fundamental way of understanding the *stance* relevant to drive the research process effectively. Paradigm proceeds into the realm of the investigation to encourage the framing of the reasoning sought in empirical observations, and to clarity of the epistemological assumptions of the evidence.

Theory of knowledge is consonant with ontology and epistemology paradigms through which understanding of one's beliefs about an area of research are reasoned and established (cf. Greco, 1999). A case study examined within its real-life setting, for example, applies an ontology paradigm (see §2.7.5). The methods applied in the case study develop understanding of the real-life contexts to shape narratives about the case (cf. Yin, 1994). Often, narratives can draw attention to dominating elements of the case, such as committee actions, project inputs and practices.

Given that these elements can present their own types of phenomena, the investigation of real-life contexts can be expected to have a limiting effect on theorising from the data gathered. The research process would thus embrace different stages (such as analyses, synthesis, contextualisation, explanation-generation and reconciliation) to resolve any inconsistency in the data gathered, and to unify the findings into broader theories. In this regard, theory of knowledge has to present appropriate paradigmatic views linking analysis, understanding and explanation as:

[a] *Ontology* (modes of examining real-life contexts and for developing understanding).

[b] *Epistemology* the philosophy of knowledge (how we come to know it through explanation of constructed empirical reality of examined settings) to address understanding.

These entwined aspects simply mean, all empirical research observes *epistemological requirements* evolving from the modes of analysis to facilitate intelligent investigations and understanding. Different theoretical positions taken in the study and in the evaluation of data collected are important to define the phenomena of interest. Methodological mechanisms also seek to claim some degree of *objectivity* with regards to representing explanations of reality or to confirm what is known about the perceived phenomena of interest (cf. Archer *et al.* 1998; Greco, 1999). It can be argued that combining methods with different types of paradigmatic viewpoints is also likely to encourage styles of rigor involving grounding in theory, evidence and persuasiveness (cf. Keen 1991).

2.8 Theory Considerations

2.8.1 Definitions

These underpinning elements of qualitative IS research methods leads logically to reviewed considerations of theory and the implication of practice in IS research.

Discussions of theory in IS research coincide with their broad and general use from classical definitions. Argyris and Schön, (1974) and Von Bertalanffy (1987) describe a theory as a set of principles and guidelines that can be applied in a variety of circumstances to explain a specific set of phenomena, subject to numerous assumptions and under a set of conditions.

Weick (1995: 386) gives a 'dictionary list' that, theory belongs to a family of words that include guess, speculation, supposition and hypothesis, to name a few. Goodman (1978) suggests that theories are versions through which the 'world' is perceived and understood. Theories undergo continuous revision, evaluation, construction and reconstruction. They are evaluated against the 'norms' of truth or explanatory power and, are valued only as the claims they make in reality.

2.8.2 Theory Classifications

In view of these definitions, there are four classifications of theory in IS research: assumptions, hypothesis, theoretical positions and theorising.

A commonly perceived position of IS research is the theoretical assumptions from reviewed body of knowledge or empirical findings for an exploratory study. This can be defined according to Garcia & Quek (1997: 444):

> The starting point of a researcher's methodological choice within IS field is not so much a problem of how many methods to employ or if those are of a quantitative or a qualitative nature. But, it is the ability to identify the philosophical and theoretical assumptions, which lead to the choice of the appropriate methodology.

A hypothesis is a research theory examined as a central concept guiding the research process, or, derived from it (cf. Schwandt, 1997). The practice in qualitative IS research studies is to build research theory from constructed concepts reviewed from literatures, empirical evidence of a case study and insights of the researcher's investigation (Eisenhardt, 1989; Galliers, 1992; Straus and Corbin, 1998; Yin, 1994).

Theoretical positions can be assumptions (or derived concepts) taken in the research process regarding methods and analysis of findings. It can be argued that, it is only possible to achieve an *objective framework* in the research process, if the researcher can use differentiated assumptions across multiple levels of analysis and in the evaluation of the data gathered. If not, the dynamic complement of the *paradigmatic views* applied in the research process can encourage clarity of assumptions through rigorous identification, description, evidence building and explanation-generation of the meanings of evidence gathered.

Theorising is another aspect that comes from the fact that theories undergo continuous revision and evaluation in the research process (Goodman, 1988; Weick, 1995). It is integrative of the use of a chosen theoretical stance or theory lens in the investigation. Weick (1995) described the features of theorising as abstracting, identification, generalisation, selection and explanation. In this regard, theorising serves to focus the reasoning behind the investigation; to explicate rich phenomena and to build upon the treatment of the subject matters presented.

2.8.3 Theoretical lens

A particular theory can be applied as a **lens** to aid investigation, grounding of empirical understanding, interpretation and explanation (§2.9.1). Callon's Actor Network Theory, (1986), for example, has been applied in IT standardisation investigations as a lens in Fomin *et al.* (2003) and Jacucci *et al.* (2003) for theorising the complexities of socio-technical contexts of IITS.

The OIPT as a lens, on the hand, has shown versatility from organisational information processing to other areas of research. For example, inter-organisational relationships (Bensaou and Venkatraman, 1995) and manufacturing environment (Flynn and Flynn, 1999); and organisational design (Galbraith, 1977; Robey, 1991). These examples show that enough studies are concerned with use of a theory lens to aid investigations. Gregor (2002), however, locates a concise taxonomy of how theory has been applied (and can be used) in IS research. Her summarised taxonomy in **Table 2-10** offer positions that can be taken to guide intentions toward a research investigation and, to an extent, can help evaluation of the results.

Table 2-10: Taxonomy of theories
(Source: adapted from Gregor, 2002, 2006)

Type of theory	Features
[1] Theory for analysing and describing:	To describe 'what exists' or classify specific dimensions or characteristics phenomenon in question by summarising the commonality, such as individuals, groups, situations, or events.
[2] Theory for understanding:	Forms the basis of subsequent theory development, or can be used to inform practice.
[3] Theory for predicting:	Presents systematic view of phenomena from a set of explanatory factors contributing to an outcome: such as causation or relationships among variables.
[4] Theory for explaining and predicting:	Interpreting 'what is', 'how,' 'why' and 'what will be, in views of: understanding underlying causes and descriptions of theoretical constructs.
[5] Theory for design and action:	How to do something.

2.9 Theoretical Framework

This framework lays the foundation for the development of the research process. The starting point is to summarise the methodological practices applicable to this research, in order to focus concise guidelines for this framework.

2.9.1 Summation of Qualitative IS Research Methods

One topic that is debated widely is that qualitative research is not based on a unified theoretical or methodological concept (cf. Flick, 1998). Qualitative IS research has come to be associated with several debates aimed at defining its multi-disciplinary nature covering research approaches (Benbasat and Zmud, 1999; Galliers, 1991, 1997, 2003), research methods and paradigms (Benbasat and Weber, 1996, Lee et al., 1997; Mingers, 2001; Weber, 2004).

There is general agreement to conduct qualitative IS research as a scientific inquiry, which observes at least seven aims: identification, description, explanation-generation, theory building, testing of theory, interpretation of evidence and conclusion. This means, a qualitative IS research process is open to competing elements (such as approaches, methods, paradigms and positions) underpinning the particulars of a chosen topic or a phenomenon of interest.

Whether complementary methods or different kinds of approaches are applied across the research process, these issues combined can make analytic rigor in qualitative IS research difficult to practice or to verify it. This researcher addresses a stronger element: **the efficacy** of the research process that seems to be overlooked in qualitative IS research, because of the pursuit for analytic rigor. In this research efficacy embraces four qualities: theory lens, constructive representations, methodological practice and qualitative verification.

Use of a theory lens: Efficacy is instilled at the beginning of the research process, in the framing of the investigation, by stating the choice of a theory lens and its stance (see §2.7.3). As mentioned in Trauth (2001), the decision to adopt a qualitative approach is due in part, to the high levels of uncertainty derived from examining mercurial qualities of settings of social construction. Trauth (2001) also argues that, the choice of lens (or theory) is often driven by a desire to avoid the shortcomings of positivism. This may be the case for strictly qualitative and interpretive cases.

As described in some detail in §2.2.4, uncertainty factors are dealt with in the framing of the investigation, thereby ensuring resolution of the treatment of the research subject matters. Toward developing efficacy of the research process therefore, a theory lens supports this resolution and grounding in theory. OIPT as lens, for example, offers a handful of guidelines (Box 3-2: OIPT guidelines), as well as, principles of analysis and design of desired results (Appendix 1). These few guidelines underpin this researcher's aims about developing efficacy, by strengthening the theoretical and methodological foundations of the research process. Combating uncertainty factors, analytic rigour and practical relevance of the importance of the outcomes occur at the same time.

Constructive representations: This is an underpinning theme about developing analytic rigour that leads to the credibility of the results. How one plans the research with an explicit aim to develop transparent, as well as, constructive analytical arguments central to the questions being addressed requires constructive representations of the methods and paradigms (Chapter 3).

Methodological practice: Qualitative research, because of its inter-mixed qualities (such as social contexts, patterns of relationships and their meanings) requires greater appreciation of methodological mechanisms that apply. Coherence and styles of rigor (Keen, 1991) strengthen methodological practices. Appropriateness of methodological practices at paradigm level, such as studying a project in its real life settings (ontology) is important to challenge analytically stated arguments, questions or subject matters for the case. Reflection must go into how different methods and paradigmatic views offer complementary strengths, so that methodological pluralism is feasible. Efficacy will then be summarised as: a research process is *adequate* if it meets particular *styles of rigor relevant* to the nature, context and characteristic pitfalls of the question or subject matters under investigation (cf. Majone, 1980).

Qualitative verification: Efficacy of a qualitative research process can be verified. This verification is presented in the conclusions of the research and contributions of the results (Chapter 9). One example is when structured analytical arguments are developed from substantiated empirical evidence of actions, this is a measure of our how well uncertainty factors have been dealt with, if not, eliminated. Another linked example is that, through developed analytical arguments, questions presented in the investigation (such as case study questions) can be answered adequately.

2.9.2 Guidelines of Theoretical Framework

The theoretical framework depicted in **Figure 2-3** has intentions towards establishing *efficacy* of this research (see §2.9.1). Guidelines [1] to [7] propose the reasoning of the investigation at hand.

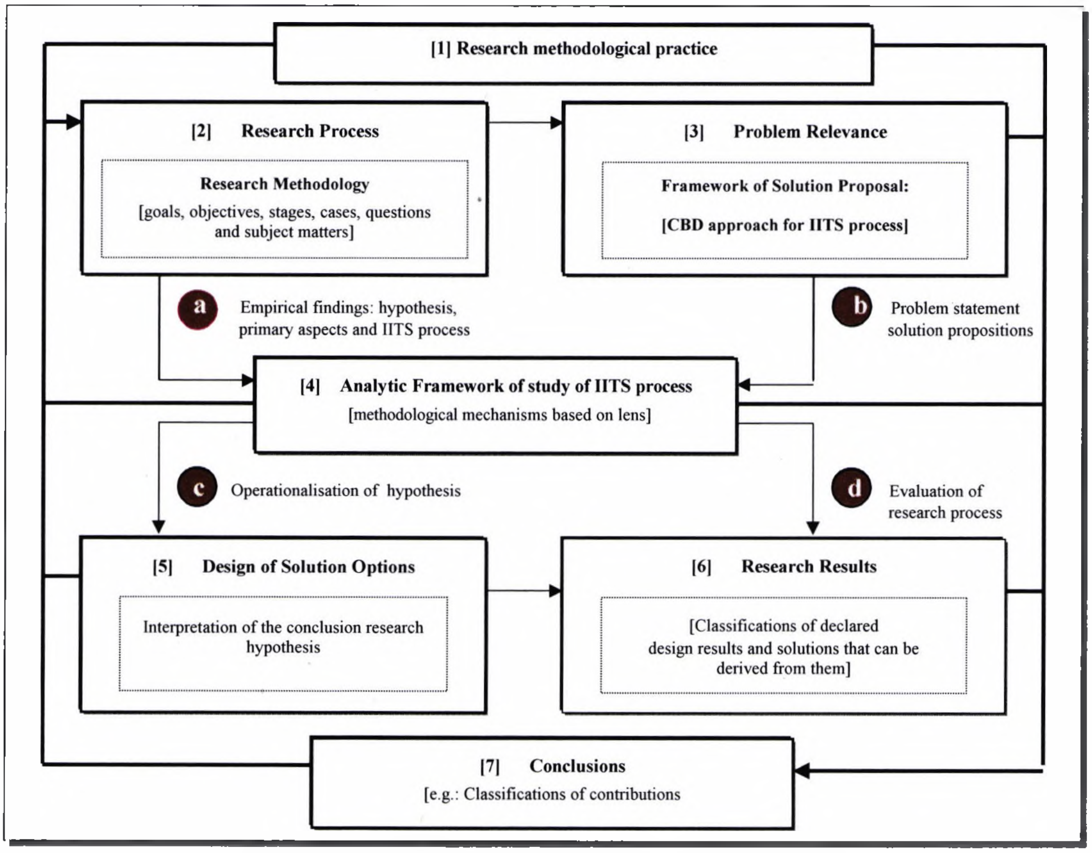


Figure 2-3: Guidelines of Theoretical framework
(Source: compiled by author)

2.9.3 Guideline [1]: Research methodological practice

This Guideline draws attention to elements that influence the research process. IITS has rich phenomena involving social, cultural and technical dimensions (Klein and Myers, 1999). Options for characterising the research process include:

[a] A qualitative research approach that is central to the explication of rich phenomena through case studies: data gathering, description and evaluation (cf. Yin, 1994, 2003).

[b] The choice of theory lens is expected to support the definition of the methodological mechanisms that apply, to include grounding the research process in theory.

[c] Paradigmatic viewpoints are necessary in qualitative research to give specificity of context and styles of the investigation. The depth of understanding settings of social construction benefits from an interpretive stance. This has implications for explanation building, and upon which meanings of examined elements are constructed (Bruner, 1993; Flick, 1998; Pettigrew, 2001).

[d] The study of IITS influences understanding of how project development occurs. An empirical case study strategy in a *positivist stance* is recommended for discovering the dimensions of the reality of project development (cf. Benbasat *et al.* 1987; Flick, 1998; Yin, 1994, 2003). The *research theory* is developed incrementally through case study investigation and *meanings* determined from empirical evidence (cf. Eisenhardt, 1989; Galliers, 1992).

2.9.4 Guideline [2]: Research process

This Guideline covers the research design and its methodology, in line with stated goals and operations objectives (see Figure 1-3). The research process is defined in Figure 3-2, which puts into context its stages and stances described in Guideline 1.

2.9.5 Guideline [3]: Problem relevance

In this Guideline, *problem relevance* is akin to a defined a *solution proposal* to develop understanding of a problem (cf. Conklin and Weil, 1997). This solution proposal depicted in Figure 3-4 (Component-based solution proposal framework) is primarily assessed as a *workable solution.* This assessment reveals the *analytical challenges* of the problem statement (§1.1.4), to include how the IITS process can be reconstructed to yield component-based project development setting. This link between solution proposal to the problem statement strengthens the selection of projects examined in the case study hence.

2.9.6 Guideline [4]: Analytic framework

This Guideline specifies an analytic framework designed as a *solution method* to *operationalise* a specified set of empirical case evidence from Guidelines [2] and [3], noted in Figure 2-3 as:

(a) Research hypothesis and IITS process for exclusive analysis.

(b) Problem statement, integrative with the constructs of the solution proposal.

Through this analytic framework, the study of the IITS process focuses on explicating its current state; issues implied in the problem statement and reconstruction actions. The methodological mechanisms are developed from the OIPT as a lens, thereby providing grounding in theory in the levels of analysis, reconstruction and in the interpretation of findings.

2.9.7 Guideline [5]: Design of solution options and evaluation

This Guideline focuses on the reconstruction of the IITS process, leading to the design of results depicting the functionality of the proposed component-based PDS. This reconstruction approach also serves to operationalise the research hypothesis **(c),** through stated analytical propositions of the solution proposal from **(b)**.

2.9.8 Guideline [6]: Research results and evaluation

In this Guideline, is the interpretation of results of the reconstructed IITS process emphasising the Standards Documentation Setting (SDS) as a test case component-based PDS. A synthesis approach (Lawson, 1997) develops how the results can be judged and categorised on specified criteria (Chapter 8). This synthesis helps to establish the content of detail of the results that makes them unique, rather than generalisation based upon the design items. Implications for practice determined from declared and categorised design results conclude the research hypothesis.

2.9.9 Guideline [7]: Research conclusions

This final Guideline, a reflexivity approach (Flick, 1998) is applied to question the efficacy of the research process (Chapter 9). **Table 2-11** illustrates criteria appropriate for interpretive research to also demonstrate the researcher's accountabilities.

Table 2-11: Guideline to evaluation of research
(Source: adapted from Lincoln and Guba, 1985)

Criteria	Summary
[1] Credibility:	- Completeness of results: details of content and solutions. - Relevance of the research results to the phenomena of interest examined. - Originality and significance of the research.
[2] Adequacy:	- Competence and transparency criteria of the research process, such that the declared results fill knowledge gaps identified in the literature. - Goal completion, successful attainment of set goals/objectives.
[3] Confirmability:	- Practical importance and relevance of the research results. - Successful attainment of set goals and objectives. - Contributions to body of knowledge and theory.
[4] Transferability:	- The results are defensible and can be implemented without change.
[5] Implementability:	- The results can be implements in other areas; practical implications for practice.

2.10 Chapter Summation

This chapter has described in great detail, the core subject matters of this research. The next chapter thus develops the roadmap of the research process. It establishes the theoretical and methodological foundations that must be competently and effectively applied in this research.

Chapter 3

Research Process Roadmap

3.0 Chapter Introduction

In this chapter it is argued that, without defined research process roadmap, the investigation and the outcome may lead to assertions. This roadmap characterises a qualitative approach chosen for this research. The initial section of this chapter gives an overview of the research process, its focus and stance (§3.1), and stages (§3.2). Research instruments are described covering: research design and its core aspects, theory lens (§3.3); methodology (§3.4); solution proposal (§3.5); case study design (§3.6); preparation for data collection (§3.7); data collection (§3.8); and, ending with analysis and interpretations of the case study evidence (§3.9).

3.1 Overview of Research Process

3.1.1 Research Object

Decisions developed from the process of exclusion of the core subject matters (§2.2.2) define the object of this research. In keeping with Garcia and Quek (1997), and Sayer (2000), the object of this research is two-dimensional. One, it is appropriate to the chosen topic (§1.1.3). Two, it observes the goals stating the expectations of this study (§1.1.6) and that eventually provide a basis for evaluating the results. For ease of reference, a decision characterising the purposive actions of the object of this research is restated, as follows:

> A critical analysis of the IITS process, followed by the reconstruction of its specified core aspects within a CBD framework, leading to an autonomous component-based project development setting.

The phenomenon being examined is the complexity of the IITS process (§1.1.4). There is interest in examining this complexity, because it has adverse consequences on *how* the extant IITS process performs and *how* IITS projects are developed.

3.1.2 IITS Research Process Typology

The research process makes reference to the typology described in §2.7 (Research Methods). Principles of efficacy are the preference for encouraging greater analytic rigour in understanding IITS project development. Efficacy is developed through four underpinning philosophical instruments: qualitative approach, interpretive stance, theory lens, positivist, methodological pluralism and role of the researcher.

This research takes a **qualitative approach**. This decision pays attention to the construction of the IITS as an area of research. It has dynamic interplay of organisations, people, practices and processes. Various layers of cultural, social and technical contexts are embedded in the dynamic qualities of project development and delivery of results. Amongst other key strengths, this qualitative approach is appropriate to challenge analytically the non-specific nature of these IITS elements together with rich phenomena that might be attributed to them. It encourages systematic analysis focusing greater understanding on meaning in content of elements and, patterns and relationships across contexts. This researcher argues that, a solid body of knowledge upon which to build its methodological foundation influences critical thinking of the research purpose and outcomes.

Interpretive stance is the central identity of this research process defined in line with Guideline [1] of the theoretical framework (§2.9). This stance dictates the iterative processes of knowledge production in settings of social construction being examined. This stance includes the abstraction of details revealed in the interpretation of findings. It supports epistemological and methodological assumptions that together frame the scientific inquiry of this research process (cf. Orlikowski and Baroudi, 1991).

This researcher stresses the importance of **theory-driven empirical research methodology** utilising OIPT as a lens to address grounding in theory (cf. Weick, 1995). Carrying forward the use of OIPT as a lens in this research, it has been adapted to aid explicitness in describing the content and contexts in which project development events occur (see §2.8.3,§3.3). It provides a link in the reasoning of the stages of investigation, in line with the object of the research and the explanation of the findings. Emphasis on grounding in theory is also influences systematic analysis, which takes into account the interpretation of the empirical evidence defining project development and the IITS process, subsequently.

This research process has its ontological basis in the study of IITS projects within their real life settings and contexts in which they are developed. **A positivist stance** (Yin, 1994, 2003) is adopted for this empirical case study approach. At the same time, the case study follows the interpretive stance in the evaluation of findings, because of the descriptive and explanation tenets unique to the qualitative approaches applied. Working between these stances and creating their interconnectedness, firmly places this research process as qualitative approach necessary unravel rich and ambiguous phenomena (cf. Lincoln and Guba, 1985; Klein and Myers, 1999).

Borrowing from Brewer and Hunter (1989); McGrath (1982) and Mingers (2001) this research process is based upon **methodological pluralism.** This is applied in the sense of combining relevant approaches that also fit into the study IITS project development as rich social phenomena. As s strength, **methodological pluralism** allows processual knowledge production (such as data collection, questioning and data analyses) of the issues under investigation (cf. Pettigrew, 1997). Knowledge production is elaborated through constructed empirical reality of the interpretation of the data gathered, and to meanings of the outcomes that aid explanation of the evidence (cf. Bruner, 1993; Flick, 1998; Orlikowski and Baroudi, 1991; Robson, 2002).

Methodological pluralism works well for this research process, because grounding in theory to include the analytical mechanisms of combined methods enrich coherence and depth in the investigation. Exclusively, the combined methods complement each other within the interpretative framework of the OIPT as a lens (§3.3.2) and epistemological underpinning of the research process (§3.1.3).

This researcher is the primary instrument within this research process (cf. Trauth, 2001). This role combines principles involving: a neutral observer and informer in the empirical study; sole accountability for data collection, data analyses and interpretation of the findings (cf. Lincoln and Guba, 2000). On the other spectrum, this researcher acts as a change agent in the reconstruction of the IITS process (cf. Trist, 1976; Robson, 2002).

This change agent role is fundamental to develop the analysis of the defined IITS process in a way that illuminates the issues for which the results of reconstruction have substantive credibility in their implications to improve practices. Implementation of the declared research results **is not** in the scope of this thesis, however. As a stimulating fact, OIPT offers practical guidelines (Box 3-2) focusing the likelihood of change agent success Tow guidelines to support this are:

[a] Determining information-processing alternatives for dealing with the complexity of organization functions.

[b] Determining information processing needs and information processing capabilities and the fit between the two to obtain optimal performance.

3.1.3 Research Philosophy

This research shows three dominating tenets mentioned earlier as interpretive, positivist and a theory lens. Methodological pluralism and multiple modes of analysis, evaluation and interpretation are contingent upon issues under investigation. In this regard, this research adopts Galliers (1997) and Walsham (1995) version of the term philosophy, which this researcher describes as:

> A paradigmatic view; a whole set of philosophical ideas encouraging a coherent investigation and of the interpretation of the outcomes.

The design of the research process is located in an *interpretive philosophy.* This provides appropriate focus for both a theory-driven research and methodological pluralism operating at the same level. Its philosophical scope has three implicit assumptions, namely ontology, epistemology and methodology.

Ontology: This is the underpinning philosophy of the intention of the empirical study through which the reality of how IITS projects are developed is unravelled. The case study is conducted within a positive stance guided by 'why' and 'how' questions to discover the depth and substance of the phenomenon of interest. These are positivist case study guidelines from Benbasat *et al.* (1987) and (Yin, 1989, 1994, 2003).

Epistemology: It addresses multiple conceptualisations how this reality can be understood and explained. The preferred epistemology approach is one of comprehensiveness to address the ontological commitments mentioned above with regard to knowledge production, understanding and interpretation.

[a] *Knowledge production* is consonant with an empirical study allowing systematic identification of IITS project development issues; evidence-building; interpretation and theory building occurring almost at that same time (cf. Bechhofer and Paterson, 2000; Straus and Corbin, 1998).

[b] One analytical goal is to *understand* settings and phenomena together. The levels of analysis make sense of the contextual depth of the social construction of IITS, to include collective social phenomena to which the data and analysis would relate (cf. Myers, 1997; Klein and Myers, 1999).

[c] *Interpretation* embodies evaluated findings as knowledge from which to locate understanding and constructed *empirical meaning of the reality* in which IITS projects are developed (Bruner, 1993; Flick, 1998; Pettigrew, 2001; Robson, 2002).

Methodological considerations that identify with pluralism involve knowledge production, understanding, interpretation and evidence building. In the scope of the epistemology, methodological mechanisms *fit* the underpinning perspectives of the research (qualitative). They have both a qualitative and interpretive base fitting this researcher's conceptualisation of a theory-driven research process utilising OIPT as a lens.

This *fit* not only encourages commitment to a coherent investigation, but also characterises the philosophical positions of this research process to clarify its dominant elements. For example, data collection, data analyses, interpretations and researcher's predisposition to produce results (cf. Orlikowski and Baroudi, 1991:24). The process of knowledge production becomes one with which to make sense of the settings being examined and of the collected data. Identifiable evidence is knowledge communicated in other parts of the research process for further action.

3.1.4 Conceptualisation of Research Design

Relevant concepts that guided in designing this research process are drawn from four research designs shown in **Figure 3-1** that follows next. The first three are interpretive designs (Galliers and Land, 1988; Jarvenpaa, 1988 and Remenyi and Williams, 1995). The other is a grounded theory design (Strauss and Corbin, 1990, 1998) utilising a systematic set of procedures to develop an inductively derived theory about a phenomenon of interest (Strauss and Corbin, 1990: 24).

This researcher **is not** following a grounded theory design. It is included in this conceptualisation, because some elements of it are relevant to this research process. For example, a multiple-case study strategy is adopted to inductively derive empirical evidence defining how IITS projects are developed. The research theory and phenomena for which solutions are needed is incrementally established from this empirical evidence (cf. Eisenhardt, 1989; Strauss and Corbin, 1990, 1998).

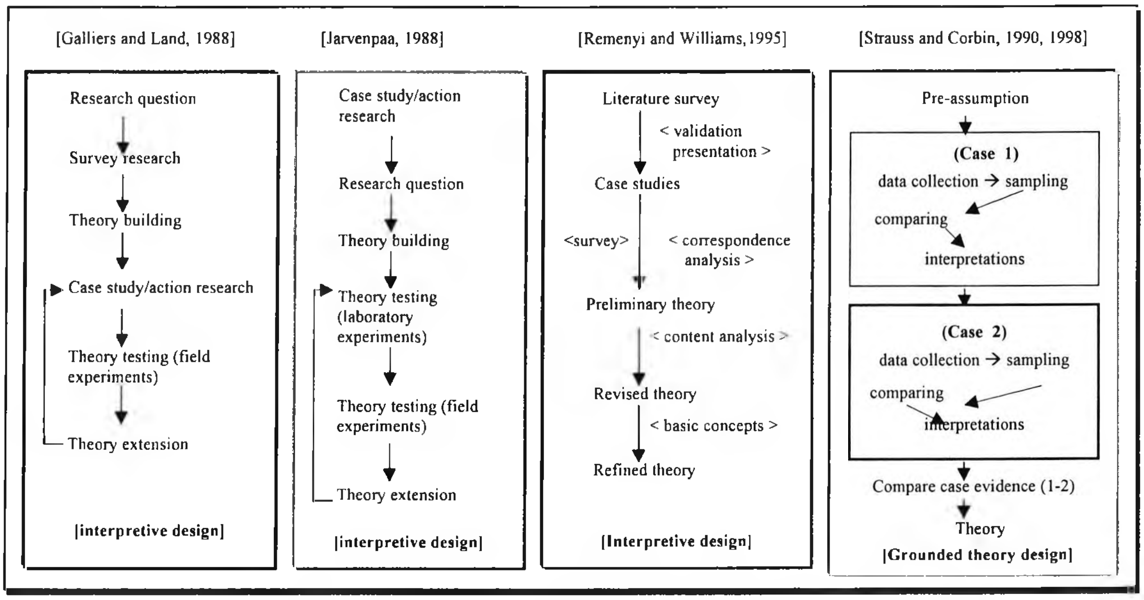


Figure 3-1: Summary of Reference Research Designs
(Source: compiled by author from mentioned literatures)

3.1.5 Definition of Research Process

Figure 3-2 illustrates the research process for studying IITS project development. Five distinctive stages of this research process are: [1] Exploratory study and literature review. [2] Research design. [3] Interpretations of research outcomes, definition and selection of empirical concepts. [4] Case study outcomes. [5] Case study conclusions and writing-up of reports. These stages form the discussion of this research process roadmap and are described in the sections that follow this.

3.2 Stages of the Research Process

In this section, the exploratory study (stage 1) is described in its entirely. Results derived from it served as a basis for developing decisions and instruments of the research process.

3.2.1 Stage 1: Exploratory Study

International IT standards development is not a frequent topic in academic research. As such, this research began with an exploratory study, from which international IT standards development was established as the object of this research. The aim of this exploratory study was one of identification of broad descriptions of the IITS environment and its issues, thereby avoiding preconceived work experience ideas regarding the direction of this research.

At this point, the reviewed body of standards literatures had provided adequate material of the features of international IT standards (see §2.3, §2.4.2). The presentation of this material was important that, it offered the most effective summation contributing to the design of this research. The results of this exploratory study can be summarised in three categorises that provided a link to intended investigations: schematic model of IITS, improvement efforts and scope of environment difficulties.

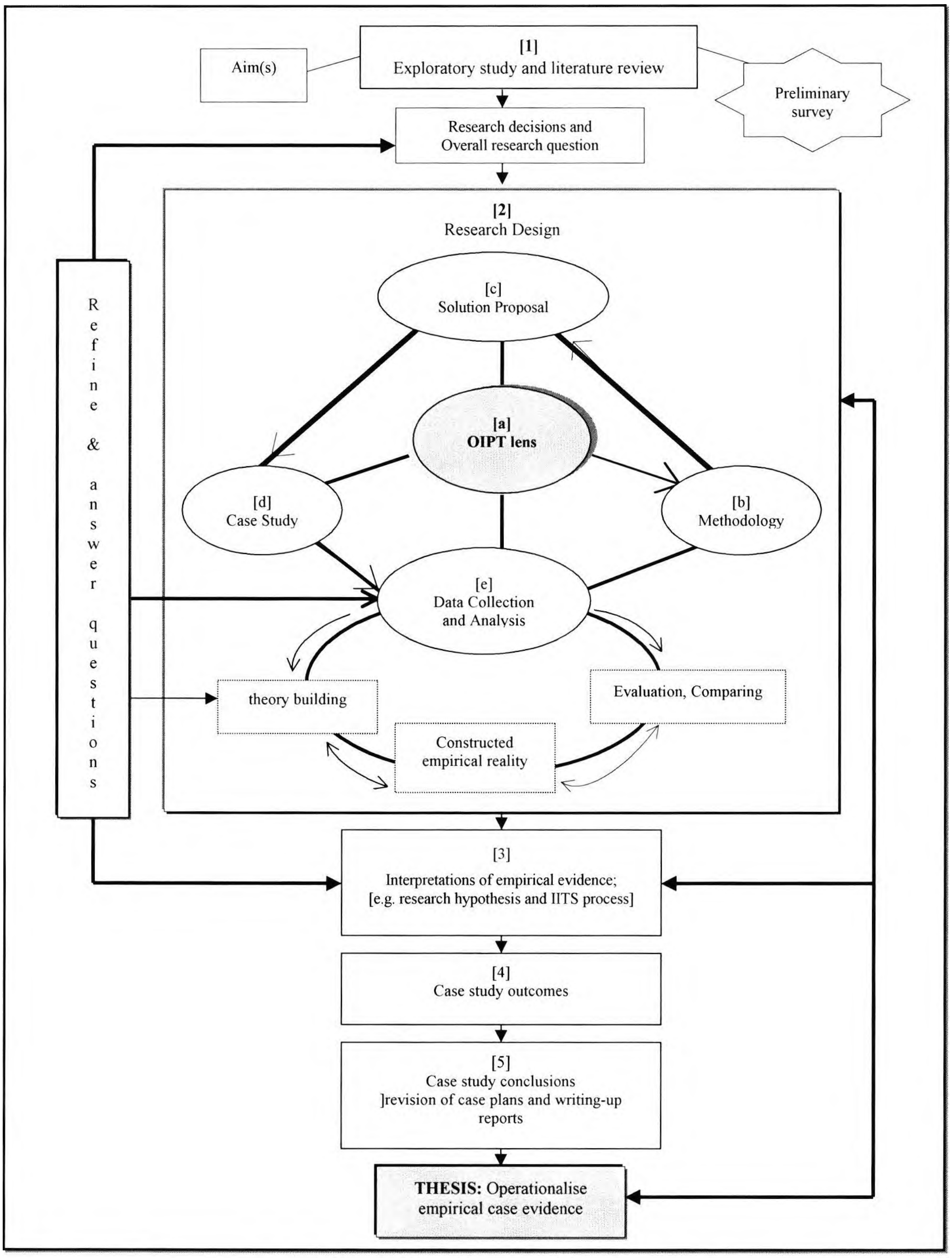


Figure 3-2: Research Process

(Source: compiled by author)

3.2.2 Schematic Model of IITS

Broad descriptions of the IITS environment yielded a wide range of issues. Instead of generalisation, explanation by a qualitative schematic model was preferred focusing more closely on an analysable scope of IITS. **Box 1** shows criteria applied to develop classifications for this schematic model, which is illustrated in **Figure 3-3** next.

By using these criteria, the boundaries between the features assembled from this study were clearly identifiable, such that the model was later referenced in the case studies to verify and refine its representations. Another result involved *a taxonomic framework* mentioned in Figure 2-1 to aid the discussion of the concepts of IITS and review of literatures.

Box 3-1: Criteria for classifying conceptual IITS features
(Source: adapted from Corbin and Straus,1990: 17-18)

Criterion 1:	Can concepts be generated from the results of exploratory study?
Criterion 2:	Do the concepts relate to any features that can be explained?
Criterion 3:	Can the features be categorised into specific dimensions. and to what extent?
Criterion 4:	Are there broader conditions that affect the categories defined?
Criterion 5:	Are there relationships that may exist between the assembled features?
Criterion 6:	Do the findings seem significant and to what extent?
Criterion 7:	Can the findings be systematically connected to form a framework for understanding?

[Criteria yields schema in Figure 3-3]

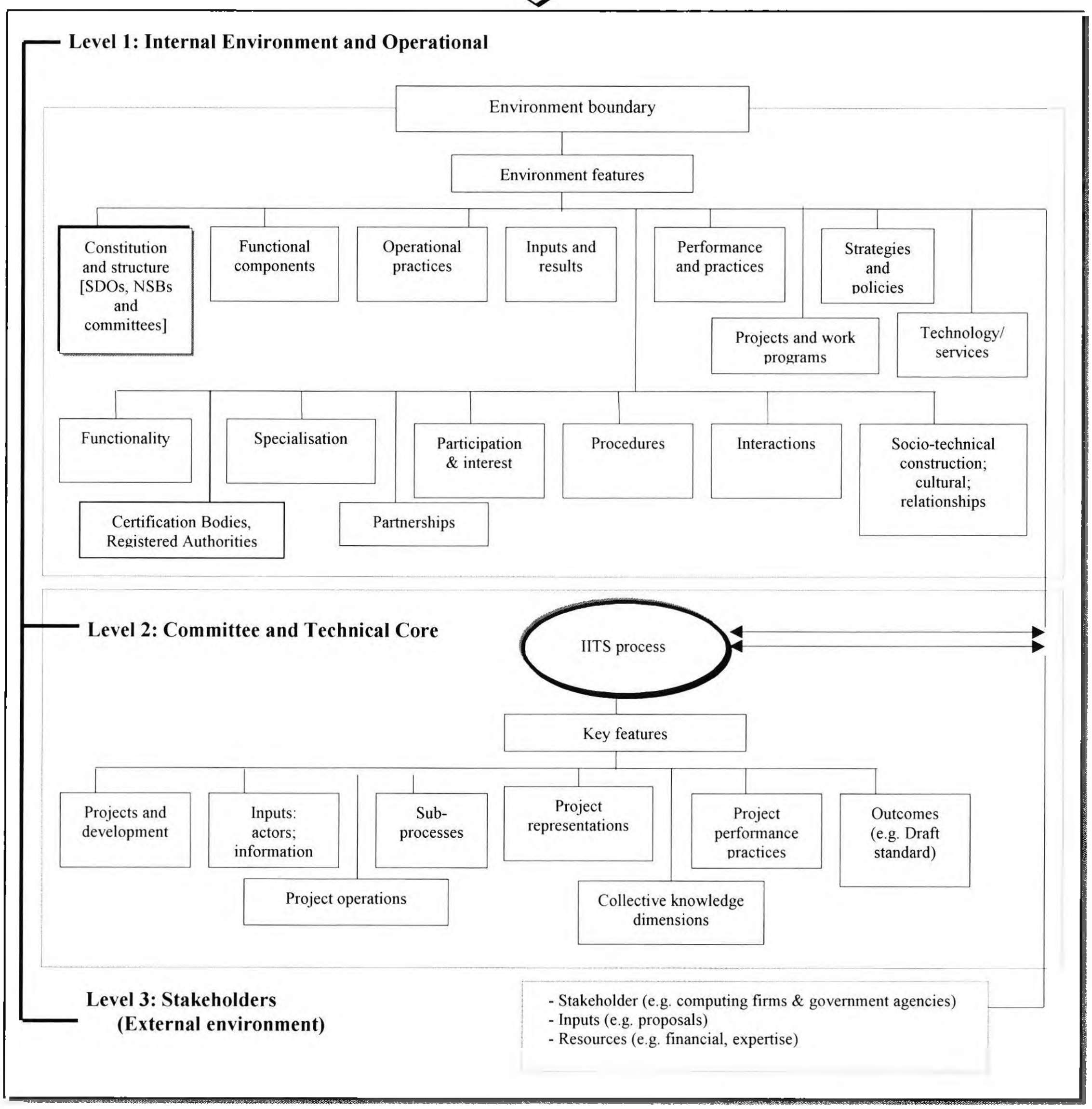


Figure 3-3: Schematic model of core features of IITS environment
(Source: compiled by author)

3.2.3 IITS Environment of Improvement Efforts

This research coincided with IITS environment efforts for improving its practices. An independent evaluation of these efforts was necessary to identify some examples that were likely to impact on this research.

Information covering these efforts was collected from SDO and NSB operational documents, to include documented semi-structured interviews the researcher carried out with selected senior managers. Administration, communication, document management and committee structures are some of the areas example areas considered for improvement. The use of technology for information processing, transactions and operational management was regarded a major improvement to extant practices.

3.2.4 Perceived Phenomena

The exploratory study produced adequate material to have a broad description of the perceived phenomena. This involved the scope of difficulties impacting on the development of international IT standards. Evaluated improvement exercises were excluded, because of many of them were in progress and lack of evidence of any changes.

The results in **Table 3-1** that follows next, produced ten items equating the most crucial generalisations of the areas of concern in IITS practices. For each item, proposition statements were developed to underpin the assumptions about the phenomena of interest. A relevant definition was taken from Brewer and Hunter (1989: 32).

> Concepts and propositions are a theory's chief components. The concepts define phenomena being examined. The propositions tell how and under what general conditions those conceptually perceived phenomena are thought to be related.

3.2.5 Research Decisions

The schematic model of environment features and perceived phenomena provided reasoned judgement for establishing research decisions that could be explained in the investigation. The decisions involved research topics (§1.3.1) and goals (§1.3.2). The research operational objectives (§1.3.3) drew attention to the analytic orientation of these decisions to link them to the case study and core subject matters of this thesis.

3.2.6 Research Question

In keeping with Lofland and Lofland (1995) and Flick (1998) the overall research question stimulates the line of investigation to raise additional questions. For example, the over-riding issue for this research was that, the research question be central to the proposition statements (Table 3-1) akin to perceived terms of the phenomena of interest. The choice of question thus, stemmed from a proposition that met these criteria. The question was established as:

> Why does it take 6 to 7 years to complete the development of an IIT standards project, when the scope of standardisation appears to exhibit unique opportunities, such as an international forum with numerous experts; commercial stakeholders; information resources and global interests?

Table 3-1: Proposition statements of perceived phenomena (Source: compiled by author)	
Items of concern	**Proposition statements**
[1] IITS environment	Complex network of environment features that support the activities and interactions.
[2] Standards development	Processes through which international IT standards are developed are not identifiable. They are varieties of procedures that seem to be more prominent that the processes.
[3] Project development	This is identifiable in the absence of a prescribed life cycle.
[4] Project time scale	The average project time scale is approximately 6-7 years, based on a number of projects that are still registered in the project manage data bases as ;n progress.
[5] Operations	Operational activities such as document processing and project management interface technical development of standards. The operational practices are, at most, costly and inefficient despite the technologies that have been implemented.
[6] Communication	Methods used in communication are not sufficient to effectively leverage the competencies of several committee working together, particularly, collaborative exchanges, information sharing and workflow.
[7] Information	Traditional methods are employed in gathering, analysing and aggregating information needed to develop IT standards. There are no resources for creating and managing 'scientific' information.
[8] Information processing	International IT standards development incurs costly and time-consuming information processing: documentation, document management and transactions.
[9] Technology	Despite the extensive IT implementations and investment, extant systems satisfy a fraction of environment operational needs.
[10] Environment changes	85% of the changes focus on environment operational matters. The results can be thought of as *first-order changes* concerned only with broadly conceived environment purposes, such as how to cope with daily operations.

3.2.7 Research Protocol

Table 3-2 following next, shows the elements of the research process protocol adapted from Klein and Myers (1999: 80). The reasoning of the research process (Figure 3-2) is to build empirical evidence incrementally, so as to derive a relevant research hypothesis from it (cf. Eisenhardt, 1991; Galliers, 1992; Orlikowski, 1993). This protocol thus supports this reasoning by increasing the degree of formality, management and rigor in the way in which the research was carried out.

3.3 Stage 2: Research Design

3.3.1 Content of Stage 2

This stage is the central core of the research process. According to Yin (1989: 27-28) a research design is:

> the logic that links the data to be collected and the conclusions to be drawn to the initial questions of a study. Every empirical study has an implicit, if not explicit research design.

For this research design, the decisions described in §3.2.5 were expanded to yield five aspects to organise investigation procedures. The aspects are separate, such that they are described exclusively for the development of the research process instruments: OIPT as a lens, methodological practices, solution proposal, case study and, data collection and data analysis.

Table 3-2: Research process protocol (Source: compiled by author)	
Protocols	**Descriptions**
[1] Critical incident	Project development in the scope of IITS environment and committee activities
[2] Case selection	Identify cases that fulfil criteria for information rich for data gathering, sensitive to IITS environment critical issues and strategic importance to perceived solution
[3] Research question	The focus of the case study to investigate perceived issues of IITS project development and implications criticised widely about activities, practices and time cycles
[4] Case study description	What the selected projects have to offer in order to choose the suitable study research instrument
[5] Case study boundaries of investigation	Focus on methods of investigation, data collection, data analysis, interpretation of evidence.
[6] Research instrument	Researcher as the primary research instrument in the application of research methods
[7] Research procedures	Use of data gathering frameworks and case study operational plans to focus items that can be examined
[8] Research process constraints	Multi-case study, qualitative longitudinal approach requiring different levels of focal tasks: data gathering, evaluation, reconciliation, synthesis and interpretation
[9] Survey approaches	Use variation in survey approaches to encourage depth in data gathering and how to work across project development levels of analysis
[10] Data control and management	Select time saving software applications and their usefulness for recording of data gathering, analysis and presentation of findings
[11] Case report	Do a report for feedback to IITS environment managers supporting the research
[12] Ethical considerations	Consent needed for conducting research, to include clause of confidentially of information

3.3.2 Designation of Theory Lens

In keeping with the taxonomy of Gregor (2002, 2006) depicted in Table 2-7 designation of the use of the OIPT in this research is that of a **theory for analysing and describing**. This designation is consonant with a general theory that has qualitative features (see §3.3.3, §3.3.4).

In Argyris and Schön (1987), Goodman (1978, 1988) and Neuman (2000), generality represents properties that are based upon the breadth of the focus of the theory and its wider context of use. Besides its quality as a general theory, OIPT is qualitative in its representation. It embraces an interpretative framework involving features that can offer grounding in theory (see §3.3.5). General, qualitative and interpretative are central qualities that make OIPT adaptable as a lens to define specific contexts in which it can be applied in a particular area of an investigation. These qualities firmly fit into the philosophical underpinning of this research process, and the researcher's preference.

3.3.3 Conceptual Representations of OIPT

The representations of the OIPT are summarised from four seminal models that are widely cited in IS literature: Model of Organizational Information Processing (Daft and Lengel, 1986); Information Processing Model of Organization Design (Galbraith, 1973, 1977); Information Processing Model (Huber, 1982) and Organization Information

Model (Weick, 1969). The shared assumptions from these four seminal models can be summarised as follows:

[1] Overall, an information processing approach might help to analyse how an organisation searches for information. The organisation can develop principles for designing its functions, structures and to understand the processes by which it creates a shared interpretation of its environment.

[2] Weick model (1969) in particular, makes the premise is that the interaction between an organisation and its external environment creates an **information environment.** The organisation receives data from its external environment that it processes in order to create information for use in performing various tasks. When an organisation's external environment is complex and dynamic, however, the implications are information and task uncertainty:

[3] Galbraith (1973, 1974) in his seminal work uses these concepts mentioned in Weick model to describe **information uncertainty** as, when an organisation cannot meet its information needs. He adds that, when there is greater uncertainty of the task, the greater the amount of information that has to be processed between decision-makers (Galbraith, 1974: 10).

[4] Galbraith (1973, 1974) described **task uncertainty** as the difference between the amount of information required to perform set tasks and the amount of information already possessed by the organisation from processing or performance results. Daft and Lengel (1986) and, Tushman and Nadler (1978) add that task uncertainty also arises when the technology utilised in an organisation or firm is ineffective to provide required capabilities.

[5] The implications are that, when the degree of uncertainty is high, organisations seek to **develop strategies and design structures** that enable them to match their **information-processing capabilities** with the information-processing **requirements** of their tasks (cf. Daft and Lengel, 1986; Galbraith, 1973; 1977).

[6] More recent scholarly works reach conclusions that, these organisational information processing views can offer: understanding of information needs (Choo, 2002); help in determining information processing capabilities and task requirements (Forster and Regan, 2001).

3.3.4 Guidelines and Principles of OIPT

These seminal models suggest that the OIPT offers shared interpretations of organisation contexts through which information processing is achieved. They draw attention to four guidelines in **Box 3-2** through which an organisation can determine and interpret its contexts of information processing hence.

Box 3-2: OIPT guidelines
(Source: adapted from seminal models)

Guideline 1:	Understanding the processes by which an organisation interprets its environment and functions.
Guideline 2:	Determining information-processing alternatives for dealing with the complexity of organisation functions
Guideline 3:	Determining information processing needs and information processing capabilities and the fit between the two to obtain optimal performance.
Guideline 4:	Determining an organisation's capacity to cope with external and internal complexity.

In addition to these guidelines, there are **six OIPT analytic principles** that are useful for understanding the functional view of an organisation and the interdependency of different elements: detail complexity, dynamic complexity, dynamism, patterns of elements, relationships among elements and uncertainty. Because these principles are analytic, they have both theoretical and methodological dimensions for questioning the dilemmas associated with information, its processing and performance of organisation tasks.

3.3.5 Methodological Considerations of OIPT

In this thesis, methodological considerations embody epistemological assumptions underpinning the OIPT and how it is customised as a lens. Foremost, the application of the OIPT is taken as a general theory of analysing and describing. **Appendix 1** illustrates the features of the OIPT generated from the four seminal models. In the customisation procedure, the features in Appendix 1 are delineated systematically to define methodological considerations involving: levels of analysis, decision parameters, analytical principles and design of solutions.

Levels of analysis: Matching *OIPT guidelines* (Box 3-2) and *principles* (Appendix 1) forms these levels of analysis. They apply to how a current state of an organisation can be described to include how it searches for information. Defined levels of analysis must draw attention to areas and perspectives that can be examined using OIPT principles as framing concepts. This approach helps to differentiate understanding of *what exists* in an organisation or in those areas examined.

Beside information and tasks, however, the OIPT is not explicit enough to clarify underlying patterns that are differentially shaped by organisation or process functions. Using OIPT *principles*, more potent levels of analysis are adopted from Pettigrew (1997) and Yammarino and Dansereau (2004). They suggest differentiation in the levels of analysis to add depth and detail that might help interpret *how* an organisation functions to a level where an overall definition of a perspective exists, for example:

[a] *Macro level:* Global definition of understanding an organisation, to include the environment in which it performs.

[b] *Micro level:* Areas within the content of an organisation's functions, such as processes, projects and work systems.

[c] *Micro perspectives:* Process practices, information, task performance and information processing.

Decision parameters are useful to control analytic actions and resolution of items examined in the different level of analysis. Potentially, an item chosen from the level of analysis has separate contexts to be questioned and explained. Distinctions can be made in the decision parameters by using 'what', 'which' 'how' and 'why' type of questions that serve as analytic rules to be satisfied in the findings (cf. Argyris & Schön, 1987). At the same time, decision parameters offer criteria by which the findings would be integrated to understand their details hence.

Principles of OIPT support analytic actions and interpretation of examined items. In a number of scholarly works (such as Bensaou and Venkatraman, 1995; Forster and Regan, 2001) *OIPT principles* have been shown to link analytical and explanation dimensions: for example, determining causes of complexity, uncertainty and task variability. Combined with relevant decision parameters, the principles aid resolution of examined items and of the findings.

Design of a solution: Daft and Lengel (1986) and Galbraith (1973, 1974) recommend that, once the organisation has been described, a major task is to determine information processing requirements and information processing capabilities. These requirements lead to another important dimension, namely *design of a solution.* Design interpretations are perceived in terms of models of an organisation's strategy necessary for improving its performance (Galbraith, 1973, 1974). Requirements form a basis for determining solution options that are available to an organisation, based upon its choice of *design strategy* hence (see Box 3-2, *Guidelines 2 and 3*).

3.3.6 Rationale of Application of OIPT as a lens

The question asked here is, what are the explanations contributing to the use of OIPT as a lens? The reasoned justifications that respond to this question cover research process, paradigmatic viewpoints and case study.

[1] Characterisation of research process

The OIPT guidelines, principles and decision parameters offer grounding in theory. In keeping with Gregor (2002), Keen (1991) and Pettigrew (1997) this is characterised by encouraging analytical rigor, methodological reasoning and theorising.

[a] In view of the variety of items in the perceived phenomena (Table 3-1: 'Proposition statements of perceived phenomena') *analytical rigor* across the stages of this research process and the case study are paramount. Rigor in the theory base of the OPIT as lens helps to analytically explicate specific details of social contexts of perceived phenomena.

[b] Methodological considerations of use of OIPT as a lens encourage *methodological reasoning* in data gathering and analysis (§3.4.5). For reasoning, OIPT principles and decision parameters can support *theorising* which is useful for analytic processes that build knowledge incrementally. Methodological reasoning and theorising together, draw attention to relevant evidence, which is the basis for developing the theory underpinning the research, its body of knowledge and conclusions.

[2] Paradigmatic viewpoint

Paradigms instil coherence in the research process (Guba and Lincoln, 1985; Walsham 1995). The qualitative nature of this research and its theoretical framework require different modes of analysis, data gathering, evaluation and interpretation of the evidence (cf. Archer *et al.* 1998: x-xi). These elements bring about 'paradigm pluralism' that fluctuates between research process stages and levels of analytic procedures of the investigation. Inconsistencies, conflicting answers to set questions or results and fragmented evidence can arise hence.

In many cases, triangulation can be used as an approach for grounding the way in which any combination of methods or paradigms are applied to obtain multiple, refracted realities of the phenomenon in question (cf. Denzin and Lincoln, 2005: 5-6). In Flick (1992), *systematic triangulation* is used involving a combination of appropriate research perspectives (such as methods and paradigm pluralism) that lead to understanding the research problem from as many different angles as possible.

Since OIPT features (Appendix 1) have been customised so that it can be extend for application in this research, systematic triangulation has been created. More so, this systematic triangulation imparts *interpretive* methodological considerations. It strengthens the integration of this lens with the *interpretive stance* of this research process. This integration, in turn, complements other interpretive paradigmatic views emerging from different levels of this investigation. On the other hand, interpretive methodological considerations ensure that the designated focus of OIPT as a lens is maintained consistently throughout the investigation. This is one way to also enrich particular ways of understanding and explicating *the reality* of the perceived phenomena.

[3] Case study investigations
The choice of a positivist case study strategy explicitly aims to discover the contexts to which phenomena attributed to IITS would be referenced: such as, committee actions or project development stages. Decision parameters and principles of the OIPT can help to focus the inductive investigation approach, by framing questions that *differentiate contexts* to understanding data collection and data analyses (see §3.6.6). Empirical case evidence that is gathered through differentiated questions, modes of analysis and contexts developed from the lens, is grounded in theory. The research theory and presence of phenomena can be established more clearly. This is, by means of *theorising* from differentiated data collection contexts presented in the case material gathered (cf. Pettigrew, 1997; Weick 1995) and *reasoned* understanding of its interpretation.

3.4 Research Methodology

3.4.1 Content and Scope

The research process in Figure 3-2 incorporates methodology, Stage 2b. This stage is linked to the three other aspects: OIPT as a lens, case study, data collection and data analysis. A number of researchers (Benbasat *et al.*, 1987; Galliers, 1992; Mingers, 1997) mention that no single research methodology is intrinsically better than any other methodology or is universally applicable to a perceived problem.

In this research design, the methodology is the set of approaches defining 'the how to' conduct the investigation successfully. An appropriate methodology incorporates an *inductive strategy* that utilises different approaches, with appropriate strengths that act upon the reality of the richness of IITS elements and perceived phenomena. The approaches place emphasis on the researcher's epistemological stance of understanding the key elements underpinning the characterisation of research process (see §3.3.6).

Here, analytic rigor and theory focus are important themes underpinning the basis from which to develop not only knowledge, but also the dimensions of the accountability of the research methodology and findings. Example dimensions cover fact-finding through data gathering; identification and interpretation of empirical evidence. These elements of the methodology and its strategy are in keeping with Mingers (1997:761):

> Each research approach focuses on different aspects of reality and, therefore it is best to combine several [methods] together in a single piece of research or intervention in order to gain the richest appreciation of the situation

3.4.2 Choice of Approaches

Table 3-3 next, gives a summary of the choice of approaches generated from the Galliers' taxonomy for IS research studies (1992: 146, 149-151). The approaches interpret also the inductive strategy of the research methodology, to include the dimensionalisation of the research process and its outcomes.

Table 3-3: Research methodology and choice of approaches
(Source: complied by author)

Methodology	Approaches	Stance and rationale approach
[1] Exploratory study	[a] Preliminary questionnaire survey [b] Literature review of specified core subject matters	**Interpretive** Fact-finding, identification, planning and definition of area of research concerns and directive decisions
[2] Participation and Observation (ethnography)	[a] Total participation through employment in the chosen area of research [b] Fieldwork in data gathering	**Interpretive** Appropriate access to the chosen area of study (focus groups and data sources)
[3] Empirical case study	[a] Structured approaches: - Application of OIPT lens for cases study questions and analytic data gathering questions - Structured questionnaires surveys (ordinal surveys and statistic analysis of results)	**Realist/ Interpretive** OIPT lens for grounding in theory of the research process
	[b] Mixed case study instruments (qualitative and quantitative) - Multiple case study - Qualitative longitudinal study - Variation in questionnaire surveys - Semi-structured Interviews	**Positivist/inductive** Five projects examined to build up case evidence and to answer specified research questions.
	[c] Document analysis	**Interpretive**
[4] Interpretations of findings	- Definition of empirical concepts, themes and phenomena located in the evidence	**Interpretive**
[5] Generate theory	- Hypothesis and its terms	**Interpretive**
[6] Operationalise categorised empirical evidence	- Analytic framework of analysis and reconstruction of IITS process	**Interpretive** OIPT as a lens for grounding methodological mechanisms
	- Design solutions	**Positivist**
[7] Specification of results	- Validation of hypothesis through interpretations of declare solutions rooted in the problem statement and solution proposal	**Interpretive**

3.5 Solution Proposal

3.5.1 Guiding Principles

Conklin and Weil (1997) state an important point of understanding a problem and a solution as follows:

> You don't understand the problem until you have developed a solution... Traditional problem-solving methods are adequate for any of the tame problems encountered in organizational life. Unless we can distinguish between tame and wicked problems, however, we are doomed to using tame problem-solving methods on all our problems. The result is frustration and ineffectiveness.

The diversity of features in schematic model of the IITS environment (Figure 3-3) and perceived phenomena (Table 3-1) clearly indicate that a variety of solutions may need to be addressed. The potential pitfall of variety in solutions is that in practice, they may be inconsequential.

In keeping with Conklin and Weil (1997, this researcher elects to define a solution proposal. This provides the basis for understanding the context of critical issues of IITS project development, for framing concepts of solution options and requirements to be determined analytically.

3.5.2 Concepts of the Solution Proposal

As a definition, a solution proposal is a *working solution of concepts.* It has an explicit aim to characterise understanding of how a perceived phenomenon can be resolved to meet a particular objective. Much of the literatures (such as Cargill, 1989, 1995; Baron, 1995; Fomin and Keil 2000; Reilly, 1994; Jacobs, 2000) describe a 'standards process' which has multiple and heterogeneous features. The structure of the process is perceived as mostly, chaotic but linear in its structure.

This researcher therefore argues that, enforcing a linear design on the IITS process would not present the 'true picture' of the cross-functionality of project development and their embedded contexts in various operational matters. Drawing upon the content details of a component-based design approach an explicit aim of the solution proposal is to structure a process that has complex and heterogeneous functional features. The research results that are expected are autonomous component-based PDS that can also be differentiated in their functions and be matched with IS resources.

3.5.3 Conceptualisation Approach

There is very little information in the reviewed process literatures that guides how to create a design-based solution proposal or otherwise. Possibly, the only reference that is closely connected to the researcher's conceptualisation of a solution proposal is Starkey (1992: 136) who recommends that:

> Before proposing solutions, the designer should be clearly aware of the basic need to be satisfied, the problems arising from that need and the constraints within which those problems must be solved.

Drawing upon this recommendation, the conceptualisation approach involves six questions explicitly aimed at framing the characteristics of this solution proposal. The questions were developed from concepts generated from reviewed literatures on process, project development and design solutions (see §2.4, §2.5, §2.6). The responses to the questions establish key decisions as input to the solution proposal framework.

Question #1: What are the issues of the problem statement and research question to which the solution proposal would be referenced?

The development of IITS projects creates interlocking issues. They impose constrains on the functionality of the IITS process leading to *wicked problems* (Brooks, 1996; Conklin and Weil, 1997). Since IITS process complexity (§1.4.2) is being examined as a possible cause of wider concerns, the assumption is that no other similar solution already exists in this environment that offers suitable alternatives. In addition, no other solution has been implemented in the IITS environment that is comparable to this CBD approach. This makes this solution proposal central to the resolution of the concerns of the IITS process and fundamental to its future practices.

Question #2: What is the subject of the solution proposal, based upon the thesis of the research?

The solution proposal is a CBD approach utilised as a design strategy to create component-based project development settings. In business or organisation contexts, such component-based settings can be expected yield a structured *design representation* that also delivers the set of *functionality* required by a specific business or organisation need (cf. Herzum and Sims 2000). This solution proposal therefore means, component-based project development settings can implement only the functionality belonging to one aspect of the IITS process. The settings can function independently to introduce transparency in the IITS process and its practices.

Question #3: Who are the targeted audience or stakeholders, for which the proposal is intended?

Conklin and Weil (1997) suggest that groups of people in the area of study make the problem solving process fundamentally social. Kunda and Brooks (2000) in their case study discussion suggest the need to look closely at factors affecting the introduction of CBD strategies in organisations. In particular, perceptions of environmental and organisation level issues (human, social, technical, interactions, communication) affecting CBD implementation success.

The researcher accepts both these views as important to the IITS, because a CBD approach has not yet been applied in this environment. This finding is based on the results of the exploratory survey which also offered insight into the targeted audience likely to benefit from this solution proposal as SDOs, NSBs and committees (see §2.1.3). The decision was therefore, to include in the case study strategy and analysis of the IITS process, the reasoning of the factors that help to ascertain whether this solution proposal is acceptable to the needs of the different groups (cf. Kunda and Brooks, 2000; Starkey, 1992).

Question #4: What are the main IITS challenges on the solution proposal?

One of the arguments presented in this thesis is that successful project development is a priority in IITS (see §1.5.6). Extensive IT systems implemented in the IITS environment in recent years suggest that there is a general acceptance among SDOs and NSBs that technology is a central to their solutions. The challenge that has thus far remained unexplored is to reconstruct the IITS process as a means to foster effective IT systems implementations. Reconstruction of the IITS process within a CBD framework presents another challenge: the functionality of the IITS process.

In addition to the baseline arguments for CBD approach, such as design representation and content creation (see §1.2.8), the functionality of the IITS process embodies different contexts comparable to those described by Hackney *et al.* (2006). The contexts in Figure 3-3: 'Schematic model of core features of IITS environment' can be summarised as:

[a] External environment (such as stakeholders).
[b] Internal environment (such as SDOs and NSBs).
[c] Committees and Technical core (covering project development and IITS process)
[d] Technology.

Question #5: What are the constraints of the solution proposal?

There are a number of intense IITS practices that suggest **constraints** on the solution proposal as structural, functional and contextual issues. A wide range of resources would be needed to cope with the complexity of IITS practices, such as communication, collaboration, co-ordination of work and information sharing. If the right kind of design representation is chosen, however, a CBD approach offers levels of granularity (or a layered design scope) that can accommodate each constraint in each project development setting. Levels of granularity can also clarify or resolve multi-dimensional issues (Herzum and Sims, 2000). For example, each project development setting would have integrated IS resources that can leverage multi-dimensional process features and practices hence (cf. Adler, 1995; Allen, 2001; Krieger and Adler, 1998).

Question #6: What are the assumptions regarding how the solution proposal is to be defined?

To answer this question, the assumption of the solution proposal is that, a CBD approach offers scope for combining separate functional and IS matters. This stems from the fact that the design representation is architecture-oriented (cf. Adler, 1995; Herzum and Sims, 2000). It can aid presentation of different views of process functionality, as well as, IS needs.

These are typical views supporting design arguments for parameterising how the IITS process can be reconstructed (see §1.2.7, §1.2.8). However, the IITS process has contexts that need to be explained in order to clarify the dominating concepts of the CBD approach that can be applied. The views are therefore matched to the contexts in which the IITS process functions. This match provides the means to address impacts of the reconstruction of the IITS process within the broader contexts to which it is connected.

OIPT as a lens is applied to ensure that these contexts are captured and grounded in theory to develop the underpinning the assumptions of the solution proposal. The contexts have also been placed in line with other up-to-date organisation issues, for example: macro and micro focus (Pettigrew, 1997; Yammarino and Dansereau, 2004); organisation's internal environment and technology contexts (Hackney *et al.* 2006). The *contexts* and their *focus* (macro and micro) are matched to the *views* and perceived IITS process *phenomena* to define *key assumptions* of the solution proposal, which are:

[a] Content of IITS process features.

[b] Operational elements.

[c] Functional management.

[d] Integration of practices.

[e] IS infrastructure for performance capabilities.

3.5.4 Summary of Contexts of Solution Proposal

Table 3-4 next, shows the conceptualisation of the constructs of the solution proposal within a CBD framework. The contexts described next make the key arguments dominating the use of this CBD framework much clearer and tighter.

External environment context: The IITS process depends on the external environment of stakeholders for inputs that propel project development, such as information, committee memberships and voluntary sponsorships. Reconstruction of the IITS process, within the broader context of the external environment, needs to take into account stakeholders as important alliances in project development (cf. Hackney *et al.* 2006). Due attention must therefore be given in the design and functionality of the proposed component-based PDS to consider its value to the stakeholders. For example, how they can contribute project inputs or obtain draft standards for ballot reviews.

Organisation's internal environment context: This involves the operational unity required of the SDOs and NSBs for their direction of IITS process performance. This context also has the underpinnings of the *enterprise argument* of the CBD approach suggesting that, where there is a great deal of complexity, functionality and IS infrastructure are key considerations (see §1.2.7). The ultimate goal is the alignment of IITS environment functions with reconstructed IITS process ensuring essential strategic and operational unity within an IS infrastructure.

Committees and technical core context: This is part of the organisation's internal environment, whereby SDOs and NSBs are responsible for committee actions through strategic direction; procedures and control of results. Technical core, on the other hand, involves how the IITS process executes project development. What this context suggests is that, the design representation of the CBD framework in creating component-based PDS draws attention to an array of factors that have influence on committee actions, IITS process performance and project development. The suggested autonomy of the component-based PDS requires attention to what is technically feasible to establish 'fit' of function (cf. Doty *et al.* 1993; Starkey, 1992). 'Fit' helps to highlight influential factors and how they can be associated in the CBD framework and to emergent practices.

Table 3-4: Contexts and views of CBD solution proposal
(Source: compiled by author form adapted concepts of Hackney *et al.* 2006; Malan and Bredemeyer, 2005)

Focus	OIPT as lens (Contexts)	Summary application of contexts and view		
		Views of CBD approach (connected to contexts)	**Perceived IITS process phenomena**	**Summary underpinning assumptions of the of solution proposal**
Macro focus	**External environment context:** - [Stakeholders impacts on internal environment]			
	Internal environment context: - [SDOs and NSBs] - [Operational unity]	❶ Structural	- IITS process depends on the IITS environment for direction and strategies. - Complex, unidentifiable and vague IITS process features.	It is central to the definition and representation of the CBD framework for: - *Content of IITS process* aligned to structural elements defining its features and inter-dependencies that form a set of functions.
		❷ Functional	- Dynamic interplay of functions and practices.	It is central to the definition of *operational elements* of project development settings aiming for: - Parameterisation of content of operational elements. - Clarity in differentiation operational elements. - Integration of practices
		❸ Management	- Functional aspects to be controlled and managed.	*Functional management*: It can support areas where management is paramount e.g.: committee performance, project inputs, process results and information.
Micro focus	**Committees and technical core context:** - [Organization internal environment] - [Project development] - [IITS process]	❹ Behaviour	- Complexity of operational matters impacting on project development. - Complexity of project development and practices. - Complexity of IITS process performance contexts	It focuses on implications for practice: *Integration of practices* of the use of the project development settings to provide a high quality of work and practices for communication, co-ordination of work, information sharing and workflow.
	Technology context:	❺ Information systems	Cross-functionality of IITS process requiring extensive IS resources	It offers aims of distributed computing environment for leveraging integration across the project development settings; higher performance capabilities and creative performance approaches

Technology context: By its design, an open layered CBD representation adds depth in defining the technology context. When the IITS process is reconstructed, it has a new infrastructure consisting of autonomous component-based PDS. In particular, project development has prominent technical core contexts, such as co-ordination, collaboration and information depending upon a well-defined technology context. The PDS can only operationalise compliance to this new infrastructure through IS unification (cf. Hackney *et al.* 2006). In the technology context therefore, integration, *fit* of function and manageable and maintainable IS infrastructure are intentions for the unification of an 'organisation's internal environment'. Flexibility in the design of the PDS emphasises the different values through which this technology context can strengthen the *'fit'* of function by integrating all matters supporting project development.

3.5.5 Characterisation of Solution Proposal Framework

This framework in **Figure 3-4** draws together decisions bearing on the responses to the six questions (§3.5.3). Its underpinning theme is a component-based approach to IITS project development depicted in three-dimensional frame to adequately characterise conceptualised features. The views presented in Table 3-4 help to differentiate content, contexts and views of functional intentions. The content is the *structural view* of distinctive component-based PDS of the reconstructed IITS process.

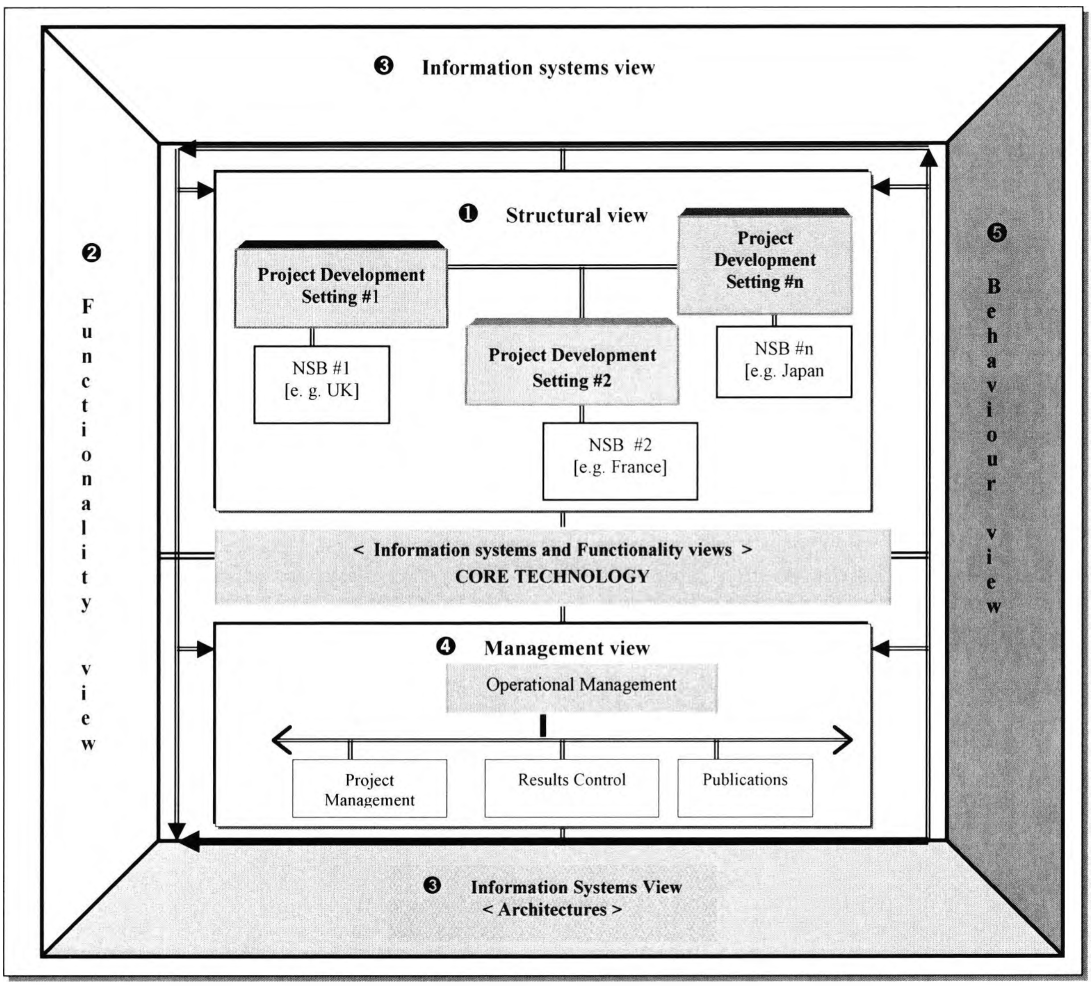


Figure 3-4: Component-based Solution Proposal Framework
(Source: compiled by author)

3.6 Case Study Design

This section discusses preparations for the case study. The decisions involved case study strategy; selection of cases; identification of focus groups and survey approaches and cased methodology.

3.6.1 Choice of Case Study Strategy

In the research process (Figure 3-2), **case study** is depicted as Stage 2d. In line with guidelines from Benbasat *et al,* (1987), Eisenhardt (1989), Lee (1989) and Yin (2003) a positivist case study strategy would be the choice to provide an inductive empirical inquiry. This is supported by a broad commitment to aid inductive data collection, examine selected cases in real-life contexts and data analysis.

3.6.2 Rationale of Selection of Cases

International IT standards development covers several subject areas with projects that deal with complex systems, problems and requirements. Given the diversity of the technical nature of the projects, pre-selection of the cases was impractical. To assist in the identification of projects that qualified for study, the researcher reviewed assembled SDO operational documents from two separate domains: generic international IT standards (GIITS) and software engineering standardisation (SES). The selection process supported intentions to provide an inductive empirical study supporting grounding of the social reality and explication of major IITS issues.

3.6.3 Decision Criteria for Case Selection

Criteria for selecting cases, taken from Patton (1990, 2002), are shown in Table 2-8: 'Case selection criteria drawing upon sampling strategies'. These criteria cover solution proposal, topical and critical projects, intensity, deviant, project contrast and convenience.

[1] Criterion of solution proposal

In this criterion, the focus is on Figure 3-4: 'Component-based Solution Proposal Framework'. that is expected to effectively deal with perceived problems that are also widely understood (or theorised) by others studying the same area. For example, reviewed standards literatures are concerned with old SDO regimes (Krechmer, 2005: 88) and the timely delivery of IT standards (cf. Rada, 1999; Gosain 2003). Projects that are selected for study would be expected thus, to represent the strategic and operational importance of this solution proposal that it deals with IITS practices that are criticised widely.

[2] Topical and critical projects

Topical projects have issues that are central to IITS, such as industry need for a standard. *Critical projects* illustrate uniqueness in either their content or their strategic importance to the IITS environment (cf. Patton, 2002). In the area of SES two project proposals that met these criteria were identified as IEEE 1074 and ISO 12207-1. They were chosen to respond to different 'sector' needs for standards describing guidelines for software development life cycle processes (SDLCP). At the time, no prior standard had dealt with SDLC issues, thereby making the projects unique and critical new topics.

[3] Intensity

According to Patton (2002), an intense case would be information-rich that it presents intense phenomena. This researcher decided on intense cases that also reflect predetermined importance and sensitivity to the IITS issues. Project proposals for ISO 10646-1, ISO 10918 (JPEG-1), ISO 11172 (MPEG-1) met these criteria based upon the following features:

[a] Multimedia concepts and technologies proposed in projects JPEG-1 and MPEG-1 were **important and urgent demands** from IT industry. Multimedia technologies had not yet been developed for wide implementation. The completed projects would be regarded as **anticipatory standards** (Hawkins, 1995) intended to guide the development of future technology.

[b] The proposal for these projects became **politically sensitive,** because they required intense R & D input and research results. At the time, the policies in this environment did not acknowledge 'open R & D activity' in voluntary standardisation activities. Urgent discussions were conducted for several years to eventually change policy for R & D, in favour of these projects.

[4] Deviant cases

From the perspectives of anticipatory standards and open R & D activity, these three projects also qualified as **deviant cases.** Their methodological requirements were different from any other projects usually accepted for development. The researcher therefore considered that these projects would offer intensity in the study of perceived phenomena (cf. Patton, 1990, 2002). In doing so, learn from their unique or deviant qualities which could be the foundation for understanding the reality of IITS projects that would otherwise not be presented in main stream cases (cf. Greco, 1999).

[5] Project contrast

The overall contrast in the projects discussed above involved GIITS and SES.

[a] The three GIITS projects (ISO 10646-1; ISO 10918, JPEG-1; ISO 11172, MPEG-1) focused on the development of tangible systems products and their functions. The project inputs involved core technology, engineering principles, perceptions about problem and requirements. The standardisation methodology (or methods that are applied) are statistical in nature (cf. Furht, 1998; Wallace, 1992). The standards would be classed as technical or product (ISO IEC 17000, 2004; http://www.cenorm.be/Boss/glossary.asp#P).

[b] The two SES projects (IEEE 1074; ISO 12207-1) focused on SDLC methods for developing and implementing software products in real life organisations. They were published as *process standards* describing guidelines or procedures for developing software systems (IEEE 610.12, 1990; ISO IEC 17000, 2004; http://www.cenorm.be/Boss/glossary.asp#P).

Although the five projects resulted in technical and process standards, their application is *generic*. The standard would define common elements, such as methods, requirements or guidelines that are independent of any particular application. The user of the standard would choose elements to suit the development of particular systems products or services (cf. Scowen, 1993).

[6] Convenience

For this criterion, a convenience factor was that the projects were also chosen for the following reasons:

[a] The projects were in their *preliminary stages of development*. This allowed comprehensive investigation of their life cycles, from inception to completion.

[b] To a great extend, the investigation would not have been accomplished defensibly or realistically without working directly in the area of IITS (see §2.1.1). Through working in an NSB, the researcher had *appropriate access* to study the chosen projects and the focus groups, to include a host of information that would normally not be made available through public means. In addition, this work experience provided access to *participant observation* (cf. Adler and Adler, 1994; Atkinson and Hammersley, 1994). This researcher's work assignments were constraints, in so far as they contributed to data gathering and utilisation of the evidence gathered to further research intentions.

[c] Another convenient factor was that, each selected project would be assigned to a committee and forum. Consequently, the researcher was able to examine the projects, committees and forums, concomitantly.

3.6.4 Summary of Selected Cases

Out of eight potentially interesting projects, five were finally selected for satisfying all six criteria discussed above. **Table 3-5** contains a summary of the complete set of cases study choices. The titles for the examined projects and forums are cumbersome to cite repeatedly. Only their reference numbers are used. The full titles are in the thesis reference section.

Table 3-5: Selected case study items (projects, forums, committees and secretariats)
(Source: compiled by author)

Project domain	Project identity	Forums	Committee	Secretariats
SES:				
	[1] IEEE 1074: Software development life cycle processes	IEEE Computer Society.	IEEE WG 1074-Software Life Cycle Processes.	USA, private organisation.
	[2] ISO 12207: Software life cycle processes	ISO IEC JTC 1.	ISO IEC JTC 1, SC 7 Software Engineering.	Canada, CSC
			ISO IEC JTC 1, SC 29	Japan, IPSJ/ITSCJ
GIITS:	[1] ISO 10646: Character Sets…	ISO IEC JTC 1.	ISO IEC JTC 1, SC 2 Character Sets.	France, AFNOR.
	[2] ISO 10918-1 (JPEG-1): Digital compression …	ISO IEC JTC 1.	ISO IEC JTC 1, SC 29 WG 1	USA, private organisation
	[3] ISO 11172 (MPEG-1): Coding of moving pictures… Part 1-Systems; Part 2-Video; Part 3-Audio; Part 4-Conformance testing; Part 5-Simulation	ISO IEC JTC 1.	ISO IEC JTC 1, SC 29, WG 11	Italy, CSELT

3.6.5 Instruments of Case Study Methodology

A case study methodology that is based upon a positivist strategy encourages in-depth of the investigation. Ontology and epistemology paradigms supporting the interpretive stance of this research process with aim to provide contextual depth in the different perspectives taken in the investigation (cf. Myers, 1977; Pettigrew, 1997). In addition there is the qualitative nature of an interpretive investigation, whereby the data collected forms the basis for explicating the various layers of contexts that are shaped by social elements: such as, human conduct of activities, events and relationships in the phenomenon of interest.

Box 3-3 gives a summary of seven instruments underpinning the design of the case study methodology, drawing upon ontology, epistemology, qualitative and interpretive viewpoints described. A brief description is given for case description, conceptual framework and case study operational plan. The other four instruments are described in the section that follows next.

Box 3-3: Instruments for designing a case study
(Source: compiled from Patton, 1990; Robson, 1993; Yin, 1994, 2003)

[1] Case description
[2] Conceptual framework of the case study
[3] Case study operational plan
[4] Units of analysis
[5] Data sampling strategy and methods and instruments for data collection
[6] Case study questions
[7] Methods and instruments for data analysis, which leads to answering specified case study questions and explanations of empirical evidence.

[1] Case description

Reviewed literatures give a number of versions of a case description. The version in Flick (1998) is a 'case profile' that gives an overview of 'what the case is concerned with.' For example, the persons to be studied, topics and challenges with regards to the research question posed. On completion, the results of the case study are included in the profile with a revision of the profile.

Another version is that of explanation building for encouraging depth in a single exploratory study. In this version, a case description is developed as a framework for organizing the case study to include goals, data collection and data analysis procedures, and case narration of the results (cf. Patton, 1990; Paré and Elam 1997; Strauss, 1987; Strauss and Corbin, 1998). If a multiple case study approach were applied, the case description would allow the researcher to repeat the research process in other cases.

[2] Conceptual framework of the case study

For case studies carried out in real world settings, Robson (2002: 4) recommends that a conceptual framework be developed to indicate what the researcher needs to know in advance, and what to look for in the investigation. Such conceptual frameworks set preconditions of developing hypotheses. Miles and Huberman (1994), Strauss (1987) use comprehensive conceptual frameworks, event networks and integrative frameworks, respectively. They capture the theory about the area to be examined. Such conceptual frameworks have the underpinnings of the positivist paradigm. The original framework eventually increases in its detail, because the results of the study would be incorporated in an emergent conceptual framework that can propose the changes to be made.

[3] Case study operational plan

A conceptual framework needs to be simple and easily understood structure primarily, to aid the investigation. Another option is to separately develop **a case study operational plan** as used in this research (Appendix 2) and Robson (2002: 183-184). Such a plan frames the requirements of the intended investigation and to ensure controlled observations.

The source is the case description that offers, in many respects, explanatory details of what the selected cases are concerned with. The operational plan can include key elements, such as: items selected for study with regards to the research question and, methods of data collection and data analysis. Evaluated findings from the different stages of the case study provide inputs to refine the operational plan and to develop case reports (cf. Patton, 2002).

3.6.6 Case Study Questions

There are two types of inquiry that can help to capture the inductive nature of a positivist case study strategy and the complexity of rich phenomena. The first type is suggested in Yin (1994, 2003) that an empirical case study would pay attention to 'how' and 'why' type of *questions* to build a logical chain of evidence needed to answer them.

The second type is the **questioning** that is all-too frequently ignored in many literatures. The fact of the matter is, the chain of evidence sought after in an empirical inquiry evolves from the questioning to which data collection, fact-finding, analytical and interpretation elements of the case study would relate. These elements attributed to questioning can be considered concomitantly to build incrementally, the research theory and phenomena.

This researcher argues therefore that, an inductive multiple-case study demands an explicit framework of **case study questions**. Differentiation in the question formats (such as what, how, why and which) offer systematic modes of analysis and greater explanatory power of the different angles of the investigation than say, selecting a wide range of items.

Analytic questions give attention to the challenges that can be encountered in *theorising* the data collected. Some of the challenges are specificity of sampling parameters (Lofland and Lofland, 1995) and fact-finding that encourages theorising in search of evidence (cf. Pettigrew, 1997). To add depth and detail therefore, the use of the OIPT as a lens can give due attention to the level of focus of both case study, analytic questions, and their differentiation (see §3.3.5, §3.3.6).

3.6.7 Units of Analysis

In keeping with Hamel *et al.* (1993); Miles and Huberman (1994), and Yin (1994, 2003) the case study units of analysis characterise the investigation process. Three features of a unit of analysis cover boundaries, sampling parameters or items to be examined and, to some extent, the methodological considerations of the investigation.

In the case of selected IITS projects, their development spans several stages, over time. Data on specified items are collected hence, in a processual manner covering each project development stage. A unit of analysis would represent a **boundary** that draws attention to the level of focus of the aspects of the study for which data would be collected (cf. Miles and Huberman, 1994).

A unit of analysis can specify **sampling parameters** to focus the case study. Patton (1990) suggests that qualitative samples tend to be purposive in terms of defining the parameters that need to be located or explained in the findings. Example parameters in Miles and Huberman (1994: 30) cover settings, actors, events and processes. In this research, analytic questions used in the data collection take into account the contexts of the sampling parameters such as:

How do committee activities evolve?
What are the features of the activities?

Questioning sampling parameters develops the understanding that might demonstrate a response to the questions hence. It is then possible to define a concept that can be linked to the sampling parameters: such as, selection of project inputs and design of tasks would be the response to how committee activities evolve.

As a methodological consideration, Robson (1993, 2002) recommends the use of a **data range** or data set to frame data collection for specified case study items, within each unit of analysis. The data range can be concepts that are central to the unit of analysis for ensuring that the data collected is analysable, such as 'content of project development'. In addition, a data range would be considered in the cases where software applications would be used to record gathered data directly into computer files for analysis, thereby saving time.

3.7 Preparation for Data Collection

3.7.1 Identification of Focus Groups

Initially, this researcher mailed an invitation letter to individuals identified from ISO directories, IEEE administration and, membership records from ISO JTC 1 secretariats and committees. Would be candidates from these sources were requested to indicate their roles in particular areas of IITS.
Later, would be candidates were identified through questionnaire returns and the researcher's participant observations in the committees. The invitation letter yielded 1236 individuals that signed the consent form to volunteer as survey candidates, to include forums, secretariats and committees for the selected five projects.

3.7.2 Classifications and Criteria for Survey Participation

A large population of survey participants was an advantage to gather a variety of experience-related views. On the other hand, this presented foreseeable complications: specifically, poor co-ordination of material and difficulty to feedback results to candidates (cf. Robson, 1993). Information overload from survey questionnaires and time demands in evaluating vast amounts of data were other expected complications. To lessen some of these complications, this researcher made the decision to classify survey candidates in order to satisfy the data gathering objectives.

Table 3-6 contains the classifications that were based upon evaluated role profiles from the invitation letter and from which selections were made hence. The classifications were valid, because they were comparable to the levels depicted in Figure 3-3: 'Schematic model of core features of IITS environment' and contexts depicted in Table 3-4: 'Contexts and views of CBD solution proposal'. This classification also confirmed the theoretical underpinning of the social settings and divisions of IITS environment.

Table 3-6: Case study survey participant categories
(Source: compiled by author)

IITS Environment functional levels	Survey participant categories & role profiles
Category 1– Environment level:	SDOs [SDOs: CEN & CENELEC, IEEE, IEC, ISO & JTC 1]. [a] Executive managers: strategies, policies and direction of standards development. [b] Senior managers: administration and operations. [c] Technical officers: project management, systems operations & operational management matters.
Category 2–Organisation level	NBs [Secretariats of the projects-Canada, France, Italy, Japan, USA and UK]. [a] Executive & Senior managers - tactical operations. [b] Technical officers and Project Managers of Secretariats also [those managing more than 2 SCs and WGs]
Category 3–Committee level:	Committees for the five projects: [a] Developers acting as Chairpersons and Project Editors. [b] Developers of each committee actively involved in other committees within JTC 1 and IEEE Computer Society.
Category 4–Stakeholders level:	Committees for the five projects: [a] Representative stakeholders in the development of the project. [b] Other interested parties in the committee and their representation.

Category 1: Environment level

This Category identified with **strategic level** involving SDOs that provide direction in separate subject domains of international standards development. Reviewed literatures (such as Davenport, 1993; Laudon and Laudon, 2000; Sauer and Willcocks, 2002, 2004) stress the importance of strong communication with senior executives and strategists of an organisation, if major exercises such as process reconstruction and IT are to be implemented successfully. An over-riding issue for this research however, was that this environment functions in a conservative way. Reservations had been aired in the invitation letter for undertaking this research that coincided with SDOs and NSBs improvement efforts mentioned in §3.2.1. The researcher's selection considerations for this Category thus involved consent from strategic focus groups.

[a] **Consent:** Prior to the investigations, the researcher sent the research proposal and a letter requesting formal consent from the IEEE Computer Society on SES and ISO JTC 1. With guidelines from Gray (2004: 363-368) and Robson (1993: 470-475) this proposal explained details of the research: its objectives, phases of investigation; data collection needs; expected results and their implications; and academic requirements agreed with the university. Through subsequent communications, the researcher was granted written permission to conduct this research. Top priority consent agreements between the researcher and SDOs covered the conduct of this research in an ethical manner, regular feedback and confidentiality in the use IITS environment information.

[b] **Strategic focus groups:** This researcher selected SDO executives and senior managers assigned with strategic and decision-making responsibilities. These groups were likely to promote these investigations and results stated to them in the research proposal. It was therefore important to establish their support in the research surveys. It would have been difficult to conduct this research, if their views were not considered otherwise.

Category 2-Organisation level

This Category identified with NSBs and SDO management teams. They also received a copy of the research proposal to influence their interest and approval of the research. Their participation in the case study surveys involved providing material on project management; functions of NSBs and secretariats; operational information and technology matters.

Category 3-Committee level

This Category involved committees selected for case study for the five projects (see Table 3-5: 'Selected case study items'). The response to the letter of invitation to participate in the case study had shown developers as having direct involvement in IITS activities, than SDO or NSBs would. It was therefore reasonable to expect that individual developers would be better equipped than executives or senior managers in describing how they developed each of the selected projects. Furthermore, the results of this research were expected to benefit the developers that they performed their activities efficiently.

Category 4-Stakeholders level

This level concerned parties with some active involvement in contributing to committee activities. Instead of speculating *how* stakeholders influence project development, the data gathered would interpret contexts of the stakeholders' involvement linked by constructs discovered in the analysis of the data gathered and its interpretation. Stakeholder alliances, expertise, commercial interest and sponsorships are some example constructs described in Axelrod (*et al.,* 1997); Hallström (2002) and De Vries and Verheul (2003).

3.7.3 Selection of Case Study Survey Candidates

An additional questionnaire was distributed to 'would be' survey candidates requesting the qualities that would entitle them to participate in the case study surveys. Qualification helped to reduce the number of survey candidates for each focus group, and to choose the 'right kind' of candidates, based upon the researcher's specified criteria in **Table 3-7** next.

Table 3-7: Case study survey criteria for participation (Source: compiled by author)	
Qualification	**Summary**
[1] Relevant past experience:	- In accomplishing one or more stages of developing an international IT standard (e.g. drafting and review). - In management the development of international IT standards (e.g. decision-making, policy formulation and business strategy management).
[2] Technical background:	- In one or more pre-defined stages of the development of the standard (e.g. requirements, design and project management).
[3] National participation:	- Within selected major standards sectors (e.g. North America, Japan and European Union)
[4] Participation commitment:	- In terms of the time spent on standards activities, in man-days or years. - Time they promised to commit to planned research review meetings.

3.8. Data Collection

3.8.1 Summary of Data Collection and Data Sources

In Figure 3-2: 'Research process' Stage 2, data collection and data analysis are interconnected aspects of the research design connected directly to the case study. The main link is from the fact that empirical case study can only be achieved through collecting qualitative data (cf. Weick, 1985; Galliers, 1992; Yin, 2003). Analysis of the qualitative data gathered addresses identifiable features and contexts to build the case evidence for answering the research and case study questions.

In keeping with Brewer and Hunter, 1989; Eisenhardt (1989) and Yin (1994, 2003) collecting different types of data, by different kinds of methods and from different focus group sources often results in a fuller picture of the phenomena under study, than would have been achieved otherwise. **Table 3-8** illustrates the data sources of this case study.

3.8.2 Data Collection Approaches

Case study data collection approaches established from reviewed literatures (such as Gray, 2004, Patton, 1990; Turoff, 1975, 1989; Robson, 2002) cover as policy Delphi, stratified random sampling, cluster sampling and real-time delphi. This variation in the approaches encourages depth in the sampling strategies, as well as, treatment of the case study questions. In addition, they create triangulation for effective data collection that helps to develop the body of knowledge to deal with the details of case study items.

The policy Delphi approach

This approach is used in the cases where there is a need to ensure that all possible views of the survey candidates can be considered to establish consensus (cf. Turoff, 1975, 1989). Questionnaires would be utilised to obtain as much information as possible from a large population across the case study focus groups. Collation of the questionnaire returns would involve a multi-stage process, both qualitative and quantitative, to systematically establish consensus on the views presented by each focus group and from which to generalise the findings.

Table 3-8: Data sources (Source: compiled by author)	
Which method?	**Which focus?**
[1] Study of focus groups	[a] **5 committees** assigned to develop the 5 selected projects [b] **2 Forums**: SES and ISO JTC 1 - [Forum individuals e.g.: strategic managers; technical officers for project management] [c] **5 Committee secretariats:** - [Secretariat individuals e.g.: executive managers; senior managers; project managers; administrative officers]
[2] Participant observation	Ethnography in the 5 committees: e. g. meeting events
[3] Case study surveys	[a] Data collection through questionnaires, interviews and observation [b] Data analysis [c] Case reports
[4] Documentary analysis	[a] Committee study and technical documents, meeting reports [b] SDO operational reports [c] Forums and secretariat operational reports
[5] Literature review	[a] Collecting literatures for understanding subject matters and methods supporting the conduct of the case study

Stratified random sampling

This survey approach offers the means to divide a survey population into small numbers of individual within a focus groups or *strata* (cf. Patton 1990; Robson, 1993). The sampling can be *stratified purposeful* (Patton, 1990), such that the focus groups is divided into workable fitting pre-determined profiles (stratum), notably:

[a] **Stratified similarity profile:** Developers working on the **same project** and in the **same committee** would be requested to respond to the **same questionnaire**. Their questionnaire responses best present data from which to establish generalisations of the evidence gathered and, to eliminate unnecessary matters from the enquiry.

[b] **Stratified differentiated profile:** Combinations used in the survey sample that it can be stratified by developers from **different committees** engaged in **separate projects** that are **at the same stage of development.**

In keeping with Robson (1993, 2002) and Yin (1994), these two kinds of profiles show that in some circumstances, *stratified random sampling* can help examine different subject matters of the case study, as well as, the subject of the survey. Cheng and Davenport (1989), however, mention that such stratified samples can create multi-dimensionality in the items or aspects for which data was collected. Comparing the material gathered from the questionnaires can eliminate this. By doing so, cross-sectional similarities and differences are determined to focus on high priority issues representative of the findings.

Cluster sampling

This survey approach is used in the cases where results from a policy Delphi survey provided yielded a multiplicity of issues requiring clarification (Turoff, 1975, 1991). The clusters in the sample would be a population divided into small number of groups having a range of characteristics that allow comparisons of the responses (cf. Gray, 2004; Robson, 1993, 2002). Similar questionnaires are given to two different groups as a basis for determining as many similarities as possible that further case study objectives. As in a policy Delphi survey, a second step after collecting cluster samples would be to calculate percentages of the total number of responses. Items that gain a high percentage of satisfactory answers were considered positive responses to establish consensus among the survey candidates.

Real-time Delphi

This used for conducting semi-structured face-to-face interviews. The interviews that are semi-structured allow open and in-depth questioning of prepared topics. In the cases where the researcher employed a stratified or cluster sample survey, it was sometimes more expedient to conduct telephone interviews to clarify a few chosen individual responses, on a one-to-one basis, than sending out a revised questionnaire.

3.8.3 Data Collection Measures

Data collection combining policy Delphi, cluster and stratified sampling approaches can be enriched from different angles. The sampling approaches produce a 'funnel strategy' depicted in **Figure 3-5.**

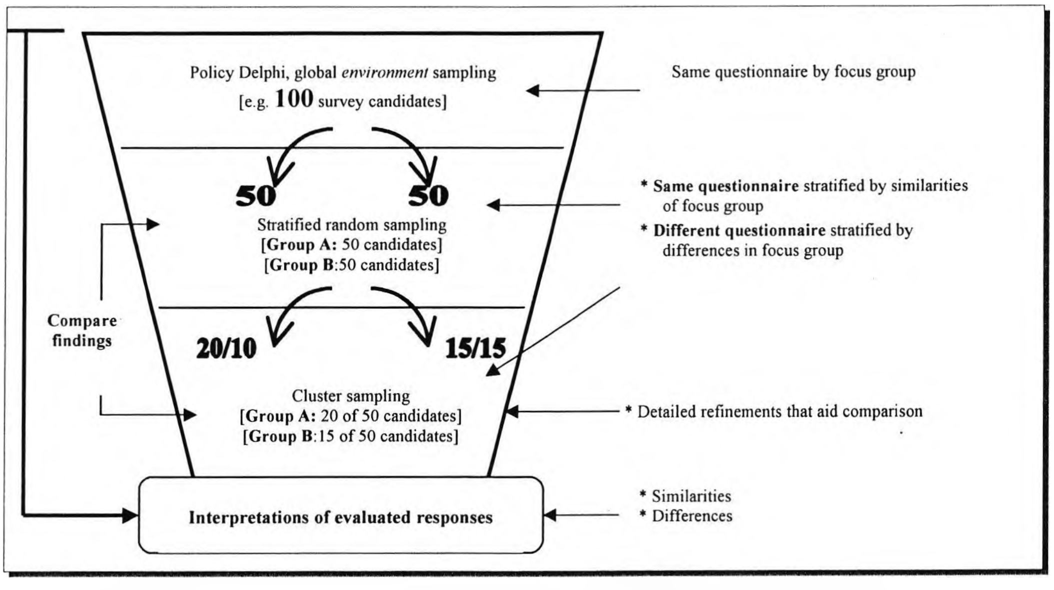


Figure 3-5: Funnel-shaped Strategy (bearing on data collection approaches)
(Source compiled by author)

This 'funnel-shaped strategy' requires **measures of effectiveness** in data collection, as well as, in the analysis and interpretations of the findings. The measures determined from reviewed literatures (such as Flick, 1998; Lofland and Lofland, 1995) concern different types of decisions taken in a multiple-case study approach. These are objectives, similar questions, refinement of questions, theoretical focus and triangulation.

Revisiting the case selection criteria (§3.6.3), information-rich or intense cases can present data collection difficulties. As a primary measure therefore, **objectives** specified for the units of analysis help the effective use of selected data collection approaches, such as the use of policy Delphi or stratified random sampling. An objective, such as to understand the content of a project can offer guidance on items for which data is to be collected broadly or intensely. If a comprehensive study is required on how a project is developed, the data collected on project content can lead to explication of specific items located in the findings. However, the objectives for each unit of analysis need a link to analytic questions. In doing so, the data collection supports theorising as the means to identify specific items and to avoid over-generalising from the data gathered.

This researcher identified that all five projects chosen for study possessed comparable development stages of development. In this regard, the **use of similar case study questions** across specified sampling parameters can provide greater possibility of identifying overlaps and anomalies in the items examined (cf. Gallivan, 1997). The data collection questions would also instil efficacy with which to check the data sources.

Refinement of the original case study questions is a measure for clarifying the data gathered for the items being examined. Measures for the refinement of questions can be summarised in line with Flick (1998:48- 49):

> It is important, that the researcher develops a clear idea of his or her research question, but remains open to new and perhaps surprising results. Clear idea about the nature of the research questions that are pursued are also necessary for checking the appropriateness of the methodological decisions in the following respects: which methods are necessary to answer the questions? Is it possible to study the research question with chosen methods at all?

Variation in the project development stages evolves as settings from the dynamic interaction of elements. New bodies of data need to be collected. More so, different kinds of **theoretical stances** co-evolve because of a particular data collection method for say, questionnaires or ethnography observations. As a measure, analytic questions determined from the OIPT as a lens offer stronger theoretical depth in the data collection. Because analytic questions have 'what', 'which' 'how' and 'why' formats they can be applied flexibly to a particular area to clarify the epistemological and theoretical stances underpinning the explication of the chain of evidence (see §3.3.5 decision parameters; Table 4-6: Case study units of analysis).

Combinations of data collection approaches and the use of similar questions across the projects being examined create **triangulated data angles**, which strengthen the grounding of the case evidence. It would clarify meaning demonstrated in the questioning of the observation (Denzin and Lincoln, 2002; Flick, 1998; Gallivan, 1997). The distinctions in the triangulation for this case study are as follows:

[a] By researcher as the primary research instrument and groups as main data sources.
[b] By use of OIPT as a lens to structure case study questions.
[c] By combining different kinds of complementary survey methods and variation in the surveys.

3.8.4 Organising Questionnaires

Diversity in focus groups presents the difficulty of sorting the chain of responses from different questionnaires used in the case study. This researcher utilised colour-paper codes to help sort and categorise questionnaire transactions to and from different focus groups.

Box 3.4 contains the codes assigned to the survey participant categories throughout the research process.

Box 3-4: Colour codes for focus groups survey questionnaires (Source: compiled by author)	
BLUE::	**Environment level:** strategic and management
WHITE::	**Organisation level:** NSBs and committee secretariats
GREEN::	**Stakeholders**, for Environment and committees levels
OLIVE:	**Case study committees** (policy Delphi strategy)
BLUE & YELLOW::	Case study committees (2-groups, Cluster sampling)
CODE E:	Emailed quick fire questions (Stratified purposeful and following new leads)
CODE F::	Faxed case study committees (dimensional Stratified random sampling)

3.8.5 Research Documents

Yin (1994, 2003) suggests that a case study database should be developed for managing qualitative case study information. Such as database can consist of four components: field notes, documents, tabular materials and narratives. Research documents listed in Appendix 3 were created as part of case study database. The documents were reviewed frequently, so that the material passed the adequacy useful for knowledge-building and quality assurance (cf. Patton, 2002).

3.8.6 Data Analysis Perspectives

Inductive analysis is appropriate for qualitative data consisting of rich elements. Two distinct perspectives for the analysis of large amounts of qualitative data useful for IITS case material are as follows:

[a] **'Within the project development stages'**: In keeping with Pettigrew (1990, 1997) and Yin (2003) this approach helps to build empirical case evidence that captures the dimensions of the reality of each project. For example, its content features, contexts and concepts present in a data sample of the stage of development.

[b] **'Across all five projects'** offers the means to associate the case evidence for the two classes of projects, namely GIITS and SES. This association of evidence provides grounds for comparing the two classes with one another and to determine specific concepts, themes that would be useful to answer both the research and case study questions.

3.8.7 Analytic Approaches

Data analysis is aimed at understanding that includes the search for coherence and order (cf. Kaplan and Maxwell, 1994). In view of the two perspectives above, the interesting question to ask is this: To what extent can the data be analysed, such that it adds value to develop knowledge that becomes empirical evidence and to understand the details that contributes to research theory?

To answer this question, the approaches that that support inductive data analysis adopt qualitative coding paradigms that have a positivist perspective towards a grounded theory: such as open, axial, and selective coding. As an initial step, **open coding** helps to sort assembled qualitative data samples with coded checklists that would have been used in the data collection process to analyse say, interview transcripts. Strauss and Corbin (1990: 74) describe it as follows:

> Open coding in grounded theory is the analytic process by which concepts are identified and developed in terms of their properties and dimensions. The basic analytic procedures by which this is accomplished are: the asking of questions about the data; and the making of comparisons for similarities and differences between each incident, event, and other instances of phenomena. Similar events and incidents are labelled and grouped to form categories.

Axial coding involves the refinement of results obtained from open coding by means of differentiated categorisations. Strauss and Corbin (1990) apply sets of questions and comparison on the categorised material to aid refinement and to establish relationships between the coded variables. Refined codes are categorised according to causal conditions, phenomena, context, action and inter-actional strategies and consequences (Strauss and Corbin, 1990: 96-99).

Selective coding is relevant to large structured data samples to systematically refine their coded details after exhaustive open and axial coding. The results might add further dimensions to specified codes, with the aim to structure and reduce them immensely.

These coding paradigms involve several analytic steps for dimensionalising how the researcher can use the empirical evidence in a categorised or structured manner. Categorisation achieved through the coding process gives a higher level of differentiation in the structured evidence that is more appropriate for:

[a] Comparative analyses.

[b] Where there is a need to develop deeper concepts, themes and dimensions that can be useful to develop a theory.

In keeping with Gregor (2000) constructs of explanation and description, since the OIPT as a lens was used in this case study for these reasons, its decision parameters are adaptable that they can be used in conjunction with these analytic coding processes. Analytic questions determined from the OIPT as a lens can be applied to reduce some of the cumbersome coding steps to encourage systematic analyses, theorising leading to refinement of data hence.

3.8.8 Comparison of Case Evidence

For this research, two classes of projects were examined, namely GIITS and SES. The case evidence presented would be compared, **within** each class of projects and **across** all five projects. By doing so, the differentiated comparisons provide the means to adequately interpret the case evidence in terms of central concepts and themes that are representative of the development of the projects. Flick (1998: 235) mentions two types of comparison strategies for contrast cases:

> The main instruments are the *minimal comparison* of cases which are as similar as possible, and the *maximal comparison* of cases which are as different as possible. They are compared for differences and correspondences. The comparisons become more and more concrete with respect to the range of issues included in the empirical evidence.

3.9 Conclusion Stages of Case Study

3.9.1 Stage 3: Interpretations of Empirical Evidence

When empirical evidence is presented, a major task is to develop interpretation of its different dimensions that can answer the questions posed in the investigation (cf. Brewer and Hunter, 1989; Yin, 2003).

3.9.2 Interpretation Criteria

Criteria to focus on the highest priority of facts are: plausibility, answers to questions, phenomena, research theory and empirical explanations. These criteria can be linked to how the case study questions are answered to define most clearly, interpretive facts and degree to which they can offer representative explanations.

Plausibility indicates the strength of the empirical case evidence. For example, the researcher's interpretations would aim to establish primary aspects or *central concepts* (Miles and Huberman, 1994) identified 'within the project development stages' (see §3.8.6). Primary aspects form the basis for defining the IITS process for analysis. If this definition can be established, the empirical evidence and its interpretations would be regarded as plausible hence.

Interpretations representative of common concepts and themes located in the compared (and integrated evidence) across all five projects provide more convincing evidence that allows the **case study questions to be answered**. Example themes would be project development features representing core concepts, generality of features expressed from each stage and their connectedness. Since OIPT as a lens is used in the data collection and data analysis, the interpretation of the concepts and themes are grounded in the theory.

When the questions are answered successfully, they can fulfil detailed theoretical **account of phenomena** that is analytically generalisable and **research theory** hence (cf. Eisenhardt 1989). Good primary aspects form the basis for constructing **empirical explanations** that result from interpretations of the evidence. The main purpose of an explanation is to represent fundamental statements and specific aspects of the reality discovered in the case evidence (cf. Flick, 1998; Robson, 2002). For example, the explanations account for the 'how' and the 'why' contexts of the circumstances in which project development occurs, to include central concepts that can help define 'what is known' from the empirical evidence (understanding). Empirical explanations are imperative in classifying the set of phenomena in ways that lead the definition of the research theory.

3.9.3 Stage 3: Case Study Outcomes

This is the final stage of the research process in Figure 3-2. Other scholarly works that have applied a positivist case study (such as Keil, 1995; Paré and Elam, 1997) place emphasis on the likely outcomes of the case study (rather than on inputs) and theory building.

In this research the outcomes of the case study would involve interpretive facts that answer central questions posed in the investigation. The outcomes also incorporate categorical empirical results that can be operationalised to then, focus on the analysis of the solution proposal.

Example empirical results are primary aspects for defining dimensions of IITS process, phenomena and hypothesis (see §4.8). Exclusively, the operationalisation of the research hypothesis through analysis of the IITS process stimulates the study of identified phenomena toward the solution(s) that address problems associated with project development and conclusions.

3.9.4 Stage 4: Case Study Conclusions

These conclusions form part of definitions of the transition from research process to the treatment of the empirical results. For example, drawing upon empirical evidence a conclusion would be to define the complex nature of the IITS process, which is one of the subjects examined in this thesis.

The conclusions provide input to the thesis with fuller understanding necessary to establish how this process can be examined. In addition, the case descriptions and case operational plans used in the investigation are revised to reflect the findings, and conclusions.

3.9.5 Assessing Case Study Design Quality

According to Yin (1994) the quality of case study designs can be assessed against four criteria. These are construct validity, internal validity, external validity and reliability. Each of these criteria has been met in the case study design explained in this chapter and evidence for this is provided in **Table 3-9.**

Table 3-9: Case study design quality criteria (Source: adapted from Yin, 2003: 34)		
Quality Criteria	**Evidence**	**Reference in this thesis**
[1] Construct validity	This was achieved by using multiple sources operational measures for the concepts being studied such as: - Multiple data collection sources - Variations in data Collection Approaches - Variation in data collection candidates: SDOs, NSBs and committees.	Chapter 3, §3.8 Chapter 3, §3.8 Chapter 4, §4.3
[2] Internal validity	This was achieved by working across and between case study units of analysis to provide a basis for determining dynamic patterns of relationships in the items examined: - Individuals from different focus groups: developers, chairmen, project editors, senior executives and managers - Explanation-building resting on empirical constructed meaning in relationships, shifting with context, such as: similarities in categorised concepts, themes and subject matters.	Chapter 3, §3.8.2 Chapter 4, §4.3.3 Chapter 4, §4.5.3
[3] External validity	This was achieved by use of replication to make use of the opportunities presented in a multiple case study: - Replication case study questionnaires across the two separate classes of projects: GIITS and SES as a basis for generalising findings - Replication case study data analysis approaches across the project examined	Chapter 3, §3.7 Chapter 4, §4.3 Chapter 4, §4.3 Chapter 4, §4.6
[4] Reliability	This was demonstrated by the methodological underpinnings of the case study in the approaches that were repeated across the two separate classes of projects, GIITS and SES: - Use of research process protocol in data collection - The projects yielded indicated ***similarities.*** - The projects yielded answers bearing on the same case study questions, where findings could be audited for *integration* and, for developing *central themes* and *primary aspects.* - Case study design and auditing approaches can be repeated in other areas,	Table 3-2 Chapter 4, §4.6 Chapter 4, §4.7 Chapter 4, §4.8

3.10 Chapter Summary

This chapter can be summarised as the planning and designing of how this research would be carried out. It has provided a comprehensive roadmap guided by five stages illustrated in Figure 3-2: Research process. This process stresses the importance of a theory-driven empirical research. OIPT as a lens is utilised for defining case study questions, data collection, data evaluation and interpretation of the findings. The next chapter will discuss the conduct of the case study focusing on Table 3-5: Selected case study items.

Chapter 4
Research Cases and Findings

4.0 Chapter Introduction

This chapter discusses how the case study was carried out. It presents the empirical evidence for defining the IITS process; phenomena attributed to it and research hypothesis. Case descriptions summarise core elements of the five projects selected for study (§4.1). The case study design is described covering the decisions taken in the investigation (§4.2). This is followed by descriptions of the conduct of the case study (§4.3) divided into macro and micro perspectives: data collection (§4.4); data analysis (§4.5, §4.6); case study interpretations (§4.7), case study closure (§4.8) and case study conclusions (§4.9). A chapter summation is in §4.10.

4.1 Case Descriptions

The five projects examined in this research were chosen from two domains, GIITS and SES (see Table 3-5). The design of the case study began with a review of each proposal for the five projects chosen for study. The results of this review are interpretative case descriptions that also give generic concepts of the foundations of standardisation applied to develop the scope of the case study. As a matter of fact, without these case descriptions, it would be difficult to develop appropriate case study units of analysis and contexts to which data collection would be referenced.

4.1.1 Project ISO 10646-1

The ISO committee, JTC 1 SC 2 on character sets was assigned to develop project ISO 10646-1. The concept of character sets is that software programs and data need to be encoded before they can be processed by IT systems. According to Bemer (1972) and Mackenzie (1980), history of character sets standards that is linked to project 10646-1 dates back in the 1870's with telegraph technology alphabet codes, followed by 'QWERTY' typewriters and typesetting character sets.

Years of debate resulted in 6-bit and 7-bit codes character sets standards. The American Standard Code for Information Interchange (ASCII), for example, is a 7-bit code character sets standard representing text in computers and transfer of data communication devices. ISO 8-bit codes of 'alphabet standards', such as ISO 8859-1 to 15 followed in succession as compatible extensions of ASCII (cf. Sheldon, 1991).

They offer a prime set for character sets useful for data processing, exchange of both numerical and textual data covering a variety of alphabets for languages, such as Latin/Arabic, Latin/Cyrillic, English and French. HTML and XML are more recent example character sets extensions for Internet applications (http://www.w3.org/Consortium/). Against this history, the case descriptions developed from the reviewed project proposal of ISO 10646-1 yielded a wide range of interesting aspects to demonstrate preparations for project development. They are technology improvement, competing projects, multi-vendor considerations, adoption and commercial interest in the project.

Technology improvement: ISO 10646-1 project proposal suggested improvement on the ASCII 7-bit codes and 8-bit code character sets of ISO 8859. Historically, ASCII characters were mostly applicable to computers manufactured in the USA. Computers made in the EU were based on ISO 646, 7-bit coded character sets and ISO 8859 with extensions for storing national language text variants covered in standards (cf. Mackenzie, 1980; Bemer, 1972; http://www.ecma-international.org/). The proposed improvement on project ISO 10646-1 was the need for additional character sets, language variants and symbols not covered by ASCII or alphabet standards mentioned above. Extended ASCII character sets would allow text and scripts to be encoded in different languages besides English.

Competing standard: At the time of this proposal Unicode Consortium had embarked on its research on a competing *de facto* standard (also known as Unicode) with similar goals to project ISO 10646-1 (cf. http://unicode.org/history/). The differences in the conceptualisation of the project goals caused disagreements within ISO JTC 1 SC 2 assigned with project ISO 10646-1. Unicode Consortia defined its project goals as: to avoid the use of computer-style control functions, such as escape sequences for switching planes of character sets and, to limit the character space to 16 bits (up to maximum of 65,536 characters). ISO JTC 1 SC 2, on the other hand, suggested a universal coded character set (UCS) mapped on to a 16-32 bit multilingual plane (up to may be 4 million characters) and escape sequences to switch between large planes of characters.

Multi-vendor considerations: The extension of well-established character sets standards to ISO 10646-1 depended upon compatibility of various applicable base concepts and technologies across market segments. The competing design goals of projects ISO 10646-1 and Unicode suggested incompatible product attributes that would not fit into a multi-vendor market for hardware, software and *defacto* operating systems environments. Gabel (1987) classifies compatibility of systems as a multi-dimensional product attribute, with each attribute assuming one of several levels that would impact on standardisation. Agreement to attempt to unify the scope of projects ISO 10646-1 and Unicode was an important issue for compatibility. JTC 1 SC 2 had to ensure multi-vendor compatibility for project ISO 10646-1 (§5.6.2). In so doing, the published standard would have product compatibility within a positive network with other technologies for its implementation (cf. Besen and Farrell, 1994; Farrell and Saloner, 1987; Gabel, 1991). However, the ISO 10646-1 proposed improvement on character sets and their theoretical product attributes were not to outweigh the advantages of multi-vendor compatibility hence.

Perceived problems: A major task for both projects ISO 10646-1 and Unicode was the identification of perceived problems of competing standards and product-line incompatible attributes. Another pressing issue was the perceived difficulty to develop character sets fitting the scope of the proposed ISO 10646-1 within a single project development cycle. On behalf of JTC 1 SC 2, ISO adopted well-established coding and character encoding (or character sets) concepts from three categories depicted in **Table 4-1.**

Table 4-1: Adopted items of project ISO 10646-1
(Source: complied by author from case study notes)

Adoption category	Features
[1] Base standards	Encoding attributes, syntax definitions and terminology providing a basis for resolving competing elements identified for project ISO 10646 and for extending proposed technology from: [a] ASCII 7-bit and 8-bit coded character sets developed within the user group ECMA, in collaboration of JTC 1 SC 2 [b] Base requirements of systems functions on the configuration of character sets, encoding layers and the syntax definition of the set of rules for language forms
[2] *De facto* solutions	Unicode draft concepts and documents (R & D results)
[3] Voluntary standards	[a] ANSI X3.159 (1989), Programming languages C [b] ISO 646 (1991), 7-bit coded character set [c] ISO 2022 (1987): 7-bit and 8-bit environments, defines standard escape sequences to allow switching between sets; supporting computer-style control functions and terminology used in describing character sets [d] Suite of ISO 6937 and ISO 8859 standards: character sets for several languages and their encoding systems

Interest in the project: Interest that propels IITS project development usually originates from industry and markets. Computing firms that later became major stakeholders and sponsors of project ISO 10646-1 also had vested interest in Unicode project. The firms represented multi-vendor and product compatibility attributes suggested in Gabel (1987): *Hardware firms*, such as Apple Computers, Compaq (then Digital), Hewlett Packard, IBM International, Intel, Microsoft Corporation, NeXT and Sun Microsystems. *Software firms*, such as Microsoft Corporation and Unicode Consortia provided operating systems and programming environments. Because of commercial participation of dominant computing firms, project ISO 10646 gained as input, *de facto* concepts, privileged information of expertise and R & D results. Base technologies involving hardware systems and programming environment offered multi-vendor product-line compatibility and complementary applications.

To summarise, ISO 10646-1 (1993) was published as a **generic standard** describing Scripts that can be implemented in programming languages, operating systems and Internet environments. The Microsoft Windows Environment, for example, adopted ISO 10646-1 multilingual texts and character sets, such as Unicode Character Maps consisting of Arabic, Latin, Hebrew and Greek Scripts. In addition, the 32-bit multi-lingual plane defined in ISO 10646-1 became the standard for financial Telerate trading room power workstations used across Dow Jones sites (Telerate Update, 1996).

4.1.2 Multimedia Standards Projects

Two other GIITS projects are ISO 10918 (JPEG-1) and ISO 11171 (MPEG -1) also known as 'multimedia standards'. The projects originated from ISO JTC 1 SC 2 in the development of 7-bit and 8-code character sets standards, to include various research efforts that began in the early 1980s within ITU-T and ITU-R groups. When coding techniques matured, a need for multimedia technologies emerged. The projects were assigned to ISO JTC 1 SC 29, established in 1988, in four main WGs: WG 9 (JPEG); WG 10 (JBIG), WG 11 (MPEG) and WG 12 (MHEG). The WG identities also became acronyms for SC 29 projects. SC29 WG 9 and W10 are now combined to form WG 1 responsible for both JPEG and JBIG standards (http://www.jpeg.org/).

Other relevant history for JPEG-1 and MPEG-1 committees can be found in Hudson *et al.* (1988); Pennebaker and Mitchell (1993); Taubman and Marcellin (2002); Wallace (1992). At the first SC 29 plenary (JTC 1 SC 29 N067, 1991); multimedia and hypermedia standards were defined according to the subject matters depicted in **Table 4-2** (cf. Hudson *et al.* 1988; Yasuda, 1989).

Table 4-2: Subject matters for multimedia standards projects
(Source: complied by author from case study notes)

Subject matter	Description
[1] Scope:	Algorithm proposals, subjective tests, system packages and implementations for the applications. Encoding for representation of multimedia and hypermedia information objects
[2] Methods:	Data compression methods and techniques used to transform digital data into equivalent compressed representations
[3] Requirements:	Image and information interchange requirements within and across applications and services such as telecommunications and broadcast networks
[4] Applications:	Product development, R & D activities including microchips and systems aspects

[1] Project JPEG-1 (ISO 10918)

Central to the direction of project JPEG-1 was the proposal for the development of requirements and guidelines for data compression methods and techniques to transform digital data into equivalent compressed representations, such as digital data, images and pictures.

Data and image compression were considered important to improve processing and exchanges within and across applications and services, such as telecommunications and broadcast networks. As an anticipated component of multimedia technology, R & D activities were proposed among different computing companies for the definition of algorithm proposals, compression methods, requirements and the JPEG-1 standard.

[2] Project MPEG-1 (ISO 11172, Parts 1-5)

This project focused on compression techniques for coding audio-visual signals and information onto digital storage media, such as compact storage (CD-ROM discs). The initial target application parameters were confined to digital storage media. From the project proposals MPEG-1 standards were scoped to be generic.

4.1.3 Summary of Project Aspects JPEG-1 and MPEG-1

Additional aspects of interest for these two projects involved, adoption of *de jure* standards, core technologies, induced multi-vendor dimensions, IITS R & D policies and success of the standards.

[1] Adoption

ISO adopted ITU *de jure* specifications to propose coding techniques in the development of both JPEG-1 and MPEG-1. The adopted specifications involved Recommendations H.120 (1989) and H.261 (1988). Although the techniques employed in both projects were similar to those in the ITU-T Recommendations, the adopted aspects were revised, to take into account explanatory constructs showing how well selected approaches satisfy the objectives a particular project.

[2] Core technologies

Both projects brought together core technologies with a wide range of subject matters covering photography, imaging, software, hardware, databases, broadcasting and telecommunications.

[3] Induced multi-vendor dimensions

Bringing together the core technologies mentioned above induced multi-vendor dimensions (Gabel, 1987) in the conceptualisation for both projects. MPEG-1 concept exploration and development in particular, were achieved through multi-vendor participation of dominant international firms of its core technologies. Multi-vendor dimensions that evolved through participation involved copyright patents, d*e facto* products, licenses and patents, techniques, privileged information and R & D environments.

Some of the stakeholder input products were eventually re-designed to take advantage of the standardisation proposals derived from JPEG-1 and MPEG-1 projects. When the standards were published, some of the patents were made available to global IT markets, for adoption optionally. According to Axelrod (1997) and West (2003), multi-vendor standards often attract such a critical mass of vendor support that any competing standard is suppressed. Vendor views of the technology impose on the market a single standard upon buyers and sellers.

[4] R & D policies

Prior to these projects, international standardisation policies did not allow 'open' utilisation of private R & D environments (see §3.6.3, item [3]). When ISO and IEC policies were later modified to favour JPEG and MPEG projects, R & D activities became core components of voluntary standardisation processes. ISO and IEC acknowledged special R & D contracts, lucrative patents and IPR that were listed in MPEG-1 and subsequent series of other MPEG standards.

[5] Success of the standards

The published standards have proved to be a success with widespread digital multimedia systems and applications for multi-vendor markets. JPEG-1 (1994) and the suite of MPEG-1 (1993) international standards are now widely implemented in the development of computing systems and applications that provide capabilities to transmit digital data and pictures over telecommunication lines.

[a] **JPEG-1** standard have shown its applications in photographic images; compression of Internet digital interactive images; Internet library storage including multimedia CD-ROMS (cf. Lesk, 1997; Wactlar *et al.* 1996).

[b] **MPEG-1** standard has been adapted to develop what is now known as the multimedia industry: video-conferencing; entertainment technologies; interactive video and sound on the Internet (cf. Chiariglione, 1998; Schäfer and Sikora, 1994). Interactive moving images and motion pictures and digital video storage devices (DVD) followed in succession with the publication of MPEG-2 and MPEG-3 international standards (Chiariglione, 1998).

4.1.4 SES Projects

Two SES projects were chosen from different two forums, because of their coinciding subject matters on the standardisation of software development life cycle processes (SDLCP). Project IEEE 1074 was assigned to IEEE WG 1074 in the IEEE Computer Society on SES. Project ISO 12207-1 was developed in ISO JTC 1 SC 7 (see Table 3-5: Selected case study item).

[1] Project IEEE 1074

Information gathering for the proposal of project IEEE 1074 began in August 1984. The initial standard IEEE 1074 (1991) was published and withdrawn. Further work was requisitioned as necessary to provide software organisations, large or small, and software engineers with the application of recommended software life cycle processes, SLCP (cf. Schultz and Godin, 1991).

Prior to submitting the project proposal for project IEEE P1074, the IEEE Computer Society on SES set up a study group. It was assigned to survey organisations within the USA that developed software products in line with specified SLCP agreed in the committee. After evaluating the information gathered from the surveys, in two separate meetings, IEEE WG 1074 defined the objectives shown in **Table 4-3** to guide the development of project IEEE 1074 to successful completion.

A decision was then made to develop a standard that offered recommendations of procedures and requirements to be fulfilled by sets of SLCP. The procedures and requirements were expected to be *mandatory* for the development and maintenance of software products. Hence, SLCP was this committee's preference for a software development process focusing on a how the life cycle for the software products would be implemented in an organisation. Reference to software development was omitted from the objectives and project scope, because this would have covered a diverse body of software development process methodologies.

[2] Project ISO 12207-1

This project was approved for development in 1991. ISO assigned the project to JTC 1 SC 7 WG 8. The proposal was a response to a survey on industry guidelines on the need for SDLCP and the management of the SLCP. The survey was initiated in the UK through a coalition of a DTI and BSI project on organisation-based SDLC processes. The scope of the proposal for project ISO 12207-1 focused on the management perspectives of specified processes, excluding maintenance of software.

Table 4-3: Objectives of SES projects
(Source: complied by author from case study notes)

Project IEEE 1074 obligations:

Target: Professional standard for commercial organisations engaged in software development, manufacturers of the products and software engineers.

Objectives:

[1] **To produce a generic process standard for developing SLC processes:**

[a] The standard has the potential to be implemented in any software development life cycle.
[b] The standard will not be modelled on any existing SLC processes.
[c] The standard will be consistent with any SLC model and project organisation.

[2] **To produce a process standard for ordering and mapping the activities.**

[a] The user would be required to order and map the activities against the selected SLC model in order to develop a time-ordered life cycle.
[b] The standard will not address a particular SLC model
[c] The standard can include measurable requirements guiding mapping of SDLC.

Project ISO 12207-1 obligations:

Target: Voluntary standard for the interest of all covering organisations engaged in software development

Objectives:

To produce a generic international IT standard of guidelines for SDLC processes:

[a] Development of guidelines for the management SDLC processes, to include exemplar models.
[b] The standard will be consistent with any SLC model and project organisation.
[c] The standard will support methods and tools necessary for SDLC processes.

The subject matters for these two SES project proposals were similar, potentially creating competing and incompatible standards for the SE sector. The two forums, the IEEE Computer Society on SES and JTC 1 SC 7 argued their obligations to the independent project proposals shown in Table 4-3. In view of the coinciding topics, ANSI, as the secretariat to ISO JTC 1 set up a Technical Advisory Group (TAG) as an 'intervening platform' to deal with the relatedness of the subject matters for these projects. TAG functions under the IEEE and it co-ordinate with JTC 1 SC 7 in all subject matters. The membership in TAG is however, still specifically reserved to USA nationals.

Although both standards IEEE 10974 (1998) and ISO 12207-1 (1995) have been accepted and adopted widely, they created some controversy, inside and outside, the IITS community. IEEE 1074 is positioned in the professional arena as a standard for organisations and for software engineers. A Guide to IEEE 1074.1 (1995, 1998) was also developed to 'translate' how an organisation can develop its SLC processes alongside the specifications in IEEE 1074 (1998). Advocates for ISO 12207-1 have provided ISO with significant pressure to either replace it or that it should include software process assessment models in line with ISO 15504-1 to -9 (1996).

4.2 Case Study Design

4.2.1 Conceptualisation of Study

According to Blumer (1986) and Lofland and Lofland (1995) the angles from which to build the analysis are sensitising concepts of the research question posed (§3.2.6) and review of the selected case (§4.1). Sensitising concepts gives direction to the researcher some important aspects of research situations or items. Blumer (1986) also cautions that, sensitising concepts can lead to inadequate level of focus or analysis. Instead, definitive concepts provide prescriptions of what can be considered in the case study.

As a framework for sensitising and understanding definitive concepts, the case descriptions described in §4.1 clearly indicate the five projects as be highly technical. They are developed in social contexts involving forums, committees and secretariats as settings. These settings create dynamic interplay of human activity, practices, processes, procedures and performance, over time. Sensitising of concepts leads to the definition of the project content: for example, details of their subject matters which are important to understand *what exists*. In addition, project development issues determined from the project content helps to define elements of perspectives and context. For example, *how* projects would be developed (perspective) and, collaboration and information sharing among developers (contexts).

4.2.2 Project Concepts

Through sensitising, definitive concepts that frame the case study were established as core elements, project development stages and committee project development phases.

Core elements determined from the case descriptions (§4.1) helped to summarise 'what each project would be concerned with'. The core elements covered the proposed content of the project; its development perspectives; standardisation attributes and specific contexts that stimulate the line of investigation. These elements were important to the formulation of relevant case study questions and items that could be examined to build constructive empirical evidence.

Conceptual project development stages were established from SDO directives (http://www.iso.org/directives; http://standards.ieee.org/). In addition, reviewed models such as Cargill (1989) and Reilly (1994), provided well-established IITS concepts for framing project development stages (see Table 2-5: Example IT standardisation models and stages). Combined results revealed **five stages** akin to an evolutionary project development approach to the development: project proposal, committee study and discussion of project, consensus (ballots), documentation of draft standards and publication IT standard.

Committee project development phases: Reviewed committee documents for each project reviewed phases appropriate for addressing technical details and for characterising the content of project development. The committee utilised these phases to also define the methodological basis upon which standardisation actions would be achieved, based upon agreed project subject matters and objectives. JPEG committee, for example, defined a project phase for the development of baseline methods for 'lossy' coding of images addressed in the standard (Wallace, 1992).

Project IEEE 1074 defined 'a survey phase' for gathering data on SCLP from organisations engaged in software development. In these committees agreed project subject matters and project phases provided an accurate body of knowledge upon which guide data gathering, and for determining the chapters of the proposed standard.

4.2.3 Project Development Perspectives

Project development stages and phases that are clearly independent from each other have potential disadvantages of ambiguity over various levels of data collection and detached observations. Whereas, perspectives contain context and themes underpinning project development dynamics. These perspectives were likely to build interrelationship in the data collection and in shaping meaning located in the evidence.

Project development perspectives were determined to provide an explicit link between the stages and phases hence. Reviewed literatures (such as, Madhavji, 1991; Hodges *et al.* 1989; Stevens and Scheffer, 1993; Humphrey, 1989) provided key concepts of perspectives that would be located in the project development. **Figure 4-1** shows the result of linking the stages and phases. It is a schema of five perspectives illuminating the different angles from which project development needs to be investigated to also bring out representative aspects in the findings. The summary of the perspectives is as follows:

[A] **Global perspective** represents the structure of the predetermined project development involving five stages, from the proposal of the project to the publication of the IIT standard (cf. Ngosi and Jenkins, 1993).

[B] **Internal perspective of project development cycle (PDC)** demonstrates five levels and their properties associated with a typical SLC process determined from Humphrey (1989) and Madhavji (1991). The five levels are also akin to representations of standards project development and committee performance contexts: technical core of project development; technical development; knowledge and tasks; human activity and methods of working; and, control procedures.
In this internal perspective, committees could not be examined adequately without due attention to well-established concepts for translating performance and practices (such as Baron *et al.* 1992; Hoffman, 1979; Hackman, 1969, 1976; McGrath, 1984; McGrath *et al.* 1993). Similarities in the identified committee performance constructs and those of concept for translating to the attributes of the internal perspective of PDC (levels 1 to 5) therefore, provided the focus to examine more specific items relevant to all five projects.

[C] Standardisation approaches are pivotal to the development of each project covering scientific methods and industry practices. Data gathered from committee actions would thus give details of the development methodology tailored for each project.

[D] **Sub-levels** indicate that IITS project development has the intensity of both technical and social elements for which data would be gathered. In addition, each project development stage progresses concomitantly with other elements from the functioning of committees, secretariats, forums and standardisation actions. These additional elements may have separate meanings hence.

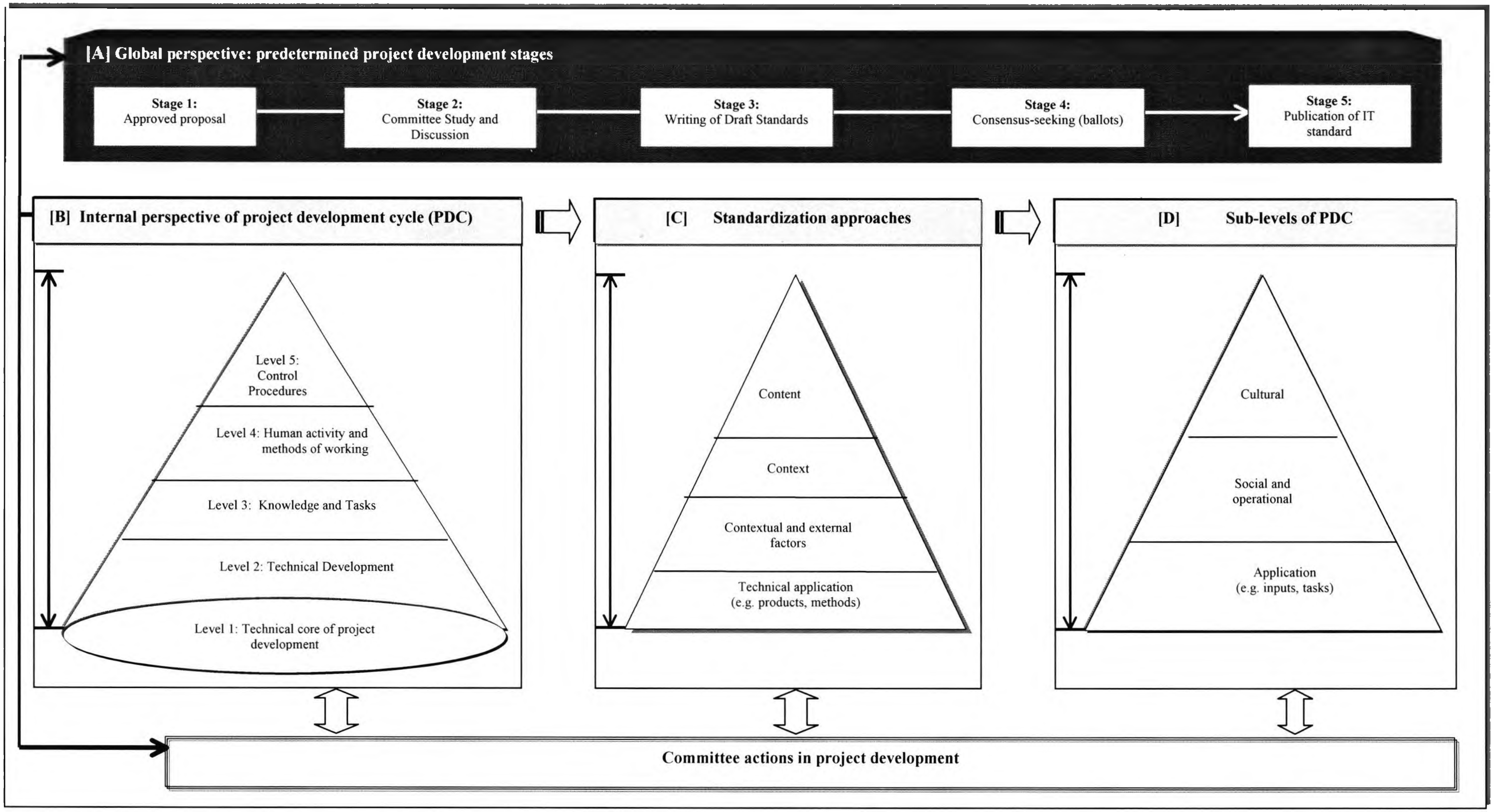


Figure 4-1: Schema of project development perspectives
(Source: compiled by author and adaptations from Madhavji, 1991; Humphrey, 1989)

Typically, mutual co-operation of developers, stakeholders and nations in the project gives *cultural* meaning (or an identity) upon which IITS actions and practices are based. Committee performance has *social contexts* drawing attention to human activity and methods of working. These sub-levels would therefore add a basis for theorising from the data gathered cross the difference project development stages. In doing so, the identity of the elements (such as social and technical), their embeddedness and meanings can be defined in relationship to each project development stage, rather than linear explanations that do not challenge dynamics of committee performance.

[E] The links between the separate aspects of this schema in Figure 4-1 are the *reality* of committee actions and of project development sought in data collection. In line with Flick (1998) and Robson (2002) evaluated case study findings would then, yield concise interpretive facts from which to establish representative viewpoints of constructed empirical reality that exists in the areas we examined.

4.2.4 Focus of Case Study

Predetermined project development stages, phases and perspectives possess characteristics to focus of the case study. The items taken from the research roadmap (see §3.4, §3.6, §3.8) to frame the case study involved: case description, concurrent investigation, project development stages, qualitative longitudinal study, data collection and analysis and case study operational plan.

Separately, the detailed **case description** for each projects (§4.1) facilitated the study through data collection, data analysis and case narration, subsequently (cf. Patton, 1990; Strauss and Corbin, 1998).

This researcher decided upon a **concurrent investigation** to save effort. The parts forming the case study, namely projects, committees, forums and secretariats were examined exclusively, ensuring specificity in the issues that make them unique. Furthermore, this concurrent approach provided a basis for examining similar case study items, using the same questions and ultimately, linking the findings.

Project development stages represented SDO procedural formality that all committees, forums and secretariats adhered to (see §4.2.2). As such, the 'global perspective' (Figure 4-1) were used as the formal stages for controlled observation and for ensuring that specified case study items were addressed according to the SDO formalities that could also be verified. Whereas, project development phases were open to interpretations of how the committees intended to develop their projects (§4.2.2). These phases would be meaningful only when specified case study items being examined were treated in association with relevant issues for the formal project development stages.

A qualitative longitudinal study is the preference, because it is time-dependent. As a convenient matter, each project evolves through a sequence of development stages that are also time-dependent. Another advantage is the fact that project development stage time scales happen to be considerably lengthy, from 6 to 30 months. This longitudinal study had the advantage of comprehensiveness bearing upon the following elements:

[a] The project development stage time scale **permitted the control** of the combined exercises. This researcher was able to conduct in depth time-based data collection, data analyses and refinement of findings, concomitantly, across a number of levels of contexts in each stage. The duration of each project development stage concluded the data collection.

[b] Time-dependent data collection and data analysis **instilled repeatability** of the approaches used across the different parts of the case study. Repeatability of data collection and data analysis approaches was useful for characterising knowledge production as the stages evolved. In turn, when knowledge generated from one project development stage was relevant, it facilitated further development in follow-in stages with attention to build empirical evidence incrementally.

[c] The project development stage time scale allowed this researcher to **account for actions,** notably: defining the stage, what could be examined, which findings could be refined and at what time.

A case study operational plan (Appendix 2) defined the items selected for study. The items fitted the profile of the core elements of each project and predetermined project development stages (see §3.6.5). **Appendix 3** (Integration for framing of study of projects) illustrates how the core elements were integrated, primarily, to prepare for longitudinal data collection. Items selected from the case study operational plan for which data were collected were then mapped to the project development stages, in relationship with the core elements of each project and PDC perspectives depicted in Figure 4-1 [A]; [B]. Further integration, after data analysis, was fundamental for deciding upon the items to guide data collection and for evidence building in follow-up project development stages.

4.2.5 Case Study Objectives

Four objectives that guided the case study were established as follows:

[1] To demonstrate how the five projects are developed, in such a way that the case study items and questions posed, become the focus of attention in the data collection.

[2] To create adequate case material for inductive analysis and for building empirical evidence relevant to answer both the research and case study questions.

[3] To develop themes demonstrating knowledge and understanding of the case evidence.

[4] To establish the research hypothesis, IITS process and phenomena of interest.

4.2.6 Case Definition and Questions

A useful framework for deciding upon case study questions was to first define the 'case', followed by the 'assumptions' of the case (cf. Stake, 1995; Yin, 2003). In so doing, understand the elements of the investigation to be questioned.

Project development is the case. It is examined from two classes of standards, namely GIITS and SES. The links in the investigation cover three cardinal aspects, namely committees, forums and secretariats and standardisation actions.

[a] **Committees** develop the projects. The assumption underpinning the case study was that, circumstances in which each committee executed each project would strongly influence data collection linked at *micro levels* and across embedded layers of contexts.

[c] **Forums and secretariats** present the *macro level* providing operational support to committees in line with SDO formalities.

[b] Project development covers **principles of standardisation** actions. These principles draw attention to more *micro levels and embedded contexts*: for example, information, processes, scientific practices and tasks.

The case study aimed to answer five questions presented in **Table 4-4**. Selected features of the OIPT as a lens were applied to design these questions, thereby strengthening the researcher's choice for a theory-driven methodology. In addition, questions bearing on the OIPT as a lens satisfied the requirements for specificity, theoretical focus, theorising flexibility in knowledge production processes and in creating meaning in the data gathered (§3.6.6; Lofland and Lofland, 1984, 1995; Flick 1998).

Table 4-4: Case study questions
(Source: compiled by author)

Research Question: Why does it take 6 to 7 years to complete the development of a international IT standards project, when the scope of standardisation appears to exhibit unique opportunities, such as an international forum with numerous experts; commercial stakeholders; information resources and global interests?	
[1]	What is the typical development cycle for the selected projects and its characteristic features?
[2]	How is each project developed to create an international IT standard?
[3]	Which perspectives explicate circumstances of committee performance of standardisation actions
[4]	Which features can be accepted as the 'true' explanation of the core dimensions of the IITS process?
[5]	Which key factors explain phenomena associated with how the projects are developed?

4.2.7 Scope of Case Study and Methodology

The study involved both intense projects and information-rich project development stages. The scope of this case study is suited to inductive data collection (§4.3, §4.4) using varied approaches (§3.8.3) and inductive data analysis (§4.6). Relevant methodological underpinnings of the case study from the research process roadmap are positivist strategy, multiple case study, paradigms and inductive data analysis.

First, the case study strategy is **positivist** in line with methods established in other key scholarly works covering Benbasat *et al.* (1987), Eisenhardt (1989), Lee (1989) and Yin (1994, 2003).

Second, a **multiple case study approach** was chosen to adequately investigate the perceived broad and complex phenomenon of IITS. Project development stages, committees, forums and secretariats are studied as **settings** that are information-rich with competing subjective phenomena. A concurrent investigation approach adds depth in understanding the issues connected to them, details specific to the items under study and accounting for phenomenon attributed to IITS efforts. The research question suggests the need for understanding **across** the project development stages, and **within** the various layers of contexts of specified perspectives.

Third, the essential links between the case study objectives and its positivist strategy are its ontology and epistemology paradigmatic viewpoints.

[a] **Ontology:** A positivist strategy is the basis for exclusive study of each project to capture reality of its development through similar stages and toward theory building. The natural social settings of the committee help to address the *reality* of project development as the stages evolve, over time (Pettigrew, 1997, 2001; Yin, 1994, 2003). This combination is a fertile ground for generating theories (cf. Benbasat *et al.*, 1987). Details of project development are unified into broader theories forming the basis for defining understanding and defining of the phenomena of interest.

[b] **Epistemology:** A qualitative longitudinal study (§4.2.4) was relevant to encourage inductive investigation, where a perceived phenomenon happens to be ambiguous. The epistemology of the longitudinal approach is it strength in selectivity of data collection and processes of knowledge production leading to understanding the reality of projects: such as, committee actions in contexts embracing the dynamic interplay of practices embedded of performance. At the same time, case study questions as instruments of data collection give attention understanding an array of factors at different time-dependent project development stages.

Inductive analysis performed on the qualitative data gathered helped to differentiate understanding of project development, so as to develop the unity that underlies the findings: such as, features of individual items and, patterns and relationships among them (cf. Patton, 2002). More so, the unity demonstrated in the findings was achieved through answering the case study questions, from which the research theory and phenomena were established.

4.2.8 Boundary Considerations

Table 4-5 next, contains a summary of how the boundaries of the case study were determined to decide upon the units of analysis and the questions that guided the investigation.

Table 4-5: Framing of case study boundaries
(Source: compiled by author)

Framing questions	Boundary and considerations
[1] What is the case?	Project development of GIITS and SES.
[2] What is inside the area of study and case?	- SES situations: SES forums, committees. - SES settings: project development stages & processes.
[3] What matters are inside the area of study?	- Factors that influence performance: e.g. communication; committee actions; information; processes practices,; standardisation approaches.
[4] What is outside the boundary of study?	- Current environment & generic international IT standards development &
[5] What crosses between two or more stated boundaries?	- Contextual factors contributing to, or, evolving from the activities e.g. project inputs, participation, events, time.
[6] What are the other boundary considerations internal or external to SES processes?	- Environment settings e.g. secretariats & operational practices.

4.2.9 Specification of Units of Analysis

Table 4-6 addresses the units of analysis. A summary of how they are applied in the case study follows.

Table 4-6: Case study units of analysis
(Source: compiled by author)

Units of analysis:
[1] Committees. [2] Project development stages and perspectives.

Perspective	Sub-units of analysis	Predetermined data range	Analytical questions [+ analytic dimensions of OIPT as a lens]
Macro	Global Environment Project forums (GIITS & SES) Secretariats (GIITS & SES)	IITS environment infrastructure Social construction Management Operational Actors and stakeholders Technology and uses	*What* features? *Which* groups? *Which* contexts of IITS? *How and why* are the features linked to project development?
	Committees (GIITS & SES)	**[* Schema of project development perspectives]** Committee structures Content of committee performance Representation and participation Context of committee performance	*How* are IITS contexts linked to project development? *What do* IITS contexts mean to project development?
Micro	Project Development stages [linked to committee actions]	**[* Schema of project development perspectives]** Global content Content of project development stage Technical content Operational content Social context Embedded contexts Emergent contexts	*What* are the core elements of the project & its proposed stages? *What* are the specific elements of each stage? *How* is the project developed at each stage? *How* do embedded items evolve? *How and why* are they connected to the principles of project development?
Study parameters	committee functionality, committee activities, project development events, processes, difficulties and outcomes		

[1] Units of analysis

There are two main units of analysis: Committees and project development stages, and their perspectives. Macro and micro perspectives are adapted from the analytical levels of the OIPT as a lens (Appendix 1: Methodological considerations).

[2] Perspectives of units of analysis

They represent the strategy of the investigation of the case, namely project development.

[3] Sub-units of analysis

They framed to acknowledge 'what is to be investigated' from macro and micro perspectives. Guha *et al.* (1997) and Miles and Huberman (1994) indicate that sub-units will often have embedded contexts. Questions guiding data collection provide control in fact-finding elements. Epistemologically, embedded contexts would be determined from evaluated case findings representing understanding of their meaning hence.

[4] Sampling parameters

Each project development stage has different issues and contexts. Thus, sampling parameters are specified to take account the subject matters of a particular stage. Example sampling parameters for macro perspective are settings, project inputs, project tasks, events and processes.

[5] Predetermined data range

For the sub-units of analysis, this researcher uses a predetermined data range (Robson, 1993, 2002). Explicit aims of a data range in this investigation are the following:

[a] To summarise the conceptual view of all types of **perceived phenomena** depicted in Table 3-1 to which the case study was referenced.

[b] To draw attention to the **contexts** of the sampling parameters of the project development stage for which data should be collected.

[c] **To save time** in transcribing and integrating case material to computer files. The same data range applied in data collection can be utilised to categorise the findings from data analysis. The structuring of the findings in computer files is reduced immensely hence.

[6] Analytical dimensions

Analytical questions (Table 4-6) proved valuable in data gathering exercises through questionnaires. They addressed fact-finding and epistemological underpinnings of the case study across multiple levels of analysis. Separately, **analytical dimensions** devised from OIPT as a lens provided some rational principle for the classification of questionnaire responses. Because of the intensity of the projects examined and the diversity of the data gathered from the case study, classifications developed the interconnectedness of individual elements demonstrated in the findings to then, define how they could be analysed.

4.3 Conduct of the Case Study

This section describes **how** the case study was carried out with reference to units of analysis. Emphasis was placed on data collection covering macro and micro perspectives in the treatment of specified items.

4.3.1 Macro Perspective Data Collection

This macro perspective (§3.3.4) is akin to the IITS environment. It provides an infrastructure in which projects are developed. Data collection in this macro perspective covered concurrent questionnaire surveys to define the IITS environment, namely organisations, forums, secretariats and committees.

4.3.2 Global IITS Environment Data Collection

As a background to the data collection exercise, the theoretical framework (§2.9.5, Guideline [4]) proposed the need to understand the IITS environment as a frame of reference for judgement of its current state. Another reason for collecting data about the

IITS environment focused on the solution proposal (§3.5). Fundamentally, the reconstruction of the IITS process within a CBD framework would create autonomy for project development. Thus, the IITS environment as an infrastructure needed to be questioned to establish the highest level of abstraction connecting it how IITS projects were developed.

[1] Focus groups and assumption

The data collection began with an **exploratory study** (§3.2.1). An important result of this study is **a schematic definition** of the core elements of the IITS environment (Figure 3-3). The questionnaire surveys that followed this exploratory study were based upon informed understanding of the IITS environment, from which the SDOs and NSBs were selected as **focus groups**.

The underpinning assumption for this global IITS environment survey was that, SDOs and NSBs were familiar with strategic and functional practices of project development presented to them through questionnaires. SDO and NSBs survey candidates would help to clarify terminology about IITS environment issues. The data collection focused on three aspects:

[a] Verification of specified results from the exploratory study. In particular, clarifying terminology about IITS environment functional structures, practices and strategies, which presented difficulty in their definition from reviewed body of standards literature.

[b] Describing how SDOs or NSBs functioned, to include experience-related definition of their functional independence, interrelationships and responsibilities impacting on project development.

[c] Describing IITS environment operational matters, such as processes, project development, project management and stakeholders.

[2] Questionnaire surveys

The focus of the survey was **research goal #1** (Figure 1-3):

> To examine the environment in which IIT standards are developed, describing critically, its representations of functioning

In total, two surveys were carried out using three structured questionnaires covering items specifies in the operational plan (see Appendix 2: Case study operational plan). The surveys focused on detailed refinement of the data collected on IITS environment strategies, functions, practices, operational content and terminology.

In the first survey, a policy Delphi approach was relevant to generate a large sample of experience-related views that would aid verification of the assembled information (cf. Turoff, 1975, 1989). The survey sample was intentionally large to cover as many organisations as possible that would offer a representative global view of IITS environment. The sample covered 5 major SDOs (CEN and CENELEC, IEEE, IEC, ISO and ITU) and 25 NSBs identified as also actively in the projects selected for study, such as Canada, France, Germany, Italy, Japan, Switzerland, United Kingdom and United States. The questionnaires provided a checklist of items with boxes for marking answers. Where necessary, the candidates were asked to indicate correct terminology for specified items that needed to be verified from the results of the exploratory study.

The second survey applied stratified random sampling (Robson, 1993, 2002). The constructs that applied involved variation in the data collection across the focus groups (see §3.8.2). Two separate questionnaires mailed to individuals identified from the policy Delphi survey mentioned above.

[a] **Category 1, environment level strategic group:** This involved 15 individuals from 5 SDOs. The first questionnaire requested survey candidates for strategic issues that SDO would be engaged in: for example, policies, management practices and operational budgets impacting on IITS project development.

[b] **Category 2, management teams from forums:** The second questionnaire included 20 individuals. Their responsibilities covered project technical officers, operations managers and programme managers selected from ISO JTC 1 and IEEE Computer Society on SES. This questionnaire requested information on the management of IITS projects, problems and technology currently in use to assist project development.

[3] Survey findings

The impact of the findings from both surveys was viewed from two perspectives: One, evaluated questionnaire responses from the policy Delphi survey produced more than adequate material that provided **explanatory verification** of checklist of items central to IITS environment as an infrastructure. For example, structures, functions and practices. Two, the stratified random sampling produced material that helped to develop **a global view of the IITS environment and its issues**, based upon the data range applied in the data gathering exercise.

To conclude this data collection, **a feedback survey** was conducted, providing survey candidates with categorised material. They were requested to indicate the most pressing issues assembled from the questionnaire responses. A scale of 1 to 5 was given to guide their responses: 1 (insignificant), 2 (low importance), 3 (medium importance), 4 (high importance and 5 (imperative). The results provided the means to consolidate appraised IITS environment items and the number issues attributed to them, as noted in the feedback survey responses. The results of this survey are in **Appendix 4**: Summary of classifications of feedback on global study items. The consolidated classifications were dependable, because they could also be linked to the items in the schematic model (Figure 3-3). Importantly, the survey candidates raised experience-related problematic issues concerning IITS project development: for example, information availability, out-of-date IS resources and cost of IITS activities.

4.3.3 Forums and Secretariats Data Collection

The selected projects were developed in two separate **forums,** which function as independent organisations: ISO JTC 1 and SES forum of the IEEE Computer of Society. **Secretariats** were assigned to manage committees and the development of the projects. Secretariats can be NSBs or private organisations (see Table 3-5: Selected case study items).

[1] Survey assumptions
In the scope of the systems approach that only applies here and not in this thesis, the IITS environment structure consists of **social organisations** (cf. Kast and Rosenzweig, 1987). The organisations are labelled as such, because they have **social phenomena** contrived by human activities, events and practices, rather than physical components. As suggested in Kast and Rosenzweig (1987), often, the boundaries of social organisations and the social phenomena connected to them are not easily definable.

The assumption that applies is to separate forums and secretariats from the IITS environment by collecting data that is only associated to them. This in turn, is guided by the researcher's decision about using the IITS environment as a framework for interpretation of its separated parts. This data about forums and secretariats develops empirical representations of their functional views, excluding areas adequately covered in the findings of the global IITS environment. These empirical representations would draw attention to only predominant relationships, similarities or differences in how of the forums and secretariats function within the IITS environment.

[2] Questionnaire surveys
A concurrent survey approach of the 2 forums and 5 secretariats mentioned in Table 3-5: ‘Selected case study items’ saved research effort. A predetermined data range (see Table 4-6: ‘Case study units of analysis’) applied in the global study of the IITS environment was repeated to ensure integration of the data gathered. The data collection approaches covered stratified random survey and semi semi-structured interviews, and documentary analysis.

A stratified random survey approach was carried out allowing small groups of individuals with similar responsibilities in the 2 forums and 5 secretariats to be surveyed together, using structured questionnaires A1 and A2 (**Appendix 4A).** Similar responsibilities provided a basis to compare questionnaire responses from the same sample. **For the two forums**, 20 individuals made up the survey population. They were divided into two groups, as follows:

[a] **Group A:** 12 senior executives and managers covering areas project development strategies, operations management and general functional practices.

[b] **Group B:** 8 technical managers, senior administration managers and support staff within ISO JTC 1 task force and, IEEE technical activities board and standards sections. The responsibilities for this category covered project management, standards development programs, technology operational matters and committee management.

The survey sample for the five secretariats involved 30 individuals. The focus groups had the following predetermined responsibility profiles:

[a] **Group A:** 15 individuals covering secretariat administration managers and support staff involved the data-to-day operations of the secretariats.

[b] **Group B:** 15 individuals involving committee chairpersons, secretariat managers. A secretariat would nominate a ‘manager’ to work with committee chairpersons and project editors.

Follow-up semi-structured interviews with a few selected individuals from the forums and secretariats helped clarification of contentious items. These items would be identified from questionnaire responses, because their terms of description would be ambiguous or the researcher could not decipher hand written answers to questions.

[3] Documentary analysis

This analysis focused on specific issues of the functioning of the forums and secretariats. Primary document sources were technical and administration managers in the two forums. For other document sources, this researcher acquired material distributed widely from the two forums for registered memberships. The document sources covered strategic plans, meeting reports from members, programs of work and operational budget plans. **Table 4-7** shows criteria for documentary analysis applied for forums and secretariats.

Initially, this researcher categorised assembled documents according to the their classifications mentioned above. This helped to identify the documents by predetermined IITS environment focus groups (such as SDO or NSBs) then, content, instructions, items for actions, which would be written each document as practice. Thereafter, selected documents were reviewed following these criteria in Table 4-7. A typical review selected topical functionality issues focusing strongly on the development of the five projects. For example, approved operational matters, ballot events and committee problems presented to SDOs for discussion and resolution. Other information, this researcher assembled from the case study field notes and evaluated questionnaire responses.

Table 4-7: Criteria for forum and secretariat documentary analysis
(Source: compiled by author based on Robson, 1993, Strauss and Corbin, 1990)

Classification of document	Criteria for documentary analysis and classification of material
[1] Operational: [actions for committee, business plans] [2] Operational reports: [new projects, ballot results] [3] Committee reports: [meeting minutes]	**Content:** - Document sources - Subjects of the document - Purpose of document regarding project actions or feedback - Intention of document in committee actions - Information input to document - Presentation of forum or secretariat results
[4] Committee chairman reports: [5] Committee project editors: [draft standards, editing meeting reports, comments to be resolved]	**Context questions:** - What is the size of document and how is it processed? - What kinds of instructions are repeated in operational documents? - What types of information do chairmen, project editors or secretariats request for say draft standards? - Which procedures are followed for document processing or transactions? - Who seems to have decision-making authority for committee information needs, actions or instructions? - Do the documents include details of operational performance? - How are ballot results processed and reported?

[4] Survey findings

The findings defined as empirical evidence were consolidated from predominant similarities in the functioning of forums and secretariats, as part of the IITS environment. This empirical evidence has greater explanatory power, which connected IITS environment functionality to the project development and to the IITS process, than perhaps a conception of the representative-ness in the relationships between them. This empirical evidence is covered in four parts, as follows:

[a] Table 6-1, protocols impacting on IITS environment functionality views.
[b] Table 6-2, IITS environment operational principles.
[c] Functional perspective of the organisations associated with the forums and secretariats (see §6.2)
[d] Operational issues impacting on project development, such as document preparations and operational information that were later examined within the content of IITS process complexity (see §6.6, §7.2).

4.3.4 Study of Committees

Five committees presenting the selected five projects were examined. The case descriptions for each project (§4.1) revealed that committees were likely present several data collection challenges, because of the fluctuations in their activities and highly specialised practices. In addition, findings from the global IITS environment suggested that besides directives for operational matters, there was no typical framework indicating how committees should perform.

The assumption applied in this study was adopted from Pettigrew (1997: 334) that, the understanding of how the five projects were developed needed to capture reality in flight by exploring the dynamic qualities of committee performance. Consequently, the study was characterised as ontological and inductive. **Ontology** involved observation of committees in their real life settings as the projects were being developed. The SES IEEE WG 1074 was the exception, because this group conducted its activities in the USA without a similar group based in the UK. However, this researcher established a contact point within this committee for the provision of documents and transcripts involving major events. **Inductive** involved intense longitudinal study of committee actions with findings translated in time and contexts of the predetermined project development stages for which data was collected.

4.3.5 Committee Data Gathering Framework

This framework has important themes underpinning the research goal #2 (Figure 1-3):

> To examine selected projects that can demonstrate the reality of how IIT standards are developed and the set of phenomena they represent with regard to the solution proposal.

The framework was designed from the basic fact that committee performance items would overlap across the five projects. This overlap is from using similar predetermined stages locating the development of all five projects (Figure 4-1: Schema of project development perspectives). Consequently, this data gathering framework pulled together specific subject matters of committee performance to maximise data gathering in line with questions under investigation. Issues addressed in this framework were included in the case study operational plans and questionnaires, subsequently.

[1] Project subject matters

The subject matters covered core elements of the project reviewed from committee project plans and included in the case description (§4.1). The data range in Table 4-6: 'Case study units of analysis' for the macro perspective of committee study items was determined from these subject matters. This data range provided a more appropriate focus drawing attention to the relationships between committee actions and the content of project development in the data collection exercise.

[2] Committee participation

Ethnography (fieldwork observations) was a central data collection approach in this committee study. The observation depended upon the material that the developers provided through questionnaires, semi-structured interviews or issues documented separately in field notes. Prior to designing the questionnaires, this researcher determined the number of developers registered as **active members** in the five committees. Active members were likely to participate throughout the project development life cycle, as such the data sources were assured. Material gathered from active members would be experience related data, as opposed to information assembled from reviewed literatures which give interpretative constructs of how committees perform (§2.3, §2.4).

[3] Committee representation profiles

The representation profiles suggested that all five committees often divided into small groups to adequately cover specified project subject matters. The developers would have varied levels of expertise or experience in specific project subject matters. In addition, experienced developers and stakeholders in the committee were more likely to provide the researcher with a rich set of data on different subject matters about the execution of the project, than say observers.

Against items [2 and [3] above, this researcher designed the survey approaches and questionnaires to fit more closely with the participation and representation profiles representation profiles across the five committees. For example, a policy Delphi survey approach was appropriate when posing questions to obtain a global view impacting on all five committees, for specified project subject matters or items. In contrast, a stratified random sampling approach focused only on one committee and its project development items.

[4] Meeting schedules

Committee meetings provided a convenient basis for event observations, taking field notes and clarifying evaluated questionnaire responses. Knowing the meeting schedules in advance therefore helped in planning face to face interviews or data collection.

[5] Concepts of performance

Concepts reviewed from relevant literatures guided ethnographic observations covering:

[a] S*ocial content* of committee performance: such as, consensus and interactions (McGrath, 1984; 1990), and stakeholder influences (Axelrod *et al.* 1988; Gabel, 1987, 1991; Leiss, 1995).

[b] *Technical content* addressing application of project information and standardisation actions.

[c] *Contrived contextual conditions* embedded in contexts of committee actions, such as project tasks, performance practices and decision-making.

[6] Concepts for translating

In framing this study, this researcher determined that some aspects of committee performance required depth in theorising the data gathered. Regrettably, when the data set is information rich, this theorising can introduce new assumptions risking the clarity of the evidence sought. To minimise this risk, **concepts of translating** offer robust analytical theorising, leading to **empirical meanings** located in the case evidence. Without these concepts for translation, the findings were mere narratives of the data gathered.

[a] Concepts from group performance practices strengthened translation of collaboration, interactions and task performance (such as Baron *et al.* 1992; Gabarro, 1990; Hackman, 1976; Hoffman, 1979; McGrath, 1984; Tushman, 1978).

[b] Concepts for translating the technical content of committee performance fitted into schema of PDC perspectives described in Figure 4-1 [C], Sublevels.

[b] Standardisation practices addressed methods of project development, contextual conditions and social perspectives. The practices fitted best into translations covering stakeholders (Axelrod *et al.* 1997); social content and contexts of project development (Callon, 1986; Latour, 1986).

[7] Data collection and data analysis

Overall, a qualitative longitudinal approach was designed to gather data from each committee across the five projects, and the duration of each predetermined development stages. Each project development stage was treated as a new setting with different committee performance contexts and, new data to collect and to analyse.

One advantage for data collection was that, all five projects showed close parallels in terms of inputs, tasks, standardisation methods and committee practices. This researcher was able to use similar structured questionnaires for all five committees, at the same time, collecting data on similar items. This data collection approach provided as basis for efficient integration of the case material and, for anomalies to be noted and treated exclusively. The other advantage was that, this researcher had the privilege to attend committee meetings observing events, which would otherwise be too intense to describe from collected data or anecdotal notes. Attending meetings helped to have a clear understanding of how committees conceptualised projects, how they discussed project subject matters and how they executed draft standards ballots.

[8] Data collection questions

This study draws attention to an extensive account of different contexts that help explicate the 'how' and 'why' factors of project development that are also differentially shaped by committee performance (cf. Pettigrew, 1997: 342). Because of the ontology perspective taken to study committee real life settings, qualitative data would be collected inductively by answering questions associated with the specified data range likely to build the representation of the *reality* linking committees actions to the execution of the projects (cf. Robson, 1993). The data collection was designed in line with Pettigrew (1997) and Yin (2003) covering 'how', 'what' and 'why' questions. These questions could deal with dynamic relationships to be traced, over time, in the definition of key aspects of the phenomena impacting on committee performance, for example:

- *How* does each committee develop its assigned project through predetermined development stages?
- *What* data should be gathered and *which* items would be analysable?
- *What* are the circumstances and layers of contexts in which various committee actions evolve?
- *Why* do these circumstances occur?

4.3.6 Committee Study- Data Collection

By using this framework hence, this study was defined as qualitative. Data gathering involved three main approaches: structured questionnaires, fieldwork observations and semi- structured interviews.

Two structured questionnaires were mailed to each committee for each project development stage (see Appendix 5: Committee case study questionnaires).

[a] **The first set of structured questionnaires** applied a stratified random sampling survey approach (Robson 1993, 2002) to focusing on small groups fitting predetermined committee representation profiles. These questionnaires posed comprehensive and specific matters for the data range defined in Table 4-6. For example, questions focusing on committee structures sought data on how project subject matters were assigned and how the committee would be structured to propel project actions.

[b] **The second set of structured questionnaires** involved clarification of checklists of technical content and social contexts of committee performance. Primarily, the items were identified from the evaluation of first set of structured questionnaire responses as having undisputed importance to each committee for the data collected from each project development stage.

Where resolution could not be attained in the data gathered, a new questionnaire was designed to re-examine identified contentious issues. In this regard, a cluster sampling survey approach (see §3.8.3) was applied. This sampling offered the best option to gather data that helped to locate essential items for resolving conflicting viewpoints separately. Conflicting viewpoints would be dichotomous descriptions on the same item that developers in the same committee provided. Items that often produced varied responses would be those requiring descriptive constructs. For example, how the committee design project tasks or evaluated task results.

Data gathered using stratified random sampling and cluster sampling approaches were also stratified from the combinations of questions posed to extract data from the individual developers. Notably stratification: by independent project elements for a particular stage being examined in the committee; by project subject matters and by representation profiles of the committee groups that responded to the questions (cf. Robson, 1993; Sayer, 2000). These forms of stratification yielded rich sets of descriptive data that were also based on well-established framing concepts that helped shape the study in the first place.

Semi-structured interviews offered discussions on compiled checklists for clarification of observed events and issues reviewed from committee documents (see §3.8.3). The interviews were conducted through semi-structured telephone and face to face discussions at meetings with a few experienced developers.

4.4 Micro Perspective Data Collection

In this section is the investigation of project development chosen as the case. The sub-unit of analysis for the micro perspective involved the predetermined project development stages (Table 4-6: 'Case study units of analysis'). This encouraged specificity to items across the five projects, their contexts of development and within their predetermined stages, over time.

4.4.1 Scope of Data Collection

All five projects consisted of highly specialised core elements and information-rich development stages. Furthermore, a predominant feature was the CBD solution proposal described in Figure 3-4. One the one hand, this solution proposal provided focus on items pivotal to introducing effective project development. On the other hand, much of the data collected required powerful explication of the dynamic qualities of project development that would govern the definition of the IITS process, as well as, be influential in arguing that this solution proposal is the right one.

In this micro perspective, therefore, a concurrent study ensured important links of project development to committee performance to be located in the data collection. As shown in Table 4-6: 'Case study units of analysis', the distinctions between the studies involved the use of different data ranges, for the specificity of the independent data collection exercises. In turn, the data ranges provided a rational principle for classifications of the data gathered (cf. Robson, 1993, 2002). **Table 4-8** that follows next illustrates the **perceived reality** that strengthened the focus of the study.

4.4.2 Global Content

Global content can be described as this: Prior to studying each project development stage, this researcher reviewed assembled committee documents, such as meting reports and study documents. This information helped to construct a global content of the project development stage, highlighting its dominating features. For example, its subject matters, intended actions, objectives, key methods and expected results agreed in each committee through their various discussions. Semi-structured telephone interviews with few selected developers for a relevant committee helped to verify the researcher's itemised descriptions of the global content of each stage.

Table 4-8: Perceived reality of project development
(Source: compiled by author)

Perceived reality elements (across predetermined stages) →	Internal PDC perspectives ←	Committee performance (across predetermined phases) →	OIPT lens focus
[1] Global content of stage	Level 5: Control Procedures	- Objectives and scope of stage - Definition of information needs, intended actions and expectations	Why?
[2] Project core elements	Level 1: Technical core of project development	- Concept exploration - Project development methodology	What? Why?
[3] Project inputs	Level 2: Technical Development Level 3: Knowledge and Tasks	- Networking of stakeholder inputs - Information management - Application of inputs	What? How? Which?
[4] Project tasks	Level 3: Knowledge and Tasks	- Execution of project and methodology - Discussions, meetings, summation of results - Development of draft standard	How? Which? Where? Why
[5] Standardisation approaches	Level 2: Technical Development Level 3: Knowledge and Tasks	- Execution of project methodology - Application of inputs/methods, R & D - Design of methods	What? Which? How?
[6] Project events (e.g. ballots)	Level 5: Control Procedures	- Review draft standards - Discussions, co-ordination, meetings, communication, consensus, decision-making, summation of results	How? Which? Why?
[7] Interim results (draft standards)	Level 2: Technical Development Level 5: Control Procedures	- Development of draft standard - Execution of project methodology - Discussions, co-ordination, meetings, communication, consensus, decision-making, summation of results	Which? Why?
[8] Project operational matters	Level 5: Control Procedures	- Document preparations, information control - Management of actions and results - Co-ordination of work - Feedback and reporting	What? How? Why?
Embedded and emergent contexts across stages: Interactions; results from committee actions; measures for managing stage; changes; time cycles; key processes; practices; problematic issues			

4.4.3 Data Collection

Data collection proceeded in three phases: structured questionnaires, fieldwork observations and documentary analysis.

The first phase applied two comprehensive questionnaires for each project development stage, focusing on carefully selected items from the global content and a specified data rang. The same stratified random survey approach (Robson, 1993, 2002) used for the study of the committees covered details of project development (see §4.3.6).

The second phase, fieldwork was structured as a longitudinal study with an important aspect of observing and recording events of the project development, as the stages evolved over time. Especially, committee meetings provided the best ground for using a series of **semi-structured interviews** to collect data on itemised events, such as committee ballots or review of project inputs (see §4.3.4). **Structured questionnaires** mailed to committees and secretariats, on the other hand, focused on gathering details of each project for the data range relevant to the project development stage being examined (see §4.3.3).

Data gathered from observing committee meetings would often be content-rich involving contexts of actions, varied events and changes, procedures, practices and results. Instead of capturing data through various structured questionnaires requiring repeated evaluation, it was expedient to do **sketchy models** integrating observed *reality*. These models would be based upon this researcher's anecdotal notes taken in meeting events. The models would be verified with a few experienced developers in each committee through questionnaires with tick boxes or quick fire questions. This verification process included asking the developers to define terminology for sequence of events and practices presented in the models, for which data was collected.

The third phase is documentary analysis. This was treated as part of structured questionnaire surveys and anecdotal data collection processes. Typically, the examined committee produced study documents developing detailed methods for each project; meeting reports of agreed actions and decisions concluding each project stage. The technical nature and variety in the committee documents required different approaches of analysis.

Documentary analysis of secretariats and forums documents yielded operational details. For example, secretariats produced numerous operational documents co-ordinating committee reviews of draft standards and preparation of ballot comments. Criteria in Table 4-7 (Criteria for forum and secretariat documentary analysis) were applied. Operational details determined from evaluated documents were then linked to committee execution of each project, for a particular stage.

Straus and Corbin (1990) and Robson (1993), for example, use sets of questions to focus on the sampling; gathering data from documents of a population of interest and their review subsequently. This researcher applied specified criteria to manage project documentary analysis and these are depicted in **Table 4-9** that follows next. These criteria may appear similar to those applied for forums, secretariats documentary analysis (cf. Table 4-7). Criteria applied for committee documentary analyses, on the other hand, fitted into the determined content of documents relevant to *how* project development evolved, and context of use of the documents in each committee or how it guided items evaluated in the case material for each stage.

4.4.4 Presentation and Preparations of Case Study Material

Qualitative case material for each study in the macro and micro perspectives covered large amounts of data with heterogeneous items. This is a result of collecting data across the global IITS environment, forums, secretariats, committees and project development stages. More so, this researcher dealt with longitudinal data collection through time-dependent contexts. Presentation of the case material as each study was completed provided different life-cycle stages of managing the case material.

Organised data helped to develop a database of case material using Microsoft Excel spreadsheets, across the multiple project development stages. The data range applied in the data gathering exercise was used for the presentation of the case study material.

Table 4-9: Criteria for committee documentary analysis
(Source: compiled by author based on Robson, 1993; Straus and Corbin, 1990)

Classification of committee document	Criteria for documentary analysis and classification of material
[1] Study and technical: [concepts, methods and project information needs] [2] Draft standards: [interim committee results] [3] Committee reports: [meeting minutes, R & D reports]	**Content:** - Document sources - Subjects committee is focusing on - Purpose of document regarding project actions - Intention of document in committee actions - Information input to document - Presentation of committee results
[4] Ballot resolution reports: [collated results from committees and SDO) [5] Operational reports: [SDO, chairman, secretariat]	**Context of use:** - Size of document and how it is processed - Methods used to execute project actions - How methods are developed in study document or their treatment - Decision-making authority of performance of actions - Details of performance of actions: decisions; recommendations - Areas and levels of conflict - Contextual element in performance of actions - How project goals are achieved for the project stage

In keeping with Crabtree and Miller (2000), Miles and Huberman (1994) and Strauss and Corbin (1990, 1998) **data reduction** was the first step in the preparations of the raw case material for detailed analysis. This 'reduction' was accomplished in the evaluation of the questionnaire using a data range and concepts that guided data gathering to record the survey responses or field notes. Further reduction involved sorting the data to develop **analysable categorisations** relevant to the data ranges applied in the data gathering exercise, for both the macro and micro perspectives of the study.

Its needs mentioning that, Crabtree and Miller (2000), Miles and Huberman (1994) and Strauss and Corbin (1990, 1998) develop codes after the initial exploration and reduction of the data gathered. The codes can be flexible to use in small to medium data samples. Whereas, codes applied in large quantities of case material, as in this case study, proved difficult to manage without qualitative research software (such as QSR N6). This software can be applied for data collection, data coding and searching for coded information, leading to analysis and interpretations.

Given the large quantity of case material and the heterogeneous nature of the qualitative data from these separate studies, however, analysable categorisations provided a coherent basis for defining the 'essential unity' underpinning the case material for each study. Qualitative research software represses this 'essential unity'. For example, the micro focus of various contexts that are also amenable to data collection and data analysis. Once data is collected, it is difficult to add in concepts of translation. Concepts of translation, especially, generate subject matters help the search for coherence in the classification of items that can be regarded as the 'case knowledge.'

4.5 Data Analysis

4.5.1 Analytical Steps

Inductive analysis was performed on categorised qualitative data. From data reduction and data preparations, an explicit aim of the inductive analysis was to build case evidence appropriate for developing empirical explanations.

Table 4-10 next, contains eight analytic steps combining epistemological and ontological dimensions relevant for inductive analysis of rich case material. *Ontology* is the examined *reality* of the empirical study. In this data analysis it is important to draw attention to this *reality* to develop depth and detail that builds empirical evidence. Ontology requires analytic rigour. This is achieved by theorising from the prepared qualitative case material using analytic questions defined from the OIPT as a lens. The results draw attention to concepts and themes to address the examined reality of each project. *Epistemology* focuses on understanding and explication encouraged from theorising the qualitative case material. The results are representations of evidence categorises fitting in with the meaning of the established concepts and themes, for comparison (cf. Strauss and Corbin, 1998; Miles and Huberman, 1994).

Table 4-10: Data analytic steps adapted from coding principles
(Source: compiled by author from Strauss and Corbin, 1998)

Analytical steps		**Descriptions and rationale**
Step 1:	Data preparation, initial analysis	Categorisation of subject matters in the data range, properties.
Step 2:	Open coding categorisation	Concept development, based on data range and categories of subject matters.
Step 3:	Selective coding categorisation [OIPT lens analytical questions]	Themes and concepts in the subject matters categories, based on specified views across macro and micro perspectives.
Step 4:	Definition of categorised themes [OIPT lens analytical questions]	Data display (models) and matrices based on defined perspectives * Review and refinement of categorised themes, perspectives and their distinctive features
Step 5:	Comparison of GIITS and SES projects	Minimal and maximal comparison of categorised findings
Step 6:	Refinement of compared evidence [OIPT lens analytical questions]	Review findings: Specific concepts, themes in the categories and properties.
Step 7:	Integration of evidence	Integrate compared specific concepts and themes. Develop Explanatory constructs of the empirical connections for answering case study constructs of the empirical connections for answering case study questions.
Step 8:	Case study closure	Interpretations, based on core concepts and themes in the empirical evidence.

4.5.2 Macro Perspective: Analysis of Case Material

After the initial data reduction and preparations (§4.4.4), inductive analysis performed on the raw qualitative case material for specific questionnaire responses. Analytic questions of OIPT as a lens made it possible to wrap up open and selective coding steps in quick succession, yielding preliminary subject matters to appreciate the content of the case material, followed by analysable categorisations.

Appendix 6A contains macro perspective scope of study (Columns 1 to 4), taken as the examined *reality* to which this inductive analysis is referenced. In Column 5 is the categorised raw qualitative case material carried over to the inductive analysis stage. In the categorisation of findings, global IITS environment *(examined reality),* for example, has been delineated to subject matters covering 'environment infrastructure, management and social construction'. Further delineation of subject matters yields *characteristics* representing epistemological items capturing typical *functional views* located in the global IITS environment case material. Themes delineating *functional views* are as follows: social construction as a functional view of SDOs and NSBs is *characterised* by actors and stakeholders. Separately, inductive analyses through open and selective coding is supported with analytic questions. This leads to refinement of categorisations to locate meaning in the evidence derived from the qualitative case material.

Appendix 6B contains an example of this these analytic steps described above and the results. Moreover, the results suggest that the use of codes or sophisticated software was not necessary after all. This is because the data range applied in the data collection exercise provided adequate coverage of parameters that were sampled. For verification, decision parameters of OIPT as a lens, such as organisational assumptions, inter-relationships and responsibilities added depth and detail to the categorised *subject matters* underpinning forums and secretariat functional practices. When *concepts and themes* were located in the subject matters, this identified with verifiable case material and plausibility to construct evidence. With regard to global IITS environment functional views, empirical evidence drawn from this inductive analysis is divided into four categories that could be explained by its meaning, as follows:

[a] **Predominant subject matters:** They describe the functional views, content and contexts theorised from the categorisations of evaluated qualitative case material.

[b] **Concepts/themes** in the categories of subject matters are divided into levels. Global IITS environment has more diversity in its concepts than say, committees. Physical and functional views are concepts. They have some level of diversity that depends on the areas examined. They create other dimensions, such as structures, core functions and procedures, so that their properties could be determined.

[c] **Embedded contexts or emergent factors:** Categorisations of the actors and their different roles would be *embedded* in IITS environment functional views. Lines of authority in IITS environment functional units are *emergent factors* from say, relationships between IITS organisations.

4.5.3 Comparison of Evidence

Minimal comparison (Flick, 1998) evaluated independent categorised results for forums, secretariats and committee with one another. This researcher was looking for distinctive similarities in categorised concepts, themes and subject matters, to then construct specific empirical evidence defining the IITS process for analysis.

Views of structures, functionality and information consisted of different dimensions defined according to concepts in the decision parameters of OIPT as a lens (Appendix 1). In this regard, **maximal comparison** represents views compared against these OIPT concepts. The concepts encourage grounding in theory and clarity of epistemological assumptions underpinning the categorised evidence. These are important details locating **similarities** in the case evidence and to explicate rich concepts and views.

Appendix 6C contains example similarities determined from maximal comparison of the analysed case evidence from five secretariats. To follow on, Appendix 6C (Column 2) identifiable similarities are delineated to the smallest definable details as possible, until the *representative-ness* of functional views across the five secretariats can be closely matched to others identified in reviewed literatures. Concepts for translating functional views from organisational literatures (such as Blunden, 1987; Burton and Obel, 2003; Fenton and Pettigrew, 2000; Ostroff, 1999) offered the basis from which to delineate similarities of operational matters. Different levels of **specificity** of the categorised concepts, themes and features are defined hence (Appendix 6C, Column 2). Specificity takes into account the *frequency* in which concepts, themes, subject matters appear across the secretariats (cf. Miles and Huberman, 1994; Robson, 1993, 2002).

Results of minimal and maximal comparisons that also included systematic refinement of the categorised case material are categorical empirical evidence. This judgement rests attention on plausible representation, specificity and frequency of subject matters, concepts and themes. Moreover, decision-making to answer case study questions rested upon the resolution of this empirical evidence in terms of: determined similarities, relationships among specific items or issues, and distinguishing them from any others to define more concrete core concepts (cf. Miles and Huberman, 1994).

4.6 Micro Perspective Data Analysis

This section summarises inductive data analysis performed on the qualitative data for project development and perspectives. The raw case material from all five projects was too diverse to be incorporated in this thesis. Because of this, the analytic steps mentioned in this text with reference to Table 4-10 (Data analytic steps adapted from coding principles) help to point to the empirical evidence in **Appendices 7A to 7I.**

4.6.1 Step 1: GIITS and SES Projects Data Preparations

Raw case material gathered for the five projects were analysed exclusively to build representative evidence. Open coding carried out on the data range (Table 4-6: Case study units of analysis) provided an adequate basis for the preparation of the raw case material for inductive analysis across the predetermined stages, as the data collection was completed.

4.6.2 Steps 2-3: Open and Selective Coding Categorisation

Categorised raw case material carried over from the preparation steps was inductively analysed. Open and selective coding principles, Steps 2 and 3 (Table 4-10: Data analytic steps...) were applied successively. This helped the identification of concepts and themes that cut across the predetermined project development stages, for each project.

As the classification of the material became clearer through coding steps, items such as 'global content, project development stage content and technical content' were combined to create a revised data range closely corresponding to the schema perspectives indicated in Figure 4-1. More so, open coding aided expedient data reduction and refinement of the case material, because the results could be categorised as analysable content whose concepts reflected how the data was collected in the first place. An analysable content contained predetermined coherent relationships among items located in the data range, and whose explanations described how the committees developed each project, at a specific point in time of the data collection exercise.

The results presented in **Appendices 7A and 7E** are based upon the revised data ranges applied on the raw case material. This inductive analysis was performed on the items categorised in the revised data ranges. Analytical questions established from OIPT as a lens were applied, theorising the categorised items to ensure greater explanatory power in building empirical evidence.

4.6.3 Step 4: Definition of Categorisations

Block diagrams in **Appendices 7D to 7I** developed from this researcher's sketchy models proved useful instruments to structure diverse results. However, the empirical evidence needed specificity indicating *which* items were connected. By using these diagrammatic details of connecting the case evidence, categorisation and other associated variables derived inductively could then be refined together.

Case evidence about standardisation approaches, for example, presented major issue-based categories connected to *how* a project was executed and in *which* circumstances committees developed or applied an agreed methodology and *why*. To understand the 'how', 'which' and 'why' contexts of standardisation approaches, the schema perspectives indicated in Figure 4-1 was applied, as follows:

[a] It offered refinement of categorised case evidence by delineating connections of items presented, and how particular themes fitted together.

[b] Explanatory details of *how* they were connected, and *why* the connections were possible helped to determine major issue-based categories of standardisation approaches.

The results in **Appendix 7D** show that, not only do the standardisation approaches contain issue-based categories, but also different types of **perspectives** connected to them could be defined. Perspectives give a clear representation of concepts with which to make sense of 'how', 'which' and 'why' contexts of the standardisation approaches. These perspectives clearly marked in a block diagram format were carried over to define the dynamic qualities of the standardisation approaches illustrated in **Appendix 7F.**

4.6.4 Step 5-6: Comparisons and Refinement

The five projects examines belonged to two classes. Notably, GIITS (technical) and SES (process) to which their development and implementation of the published standards would be referenced (see §3.6.3, item [4]). After categorisations, connection of case evidence, the primary consideration is construction of empirical evidence and its meaning. The other consideration is the definition of a research theory, where theory building would have occurred incrementally in the data collection and the analytic steps of the case material (cf. Bechhofer and Paterson, 2000; Eisenhardt, 1989).

For effectiveness of an evaluation intended to yield a research theory, inductive minimal and maximal comparisons were performed on the case evidence for the two classes to which the five projects were referenced. Comparing the five projects with one another, would have involved cumbersome information-rich case evidence and classifications. This approach potentially requires more intense processes of data reduction, which can remove meaning of case the evidence. This researcher examined similar project development stages and study approaches for all five projects to avoid polarised findings. Instead of diverse comparing categories of evidence or committees, forums, secretariats and projects, a comparison of the two classes was more valuable to attain explanatory details and meanings that could easily be traced in the case evidence. Corbin and Straus (1990) and Flick (1998), on the other hand, conduct inductive comparison of the cases examined.

Appendices 7B and 7C contain important aspects of the comparisons for this case study and the results, as follows:

[a] *Minimal comparison* of GIITS and SES sought only **specific concepts** that were also **intensely universal** across the five projects examined. In this regard, consistency and specificity in categories of the determined subject matters, concepts and themes were requirements for assigning relevant meaning attributed to the compared evidence. **Intense universal concepts** would have commitment to methods, practices and rules of standardisation, as applied across the five projects. Concept exploration, requirements analysis and documentation of standards are examples of intense universal concepts derived inductively from the case evidence.

[b] **Maximal comparison** involved an inductive refinement of the case evidence. First, analytical questions defined from OIPT as a lens assisted in clarifying the details of the case evidence toward plausible similarities or differences. Second, relevant concepts for translation were applied in the *comparison* to that clarify specific details of the *reality* of project development and of committee performance. Ultimately, similarities in the two classes of projects were worth pursing. They identified with key relationships among a variety of items that could hold **specific meanings** located in the case evidence to make **a conclusion**, perhaps at the same project development stage, for example:

> **Stage 1** for both GIITS and SES projects examined [*similarity by compared project stage*] yields **15 information abstraction processes** [*similarity by specified items in the project stage*], leading to **the definition of project problem space** *[similarity by meaning located in the specified items]*. These processes and project problem space are judged upon a clear appreciation of concepts in the SWEP Model [*maximal comparison*].

On the other hand, **differences** located in the compared case evidence identified with items that were less important, insofar as they produced unsatisfactory relationships or patterns. If the items were less important than others were, this helped to eliminate biased views that may have been introduced in the analysis or evaluation procedures. Moreover, research theory and phenomena of interest are established from empirical evidence that closely fits interpretive facts resting upon the meanings located in compared evidence (cf. Eisenhardt, 1989; Strauss and Corbin, 1990, 1998).

Concepts for translating such as those described in §4.3.5 item [6] proved useful in the refinement and final resolution of the compared case evidence. They added depth in the *plausibility* of the results derived from maximal comparison of the two classes of projects. This plausibility means, subject matters or concepts derived from maximal comparison became more concrete and tighter with respect to the range of issues included in the empirical evidence (cf. Flick, 1998: 235). As added advantage, the results of maximal comparison would be as closely connected as possible, or, consistent with well-established terminology applied in project development.

[1] Refined representations of *maximal* case evidence therefore yielded specifications of the technical content of project development: such as, processes identified from universal concepts (Appendix 7E); perspectives of standardisation approaches (Appendix 7F) and project tasks (Appendix 7H). This evidence together was consistent with the constructs in Figure 4-1 (Schema of project development perspectives) that guided data gathering. This result by itself is confirm *plausibility* of the evidence as well as the perspectives. The evidence in block diagrams provided greater explanatory power parameterising identifiable relationships located in the case evidence, with respect to the PDC perspectives.

[2] *Concepts for translating* group performance practices encouraged specificity in the themes underpinning 'micro-aspects' of project development that would otherwise be difficult to define. As shown in **Appendix 7G,** the concepts for translating applied to case evidence on committee project tasks yielded **special identities,** such as planning tasks, problem analysis and judgement. These identities were consistent with well-tried concepts taken from reviewed literatures covering Baron *et al.* (1992); Gersick and Hackman (1990); Hoffman (1979); Hackman (1977, 1990); McGrath (1984) and Tushman (1978).

To confirm plausibility of the case evidence, these special identities connected the content of project tasks to committee performance, thereby creating task profiles that could be matched to the PDC phases. Alternative terms for concepts already defined as universal across the compared case evidence of the two classes of projects were avoided. This is because alternative terms introduced new categories and polarised terminology that did not add any resulting clarification of the empirical evidence.

4.6.5 Aims of Integration of Empirical Evidence

In a number of literatures (Atkinson and Hammersley, 1994; Brewer and Hunter, 1989; Miles and Huberman, 1994) claims of validity (internal, external and interpretive) articulate generalisability and meaning of the empirical evidence. The conditions by which validity is determined, such as co-variation of variables can be sources of ambiguity in the explication and usefulness empirical evidence (cf. Brewer and Hunter, 1989; Hammersley, 1992).

This researcher applied an integration approach of the empirical evidence with explicit aims to:

[1] Develop a basis for **connecting major concepts** located in the empirical evidence for the macro and micro perspectives.

[2] Eliminate as many identifiable **uncertainty factors** as possible from the empirical evidence. Uncertainty factors involved broad generalised items that did not propel research intentions. Given the heterogeneous variables in the empirical evidence, the possibility of a rival (or alternative extended) hypotheses could not be ruled out. Elimination of broad generalisations ruled out any rival hypothesis hence.

[3] Achieve **transparency of judgement** of core concepts to develop explanations of the empirical evidence.

4.6.6 Integration Criteria

Table 4-11 that follows next, presents criteria applied to integrate the empirical evidence and to then, select core concepts. In the interest of linking the empirical evidence to research intentions, these criteria applied in this integration exercise were matched to the views determined for the CBD solution proposal framework (Figure 3-4).

4.7 Step 7: Integrated Case Study Interpretations

In this section core concepts inductively derived from the integration exercise are used to develop themes underpinning the interpretive facts of the empirical evidence. Themes offer fundamental interpretations and explanatory constructs of the meaning of the empirical evidence.

4.7.1 Themes of Integrated Empirical Evidence

Macro perspective Theme #1: Overall representation of IITS environment

The key concepts located in the integrated empirical evidence of the macro perspective are the reality of the functioning of the IITS environment. The global view suggests a perceived structure contrived from inter-organisational relationships between SDOs, forums and NSBs.

This perceived structure has corresponding functions, operational and management practices and responsibilities that give meaning focusing on how the IITS environment operates as an infrastructure. As suggested in Jakobs (2000) these features described here have profound importance to the development of the standards, and can not easily be separated. This 'infrastructure view', however, seems to exclude the processes which define the 'core business' or core pursuits of the IITS environment as in its accountability to its stakeholders, practices and responsibilities.

Table 4-11: Criteria for data integration
(Source: compiled by author)

	OIPT as lens (Contexts bearing on solution proposal & project development)		Empirical criteria (connected to contexts)	Descriptions of empirical representations
Macro focus	**External environment context:** - [Stakeholders impacts on internal environment] **Internal environment context:** - [SDOs and NSBs] - [Operational unity]			
			❶ Structural	- Universal concepts of **physical structures, boundaries and reporting mechanisms** connected to them.
			❷ Functional	- Universal concepts connecting **functionality** of global IITS environment, forums, secretariats and committees. - Concepts suggesting common **operational matters and difficulties.**
			❸ Management	- Core concepts suggesting **identities of management practices** and area where they are paramount.
Micro focus	**Committees and technical core context:** - [Organization internal environment] - [Project development] - [IITS process] - [Embedded]:		❹ Behaviour	- Subject matters of **recurring practices** and suggesting distinctions between them.
			❺ Project development view [* new findings]	- Universal core concepts and subject matters suggesting **a project development cycle** its design or structure. - Embedded issues brought into the project development cycle through participating parties (e.g.: SDO operational procedures and R & D activity).
			❻ Process view [* new findings]	- Universal core concepts suggesting **the existence of processes and sub-processes** guiding project development. - Universal core concepts that can distinguish between the processes. - Universal core concepts supporting the **performance of these processes.**
			❼ Information view [* new findings]	- Universal core concepts suggesting **the information perspectives** connected to project development and processes (e.g.: information processing practices; information management).
	Technology context:		❽ Information systems	- Universal core concepts that can make distinctions in the applications of IS, based on behaviour, project development and process views

4.7.2 Micro Perspective

Integrated empirical evidence of the micro perspective yielded six themes. Concomitantly, the discussion of the themes provides the answers to the case study questions posed.

Theme #1: Overall reality of the micro perspective
Empirical evidence presented in Appendices 6A to 6F reveals the uniqueness of IITS project development on several dimensions. For example: highly technical projects, scientific subject matters, highly specialised information and standardisation approaches requiring R & D input. These specialised dimensions have important implications, such as provision of information to committees, communication, co-ordination of work through functional integration strategies and technology choices.

4.7.3 Themes Answering Case Study Questions

Theme #1: Project development cycle

> Question #1: What is the typical development cycle for the selected projects and its characteristic features?

To answer this question, the integrated empirical evidence suggested that all five committees employed a PDC, as universally acceptable practice. This evidence confirms the perceived reality that guided the investigation (Table 4-8: Perceived reality of project development). The PDC that is universal across all five projects has six phases that are described in greater detail in Figure 6-4 (Features of IITS process). Two levels underpinning important themes of this PDC are: **Level 1,** the technical core of project development. **Level 2**, technical development of concepts assembled in the committee, to include the standardisation methodology, experimentation of concepts and implementation of findings.

Theme #2: IIT standards core process

> Question #2: How is each project developed to create an international IT standard?

The response to this question revisits the PDC. Integrated core concepts of the predetermined project development stages demonstrate a PDC that also has distinctive types of processes. Similarities in the core concepts across the five projects yielded a **core process**, which distinguishes it from any other processes identified in the evaluations (see Figure 6-4: Features of IITS process).

An empirical definition of this core process improves on the predetermined five stages that guide the data collection exercises, hence. Other scholarly works describing the process of standardisation (Cargill, 1989, 1995; Ngosi and Jenkins; 1993; Reilly, 1994) made a similar suggestion of the existence of a core process, which makes this finding a dependable result. The IEEE Computer Society directives (IEEE 2005) and ISO IEC directives (ISO 2004), on the other hand, do not mention a core process. They specify stages of procedures they defined for guiding the development of projects and approval of draft standards.

Theme #3: Committee performance perspectives

Question #3: Which perspectives explicate circumstances of committee performance of standardisation actions

The answer to this question revisits the five levels presented in the internal perspective of PDC that guided the study and explication of the evidence (Figure 4-1: Schema of project development perspectives, [B]). The circumstances of committee performance are determined primarily, by their explanation for content, contexts of standardisation actions and contextual factors described next.

Theme #3A: Content circumstances

Information propels committee actions. Content circumstances, in which committees gather relevant information, for example, define the practices they apply to develop the standardisation methodology and key aspects of the standard. **Appendix 7F** (Perspectives 2, 3 and 4) shows a block diagram of core empirical interpretations of these content circumstances. These interpretations can be related to concepts for translating adopted in the SWEP reference model (1993) to draw attention to fundamental views defining the meaning of content circumstances, namely technology, customer, organisation and process, and product.

For example, the *'technology view'* indicates that committees gather project inputs as commercial products, information and engineering practices to develop scope of the project and standardisation approaches. Stakeholders represent the *'customer view'* that, they have vested interest in the project. The writing of the standardised results focus on the implementation of the published standard in the stakeholders' *organisations.* Furthermore, these views matched those identified in the perspectives of standardisation approaches (see §4.6.3; Appendix 7D). This match suggests the effectiveness of the data collection, inductive analyses and of the empirical evidence by their connection to concepts for translating.

Theme #3B: Context circumstances

The empirically determined context circumstances are also consistent with Figure 4-1 Level 3 (Human activity and methods of working) and Level 4 (Knowledge and tasks). In this theme, empirical evidence of committee performance clearly focuses micro aspects of project development: such as, collaboration, information gathering, technical development and design of project tasks. With this diversity of micro aspects, the committee requires specific guidelines for establishing their methods of working for the successful completion of projects.

Theme #3C: Contextual factors

Contextual factors explicate the dynamic interplay of project development issues and embedded mechanisms that are differentially shaped by committee performance. Integrated core concepts of the empirical evidence revealed several contextual factors. In particular, a *draft standard* is an interim result produced from a project development stage. Each draft standard goes through a *review cycle,* by individual developers, to gather *comments* for consideration. The comments are discussed at scheduled *committee meetings*, followed by *refinement of the draft standard.*

These highlighted contextual factors cause a series of events to occur within the realms of the practices that committees follow to achieve results, such as formal ballots. As such, committees need implicit and explicit reference to evaluated cumulative information to challenges that these contextual factors bring in individual project development stages.

Theme #4: IITS process

> Question #4: Which features can be accepted as the 'true' explanation of the core dimensions of the IITS process?

For this question, all five committees employed the core process and PDC mutually, as the two features that form the *IITS process* (see Themes #1 and #2). During project development, however, the IITS process creates layers of sub-processes, procedures and task categories generated from embedded contexts (see Appendices 7E and 7G). This combined use of IITS process features (core process and PDC) means, there are *core dimensions* that need to be analysed and questioned separately.

Theme #5: IITS process operations

Empirical evidence from forums and secretariats suggests that, there is an *operational view* that supports the IITS process. This view presents highly specialised operational issues, such as information processing, co-ordination of work, management of committee activities and registration of projects. While these operational issues might help alignment of IITS process to IITS environment strategies, they possess *embedded contexts* in the treatment of project development items. Defining this *operational view* might therefore help to differentiate understanding of the IITS process performance.

Theme #6: IITS process project time scales

These time scales have been subject to scrutiny in a number of scholarly works (such as Krechmer, 2005; Rada, 1999). In this empirical evidence, time scales determined for each project development stage depended upon connecting an array of factors. For example, the content to the project, availability of relevant information to committees and milestones impacting on committee performance effectiveness in observing targeted time scales.

4.8 Step 8: Case Study Closure

4.8.1 Primary Aspects

Table 4-12 next, shows ten categories of primary aspects from empirical core concepts and themes. They summarise 'what the IITS process is concerned with' in the reality of project development and functional issues located in the empirical evidence (cf. Ngosi and Braganza, 2006).

Table 4-12: Primary aspects of IITS process perspectives
(Source: compiled by author)

OIPT as lens (Contexts)	Primary aspects	Example details
External environment	[1] Environment in which IITS process exists:	Structures and functional components serving the IITS process.
Internal environment	[2] Definition of IITS process:	Core process; project development cycle.
	[3] Formal sub-processes:	Adoption of standardised concepts, communication, collaboration, operational and information.
	[4] Contexts to which IITS process is referenced:	Project subject matters, project inputs, committee performance, standardisation practices and procedures.
Committees and technical core	[5] Content of IITS process:	Stages, phases, projects, inputs, practices, tasks, events, procedures, interim results and outcomes.
	[6] Content of project development:	Projects, project development cycle phases, project development strategy, standardisation approaches.
	[7] Contextual conditions and influences:	Methods of achieving standardisation, participation and stakeholders.
		Communication, collaboration, co-ordination, co-operation, information exchanges and negotiations, meetings.
	[8] Constraints in execution of IITS process:	Expertise, information, project specialisation, knowledge, tasks, methods of working and representations of project development.
Technology	[9] Use of technology:	Operational management, processing and transactions

4.8.2 Phenomena Attributed to IITS Project Development

The case study posed another question:

Question #5: Which key factors explain phenomena associated with how the projects are developed?

This question relates to the problem statement (§1.1.4) that the complexity of the current IITS process is out control to appreciate a specifiable phenomenon. The answer to this question is that, the complexity of the current IITS process has other phenomena that can be confirmed in the following three linked empirical evidence:

[1] **IITS process features:** The extant IITS process, by virtue of the development of the project through the core process and PDC, creates *complex ubiquitous features* over time.

[2] **Contexts and views:** The primary aspects demonstrate clearly that, the IITS process has several a variety of *contexts and views* linked to its features, and more so, its functionality (see Table 4-11: Criteria for data integration). In its current state, these contexts and views together have value in defining how the IITS process can be execute project development. In terms of complexity, however, the immense number of IITS process features, performance contexts and embedded elements can no longer be supported in a linear-oriented structure. From the perspective of empirical *reality,* each project looses its meaningful content. This 'meaning' may not be detected because of the chaotic features, and dynamic interplay of interactions, practices and sub-processes that are not accounted for or are not being supported effectively.

[3] **Variety of phenomena:** Categorically, chaotic features, multi-dimensional contexts and embedded elements are sources of complexity of the IITS process. As described in Corning (1998), ultimately, this kind of complexity grows to produce a variety of other phenomena. To demonstrate this, **Table 4-13** contains eight empirically determined example areas of IITS process with complex issues and *how* they have 'knock on effects' as the *other phenomena* connected to the five case study projects.

Table 4-13: IITS process areas *vs* variety of phenomena
(Source: compiled by author)

Example areas with complex issues	Summary of imparted phenomena
[a] Information:	Diversity in project information as input and use of this information.
[b] Interactions:	Abstruse interactions between diverse numbers of participants interpreted in different forms, e.g.: communication, collaborative interchange and meetings.
[c] Operations:	Islands of operations that have exclusive varieties of procedures
[d] Procedures:	Use of the variety of procedures that can create misinterpretation project development actions and IITS performance.
[e] Projects:	Complexity of the projects that embody high technical and social contexts.
[f] Participation:	Complexity of committee project participation that is equated in different contexts: such as alliances, co-operation, coalition and collaboration.
[g] Stakeholders:	Complexity of stakeholders and their demands.
[h] Technology:	IT resources that serve several underlying IITS process performance purposes.

4.8.3 Research Hypothesis and Explanatory constructs

The research hypothesis described in **Box 4-1** exemplifies the most crucial interconnected claims of the classifications of the empirical evidence (concepts, primary aspects and phenomena) to which the solution proposal can be referenced. This hypothesis has been deigned to provide explanatory constructs [1], [2] and [3] that draw attention to its operationalisation.

Box 4-1: Research Hypothesis
(Source: compiled by author)

[Hypothesis]	**The reconstruction of the IITS process within a CBD framework creates autonomous component-based project development settings that are expected to:**
[Explanatory constructs]	[1] Reduce excessive features, contexts of complexity and uncertainty that cause of problems in performance.
	[2] Demonstrate a cohesive set of functionality required by specified core aspects of the IITS process.
	[3] Create combinations of functionality and operational capabilities that match IS requirements.

4.9 Case Study Conclusions

Three main conclusions summarise the empirical evidence from the macro and macro perspectives of this case study. These conclusions together, outline the issues responding to the problem statement (§1.1.4) and to move forward its exclusive examination.

Conclusion #1: The IITS environment

This environment is a complicated infrastructure with several contexts that are volatile to examine. Macro perspective theme #1: Overall representation of IITS environment (§4.7.1) suggests the need to examine the IITS process, not as a single entity, but one that interacts as part of this complex infrastructure.

Conclusion #2: IITS process

Empirical evidence of how the projects are developed (§4.7.3, themes #3 to #6) and primary aspects of IITS process perspectives (Table 4-12) clearly confirm the complexity of the IITS process. This complexity opens up an array of areas demonstrated in Table 4-13 that also give rise to a variety of other phenomena connected to the IITS process. These results therefore question the clarity of the IITS process, to include the breath and depth of its problems.

Conclusion #3: IITS process reconstruction proposal

This empirical evidence mentioned above leads logically to the conclusion that the reconstruction of the extant IITS process within an open layered CBD framework is the right proposal. The analysis and reconstruction of the IITS process needs to be operationalised together, leading to fundamental understanding of solution options that can confirm the solution proposal.

4.10 Chapter Summation

In this chapter, the research cases and their comprehensive empirical study have provided evidence, which answered five case study questions. The use of the OIPT as a lens provided grounding in theory and stronger theoretical focus allowing for different parts of the research process to be linked. The next chapter is the transition phase focusing on the definition of the problem frame and an analytic framework to study the IITS process.

Chapter 5

Transition Phase: Analytic Framework

5.0 Introduction to Chapter

In the first phase, the research process described in Figure 3-2 covered three core subject matters: scope of international IT standards development, project development and research methods. This second phase is the transition from the research process embracing the building blocks devoted to two other core subject matters, namely analysis and reconstruction of the current IITS process.

This chapter begins with a summary of the content of the transition phase (§5.1). The building blocks are described as: operationalisation (§5.2), problem frame (§5.3), consequences linked to problem statement (§5.4) and importance of the solution proposal (§5.5). An analytic framework for the study of the IITS process is developed (§5.6) and described at two levels, which are macro (§5.7) and micro (§5.8) characterising its application. The chapter concludes with a summation (§5.9).

5.1 Introduction to Transition Phase

5.1.1 Content of Transition Phase

This researcher found it necessary to define a transition phase from the research process in which a specified set of empirical evidence is organised for operationalisation. Figure 5-1 that follows next, depicts the link between the research process and transition phases. The set of empirical evidence carried forward from the research process to this transition phase is restated for ease of reference, as follows:

[a] **Primary aspects** of IITS process (Table 4-12): The usefulness of these primary aspects is to establish the various representations of the IITS process, such as structure and functions. In addition, they show that there are many more elements and factors that impinge on the IITS process and project development, than the complexity suggested in the problem statement (§1.1.4).

[b] **Phenomenon of interest**: This demonstrates the complexity of the IITS process impacting on a variety of other areas (Table 4-13). The problem statement to which this evidence is referenced is delineated into principal parts as a means for understanding underpinning elements that add depth to its analysis.

[c] **Research hypothesis** (Box 4-1, §4.8.3): This is an interpretation of the empirical evidence for which the solution proposal is examined.

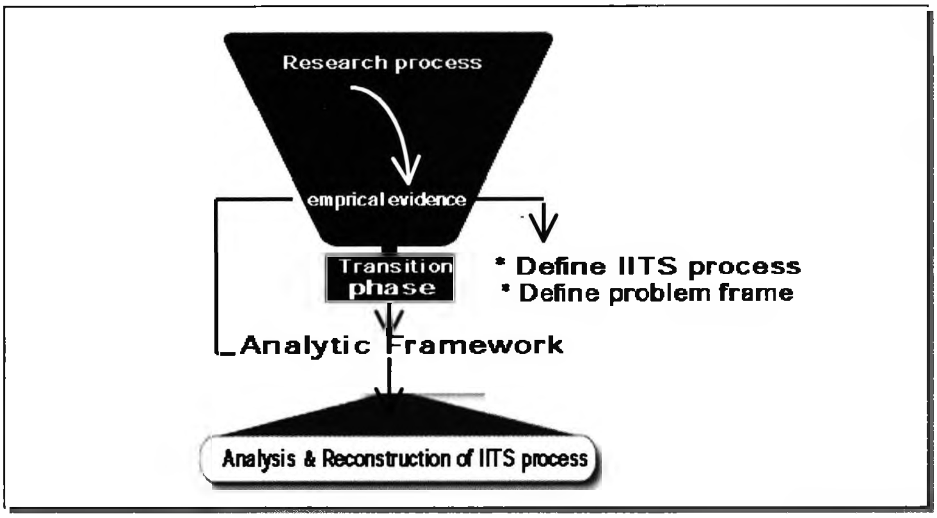


Figure 5-1: Linked content of transition phase
(Source: compiled by author)

In keeping with Vickery and Vickery (1992), developing knowledge to explicate this range of empirical evidence and the proposed solution will depend upon frameworks for putting together concepts for tacit or explicit action. Since the OIPT as a lens was applied in the research process, this empirical evidence has grounding in theory that is also central to the paradigmatic viewpoints addressed in the case study.

This transition phase has an explicit aim to define an **analytic framework**. It is argued that, this framework has greater explanatory power to develop knowledge to operationalise this empirical evidence in an integrated manner and to also account for the actions that are taken. This operationalisation procedure is described in great detail to frame the principal parts of the problem statement described in §1.1.4.

In the chapters that follow this (Chapters 6, 7and 8), the IITS process is defined and singled out for systematic analysis, followed by its reconstruction. The analytic framework applies OIPT as lens to encourage analytic rigour, which includes strengthening the theoretical and methodological tasks for linking this empirical evidence to the analysis and reconstruction of the IITS process through a number of decisions. In turn, these decisions are influenced by value-laden beliefs about how the IITS process can be reconstructed within a CBD framework to yield results suggested in the solution proposal (Figure 3-4). By using the OIPT as a lens in this analytic framework, the analysis and reconstruction of the IITS process are linked methodologically to operationalise the research hypothesis.

5.2 Operationalisation Defined

The main study of the IITS process deals with the operationalisation of the research hypothesis. Jackson (1994: 252) gives a good summary that draws attention to the central concepts of the operationalisation procedures of a research hypothesis:

> [1] A problem can be characterised by its *principal parts* and a *solution task.* [2]The principal parts of a problem to prove are the *hypothesis* and the *conclusion.* [3] The solution task is to show that the *conclusion* follows the *hypothesis.* [4] The principal parts of the problem are the *unknown*....and the *condition* given in the *data.* [5] The solution task is to construct the *unknown* so that it satisfies the *condition* with respect to the *data.* [6] The principal parts and the solution task of a problem thus form a structure within which the problem can be considered systematically, and an appropriate solution method chosen or devised. Such a structure may be called a *problem frame.* [7] To understand a problem is to have fitted it into an appropriate problem frame by identifying its principal part and the solution task.
>
> *(Italics are the author's accentuation points of the concepts).*

In view of these concepts, the research hypothesis in Box 4-1 is categorised as subjective in its content. This is because it is derived from reasoned judgement of qualitative empirical evidence. This research has a predetermined component-based solution proposal framework (Figure 3-4) to which the reconstruction of the IITS process and its results are referenced. The focal tasks of the operationalisation procedure therefore include a full analytical test of this research hypothesis.

This analytical test is achieved through systematic levels of analysis of the IITS process, followed by its reconstruction that is unified by means of the explanatory constructs of the hypothesis. In the different levels of analysis, new knowledge is generated, which provides the basis for determining appropriate solution options fitting into the scope of the predetermined solution proposal framework. A component-based project development setting is designed, from which solutions can be determined.

The evaluation of a subjective hypothesis, however, does not follow abstract scientific criteria or mathematical formulae such as those employed in quantitative research (cf. Huber, 1995). In this thesis, formal testing of a subjective hypothesis is not obligatory. This analytic framework is interpretive. The OIPT as a lens is interpretive in the sense that it shapes the constructs of this analytic framework; provides the reasoning behind the study of the IITS and grounding in theory in the findings. As such, this researcher can only establish the resolution of this hypothesis in the interpretive sense, as to how the operationalisation adequately dealt its explanatory constructs (Box 4-1).

Moreover, the resolution of this hypothesis draws upon design results from the reconstruction exercise. Of particular relevance to this research, these design results form the basis for determining sets of solutions to answer thesis **question #3** (§1.5.7):

> Which solutions are fundamentally effective to enhance IITS process performance and leverage successful project development?

The conclusion of this hypothesis rests on the meaning of the design results and sets of solutions as: combined outcomes of the research that are declared as the 'true explanation' of how to resolve the examined complexity of the IITS process (cf. Checkland, 1987: 27). For a subjective hypothesis, therefore, these combined outcomes lead logically to the conclusion that the solution proposal is legitimate and valid. This is demonstrated in the explanations of design results that offer dominant representations of how a component-based project development setting and reconstructed IITS process would function.

Table 5-1 gives a summary of how these concepts have been structured to define the central themes of this transition phase, in line with this operationalisation procedure adapted from Jackson (1994). These themes guide the discussions that follow next.

Table 5-1: Central themes of transition phase
(Source: compiled by author from adaptation of Jackson, 1994: 252)

Central themes	Properties	Thesis reference
[1] Problem frame:	- Problem statement [its content of detail and consequences as its relevant parts] - Thesis questions#1; #2 ; #3	Chapter 1 (§1.1.4) Chapter 1 (§1.5.7).
[2] The *unknown:*	- IITS process [to be defined, analysed, evaluated and reconstructed]	Chapters 6, 7
[3] The conclusion:	- Predetermined solution proposal [for creating autonomous component-based PDS]	Chapter 3 (Figure 3-4)
[4] Conditions given in the data:	- Hypothesis and its explanatory constructs to be satisfied - Problems to be solved; requirements to be met; assessed solution options from analysis of IITS process	Chapter 4 (Box 4-1) Chapters 4, 7, 8
[5] Solution task:	- Analytic framework [problem frame, solution methodological mechanisms]	Chapter 5 (Figure 5-2)

5.3 Problem Frame

In view of the themes mentioned above, the problem statement (§1.1.4) and solution proposal (Figure 3-4) link various concepts under different circumstances of analyses and interpretations. In keeping with Bowen (2006), Blumer (1986) and Lofland and Lofland (1995), sensitising concepts on the problem statement is applied to define a problem frame. This serves to establish precise concepts to shape the theoretical and methodological foundations of the analytic framework, as the solution task. **Table 5-2** gives a summary of the sensitising concepts on the problem statement. The result is the problem frame to guide the discussions that follow next.

Table 5-2: Sensitising concepts on problem statement
(Source: compiled by author)

	theoretical	empirical	Parts of problem statement
Realities	What are the enduring criticisms?	What are the empirical focal issues that can be explained?	Complexity of the current IITS process is out control to appreciate a specifiable phenomenon.
	What is at stake?	What are the empirical consequences?	
Ideal state	What is at stake?	Why is a CBD approach important?	Complexity of the current IITS process is beyond the use of conventional solution approaches.
	What trends are out there?	What solutions can be expected?	

5.3.1 Problem Frame: Realities and Ideal State

First, a problem frame has **theoretical and empirical reality.** Theoretical reality helps in thinking about enduring criticisms and concerns that might have particular relevance to shape the study of the IITS process. Enough research studies (such as Cargill, 1989, 1995; Fomin and Keil, 2000; Jakobs, 2000; King and Lyytinen, 2003; Rada, 1999) have offered discussion about the process of IT standardisation as complicated, chaotic and slow (see §1.3.2). Other unquestioned arguments (such as Baron, 1995; Cargill, 1989, 1995; Willingmyre, 1997) suggest that this process has some advantages. Notably, its consensus approach and formality that take into account global interests of various parties whose involvement would otherwise be omitted. These advantages are compared to consortia-based organisations that are often criticised as less formal and less rigorous in producing IT standards, than government-sanctioned SDOs such as ISO (cf. Willingmyre, 1997).

Empirical reality from this research developed as themes answering case study questions (§4.7) clearly indicates that consensus or any other formality employed in the IITS process does not translate into better performance. Moreover, theoretical criticisms of slowness may be less relevant, because IITS projects have lengthy time scales anyhow. The empirical reality is that, successful project development rests upon the effectiveness of the approaches employed in the IITS process. These approaches appeal to this question: Why is the IITS process complex and chaotic? This means, issues associated with complexity need to be adequately addressed. In doing so, these realities can be explained as knowledge about the ideal state to which problem solving is referenced (cf. Newel and Simon, 1972).

Second, a problem frame has an **ideal state** that responds to the realities by first answering the question: 'What is at stake?' Reducing complexity of the IITS process is a starting point to acknowledge and to respond to these realities. Empirical consequences of complexity of the IITS process described next, serve to give explanations of the knowledge upon which to build the decisions for the ideal state. One prominent decision is to create autonomous component-based PDS from reconstructing core aspects of the IITS process, thereby reducing complexity (see §1.2.5, §5.5).

5.4 Consequences of the Problem Statement

One part of the argument in the problem statement is that, the complexity of the current IITS process is out control to appreciate a specifiable phenomenon. Sensitising concepts (Table 5-2) shows that, discussing the problem statement within a problem frame helps to unravel an overall view of IITS process complexity.
Four statements [#1 to #5] that emerged most clearly from the constructed empirical evidence (§4.8) are guide rational discussion of the consequences. They are content of the IITS process, expectations, operational co-operation and contexts of complexity. The consequences are discussed for each statement.

5.4.1 Statement #1: Content of IITS process is central to its actions and results

Extant literatures use a generic term standards process or process of IT standardisation process (Baron, 1995; Cargill, 1989; 1995; Jakobs, 2000; De Vries and Verheul, 2003; Fomin *et al.* 2003). In spite of the fact that procedures that guide the IITS process are now accessible widely over SDO Internet resources, the use of a generic term implies that this process has no formal structure.

Consequence #1-1: process structure
Major SDOs, such as IEC, IEEE, ITU and ISO outline the stages a formal procedure they use to guide project development. For this content consequence, this empirical evidence confirmed that there is no current framework that can illustrates or mentions an IITS process. This means, in practice, project development is being executed from theoretical assumptions of procedures that have no comparison to a formal process structure. According to Holdsworth (1994) and Humphrey (1989), a process structure gives the theoretical foundation for defining its focus, performance or requirements.

Consequence #1-2: competing IITS process elements
The IITS process stages and project development phases that guided the case study pointed to the evidence of the presence of competing elements (see §4.7.3, Theme #4). The five committees examined in the case study regarded the content of the core process inadequate to guide their specialised and technical activities. Instead, they defined and utilised a PDC to meet their technical obligations. This empirical reality reveals that using both this core process and PDC increases the number of stages through which these projects are developed. The result is the competing IITS process elements that shift with time and context, and can not all be verified.

5.4.2 Statement #2: IITS process expectations

Whenever each project begins, the IITS process imparts different types of expectations to be fulfilled directly or indirectly.

Consequence #2-1: SDO expectations
SDOs consider results produced from the core process to the have importance to the IITS environment, because it provides procedural guidelines intended to fulfil SDO management objectives. For example, SDOs expect a committee to produce a draft standard, as a specified deliverable of the core process.

Consequence #2-2: Committee expectations
Committees, on the other hand, have IT firms as major stakeholders of the standard. Committees want a standard that has perceived advantage to succeed among others in the IT market. The timeliness of the standard in the market place can impact on competitive advantage objectives (cf. Porter, 1998).
Firms representing major stakeholders of project MPEG-1, for example, became early adopters or visionaries (Moore, 1999) of the opportunities the published these standards were likely to present in the market place. Early adopters tend to shape market trends through introducing products developed from draft standards. However, Farrell and Saloner (1986) argue that these early adopters are unlikely to experience the benefits of market network effects in the short-term, because there are few competitors on the same draft standard.

In this consequence, therefore, the scope of IITS process expectations can be described as characteristically incompatible. SDOs focus on produced from its core process aligned with its strategies. Committees make stakeholder wishes a priority. Despite formal procedures guiding the IITS efforts, the combined use of the core process and PDC potentially creates incompatibility of expectations and unfilled strategies. When expectations are not met, certain project development stages would be repeated until a successful result is attained. These issues increases ambiguity and complexity of IITS process performance.

5.4.3 Statement #3: IITS process relies heavily on operational co-operation

Empirical evidence reveals that forums, NSBs and SDOs are independent organisations representing IITS environment functional units. These organisations define objectives that guide their independent functioning.

Consequence #3-1: procedures and obligations

IITS environment operational matters require several procedures that attempt to counteract misinterpretations of independent goals of each organisation. The goals are brought together to define mutual requirements for operational co-operation (cf. Blunden, 1987). Such procedures are stated as obligations for functional unity. Example obligations are stated in the ISO Strategic Plan (2004) and ISO Code of Ethics (http://www.iso.org). Whether they are mutually agreed upon or imposed as obligations, the complexity of the operational matters subsumes procedures. Problems arise hence, in defining desired content of operational decisions supporting IITS process performance (cf. Born, 1994; Holdsworth, 1994).

Consequence #3-2: process paradox

The functionality of the IITS process is an example of the process paradox that Keen discusses in great detail (Keen, 1997:1-6). The IITS process continues to produce a number of highly commercially renowned standards, such as JPEG and MPEG. At the same time, the mechanisms that drive this process have multi-dimensional difficulties.
Empirically determined difficulties cover exorbitant operational costs of catering to numerous committees, lengthy project development time scales and unnecessary activities. Essentially, committees are interested in the value-adding facilitated processes. IS resources currently in use do not provide the committees this value to perform their activities efficiently.

5.4.4 Statement #4: IITS process produces contexts of complexity

IITS process contexts have two facets. One, it has contexts that helped to frame the solution proposal, and which were confirmed empirically, because they provided criteria for the integration of evidence from separate areas of the case study (see Table 4-11). contexts are external environment, internal environment, committees and technical core, and technology (cf. Hackney *et al.* 2006). Two, these contexts create embedded factors generated by IITS process performance (see Table 4-13).

Consequence #4-1: intensity of IITS process contexts

These contexts described above, grow over time. They adopt interweaving and diffuse layers of elements that contrive dynamic relationships. This intensity of contexts, limits effective IITS process performance and its evaluation.

Consequence #4-2: intensity of project development contextual features
All five projects examined in the case study reveal intense contextual features that are shaped by performance and practices. Contextual features covering communication and collaborative information exchanges are also deeply embedded project development constructs. The intensity of project contexts leads to more complexity, such as and dense and diffuse features that are difficult to manage. Project development is forced to be inflexible and riddled with uncertainty. The use of a variety of procedures and policies is imperative to counterbalance uncertain contexts in performance (Blunden, 1987; Galbraith, 1987).

5.5 Importance of the Solution Proposal

The consequences discussed have raised far-reaching implications suggesting that, despite the IITS environment improvement efforts summarised in §3.2.3, IITS process complexity has not yet been adequately dealt with. The second part of the problem statement indicates that, complexity of the IITS process is beyond the use of conventional solution approaches (§1.1.4, Table 5-2).

A solution has been proposed as a CBD approach to solve complexity of IITS process. Two questions posed here, qualify the problem frame consequences against the epistemological assumptions underpinning this solution proposal as an 'ideal state':

Why is the component-based solution proposal important to the IITS process?
What solutions can be expected?

To answer the first question, arguments supporting the importance of the component-based solution proposal are incisive method, challenges and significant advantages.

Incisive method: Unequivocally, IIT standards can no longer be developed in an unstructured process that has deep-seated complexity, chaos and *wicked problems.* A CBD framework is an incisive method, by its capability to challenge sources of complexity. Furthermore, reconstruction of the IITS process within a CBD framework can develop the right solutions fitting project development constructs, and for the resolution of several other issues impacting on this process.

The challenge: Toward an ideal state, the main challenge is the reconstruction of core aspects of the IITS process. The development of draft standards, for example, has been identified as a core concept of the IITS process (§1.1.6). This is where a CBD framework becomes important as an incisive method. This reconstruction leads to autonomous component-based PDS emphasising concept-oriented functionality across the IITS process (Chapter 7).

Another challenge is the robustness of the elements of the core concept to withstand intensive adaptations, so that they fit into a specific design representation of the CBD framework to yield concept-oriented functionality. In this regard, these challenges have been overcome. The design results of the SDS as test case, clearly show that a CBD approach is important to the IITS process. The SDS illustrates that concept-oriented functionality gives special prominence to the development of draft standards focusing only on the conditions and requirement that apply (see §7.3).

Significant advantages: Trends for CBD business and organisation processes point to reduction of complex performance contexts, autonomous concept-oriented process functionality and integrated of process features (Adler, 1995; Herzum and Sims, 2000; Krieger and Adler, 1998; Veryard, 2000). Drawing upon these well-tried concepts, a CBD framework is expected to 'unbundle' the IITS process for effective performance. Beside concept-oriented functionality one of the central themes of this reconstruction exercise is to also 'unbundle' the dynamic contexts of IITS process (cf. Veryard, 2000). Diffuse contexts are sources of complexity. They do not add depth to IITS process, except ambiguity, dynamism, variety and uncertainty (see §1.5.5).

To answer the second question, creating component-based PDS not only helps to reduce IITS process features, but also contexts and sources of complexity, and of the relationships between their properties. They are expected to introduce transparency, because they have a high degree of functional independence from the IITS process. Each PDS can provide greater transparency of solutions regarding project development constructs and integrated functional content (cf. Adler, 1995; Veryard, 2000).

A CBD approach is a radical choice of strategy and a major challenge for any organisation to undertake (cf. Kunda and Brooks, 2000). In view of the consequences described (§5.1.5), it can be argued, the complexity of the IITS process poses far greater threats. The radical nature of this CBD approach is insignificant, compared to how the reconstructed IITS process can tap into fundamental solutions that offer extensive benefits for the long-term future. For example, flexible analysable actions, ease of management of components and evolution-transparent project development that are rewarded by measurable performance results. In other words, the positive implications of future IITS project development are several, such that they outweigh the radical nature of a CBD approach.

5.6 Analytic Framework for the IITS Process

5.6.1 Overview of Analytic Framework

In this thesis, an analytic framework is, on its own merit, a structured approach to the solution task fitting the problem frame (cf. Jackson, 1994). This framework gives greater attention to the assumptions underpinning the researchers' choice of approach to integrate the analysis and reconstruction of the extant IITS process, in parallel with the intentions of the solution proposal.

5.6.2 Analytic Framework Concepts

Findings from the problem frame suggest that the IITS process needs highly differentiated and specialised analytic levels, in order to define its dynamic qualities.

Coherence to examine such a complex and unstructured process begins with its base concepts described in **Table 5-3**. The problem frame provides the data source covering broad statements from which underpinning constructs and analytic concepts (§1.6.1) are developed.

Table 5-3: Summary of problem frame base concepts (Source: compiled by author)			
Problem frame statements [What?]	**Underpinning constructs [Which?]**	**Analytic concepts [How?]**	**OIPT as lens [Which? How?]**
[1] Content of the IITS process:	Process Project development Environment Embeddedness	Contrast analysis - Features (static) - Structural (static) - Functional (static)	complexity dimensions (static)
[2] IITS process expectations:	Environment Process Project development Interconnectedness	Functional	ambiguity dimensions
[3] Operational:	Environment Process Project development Embeddedness Interconnectedness	Contrast analysis Structural (static) Functional (dynamic)	complexity dimensions
[4] IITS process contexts: - of complexity - contextual	Process performance Project development Embeddedness Interconnectedness	Contrast analysis - Features (dynamic) - Functional (dynamic)	complexity dimensions (dynamic)
[5] Wicked problems:	Problem Relevance - Solution proposal - Problem space - Problem solving	CBD framework: - Design representation - Design choice/rational - Content of function intent	solution options critical issues requirements

5.7 Macro Level of Analytic Framework

There are three main features that give a definition to this analytic framework: OIPT as a lens, empirical evidence and methodological mechanisms.

First, this analytic framework applies the **OIPT as a lens** for description and explanation (cf. Gregor 2002, 2006). More so, this framework influences efficacy because the use of OIPT as a lens strengthens grounding in theory. It offers more appropriate *theoretical focus* essential for examining a process with abstruse features and embedded contexts. It draws attention to *theorising* to build the treatment of the empirical evidence (Pettigrew, 1997, 2000). Description, explanation and theoretical focus together help to develop the methodological reasoning behind the analysis and reconstruction of the IITS process. New knowledge for understanding the details of the IITS process have theoretical underpinnings of the meaning from which to characterise solutions sought (cf. Pettigrew, 1997, 2000; Weick, 1995).

Second, this analytic framework gives careful attention to the specified elements of the **empirical evidence:** primary aspects, phenomenon of interest and research hypothesis (see §5.1.1). The IITS process is defined from primary aspects (its content and performance), linking this to its analysis and explanations of its complexity (cf. Pettigrew, 1997). The characterisation of the IITS process makes a separate link to the operationalisation procedure involving reconstruction and analytic test of the research hypothesis, towards its conclusion.

Third, most central to this analytic framework is its application of its approach. This is defined as **methodological mechanisms** that encourage clarity of 'what is required', together with focal tasks of differentiated levels of the analysis and reconstruction of the IITS process ('how to'). To develop an approach, however, the mechanisms need a particular pattern to make sense of the analysis and interpretation of the findings.

Overall, the methodological mechanisms draw heavily upon well-established framing concepts that help with differentiation of the levels of analysis, and to reduce variety in elements that can be covered in this analytic framework. Selected features of OIPT as a lens (from Appendix 1) are integrated in this analytic framework. The methodological mechanisms embody the following base concepts illustrated in Table 5-3 (Summary of problem frame base concepts).

Underpinning constructs: The problem frame statements produced underpinning constructs that are common across the IITS process. These are process and project development views, environment, embeddedness, interconnectedness and problem relevance. These constructs are of particular relevance to the contexts applied in the solution proposal Table 3-4 (Contexts and views of CBD solution proposal) and those derived empirically, for example: Table 4-11 (Criteria for data integration) and Table 4-12 (Primary aspects). This match makes the underpinning constructs reliable to draw attention to specificity of the details of the analytic framework.

Analytic concepts: The complexity of the IITS process requires *contrast analysis* necessary to characterise its details realistically. Well-established process contrast analysis concepts are *static and dynamic.* They have been adapted from a number of scholarly works covering process and performance analyses (such as Born, 1994; Dorfman and Thayer, 1990; Kruchten, 2004; Rossett, 1992, 1999).

Project development is executed through the IITS process. While contrast analysis is relevant to the IITS process, project development contexts offer appropriate focus for explication of dynamic elements and deep-seated issues of complexity that would otherwise be ignored. Example elements are project information, committee technical constructs and performance practices. In the levels of contrast analysis, *dynamic analysis* incorporates relevant principles of *processual analysis* (Pettigrew, 1997, 2000) to study project development. This combination allows for explicitness in the interpretation of empirical evidence unique to the five projects examined.

Evaluation of the IITS process: OIPT as a lens has been designed to facilitate comprehensive analytic actions, evaluation and interpretation of findings. In this analytical framework, the evaluation of the IITS process must provide accurate explication of complexity and performance elements for defining realistic reconstruction actions. Complexity, ambiguity, dynamism, variety and uncertainty are the lens criteria identified as relevant for analytic evaluation and interpretation. The evaluations focus on IITS process performance dimensions, such as characterisation of social and technical contexts of project development; critical issues of complexity; requirements and solution options.

5.7.1 Criteria of Use of Analytic Framework

This analytic framework adopts a rich set of multi-dimensional principles. Plausibility, efficacy, integrated approach and intrinsic value are criteria that draw upon how this framework is applied.

Plausibility is a quality demonstrated in the extent to which principles adopted from other areas (such as process analysis) are applied in this analytic framework to develop appropriate methodological mechanisms. Useful analytic principles reviewed from other areas cover: information seeking and retrieval research involving the study of organisational tasks (Byström and Järvelin, 1995); information needs (Wilson, 1999) and task-based information seeking methods (Järvelin and Wilson, 2003). Relevant theory-driven analytic frameworks covered Forster and Regan (2001) and Johnston and Gregor (2000). This reference to other frameworks is supportive of plausibility criterion.

Efficacy is a criterion addressing the *analytic rigour* in this analytic framework. This is consonant with grounding in theory facilitated through the OIPT as a lens, and with developing a coherent set of methodological mechanisms unique for the IITS process.

Integrated approach is from the fact that there are connected parts and levels in this analytic framework. In practice, different types of methods with unique paradigmatic qualities would be a plausible tactic. This is because this study of the IITS process has different levels of analysis and of the reconstruction exercise. However, methods pluralism would be lead naturally to different kinds of evaluations and interpretations of the findings resting upon the paradigmatic views of the methods. In the interest of *coherence*, therefore, this analytic framework methodologically connects different levels necessary to generate intelligent analyses, knowledge production, understanding and explication of elements contributing to a conclusion (cf. Ngosi and Braganza, 2006).

Intrinsic value is a criterion of judgement of this researcher's work, together with accountability for actions and results. This framework is a powerful tool guiding this researcher (and the readers) to the results of this research. It can not be validated empirically. The use of the framework can only be summarised in the conclusions of this research, based upon its intrinsic value for producing the results that are declared in this thesis (cf. Wilson, 1999).

5.8 Micro Level of Analytic Framework

Figure 5-2 presents the analytic framework which by its definition integrates the study of the IITS process, namely: analysis (Chapters 6 and 7) and reconstruction (Chapter 8). The framework is divided into six parts defining its methodological mechanisms. The parts are described separately to give the readers of this thesis understanding of the comprehensive nature of the study of this process. In the different levels of this analytic framework are areas for developing understanding of the various layers of context of the IITS process, such as synthesis of the findings; determining solution options; reconstruction and interpretation. Categorically, the methodological mechanisms in this analytic framework give the style of analytic rigour lacking in many process studies.

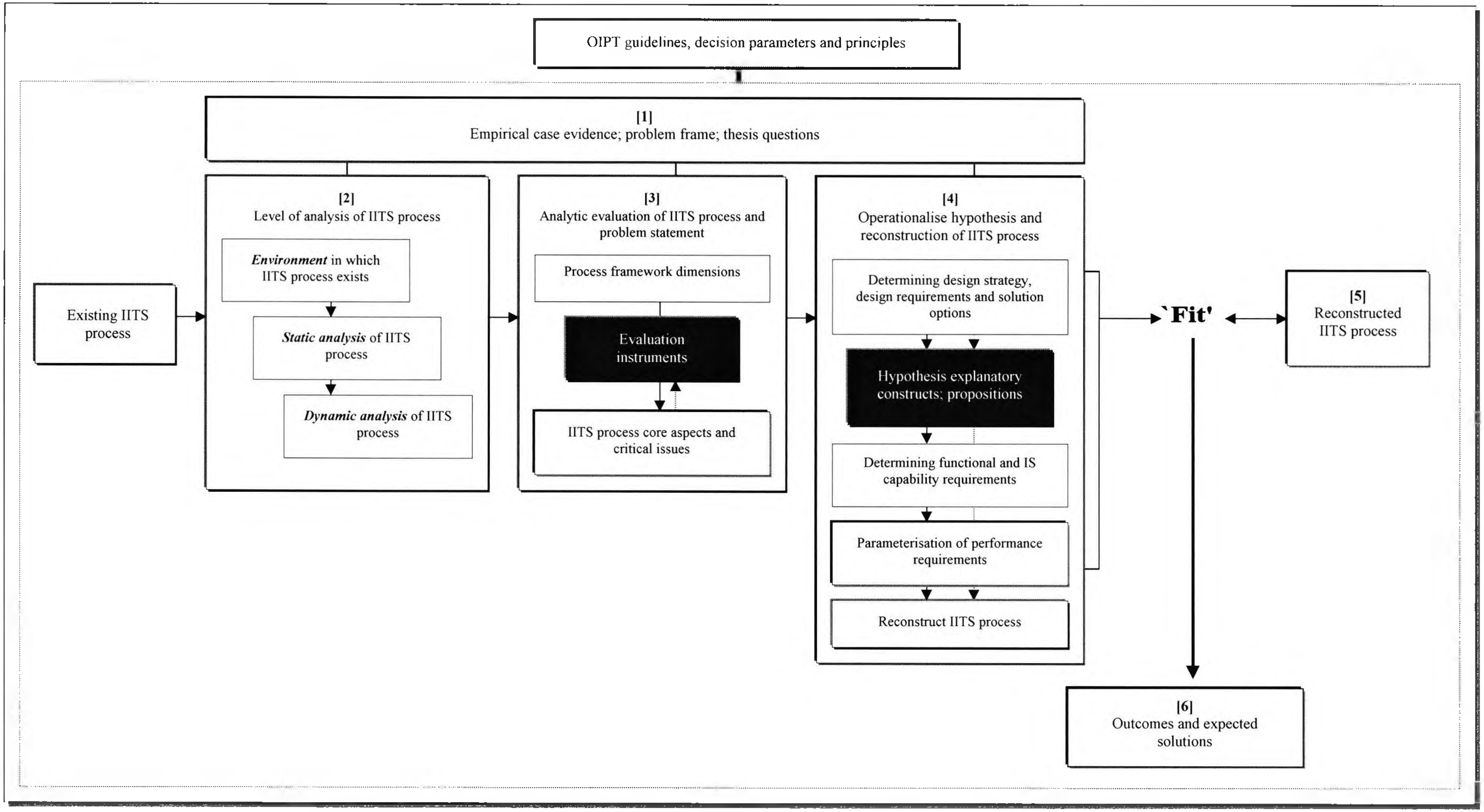


Figure 5-2: Analytic Framework of the analysis and reconstruction of IITS process

(Source: compiled by author)

5.8.1 Characterisation of Analytic Framework

Part [1]: Empirical case evidence

This part is the point of reference of the study of the IITS process. It includes empirical evidence summarised in §5.1.1; thesis questions (§1.5.7) and problem frame consequences of the problem statement (§5.4).

Part [2]: Levels of analysis of IITS process (Chapter 6)

This part defines the study of the extant IITS process with reference to guideline 1 of the OIPT lens (Box 3-2, §3.3.4). The foal tasks of the study of answer thesis **question #1** (§1.5.7):

> How can the IITS process be analysed to demonstrate how the projects are developed and to address critical issues of its complexity?

Altogether, there are three levels emphasising contrast analyses involving the underpinning constructs of the methodological mechanisms of this analytic framework:

[a] Environment in which the IITS process exist
[b] Static process analysis
[c] Dynamic process analysis

The importance of contrast analyses is analytic rigour complementing differentiation, specificity and coherence, as follows:

One, each level ***differentiates*** understanding of the IITS process across multi-lateral levels of analysis. Static analysis (Born, 1994; Dorfman and Thayer, 1990) deals with content features, such as life cycle, functions, deliverable items and technical details of project development. Dynamic analysis (Dorfman and Thayer, 1990; Kruchten, 2004; Rossett, 1992, 1999) has emphasis on performance and embedded elements.

Two, contrast analysis provides ***specificity***, because data are collected from each level exclusively. Specificity provides location of explanation of elements that give substance to the dynamic interplay of factors influencing IITS process performance and embedded elements (cf. Pettigrew, 1997).

Three, differentiation in the levels of analysis encourages ***coherence*** to arrange the classification of findings to then, develop specific details of the evaluated at each level. The findings from each level of analysis are linked through different stages of evaluation, synthesis and reconciliation.

Part [3]: Analytic evaluation of IITS process and problem statement (Chapter 7)

In this part, an analytic evaluation of IITS process performance has two explicit aims. First, to define IITS process performance in terms of the critical issues associated with complexity and phenomena. Second, to classify details of the IITS process explaining the epistemological underpinnings of the integrated facts of IITS process performance for consideration in the reconstruction exercise:

[a] A process framework is defined providing a summary of the IITS process performance. There is a systematic evaluation of the contexts of complexity through criteria specified for the OIPT as a lens.

[b] This framework is the basis for theorising about the core aspects of the IITS process, its challenges and critical issues.

Part [4]: Operationalisation of hypothesis and reconstruction (Chapter 7)

In this part, the focal task is the combined operationalisation procedure for the analytic test of the research hypothesis, leading to the definition of the reconstruction actions. Integrated facts from parts [1] and [2] give explanations to answer thesis **question #2** (§1.5.7):

> Which core aspects of the IITS process can be reconstructed to deal with specified critical issues and to create a test case project development setting?

To adequately answer this question, the **operationalisation procedure** is executed in systematic steps forming the solution method. Explanatory constructs of the research hypothesis form part of the steps (Box 4-1, §4.8.3), to include the specifications of the core aspects of the IITS process and critical issues. The steps cover key elements adapted from reviewed literatures covering design issues (such as Galbraith, 1973, 1987; Lawson, 1997; Lee, 1997; Starkey, 1992):

[a] Operationalisation requirements are the design strategy, requirements for design functions and solution options (cf. Starkey, 1992). Specified dimensions of OIPT as a lens ensure clarity of explication of the design features and solution options simultaneously (cf. Galbraith, 1973).

[b] Framing of reconstruction actions deals with selection of core aspects for reconstruction (§7.5).

[a] Exclusively, the reconstruction exercise is carried out on the development of draft standards selected to primarily create a core aspect of the IITS process. Successful reconstruction requires structured modelling; otherwise, the results might not meet stated requirements for functionality. Thus, BDDs and AFDs (Rock-Evans, 1992) are the choice of modelling notations applied to give a structured representation of the content of each core aspect.

Part [5]: Reconstructed IITS process (Chapters 7 and 8)

This part defines the design results from part [4]. The first design result is that the component-based Standards Documentation Setting (SDS). It embodies functional and IS design results which to differentiate the explications of its operational content as a component-based PDS. The second design result is the representations of the reconstructed IITS process compared to the predetermined solution proposal.

Part [6]: Outcomes, expected solutions and synthesis of results (Chapter 8)

This final part answers thesis **question #3** (§1.5.7):

> Which solutions are fundamentally effective to enhance IITS process performance and leverage successful project development?

The choice of design result for the SDS is the focal point for the synthesis of results. A result specification framework (Figure 8-1) is applied with powerful instruments providing concurrent synthesis and decisions making. In addition, this framework provides coherence of synthesis, by classification of the interpretations of the results that apply to the SDS: Functional, Technical-IS and Tacit strategies.

This synthesis approach draws attention to the methodological and theory lens meanings in the results. The interpretations of the results thus have depth, because the classifications cover specification of 'fit' of their context of use and solutions. Relevant concepts of *fit* are adapted from OIPT as a lens (Galbraith, 1977; Daft and Lengel, 1986; Doty *et al.,* 1993) involving:

[a] Dimensions of 'fit' of solution matching the functionality of the SDS.

[b] Dimensions of operational content fitting specified solutions for use of IS.

[c] Definition of the minimum sets of requirements to be met: such as, capabilities and practices for the SDS and reconstructed IITS process framework.

5.9 Summation of Chapter

In this chapter, a transition phase sensitised concepts of the problem statement to present a problem frame that justifies the operationalisation of the empirical evidence. This approach also developed substantive concepts that strengthened the design of the analytic framework, and clarity of the epistemological assumptions underpinning theory lens methodological mechanisms. The next chapter is the application of this analytic framework focusing on the static and dynamic analyses of the current this IITS process.

Chapter 6

Current IITS Process and Findings

6.0 Introduction to Chapter

This chapter provides comprehensive static and dynamic analyses of the current IITS process. Measures from the analytic framework guiding this study are summarised (§6.1). The results from the levels of analyses are the environment in which IITS process exists (§6.2), committee operational perspectives (§6.3), static (§6.4) and dynamic IITS process (§6.5). Example areas of IITS process with dynamic interplay of elements are described (§6.6), followed by contextual and embedded features (§6.7). The current IITS process is summarised (§6.8) through its identified functional perspectives applied to integrate the findings (§6.9). The chapter concludes with a summation (§6.10).

6.1 Measures From Analytic Framework

The analytic framework (Figure 5-2) is the approach followed in this chapter to study the current state of IITS process. This framework gives a justification for how thesis question #1 is answered. This question is restated here for ease of reference:

> **Thesis question #1**: How can the IITS process be analysed to demonstrate how the projects are developed, and to address critical issues of its complexity?

6.1.1 Part [1]: Empirical Evidence

Empirical evidence mentioned in §5.1.1 is carried forward as presented. It provides guidance to the discussions that follow next.

6.2 Results of Current IITS Process Environment

6.2.1 Part [2]: IITS Environment Defined

The first level in part [2] of the analytic framework is the environment in which IITS process exists. **Figure 6-1** presents the empirically determined constitutional structure defined in this thesis as the **IITS environment**. IITS is one of the main subject areas. 'Environment' is a fitting interpretation, because the six divisions in this diagram form the cardinal constitutional perspective of standards-making bodies. The definition of this constitutional structure also draws the readers of this thesis to the features upon which the IITS process depends for its functionality.

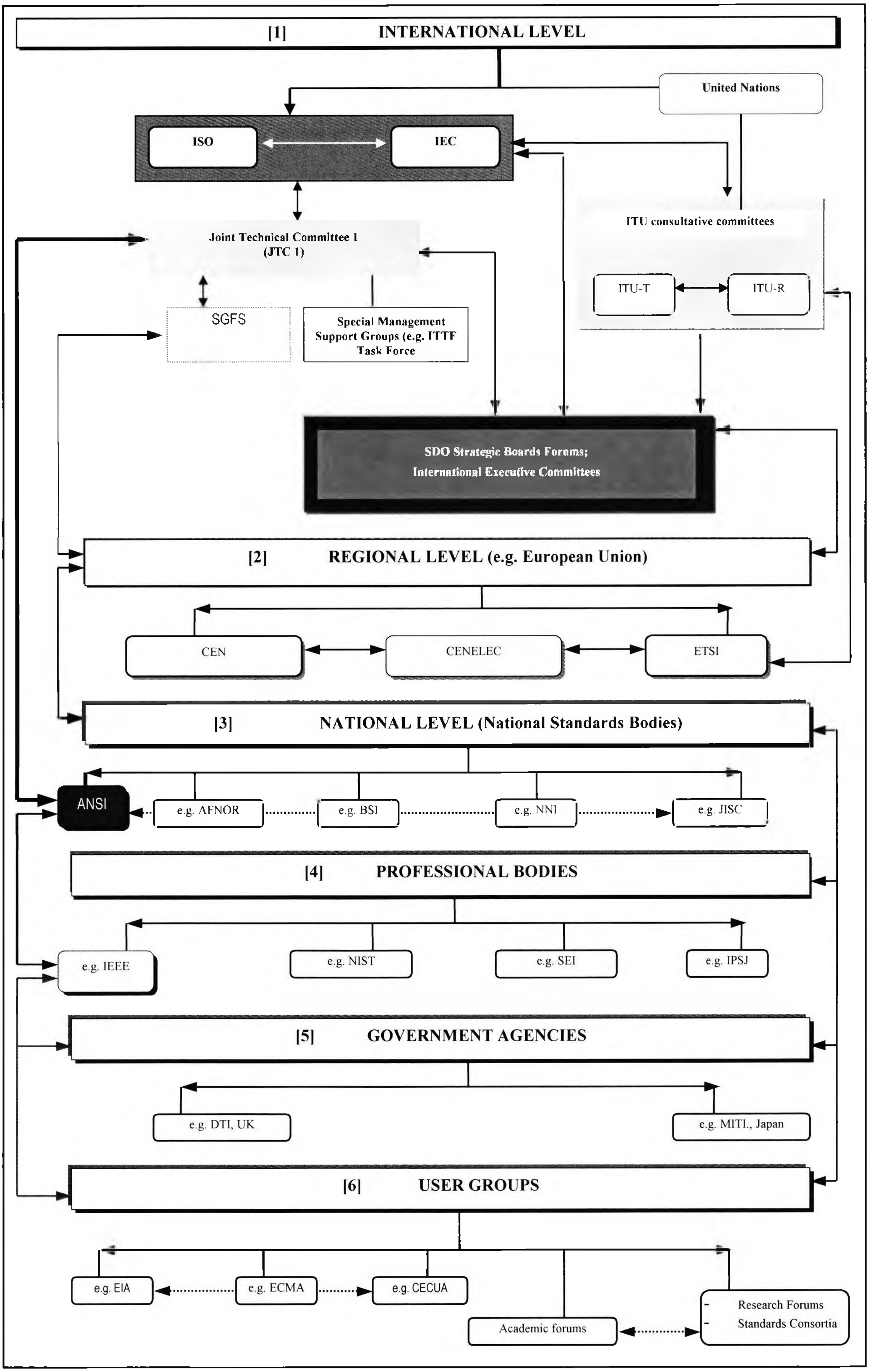


Figure 6-1: Constitutional Structure of IITS Environment

(Source: compiled by author)

6.2.2 IITS Environment Functional Perspectives

The basis of this analysis is *how* the extant IITS environment functions with reference to its constitution described in Figure 6-1 above. A number of scholarly works covering organisation studies (such as Burton and Obel, 2003; Galbraith, 1973, 1977; Robey and Sales, 1999; Yammarino and Dansereau, 2003) describe functionality as a subset of the total organisation. Empirical results from this research reveal that this constitutional structure operates within the 'internal environment context' and 'external environment context' (cf. Hackney *et al.* 2006, Table 4.11: Criteria for data integration). This researcher argues that, since these contexts represent the empirical reality of IITS, they offer a helpful contribution to differentiate understanding of the environment structures and functionality perspectives.

First, the point of reference of the **'internal environment context'** is the constitutional structure. This is designed for the co-operation of nations, standards-making bodies and other independent organisations that propel IITS efforts. This form of constitution permits the scope of *functioning* of the IITS environment with independent organisations pursuing mutual goals and activities, together in one structure. It is akin to the containment of independent organisation functions. SDOs, NSBs and professional bodies also serve independent objectives and functions in the different levels of this constitution, such as Regional and National. Because this constitution greatly depends upon co-operation, these independent organisations represent IITS environment *functional units*. The different levels mark *boundaries* between these organisations, with a focus on required operational co-ordination and reporting mechanisms.

Second, **'external environment context'** is concerned with stakeholders. Definitions from Bryson (2003), Mitchell *et al.* (1997) and Friedman and Miles (2002) suggest that stakeholders have a legitimate interest or a share in an organisation's activities, particular projects and results, to include their success in the marketplace. In Figure 6-1, SDOs involving ISO and IEC are the highest authority. They have the entrusted responsibility to direct IITS efforts and, to address the needs and wishes of member nations. On the one hand, constitution makes NSBs, professional, government agencies and user groups stakeholders to SDOs. On the other hand, each organisation functions independently. It can attract stakeholders to which it attempts to address its activities and results. Through its constitution and by its connection with the 'external environment context', the IITS environment attracts multiple-stakeholders hence (see §1.1.1).

Indeed, IITS environment is self-funding and non-profit making. The role of stakeholders is therefore a central core of its functioning. Typically, corporations, industries, government bodies and voluntary investors contribute expertise, finances, information and technology. The stakeholders can be involved in the development of any project depending upon their co-operation, contribution, interest and representative influence.

Another meaning that can be added is that, together, constitution and functioning impart the IITS environment *ideology* that influences the way these independent organisations co-ordinate through agreed practices or procedures (cf. Egyedi, 2000). The connection between constitutional structure, functioning or ideology, however, is not immediately apparent. This is because there are several other features interacting in an unassuming manner. Committees, processes, practices, inter-organisation relationships, management, policies, practices, strategies and resources fit into the scope of IITS environment functionality. IITS efforts impart cultural, social and technical contexts with different factors: for example, responsibilities (§62.4, §6.3.3) and practices (§6.3.4) have an influence on IITS environment functionality.

The IITS environment is therefore, subsumed in *constitutional meanings* of a chosen ideology bearing upon its content, functionality and practices. Other types of approaches of their analysis are needed, such as institutional analysis (DiMaggio and Powell 1991) and systems thinking (Checkland and Scholes, 1991, Wilson, 1990). However, these approaches are incompatible with the goals of this thesis.

6.2.3 Protocols of IITS Environment Functional Perspectives

Another important aspect of this analysis is protocols underpinning IITS environment functionality. **Table 6.1** that follows next, presents predominant protocols derived from the empirical evidence of the study of forums and secretariats (§4.3.3; Appendix 6B). This evidence illuminates the fact that, IITS environment is a complex infrastructure (§4.9, Conclusion #1). These protocols are implemented to ensure some degree of functional effectiveness.

6.2.4 Environment Functional Participation

An interesting point is the fact that, these protocols in Table 6.1 draw upon the status of participation assigned to the organisations represented in the constitutional structure. This participation is a functional aspect, as well as, a requirement necessary to endorse co-operation and responsibility formalities for various activities. Without a description of this participation, it is an impossible task to define IITS environment functionality that is embedded in the scope of the IITS process. Within the constitutional structure (Figure 6-1) there are five main categories of participation, namely: co-operation, collaborative and specialised liaison, professional alliance and operational co-ordination.

Co-operation is a practice at environment level. It is contrived from the cross-functional relationships and inter-organisation relationships (cf. Bensaou and Venkatraman, 1995; Blunden, 1987; Williams *et al.* 1996). In the IITS environment in particular, independent organisations register their participation to become members to various committees that develop assigned projects. Although the concept of inter-organisation relationships applies, SDOs (such as CEN, CENELEC, ISO, IEC, and IEEE Computer Society) tend to follow **integrative functional relationships** among them to promote the co-operation needed to connect their separate subject matters and strategies.

Table 6-1: Protocols of IITS environment functionality (Source: compiled by author)		
Environment levels	**Participation category**	**Functional responsibilities impinging on IITS process**
[1] Strategic level [SDOs]	**Active**	[a] Conjoint ownership and authority established from the need to merge interconnected subject matters (e.g. ISO and IEC). [b] Entrusted responsibility and social responsibility for strategic direction, policies, management and results.
[2] Strategic level [management]	----	Tactical, technical and operational management e.g.: [a] JTC 1, accountable to ISO and IEC for IITS technical and procedural activities. [b] ISO Task Force (ITTF) project management; ballot registrations; standards publications; technology resources.
[3] Organisation level [NSBs]	**Active and full voting rights**	Assigned operational responsibilities among member nations: [a] NSBs, acting for SDOs (e.g. Switzerland secretariat to ISO; ANSI secretariat to JTC 1). [b] NSBs acting as secretariats for: operational management of committees; monitoring projects; dissemination of information.
[4] Organisation level [Specialised]	**Collaborative liaison**	Assigned specialised responsibilities e.g.: [a] Certification Bodies, CBA (e.g. Certified Laboratories): testing activities from IITS process e.g. type approval tests for compatibility, safety, compliance of equipment and conformity of the systems recommended in IIT or national standards. [b] Registration Authorities (RAs) e.g.: Registration of terminology; technology functions; maintenance of requirements or implementation of registrations.
[5] Stakeholders level	**Collaborative liaison**	[a] Government agencies (e.g. UK, DTI): [b] Industry User groups focusing on specific IT industry needs (e.g. ECMA). [c] IT firms supporting IITS strategies and policies as Recognised Operating Agencies (e.g. UK BT).

Procedural conventions such as those in ISO Guide 26 (http://www.iso.org/directives) are then specified to encourage integrative co-operation, co-ordination and relationships hence. However, each SDO has the responsibility to its members to devise methods that enhance co-ordination and promulgation of activities, decisions, information and standards.

Collaborative liaison strengthens open contributions to IITS activities and decision-making processes. The Regional Level, for example, the EU has a centralised standards development infrastructure through CEN, CENELEC and ETSI. This unity produces European standards that address and promote the harmonisation of essential requirements perceived by a number of nations within the Union, such as France, Germany and UK. These standards bodies can be legally participate at both, at national and international levels. For example, ISO assigns collaborative liaison to CEN, CENELEC and ETSI. This liaison allows these bodies to act in an advisory capacity, when there is an IITS project deserving inputs from the EU standards community. Independently, NSBs within the EU can utilise their full voting rights to comment on international draft standards under review, to JTC1 (cf. Jakobs, 2000).

Specialised collaborative liaison is another status that is given to forums engaged in pre-standardisation efforts, such as the development of functional standards (cf. Cargill, 1989; Jakobs, 2000). An example is the now the disbanded Special Group on Functional Standardisation (SGFS). However, SGFS still supervises the revision and maintenance of functional standards that are produced in various EU project teams and workshops.

Professional alliance is a status formed to acknowledge the fact that IITS environment has subject areas, problems and requirements that overlap each other. Three key areas in which professional alliances are exercised are as follows:

[1] *Standards business professionals* chosen from SDOs and NSBs participate in SDO Strategic Board Forums and International Executive Committees. They evaluate assessed problematic issues raised from various activities and from stakeholders. Shared strategies and policies are then defined to ensure that SDOs and NSBs implement effective measures for improving co-operation and communication mechanisms in the use of information.

[2] *Standards business domain* is where policies, procedures and management practices are developed, to include provision of services to stakeholders and society in general. Standards professionals selected from committees or from experienced managers and industry consultants contribute to business domain issues.

[3] *The Professional Level* involves major organisations such as the IEEE Computer Society. It does not produce international standards. However, its professional standards (such as IEEE 1074), are developed with the aim to align with international standardisation principles. These standards can be submitted to ANSI the secretariat to JTC 1, for adoption internationally and, without amendment.
In the cases where there are areas of conflict, it is always hoped that professional alliance contributions might help improve the co-operation of requirements and decision-making. In the development of the case study projects IEEE 1074 and ISO 12207-1, ISO JTC 1 TAG was created to manage resolutions of the conflict of interest regarding the coinciding subject matters and draft standards ballots (see §4.1.4).

In recent years, however, professional alliances have been extended to include user and consortia standards organisations that respond to the needs of manufacturers or sectors. For example, '7 and 8 bit code standards' produced in the user group ECMA were adopted in JTC 1 SC 2 for the development of project ISO 10646 (see Table 4-1: Adopted items of project ISO 10646-1). ECMA, on the other hand, has collaborative liaisons with consortia standards organisations such as W3C that produces XML formats for Internet-based applications (http://www.ecma-international.org/; http://www.w3.org/Consortium/).

Operational co-ordination is a necessary requirement within this constitutional structure to allow lateral-organisational relationships underpinning all standardisation activities (cf. Galbraith, 1977, Ostroff, 1999). Typically, NSBs provide committees with operational co-ordination. The NSBs must be registered as active member nations to an accredited SDO. They are required to have authoritative involvement in their own country that allows them to develop independent standards that deal with national requirements and concerns. Active membership entitles NSBs full voting rights for all matters concerning all standardisation activities. This includes active roles for matters covering:

[1] **Secretariat responsibilities** to manage IITS committees. This role is akin to operational facilitators to co-ordinate activities and results (cf. Williams *et al.* 1996)

[2] **Participation in policy development** within the subject areas covered by relevant SDOs. This includes designing the scope of technical concepts, procedures and the obligation to comment on the accuracy of the content of all standards.

[3] Another non-role issue is that NSB can benefit from having **influential representation** in the IITS process. Success of the international committees depends upon contribution from several national efforts. In the case study projects ISO 10646, ISO 12207-1, ISO JPEG-1 and ISO MPEG-1, it was practice for NSBs to create equivalent groups that propelled the activities of the international committees. This connection brings together a wide variety of stakeholders. Often, projects that have high priority have both national and international influences involving information or R & D activity from global IT firms and support of government agencies.

6.3 Committees Operational Perspectives

6.3.1 Committee Structures

This evaluation draws upon the empirical evidence of the structures of the five committees examined in the case study. **Figure 6-2** illustrates abstract structures concerning case study committees for ISO JTC 1 SC2, SC 7 and SC 29 and how they fit in the constitutional structure as sub-levels. This diagram further simplifies Figure 6-1: 'Constitutional Structure of IITS Environment'.

Drawing upon this elaborate structuring, this researcher argues that project development can not be described adequately without due attention to the committee structures. This is because the performance of the committees is apart from the environment context in which they are embedded (cf. Mohrman *et al.* 1995:xv). This link between the constitutional structure, committees and project development thus draws attention to an array of other features. For example, subject matters, hierarchical methods, institutionalisation and cross-committee liaison.

Subject matters: Figure 6-2 shows that committees are structured according to IITS subject matters assigns by an SDO. The subject matter legitimatise, among other things, accountabilities for project development and the results of the activities. For example, ISO SC 7 is assigned with most areas concerned with software engineering standards and quality management projects, producing standards such as ISO 12207-1 (see Table 3-5: Selected case study items). Furthermore, the subject matters help to manage a wide variety of topics that SDOs deal with through their co-operation practices and to balance operational priorities.

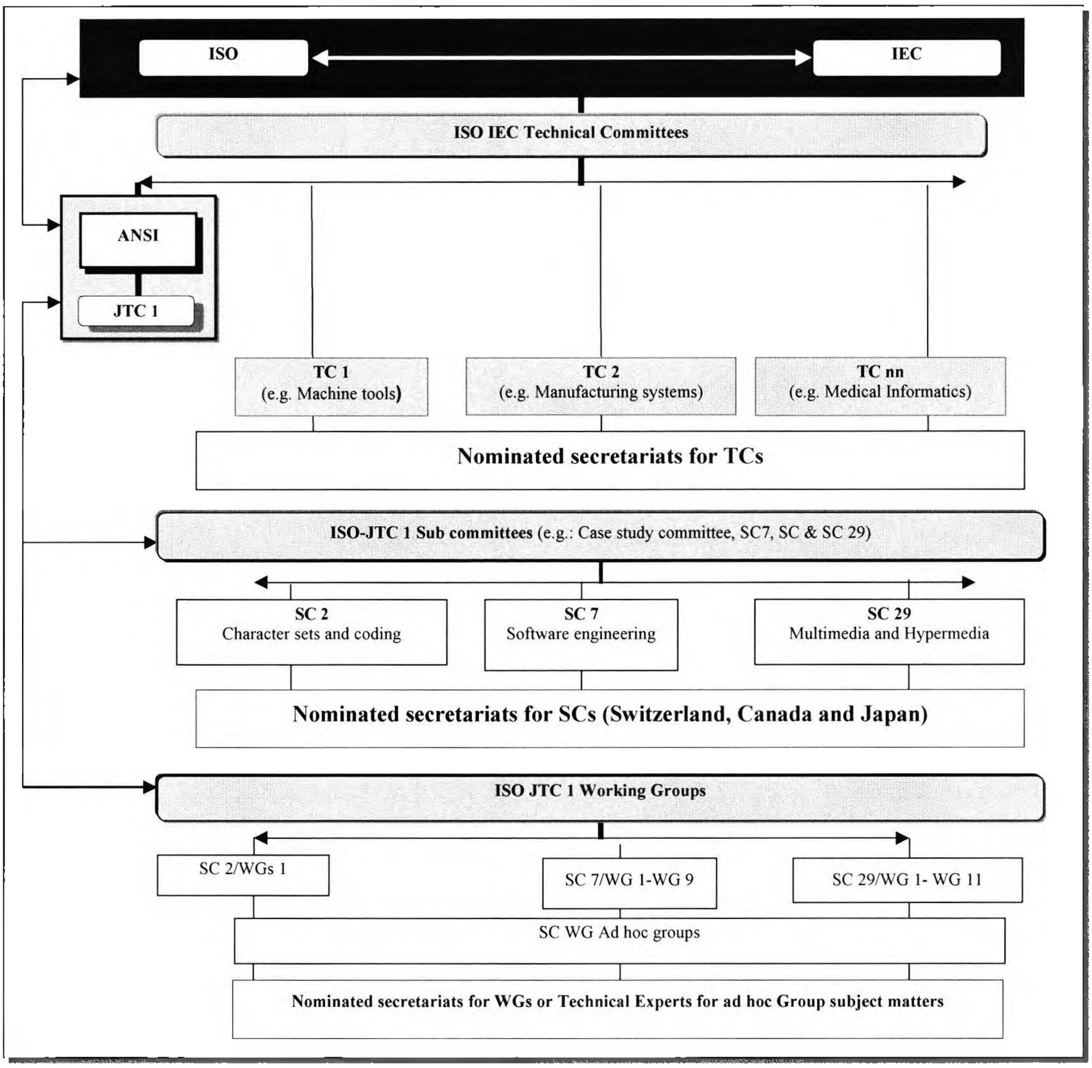


Figure 6-2: Abstract Structures of JTC 1 Committees (based on case study)
(Source: compiled by author)

Hierarchical methods: Predominantly, IITS environment constitutional and committee structures are linked by hierarchical mechanistic methods of communication such as those mentioned in Galbraith (1987). Committees report issues of conflict and results through an assigned secretariat, for consideration by an SDO. In turn, reciprocal elements between committee, secretariat and SDO involve complex communication procedures, decision-making processes and feedback cycles. When procedures are not followed, however, the lines of communication are disrupted. If this is not the case, decision-making processes through the hierarchical mechanistic structure take considerably longer to complete (cf. Blunden, 1987; Wagner and Hellenbeck, 1992).

Institutionalisation: Institutional studies on standardisation (such as Schmidt and Werle, 1998; Werle, 2001) found that standards-making bodies develop and maintain their own ideology of institutionalisation: for example, voluntary participation in committees, collaboration, negotiation and consensus rules. The emergence of committee structures is thus, in part, due to the IITS environment institutionalisation requiring formality through rules and procedures. This institutionalisation is extended to the committees, because this IITS environment ideology entrenched in its functioning and practices permits this.

Consequently, committees for their reliance upon collaborative efforts of various experts to develop projects, create their own hierarchical structures and reporting mechanisms. Committee structures can also function independently from SDO and NSB structures. However, this creates *expert power* and professional bureaucracy (Tidd and Hull, 2002) within environment functional structures, in order to cope with uncertainty (cf. Paton, 1987).

Cross-committee liaison: While a hierarchical structure does not provide straightforward collaboration of highly technical projects, cross-committee liaison is the norm in IITS efforts. It is encouraged for sharing information on connected subject matters. It influences problem solving and creativity in projects that often have cross various subject matters. It is not a solution to project development problems, however. Scowen (1993: 25) raises a problem of cross-committee liaison that supports this:

> Almost all the members of the committee and working groups, despite the official liaisons, know little about most existing standards nor the work which is going on in other subcommittees. The inevitable result is that many standards, despite the requirements prescribed in the Directives, redefine the same concepts. Naturally, they do it more or less different in content, notation, and terminology. The standards are therefore unnecessarily large and incompatible with each other. They also take considerably longer to complete.

6.3.2 Committee Functionality

Committee functionality relies heavily upon **responsibility** to the constitutional hierarchy and to the committee structure itself, together with **accountability** for actions and results.

Figure 6-3 gives an empirically determined functional structure from project IEEE 1074. Interestingly, this format of committee structure and functionality was identified in the empirical evidence as universal to all five committees examined in the case study. IEEE WG 1074 is used here as an example, because it clearly presented stronger links between the features already described in §6.3.2, such as structure, subject matters and how assigned responsibilities fit into the scope of project development. Together, these features, make the committee structure a functional entity which has supporting operational elements.

6.3.3 Committee Responsibilities

These responsibilities elaborate the content of Figure 6-3 covering chairpersons, convenors, project editors, rapporteurs and subordinate committee.

Committee chairpersons are often chosen from nations that pledge to provide direction for the project. This is based upon the expertise of the chairperson in the project subject matters; sponsorships that have government and industry approval of that nation. Chairpersons are required to possess specialised knowledge to proactive leadership to direct the development of the project to successful completion. They have the responsibility to ensure that a project has a good cross section of subject disciplines unique to the objectives to be pursued in the IITS process and IT markets.

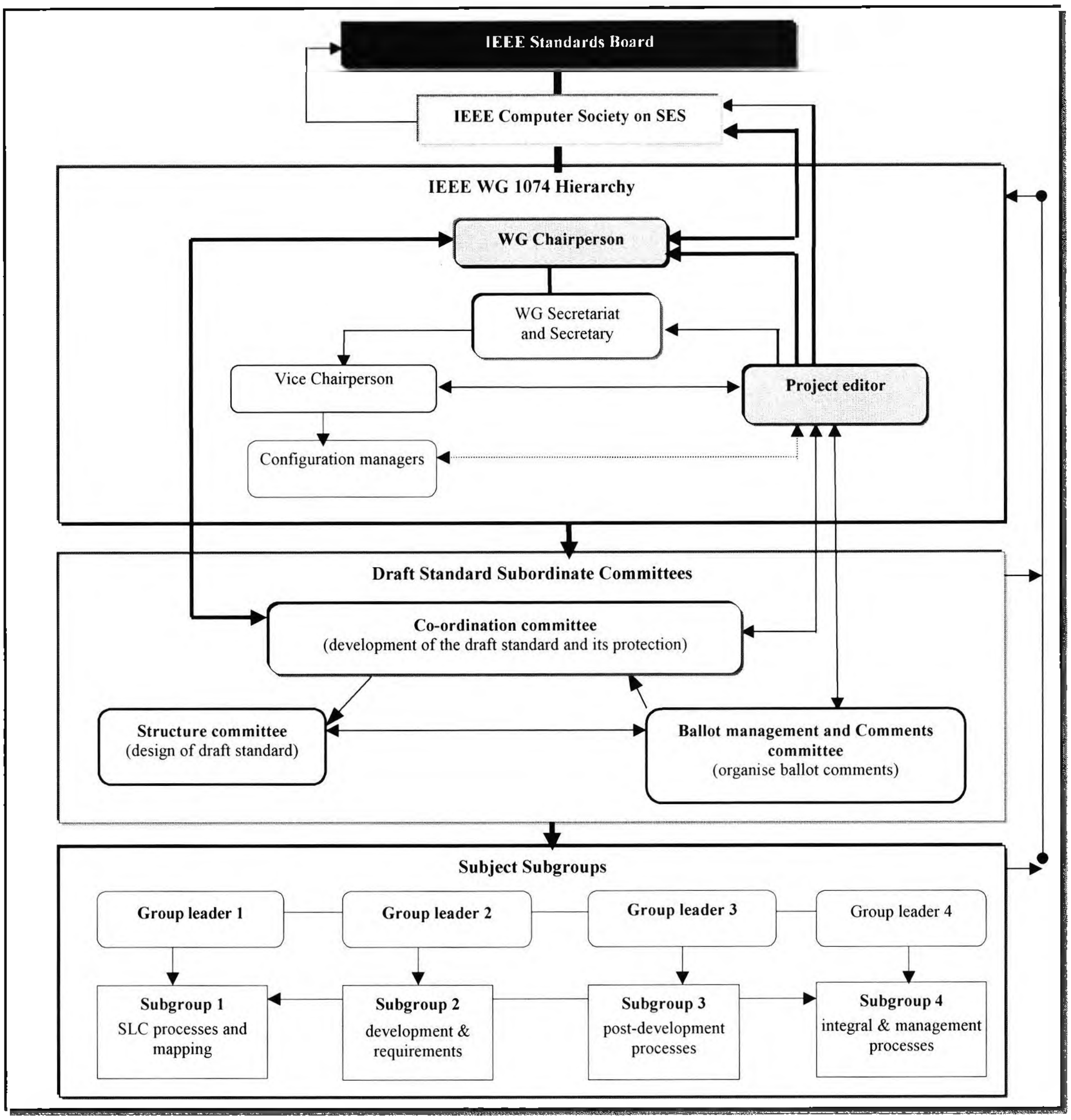


Figure 6-3: Structure of IEEE WG 1074 (based on case study)
(Source: compiled by author)

Convenors is the term commonly assigned to separate this role from that of the SC chairperson. Other detailed responsibilities of IITS chairperson and convenor roles can be found in a survey conducted by Spring *et al.* (1995). Overall, convenor lead WGs providing subject matter and plenary meeting leadership, and conflict resolution on technical issues.

Project editors are accountable to the committee and SDO, for the documentation of draft standards for a specified project. Empirical evidence across the five committees examined reveals that, when a project has several other parts, as in MPEG-1 (see Table 3-5), it can be assigned one to more project editors to be accountable for each part. Draft standards involve collaborative writing. Individual developers would be assigned to write a section or a chapter of a draft standard. In this regard, project editors have the responsibility to co-ordinate the committee's collaborative writing tasks of a draft standard and its refinement. They have the final say on the confirmation of the technical content of the final text of the proposed IIT standard.

Project rapporteur is another central role assigned to developers with expert authority in particular subject matters. Rapporteurs to project MPEG-1, for example, had the responsibility to the committee, to manage information and technical documents; to analyse the inputs gathered from R & D results. They work with convenors and project editors to establish efficient methods for selecting committee knowledge required in the development of the draft standard.

Subordinate committees: The development of a draft standard is complicated that it can span several years. IEEE WG 1074 and MPEG-1 committees, for example, established 'subordinate committees' with the following responsibilities:

[a] *Co-ordination committee* to protect the content of agreed project inputs and the intended standards. This committee would also oversee the technical development of draft standards, its reviews, comments and refinement.

[b] *Draft standard structure committee* to manage the chapters of the draft standard.

[c] *Ballot management and comments committee* for evaluation, collation and management of comments for committee meeting decision-making processes.

These empirical findings of committee functionality support Cargill (1997:10) who indicates that, the decisive position of the committee in agreeing the scope and nature of the work facing it, together with the role of the chairperson are necessary to drive the project towards its goals. To add to Cargill (1997), these committee functional practices reflect the complex nature of the projects and the development cycle. The structure described in Figure 6-3 suggests that the committees can work independently 'outwardly-oriented' toward the objectives pursued in the project development cycle (cf. Quinn *et al.* 1997:507).

Given the fact that project information resources are limited to human effort, committees face the challenges of organising the developers into teams matched to subject matters and to available expertise. An organised structure instils formalities to empower the developers in gathering project information and completing assigned tasks for which they are accountable. Subordinate committees would then increase the chances of the committee to manage the project development life cycle more effectively.

6.3.4 IITS Operational Practices and Principles

IITS projects development impinges on cross-functional operational practices. Selected NSBs are assigned secretariat responsibilities to manage committee activities. Secretariats channel committee formal concerns and results (such as draft standards) to a designated SDO for consideration. Using NSBs, as 'operational units' is an approach, which can reduce the need for processing information across various organisations (cf. Galbraith, 1977, 1987). Information promulgated from SDOs to NSBs, for example, is distributed locally to committees in that nation. Thus, these operational practices can be thought of as a tacit, because they achieve the IITS environment objectives bearing on the constitutional structure for: accountability for actions and results, co-operation and co-ordination of functions.

In **Table 6-2,** well-established framing concepts from reviewed literatures (such as Best, 1996; Correia and Wilson, 2000; Wagner and Hellenbeck, 1992; Watson, 1993; Wilson, 1999) are helpful to add depth and detail to the empirical explication of the principles underpinning IITS operational practices.

Table 6-2: IITS environment operational principles
(Source: compiled by author)

Operational principles [What?]	**Features [How?]**	**Areas [Which?]**
[1] Information preparation:	Information is presented in documents transacted to participants: document numbering for reference in all action or correspondence	SDO management groups; NSBs, committees
[2] Information exchange:	Communication, co-ordination, meetings and workflow leading to certain actions and outcomes	SDO management groups; NSBs, committees
[3] Operational control and maintenance:	Registration numbers translated into inventory for: ballot results, documents, inventory records, draft standards, published standards	SDO management groups; NSBs,
[4] Understanding of required actions:	Each document that is transacted bears instructions for action; deadline for returns of required actions; decisions	SDOs, NSBs committees
[5] Confidentiality:	- Decisions as to whether members and non-members can access the standards documents promulgated through their Internet portals or NSBs - Copyright clauses and policies for intellectual property right are utilised to manage aspects of confidentiality	SDOs, NSBs SDOs, NSBs
[6] Reciprocity	Channels of reporting and feedback within the constitutional structure, and externally with stakeholders - Inter-organisational operational sharing of resources, information - Delivery of services to users/stakeholders; value to stakeholders and society - Promulgation of activities, results	SDOs, NSBs committees
[7] Information management	- Media such as the Internet and paper add value to the management of information: storage, search, retrieval for on-going actions - Management of projects: monitoring stages and events for on-going actions	SDOs, NSBs committees SDOs, NSBs
[8] Technology management	Inventory of resources; management of IS operational procedures;	SDOs management groups, NSBs

6.4 Part [2]: Results of Current IITS Process

6.4.1 Content of Static Process Analysis

In this second level of the study of the current IITS process, static process analysis is applied. According to Born (1994), Dorfman and Thayer (1990) and Krutchen (2004) static process analysis describes the current state of a process, at a certain point in time.

A concern with the current IITS process is its *unstructured* and chaotic nature (see §5.4.1). It has highly interconnected *social contexts* from diverse participating groups. It is highly *technical and specialised,* because IT standardisation is a process of technology generation. These views are well supported by a number of other standards scholarly works (such as Cargill, 1989, 1995; Fomin and Lyytinen, 2000; Fomin and Keil, 2000; Jakobs, 2002; Hanseth *et al.* 2006; Schmidt and Werle,1992; 1998).

This static analysis is theorised from the empirical evidence to generate the definition, content details and criteria of functioning of the extant IITS process. The empirical evidence referenced in this analysis covers primary aspects (Table 4-13) and complementary categorised elements of project development (Appendices 6 and 7).

6.4.2 Definition of IITS Process Structure

The first step is sense making of the empirical evidence to reveal a definition of the extant IITS process. As identified in the empirical evidence themes #1 and 2 (§4.7.3) the extant IITS process has two main features: core process and PDC. **Figure 6-4** illustrates these two features side by side to distinguish between their structures and content. In project-based processes, **stages and phases** have similar meaning. Both consist of a basic set of activities for establishing the underlying structure of a process that span the project development life cycle. Relationships among major milestones in each phase lead to a deliverable item or completion of the project within a stated time cycle (Dorfman and Thayer, 1990; Sommerville, 2004).

As a distinction therefore, **stages** are used for the core process, because it guides the development of a wide spectrum of international standards. Empirically determined core concepts clearly suggest that this core process evolves through seven stages, over time. SDO procedures are specified to guide its required functionality (cf. http://iso.org/directives; http://ieee.org/).

For the PDC, **phases** are used because it is regarded as an informal feature to the SDO performance specifications. Six phases were determined as universal across the five committees examined. Although the committees followed SDO procedures specified for the core process, they employed the PDC for defining technical principles of the projects. All the same, the PDC has equal importance in the successful completion of the project. This mutual use of the core process and PDC only highlights the fact this IITS process has various layers of esoteric content elements and contexts impacting on project development features, such as those illustrated in Figure 4-1 (Schema of project development perspectives).

6.4.3 Static Content of Core Process

The details of this static content also defining criteria of functioning of the extant IITS process are described with reference to Figure 6-4 that follows next. Without due attention to this simplistic static content, this researcher's attempts to link the core process and PDC become immensely complex. This can confuse the readers, rather than grab their attention.

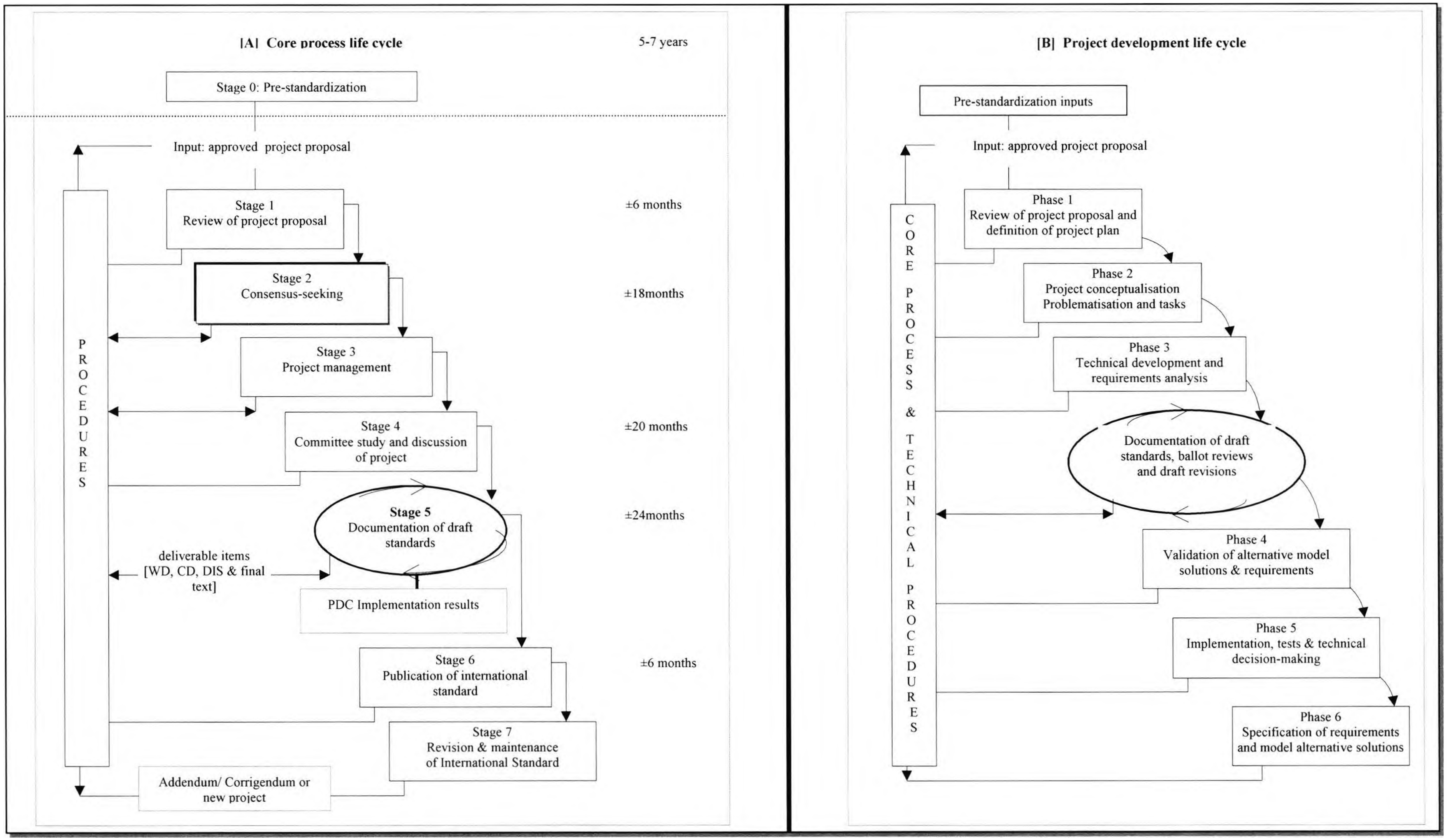


Figure 6-4: Features of IITS process: Life cycle models (based on case study)
(Source: compiled by author)

Stage 0: Pre-standardisation

Inputs that propel the core process usually originate outside the IITS environment through various continuous pre-standardisation efforts. Example results of this stage are base standards, systems profiles, taxonomies, methods and reference models from which many projects would be proposed; or to foster methods for use in the development of the project (Cargill, 1989; Table 2-2).

This pre-standardisation stage also has importance for the adoption of published standards. Many donor standards are adopted which contribute base principles, requirements and model techniques defining common elements required for development of a particular project. Examples of adopted aspects have been described for project ISO 10646-1 (Table 4-1), and JPEG-1 and MPEG-1 (§4.1.3). In addition, project JPEG-1 coding proposals evolved from pre-standardisation of baseline techniques for digital image compression. This work involved the collaboration of ITU-T working group (then CCITT SGVIII) and ISO JTC1 SC2 (Wallace *et al.* 1988; Léger *et al.* 1988, 1991).

International agreements on adoption have been known to be obtained and finalised within 18 months (IEEE, 2005; ISO, 2004). Adoption procedures follow the stages specified for the core process. Items that are adopted would be revised in the development of the project.

Stage 1: Project Proposal

An approved project proposal is input that activates the IITS process formally. It is submitted to an SDO as a comprehensive document presenting the proposer's decisions, which as include: assessed market needs for a standard; technology problems or regulations to be addressed; conceptualised development methodology, sponsors and results (cf. Berg and Schummy, 1990; Bonino and Spring, 1999; Ngosi and Jenkins, 1993). Ballot procedures follow to evaluate the proposal that it meets criteria for relevance of development; perceived technological and commercial benefits, and societal implications of the intended standard (cf. ISO Directives, 2004).

Stage 2: Consensus-seeking

This stage is central to the aims of establishing consensus agreements in the IITS process. Ballot processes are carried out to determine whether a project proposal is worth pursing. If there is sufficient support from voting member nations, the SDO approves the proposal as a standards project. When the existence of a draft standard has been authorised (Stage 5), consensus seeking is concerned with five principal procedures: review, ballot, public inquiry, decision-making and resolution.

Stage 3: Project management

Project management occurs constantly throughout the development of the project. It covers a wide variety of activities that are not openly connected. For example, once a project is approved, a committee is set up, if one does not already exist. Chairperson and project editor are appointed. Once these formalities are completed, the SDO registers operational number identities and titles by which both the committee and approved project will be known throughout its life cycle. Registration provides operational information and inventory to SDOs.

This information is passed on to NSBs for monitoring the project-in-progress, committee activities, results and any other transactions (see Table 6-2: IITS environment operational principles). Taken at this broad level, these main features of project management are akin to accountability of SDO and NSB operational matters to the IITS process, rather than providing a focus on project development and resources (cf. Archibald, 1992).

Stage 4: Study and discussions

Through several study sessions, the committee conceptualises and defines how the project should be developed. Inputs to study sessions involve problem(s) to be solved; base technology; industry practices; products from IT providers and domain-specific information. Discussions among the developers are conducted through several meetings to review and consolidate information inputs. The results of study sessions are technical documents for developing the concepts of the project and draft standards.

Stage 5: Documentation of draft standards

This is currently the only means to report the results derived from the IITS process. When various concepts and requirements have been evaluated through study sessions, the committee writes a series of draft standards (see Table 6-4: Categories of deliverable items). When a draft standard has passes committee review criteria, the project editor requests the SDO to authorise the existence of each draft standard and its progression to a ballot, at international level (Stage 2: Consensus-seeking).

Stage 6: Publication of international standard

The approval of a draft international standard (DIS) leads to the preparation of a final draft, also known as final text. This task is assigned to the project editor and developers from subordinate committees (see §6.3.2). This final text would be submitted to the SDO, with a recommendation to publish the IIT standard. The standardisation process would be completed. The publication is announced. If there are no other assigned projects, upon publication of the IIT standard, the committee is disbanded. However, many committees remain active for revision and maintenance processes of the published standard. For the five projects examined, the committees still exist and they continue to develop other projects assigned to their subject domain.

Stage 7: Implementation, revision and maintenance

These items are usually external to this core process. Projects IEEE 1074, ISO 10646-1, JPEG-1 and MPEG-1, however, illustrated that highly technical projects require implementation of stable concepts to attract interest. This is where, early adopters come into the picture (see §5.4.2). Although the market may present an uncertain feel for the draft standard, implementation information from early adopters helps the committee to refine major concerns about the acceptance of the standard, when it is published.

The usual implementation is carried out on a published IIT standard. When the standard has been adopted widely in different sectors for which it was designed, implementers would raise concerns and request for its revision. These revision requests are submitted to an SDO, so that it acknowledges errors or criticisms concerning the implementation of the IIT standard. If the request for revision is accepted, the SDO initiates the revision process that would start from proposal (Stage 1) to publication (Stage 6). A proposal for revision is reviewed through consensus procedures (Stage 2).

Overall, published standards need **revision** to keep the requirements and recommended guidelines current. The committee that developed the IITS standard is usually assigned with **revision and maintenance**. Example formats of revision process are: a completely new standard. The other is a standard that incorporates amended sections or corrigendum (such as ISO 11172-2, Corrigendum 3-2003), until a time comes when a full revision is carried out.

6.4.4 Project Development Milestones

Table 6-3 contains a complete summary of the empirical milestones for each of the case study projects and time scales. Milestones, such as project proposal reviews, production of draft standard and their evaluation are part of the content of IITS process. The time scales presented were calculated across the five projects, from the completion of each examined stage. SDOs only give time scales for draft standards ballot evaluations.

This empirical evidence demonstrates that, the average project time scale from a project proposal to the publication of the IIT standard is approximately 6½ years. This evidence is an important one. It supports the research question, which perceived the project development as 6 to 7 years despite the numerous developers that develop it (see §3.2.6).

Table 6-3: Case study project milestones and time scales
(Source: compiled by author)

Projects	Review of project	Working draft (WD)	Committee Draft (CD)	Draft international standard (DIS	Final texts	Publication	Complete cycle time scale
IEEE 1074	**±19**	**months**	**±18 months**	**±18 months**	**±11 months**	**±6 months**	**72 months**
[MILESTONES]	2 drafts of proposal, based on survey studies	reviewed committee & feasibility	[2 drafts]	[2 DIS ballots] harmonisation with ISO 12207-1	[2 drafts]		
ISO 12207-1	**±15months**	**±8 months**	**±12 months**	**±18 months**	**±18 months**	**±6 months**	**77 months**
[MILESTONES]		2 drafts of SDLCP	2 drafts clarification of SDLCP	[2 DIS ballots] harmonisation with IEEE 1074	[2 drafts]		
ISO 10646-1	**±20**	**months**	**±12 months**	**±27 months**	**±15 months**	**±10 months**	**84 months**
[MILESTONES]	Adoptions of Standards refinement	Base & of concepts	2 drafts clarification of SDLCP	[2 DIS ballots] harmonisation with Unicode	[2 drafts] restructuring		
ISO 10918-1 (JPEG-1)	**±20**	**months**	**±12 months**	**±18 months**	**±22 months**	**±15 months**	**85 months**
[MILESTONES]	Adoptions of methods refinement	base & of concepts	2 drafts clarification of algorithm & selections	[2 drafts] clarification of methods, image issues.	[2 drafts] refinement, compliance issues		
ISO 11172-1 (MPEG-1, Pts 1-5)	**±10**	**months**	**±6months**	**±10 months**	**±12 months**	**±6months**	**44 months (averaged)**
[MILESTONES]	→ rejection of initial proposal → 2 drafts of reviewed proposal, based on workshops → Adoptions of ITU-T Recommendations → R & D activity, subjective tests → Selection of R & D items & policy matters → Evaluation of R & D results			→ **R & D results** → early adoption results → subjective tests			

6.4.5 Core Process Deliverable Items

Table 6-4 illustrates IITS process deliverable items. The table incorporates empirical explications of each item.

Table 6-4: Categories of deliverable items
(Source: compiled by author)

Deliverable items	Content
[1] Technical documents:	Produced through committee study discussions and project development activities.
[2] Study documents:	They can contain proposals of project inputs covering concepts, methods of standardisation and information.
[3] Draft standards (interim results) [a] Working draft (WD):	Preliminary concepts of the developers' understanding of the project proposal and project hypothesis to be examined
[b] Committee draft (CD):	Definition of the problem to be solved Preliminary requirements and possible model solutions sought after in the project development strategy.
[c] Draft international standard (DIS):	Proposed standardised model solutions and requirements for approval through a 'public inquiry ballot'
[d] Final Text (FT):	Proposed specification of IIT standard pending approval or revisions from DIS.
[4] International IT standard:	Technical specification of standardised requirements, model aspects for computing systems solutions or best practices for processes Can contain instructive measures that are binding, such as conformity and compatibility

6.5 Part [2]: Results of Dynamic Analysis of IITS Process

6.5.1 Content of Dynamic Analysis

In the analytic framework (Figure 5-2), dynamic analysis is the third level of the study of the IITS process. Born (1994), Dorfman and Thayer (1990) and Rossett (1992, 1999) apply dynamic analysis to capture the execution of a process covering its activities, products and requirements. Borrowing from these well-tried concepts, this dynamic analysis draws upon the underpinning constructs outlined in Table 5-3 (Summary of problem frame base concepts). These constructs help to develop a more appropriate processual analysis that shares similar abstraction such as those outlined by Pettigrew (Pettigrew, 1997:339-342; 2000):

[a] Explicating IITS process performance across various layers of contexts of committee actions, and theorising from the empirical evidence.

[b] Describing project development to reveal dynamic interplay of practices and embeddedness elements in the meaning of IITS process performance.

[c] Connecting project development to the location and explanation of specific items underpinning observed mechanisms.

For ease of reference in the sections that follow next, **Box 6-1** gives a summary of the key findings from dynamic analysis and their classifications.

Box 6-1: Summary findings of dynamic analysis (Source: compiled by author)	
Key findings	**Classification of performance contexts**
[1] Committee review of project proposal	Contextual, embedded and technical
[2] Standardisation approaches	Technical content
[3] Project development strategy	Technical content
[4] Project tasks	Contextual, embedded, social and technical
[5] Draft standards ballots and revision process	Contextual, embedded and technical
[6] Committee interactions e.g. collaboration	Contextual embedded and social
[7] Committee participation and influences	Contextual influences
[8] Committee information infrastructure	Embedded technical content

6.5.2 Committee Review of Project Proposal

A sensible starting point is where the project begins in the IITS process. All five committees examined in the case study initiated project development by reviewing the approved proposal as presented, to include comments evaluated from ballot results. If the proposal is adopted in the committee without a comprehensive review, the project is likely to have shortcomings, such as inappropriate scope and methods that are important to information gathering exercises.

The practices applied to review a project proposal have contextual, embedded and technical elements that are not easily discernible. Relevant framing concepts from the 'Social Translation Framework' by Callon (1986) and Latour (1986) are used here, to illustrate their representation and meaning in the content of the IITS process. **Table 6-5** following next, contains detailed constructed meaning of the results suggesting that the review of a project proposal opens up an array milestones leading to development: conceptualisation, planning, framing, problematisation, enrolment and mobilisation (cf. Ngosi and Braganza, 2006). The practices described in this table point to the details underlying project proposal review mechanisms. It is interesting to note that, many of these mechanisms eventually become scenarios and sub-processes that are embedded in the IITS process layers of context (see Table 7-3).

6.5.3 Standardisation Approaches

Empirical evidence shows that standardisation approaches embody engineering practices, scientific methods, techniques and technology aspects that form the project development methodology (cf. Berg and Schummy, 1990). Concepts determined from input systems products or assessed stakeholder organisation processes provide explanatory constructs to design these approaches. There are two main phases in which the approaches are developed: conceptualisation and problematisation.

The conceptualisation phase is the review of the project proposal (Table 6-5, 'Phase 1 of the PDC'). This is where project inputs are put through rigorous analyses to select and to design required standardisation approaches. This phase includes the conventional practice of adopting existing approaches and established standards relevant to these projects (see §6.4.3, Stage 0-Pre-standarsation).

Table 6-5: Phases of project proposal reviews and practices
(Source: compiled by author)

Review phase	PDC Milestones	Practices
Phase 1:	Conceptualisation	- Review of proposal as presented together with ballot comments - Determine conceptually feasible project inputs and project development framework - Define project technical information and adopted elements: (e.g. base standards, methods, products, regulation and implementation issues to be addressed).
Phase 2:	Planning: Project plans:	Guide conceptualisation of the development strategy: - Project objectives, items to be standardised based on the technical information accepted in the committee
	Business plans:	Committee project operational requirements submitted to SDO for prioritisation: - *Committee pledges* of sponsorships, importance of project, schedules, man-effort and skills to be contributed to the successful completion of each project. - *Secretariat* plans of targeted expenditure for project administration and meetings. - Plans are updated periodically to establish new operational requirements, with respect to results from completed stages.
Phase 3:	Framing project needs	Substantiates project information inputs and project development strategy: - Establish committee structure for successful project development e.g. protection of draft standards. - Definitive project subject matters. - Standardisation methodology. - Master structure of draft standard guiding actions.
Phase 4:	Problematisation	Processes yielding theoretical problem, project hypothesis or input concepts for analysis and leading to standardisation:. - Selection of core inputs and methods. - Forward predictions of possible standardisation actions. - Definition of tasks, desired model solution fitting methods and problem and hypothesis to be examined.
Phase 5:	Enrolment	Committee establishes operational practices for the project e. g: - Maintenance and management of information. - Governance of the master structure of the draft standard. - Creating transparent project alliances and collaborative networking to support project development (e.g. expertise, implementations of results, R & D environments).
Phase 6:	Mobilisation	Promotes mechanisms for agreed co-operation and collaboration to propel project development activities or practices e.g.: - Learning and creation of knowledge - Forming technical creativity - Constructive team-work

The problematisation phase helps to define the standardisation approaches (Phase 4 of the PDC). Although adopted approaches for the project would be similar to those of the donor standard or *de facto* technique, extensive revisions and detailed are carried out on preferred approaches. Approaches that are finally selected take into account explanations of how well they satisfy the objectives of a particular project agreed in the committee, and how they fit in with project subject matters.

In this regard, problematisation requires some explicit definition of a theoretical problem or hypothesis to be examined. In projects ISO 10646, JPEG-1 and MPEG-1, R & D activity played a central role in the selection and definition of the project base concepts and preferred approaches. Furthermore, R & D activity provides independent assessments to address their dependability of selected approaches; to determine the technical scope of the problem or project hypothesis; and the technology (or process) for which the standardisation actions will be referenced. Exclusively, the hypothesis becomes a basis from which the committee can demonstrate the choice of standardisation approaches.

JPEG-1 standardisation approaches, for example, involved lossless mode image-compression algorithm, based upon 'Discrete Cosine Transform (DCT)', matched to selected software architectures and other sophisticated coding, and compression methods (Clark, 1985; Schäfer and Sikora, 1995; Wallace, 1992). Eventually, the tradeoffs between adopted approaches, their revision through R & D assessments and project tasks emerge as a rich methodology (cf. Ngosi and Braganza, 2006). This is expected to be repeatable in the project development cycle to develop more rigorous approaches (or a model methodology) to test the project hypothesis for which the standard is intended.

6.5.4 Project Development Strategy

Universally, the five committees examined would begin the project with the assumption that there is no existing strategy to support the concepts to be standardised, albeit the proposal presented, adopted standards or other reviewed inputs. The project development strategy is, therefore, established as a separate entity through problematisation (PDC Phase 4), in line with chosen standardisation approaches. The project development strategy is methodology-oriented. It qualifies the 'how to' actualise project development involving:

[a] Definition of the project development methodology: This will demonstrate a refined version of the combined approaches applied in the standardisation process or derived from it.

[b] Design of project tasks of particular relevance to each project phase and desired methodology. Project tasks lay the foundation for gathering information and for the technical attention needed in the development of the project.

[c] Definition of how project tasks would be executed to develop a methodology that tests a stated hypothesis to meet stated project objectives.

[d] Definition for solving an identified problem or testing a project hypothesis.

Appendix 8A illustrates a comprehensive model that brings together multi-dimensional processes through which a project development strategy evolves. This model incorporates key paradigmatic views underpinning the ISO SC 7 SWEP model (1993) applied in the case study to summarise case study findings and the representations of the project development strategy. **The paradigmatic views** (such as participation, customer, product and process) drawing upon the similarities in the empirical evidence add depth to define separate processes through which standardisation approaches, project tasks and technical information are abstracted hence (also see Appendix 7D). These relationships provide the micro-focus connecting project development to the explanation of the technical content of the project. The definition of the project development strategy across the five project examined was approximately 2 to 3 years.

6.5.5 Dynamic Content of Project Tasks

The design of the project tasks is carried out within the framework of the paradigmatic views of the project development strategy. The way in which these view are executed present a variety of phenomena, because of their interlocked contextual and embedded dimensions. **Appendix 8B** illustrates empirically determined components of project tasks. Levels 1 to 6 define the underpinning elements contributing to the design of the project tasks, leading to Level 7, their eventual performance.

6.5.6 Project Task Perspectives

The comprehensive definition of how project tasks are designed (Appendix 8B) generates diffuse perspectives bearing on the contexts in which inputs are reviewed and selected from say, scientific methods and IT products. Task direction, technical, project plans, enrolment, mobilisation and task performance are example perspectives that also reveal dynamic interplay of practices central to the project development strategy.

Task direction perspective

The committees examined in this case study had one common problem. When they begin to conceptualise the project proposal, they enter a 'grey area'. There are no blueprints laying out how a project can be developed, or, which types of information should be utilised. The Master Plan for SE Standards, MPSE (IEEE, 2001) is a typical example of a task direction perspective. This plan was developed as taxonomy to provide committees with task definition guidelines.

This taxonomy was applied in the SES projects IEEE 1074 and ISO 12207 in the following context: When the committee has defined its project development strategy, the MPSE can be expected to help determine dimensions fitting the technical constraints of the project, such as methodology and design of tasks. However, each project development stage has different sets of tasks unique to the problem contexts. Committees therefore continuously gather, process and review new information to design or revise tasks for each project stage. New information helps to make decisions that propel task performance (cf. Ngosi and Braganza, 2006).

Technical perspective

This is concerned with the definition of the project problem context to be linked to project tasks, namely: the problem, project hypothesis, methodology and problem space (see Appendix 8B). In this technical perspective, projects ISO 10646-1, JPEG-1 and MPEG-1, for example, required extensive coding and programming procedures to develop both adopted and conceptualised approaches. In this example, project tasks are designed to be comprehensive to present how identified elements of the problem context would be examined exclusively, leading to base concepts and definition of the standardisation methodology (see Table 6-6:Sample project plan and task perspectives).

Project plan perspective

Each element selected for project development helps in developing a formal plan (Table 6-5, PDC Phase 2). Across the five committees examined in the case study, each plan had similar guidelines for the conceptualisation of the development strategy. **Table 6-6** next, illustrates a sample project plan with explanations connecting task perspectives to items underpinning observed mechanisms of committee performance and of the project development strategy.

Table 6-6: Sample project plan perspectives
(Source: compiled by author)

	Summary	Link to project development strategy
Project operational practice perspective		
[1] Committee functional structure	Organisation of project development.	Active memberships, skill availability, communication exchanges
[2] Committee procedures e.g.: [a] Information management [b] Ballot management	- Technical development - Information gathering - Review of its draft standards.	Organises how committee manages the project instruments and results
[3] Targeted audience [a] Sectors e.g. software [b] Stakeholders [c] Sponsors	- Parties with vested interest - Pledged commitments	Acknowledge the participants in the standardisation process and, potential implementers.
[4] Scope of Project [a] Purpose of the standard	- Objectives, subject matters	- Intention and scope of its recommendations. - Market influences.
Technical tasks and task performance perspective		
[1] Agreed project inputs	Inputs from project proposal, to include input products, adopted methods and requirements to be standardised.	Definition and development of the project development methodology.
[2] Concept exploration	**[IEEE 1074, ISO 12207-1]** Organising input information and processes for software development and maintenance. **[JPEG-1, MPEG-1]** Developing base algorithm	Development of base concepts of the project.
[3] Project models/or approaches	**[IEEE 1074, ISO 12207-1]** e.g. SDLC processes. **[ISO 10646]** programming procedures, coding of character sets. **[Projects JPEG-1, MPEG-1]** data and image coding techniques.	Development and definition of standardisation methodology.
[4] Requirements analysis [5] Problem analysis	Customer needs assessed for the project.	- Development of conceptualised requirements and project hypothesis test.
[6] Implementation [7] Testing	Defining generic concepts and evaluation parameters.	- Documentation of implementation issues (through Model Organisations). - Checking whether the standard ensures compliance with stated requirements.
Documentation task perspective		
Master structure of standard	- Chapters of the draft standard guiding documentation tasks - Assignment of chapters to developers	Linking results from project development strategy their translation in the draft standard.

Project enrolment perspective

Enrolment (Table 6-5, PDC Phase 5) occurs when the committee agrees on a project plan, the development strategy, a hypothesis or problem for analysis. Enrolment aims to create transparent project alliances, within the committee, that can support project development with expertise, knowledge and information (cf. Axelrod *et al.* 1997; Baxter, 1995). For projects ISO 10646 and MPEG-1, the committees agreed on a variety of core inputs from different contributors or sponsors. Alliances that subsequently propelled project development efforts involved four major categories: contributors, stakeholders of the project, IT market sectors (hardware and software) and potential implementers of draft concepts.

Project mobilisation perspective

In the Social Translation Framework by Callon (1986) and Latour (1986), mobilisation represents agreed co-operation. In the five committees examined in the case study mobilisation (Table 6-5, PDC Phase 6) is part of the project operational practice perspective (Table 6-6). It calls for organised common sense of how committee members can co-operate effectively to execute set project tasks, for achieving set goals. Collaboration among diverse committee alliance groups provides better explanations to deal with complex project networking, which promotes inputs, requirements and model solutions, favoured by the groups of alliances.

Task performance perspective

In this perspective, committee task performance works hand in hand with mobilisation mechanisms. In practice, mobilisation of a project leads to the execution of specified tasks achieved in line with *consensus principles* that apply to the decisions agreed in the committee (also see Appendix 8A). If consensus is not possible, this is a sign of conflict that needs to be resolved through committee study sessions, meetings or a procedure designed for resolution.

Another facet of this perspective is the fact that evolution of the project accounts for task performance which acquire *learning contexts* similar to those described in a number of scholarly works (such as Mohrman *et al.* 1995; Orlikowski, 2002; Quinn *et al.* 1997; Snowden, 2002). These authors take the view that 'learning' is something distinct from the mere assimilation of information and knowledge.

As project development stages evolve over time, committee learning contexts focuses on the content of project tasks (cf. Mohrman et al. 1995); practices of knowing the process of the work (Orlikowski, 2002) and shared experience in the committee. These features are also differentially shaped by: information exchanges; expertise and use of scientific methods that generate cumulative knowledge; forming project alliances; technical creativity; constructive team-work and operational practices for the attainment of a mutual objective. Project tasks defined as such lead to the process of relating performance to approaches that customised to yield a result, such as a draft standard (see Appendix 8B, Level 7).

6.6 Dynamic Areas of IITS Process

The documentation of draft standards and ballot evaluations have been singled out as dynamic areas of the IITS process that also embrace multi-dimensional layers of context. Their characterisation offers explication of key aspects that include dynamic interplay of committee actions, practices, processes and performance, over time.

6.6.1 Documentation of Draft Standards

The IITS process produces a series of interim results in the form of draft standards (see Table 6-4). The documentation of a draft standard is a conventional practice to specify results derived from project development. In the draft standard, the committee interprets precise scientific evidence of the results of standardisation: for example, specification of a method, requirements and model solutions to the problem examined.

Appendices 8C and 8D illustrate empirical models of the documentation of draft standards and revision. Key features taken from this model are summarised in **Table 6-7**. The empirical models are credible, because the framing concepts are supported by other literatures such as Hawkes *et al.* (1993:183). Theirs is a single version linking documentation and post-ballot revision of the draft standard. This researcher argues that documentation of the draft standard and post-ballot revision are intertwined. However, they are separated by contexts, such as plenary meetings and evaluation (see Appendix 8E).

Table 6-7: Components of documentation of draft standards
(Source: compiled by author)

Key component	Basic elements
[1] Documentation of draft standard	
[a] Master structure of draft standard:	Objectives, chapters of the draft standard.
[b] Committee study and discussion:	Concept exploration: - Plenary meetings - Technical and study documents - Information gathering and evaluation. - Evaluation of documents and abstract model solutions for review.
[c] Technical development:	Execution of project development strategy and project tasks: - Information gathering and evaluation. - R & D activity, development of methodology. - Draft concepts and project hypothesis. Conceptual requirements of the draft standards: - Requirements analysis, verification. - Technical decision-making.
[2] Revision of draft standard	
[a] Master structure of draft standard:	Revised objectives, chapters of the draft standard.
[b] Ballot:	Accepted ballot comments: - Technical and editorial comments. - Resolutions. - New information from plenary. - Best alternatives of the problem examined in the project. - Editing meetings and collation of comments.

6.6.2 Draft Standards Ballot Practices

Ballots are carried out in Stage 2 of the core process (see Figure 6-4: Features of IITS process). In its life cycle, a draft standard goes through three ballots that are also named after the deliverables: WD, CD and DIS. Empirical evidence suggests that there are three perspectives with different sets of conditions that influence ballot evaluations: SDO, NSB and committee.

In the SDO perspective, the SDO Task Force initiates a ballot when a committee submits a draft standard for evaluation through various member nations (cf. ISO, 2004). SDO procedures cover project management processing. For example, registration to acknowledge the draft standard, to include instructions for how votes and comments should be presented and the ballot time scale. Ballots for WD and CD can be completed within 4 months, which excludes the writing processes (http://iso.org; http://ieee.computer.org/portal). In addition, the SDO Task Force registers ballot results from member nations, for the committee assigned with the project to evaluate. These ballot procedures firmly place the SDO as the 'functional controller' of IITS process endeavours and results. The procedures exercise reasonable measures in the international due process, ensuring that all parties likely to benefit from the standard, reach amicable consensus agreements (cf. Baron, 1995; Cargill, 1989; Jakobs, 2000).

In the NSB perspective, the obligation to SDOs is to promulgate any current draft standards for ballot review and subsequent published standards. Each participant NSB passes judgement on a single vote and accompanying position of comments for that nation. Within the NSBs, representative groups involving user groups and government agencies are always called upon to submit the results of a public enquiry carried out on a DIS, to NSB committees.

The explanation is that, individuals in the public domain are not directly involved in the development of the project. Moreover, they may not be familiar or competent to deal with technical nature of the draft standard and its review processes. Thus, user groups consisting of major sectors of industry and other interested parties with knowledge of the project and its subject matters are openly invited to comment on the compliance of the DIS to society-wide concerns, such as industry practices and safety.

In the committee perspective, a ballot serves as a formal method for determining the impact of a draft standard using new information provided by identifiable reviewers. The ISO procedure of ballot evaluations through various member nations provides measures for identification of reviewers.

[a] *Individual national reviewers* have the responsibility to provide an expedient critique of the content of the draft standard covering its technical and editorial accuracy. They assess whether the committees' interpretations of methods or requirements stated in the draft standard meet specified criteria of desired model solutions. Member nations gather ballot results through NSBs, for registration of a single vote and supporting comments.

[b] *Ballot management* was significant in all five committees examined in this case study One reason being, the complex nature of the subject matters of the five projects, which attracted unique approaches, technical information and diversity in ballot comments subsequently. Ballot management provides collation of comments to initially determine their content, quality and criteria of fit to the master draft standard.

[c] *Structured collation of comments* is carried out in editing meetings involving the project editor, convenors and selected experienced developers (see Figure 6-3: Structure of IEEE WG 1074). In this meeting, collation defines precise terms of the aspects of the ballot comments that a committee needs to accept, reject and the identification of contentious viewpoints. It includes integral processes of 'marking' the master draft standard against ballot comments making way for a revision process.

[d] *Position papers:* Where the ballot comments presented seem incompatible, the project editor requests the committee for position or working papers that help clarify specific issues from the ballot. Such papers are reviewed at committee plenary meetings, at the same time as the resolution of ballot comments (cf. Hawkes *et al.* 1993).

6.6.3 Ballot Evaluations

An example of a ballot evaluation is a public enquiry for a DIS, also known as 'the enquiry stage' (Gibson, 1995; ISO, 2004; Jakobs, 2000). This ballot is central to the publication of an IIT standard. Similar to all draft standards, however, a ballot evaluation is guided by four criteria: technical content, editorial accuracy, relevance of draft standard and potential impact of the standard when published (http://iso.org; http://ieee.computer.org/portal).

Technical content is the basis for the specification of essential requirements, or guidelines of a method to which the IIT standard would be referenced. Evaluation of technical comments presented in a ballot has the explicit aim to promote the harmonisation of the requirements or other contentious matters concerning the draft standard. This harmonisation begins nationally in NSB committees, by examining requirements or methods utilised in the project development strategy compared to the results presented in the draft standard under ballot review.

User Groups provide some technical translation of the concerns or needs raised through public domain assessments of the draft standard. In keeping with some of the 'golden rules' presented in Meek (1995: 251), harmonisation ensures that the requirements or method in question can be tested and can be implemented in the user environment, without unjustified modification. Harmonisation is also akin to defining conformity and compatibility measures that are binding on industries and organisations (cf. Gabel, 1991; Meek, 1995). When the technical content of a DIS is agreed, it has relevant specifications for the user, such as requirements, methods, recommendations for compliance bearing on the harmonisation processes applied in the committee.

Editorial accuracy is the language presentation of the written document of the IIT standard. Collaborative documentation is prone to human errors and inconsistencies in the use of language, terminology and interpretations of technical concepts. Ballot comments indicate any language inconsistencies. The project editor has the final responsibility to ensure the editorial accuracy of the draft standard. Editorial consideration identified in the empirical evidence across five projects match closely with those described by Scowen (1993) for generic base standards and Meek (1995) 'golden rules', for example:

[a] Appropriateness of use of terminology that applies to the subject matter of the project.

[b] Technical content for implementation practice in the IT market.

[c] Facilitating the inter-working of the standard under development with others in the same class, because they are based upon the common foundations.

Relevance of a draft standard determines what the committee and stakeholders might want to see incorporated in it, or excluded from it. Project IEEE 1074, for example, aimed to demonstrate its potential *relevance* to provide instructive measures for SLCP practices and guidelines that are mandatory for the development and maintenance of software, whether stand-alone or part of a system (IEEE 1074, 1995: 11). This relevance takes into account the need for the standard by identifiable issues and, implementation benefits to industry sectors and organisations. A positive ballot result would provide evidence to confirm the relevance of the intended IIT standard hence.

Potential impact of the IIT standard takes integrative perspectives, notably, committee, target user, implementation and ballot.

In the committee perspective, potential impact is determined in the conceptualisation and problematisation phases of the project prior to its development (Figure 6-4: Features of IITS process, PDC Phases 1 and 2). Example criteria are agreed objectives and scope of the project that define how the project is to be developed to improve on existing technology (see Table 4-3: Objectives of SES projects).

The user perspective, on the other hand, is the accountability of the standard to multiple stakeholders with vested interest in the project development strategy and its implementation, subsequently. Potential impact is determined from the contributions that stakeholders make for the successful completion of project development. Stakeholders cultivate their objectives, products, industry practices and strategies within committee guidelines.

The implementation of the targeted IIT standard is crucial to define how it will be received in the IT market (cf. Besen and Farrell 1994; Gabel, 1991). Project MPEG 1-5, software simulation (Table 3.5: Selected case study items), for example, described source code procedures for the design of programs in the development of data storage media. As a method for gathering implicit information of the implementation potential described in the DIS, various simulation tests were carried out in model organisations to reproduce the input source code. The results provided explanation of the procedures a user would apply in their environment, under similar conditions developed in the simulation tests. Thus, implementation of the same data set in different model organisations provides explanations of the 'actual' requirements or model solution to the project context being examined.

Ballot discussions pick up on the results of such simulation tests as new information to which the committee needs to respond. Independently, ballot decisions from the committee regarding these test results would help to define implicit impact of the IIT standard covering:

[a] A model solution strategy and requirements that validate the project hypothesis being tested.

[b] The committee would state the harmonisation results derived from project development and those of the test results to specify requirements or procedures or both.

[c] Simulation test results confirm the implementation details and their value that can be incorporated in the standard. MPEG 1-5 (1995) is published as Technical Report (TR) of the standard. It lists, as part of its content, the test logs and results that the recommended implementation procedures that the user of the standard is likely of obtain, when the same source code procedures are applied in their environment.

6.6.4 Ballot Resolution

Decision-making on the votes and comments establishes the acceptance or objection of the current draft standard under ballot. This may necessitate a ballot resolution carried out in a committee meeting setting. **Appendix 8E** presents a comprehensive empirically determined model of a ballot resolution process. Three implications of a ballot resolution are negotiations, consensus agreements and progression of the project.

[1] **Resolution of a ballot** works from the premise of identified conflicting views presented in the collated comments and votes. In the meeting discussions, the committee cultivates **negotiations** on technical and editorial accuracy, expectations of impact, requirements and wishes of all parties interested in the standard.

[2] **Consensus agreements** among committee members establish sets of decisions and conclusion reached from the ballot resolution meeting. The agreements determine reasonably accurate claims of model requirements and solutions that can be specified in the IIT standard, subsequently.

[3] **Progression of a project,** from one stage to the next, is based upon a positive ballot. A new project development stage indicates a new status of events. For example, a new input state and a new draft standard that needs to be developed. Disapproval of comments will necessitate a default ballot, until specified criteria of consensus is satisfied or extensive revision to the draft standard (ISO, 2004).

6.7 Contextual and Embedded Elements

6.7.1 Content of Elements

Technical and social aspects that evolve during project development create a variety of contextual elements. Because these elements co-exist with committee performance, they become deeply embedded in the practices, sub-processes and across contexts, over time. Against this summary, four items from the results of dynamic analysis that illustrate the content of these contextual and embedded elements: participation, information infrastructure and interactions.

6.7.2 Participation Influences on Project Development

The focus of this discussion is the participation profiles established for the five committees throughout their life cycle, and the significant similarities in the evidence. The profiles reveal factors akin to those described in the body of literatures covering standardisation participation issues (such as Axelrod *et al.* 1997; De Vries and Verheul, 2003; Gabel, 1987, 1991; Leiss, 1995; Schäfer and Sikora, 1995). The influences of the participation from these profiles involve implementation value of the standard, standardised requirements, networking of project inputs, project subject disciplines, and, documentation of draft standards and ballots.

Implementation value of the standard (as well as potential impact) is not established on the basis of rational decisions. One approach that indicates implementation value is vested interest on the project. When stakeholders, such as diverse industry groups and individual IT firms get involved in the committee, this is often a categorical signal that that they **need the standard** and that they **would implement it.**

As in the example of project ISO 10646 (§4.1.1), committee memberships represent alliances of market segments (Axelrod *et al.* 1997) that also help to cultivate vendor compatibility (Gabel, 1987) sought after in the project development strategy. What transpires in the conceptualisation and problematisation phases of the PDS, is to establish which of those committee participants can form alliances that strengthen the arguments for the implementation value of the intended standard. Alliances and implementation value are also connected in their scope, to standardised requirements and networking of products described next.

In the committee, IT firms pursue various strategies for attaining **standardised requirements or model solutions to assessed problems.** As dominant manufacturers of systems products, they bring independently assessed market needs to be translated in the project development strategy. Their participation in the IITS process helps to validate that their products conform to standardised requirements and other specifications that are internationally accepted. Their co-operation and investment (expertise, research efforts, sponsorships and time commitment) in the project development strategy confirms the implementation value that they work hard to attain. Once a committee establishes the value of intended standard, very few firms or industry groups withdraw from the IITS process. Instead, they perceive the implementation value of the standard as payback on their investment.

Networking of project inputs is a prominent feature of participation in a committee. Major stakeholders for project ISO 10646, for example, could be categorised as firms specialising in hardware and software systems (see §4.1.1). When separate input products and methods from these firms are combined for standardisation, the result is *networked inputs* that influence the project development strategy. 'Networking' can be presented as: committees express standardisation approaches and problems to be addressed from input systems products, R & D results and engineering methods that participant IT firms contribute.

In particular, networking of systems products creates multi-vendor compatibility network effect in the project development strategy (Gabel, 1987, 1991). On the other hand, networking of R & D results and engineering methods can create complementary applications (see §4.1.1). For example, programming (software aspect) of various world-wide scripts in project ISO 10646-1 in Microsoft operational environment (hardware aspect) created widespread implementation of products, such as `Windows Environment', Internet explorer and word processing software applications utilising world-wide scripts.

Participation in the IITS process **brings relatedness in project subject disciplines.** Projects JPEG-1 and MPEG-1, for example, presented different types of subject domains covering broadcasting, software, hardware, databases and telecommunications. The participation profiles reveal that diversity in stakeholders encourages collaborative exchanges of privileged information, especially when the project exhibits a cross-section of subject disciplines. Project subject matters derived from these subject domains helped the definition of specific multimedia properties considered in these project, to include guidelines for developing multimedia applications and fostering their implementations (cf. Schäfer and Sikora, 1995). With this variety of subject disciplines, the project development strategy defined in the committee attempts to 'strike a balance' between social and technical contexts, and their embedded items: such as information and collaborative sharing.

Documentation of draft standards and ballots benefit when a committee has diversity in stakeholder alliances. Leiss (1995: 61) mentions that the tasks of setting and enforcing standards are best conceived as a process of continuous micro-management. This requires the participation of a broad range of stakeholders. Because of their intense perspectives, therefore, documentation of draft standards and ballot reviews require that the committee argues for the best internationally accepted range of alternatives in the functioning of technology and perceived benefits.

Privileged information embodies *de facto* products, requirements, patents, research results and IPR. When relevant, privileged information is critical for the committee to carry out synergistic documentation and ballot review processes. What the committee needs is the right kind of project alliance that brings the best available expertise, knowledge, science, and technology to bear on decision-making processes.

The following items summarise the participation profiles and key influences described:

[1] When a project fails to attract the 'right kind' of a good cross-section industry representation, it is almost always not worth pursuing. All five projects required significant commercial and technological inputs, upon which to develop the anticipatory standards that are now implemented widely in global industry domains.

[2] When a project has these diverse networked inputs (such as multi-dimensional subject matters, methods, products, information and stakeholders), measures of compatibility or compliance may need to be established in the standard.

[3] R & D activity greatly improved understanding and definition of the paradigms underpinning the networking of products. The results of R & D activity establish the implementation goal of the intended standard to offer implicit or explicit relatedness of various inputs and of those derived from the project development strategy.

[4] From the point of view of the intended standard, intense networking of project inputs as in MPEG-1, made it necessary to divide the project into different parts, whereby the implementation goal of the standard and networked results would be structured more effectively. MPEG-1 standard has five different parts: systems, video, audio, compliance testing and software simulation (see Table 3-5: Selected case study items).

[5] In turn, each part of the project creates its own participation profiles and networking. For example, stakeholders' invest their financial resources in the different parts of the project that they have expertise in or from which they wish to develop their IT applications or business strategies.

[6] A project is developed constructively, when it has relevant representation of vested interests, adequate technical skills, prominent networking of inputs and confirmed financial resources. The committee is expected to observe principle of timeliness at each project development stage. These are critical issues of the due process of consensus (cf. Baron, 1995).

[7] The IITS process is market-driven. In the committee setting, different types of members represent also mix and match market influences, multi-vendor considerations (Gabel, 1987; Matutes and Regibeau, 1988). Participation in a project that has strong multi-vendor market influences (such as manufacturers, service providers and systems products) is an appropriate positioning for both the project and intended IIT standard. A project favoured by committee participation and IT market dynamics are inter-linked hence.

[8] Manufacturers, service providers and vendors will use the published IT standard as a business tool or reference manual. Thus, any product that is sold on the market will eventually promote standardised concepts of those inputs contributed by the firms that participated in the IITS process (Ngosi and Braganza, 2006).

6.7.3 Committee Information Infrastructure

The participation profiles described above, in particular subject disciplines, networked inputs and influential stakeholders explicate the committee information infrastructure. **Table 6-8** following next, contains the details of this information infrastructure that draw upon categories of similarities located in the compared empirical evidence. Relevant concepts for translation from Correia and Wilson (2000) to define categories of the information infrastructure. Explicit and implicit of features of each category were then determined.

Table 6-8: Key categories and features of committee information infrastructure (Source: compiled by author)	
Categories	**Features**
[1] Project proposal inputs:	- Project proposal; core technology aspects and problems. - Project title; subject disciplines. - Market survey results; project subject matter survey results. - Ballot proposal comments.
[2] Technical information:	- **De facto:** scientific & engineering issues; industry practices; systems products; research results; industry & organisation processes - **Specialist:** scientific paradigms; project taxonomies (e.g. MPSE); licenses; IPR for specialist knowledge, patents; R & D activities. - **Standardised:** Base standards describing abstract technical information developed from products, industry or sector practices, processes, terminology and glossary. - **Reference models** addressing provision of a function (or closely related functions) for common systems products, processes or services.
[3] Project methodology:	- Methods inputs. - Methods derived from project development (e.g. JPEG algorithm). - Project life cycle including processes and plans that can be repeated.
[4] Contextual inputs:	- Participation profiles (e.g. committee memberships, stakeholders, users; technical expertise, market strategies). - Problem and solution views of the stakeholders & intentions of the standard.
[4] Third party environments: [subcontracting of results of standardisation]	- R & D environments (e.g. programming, implementation and testing). - Registration Authorities for specialised results, according to specified international agreements. - Certification Bodies for Type Approval Tests for compatibility, safety, compliance and conformity recommendations.
[5] IS and services:	- SDOs and NSBs internet resources; secretariat information resources. - Committee servers for email services.
[6] Operational information:	- Published documents; project plans; ballot results; technical procedures bearing on task performance and decision-making. - Policies for functional responsibilities, intellectual property rights and aspects of confidentiality. - SDO procedures guiding standardisation actions.
[7] Collective knowledge:	Is presented as constructs of the standardisation experience and results e.g.: - Strategies, management and practices. - Product networking and creation of information. - Goal congruence in project results from creation of information. - Results that specify technical compatibility for a chosen technology.

6.7.4 IITS Process Interactions

Predominant IITS process interactions can be thought of as highly contextual. This is because they possess qualities that shape the underlying mechanisms of project development and IITS process practices. Four examples of interactions are communication, co-ordination, collaboration and meetings.

Communication is a core component of every aspect of the IITS process. Drawing upon studies on group practices (such as Baron *et al.* 1992; Faraj and Sproull, 2000; Hackman, 1977; McGrath, 1984; 1990), communication presents three embedded contexts: collaboration, co-ordination and meetings.

One, **collaboration** propels committee actions through contribution, co-operation, information exchange and involvement in interacting with others. Effective collaboration justifies the representation of the solutions sought after in the standard.

Two, **co-ordination** among individual developers embraces collaborative information exchanges that facilitate performance of assigned tasks (McGrath, 1984; Faraj and Sproull, 2000).

[a] Committees assign individual developers to work on interrelated project topics that will yield results to contribute to a section of the master draft standard.

[b] Individual efforts would be co-ordinated through appointed convenors or group leaders that collate these task results. Co-ordination procedures bear on the level of review and decision-making mechanisms to ensure consistency of the work. Convenors or group leaders have the role to collate task results, followed by meetings for resolution of concepts and summation (cf. Baron *et al.* 1992; McGrath, 1984).

Three, **committee meetings** are mechanisms for building technical information and knowledge through shared learning contexts: discussions, decision-making, resolution and feedback (cf. Evaristo, 2003; Faraj and Sproull, 2000). As shown in Appendix 8E, each meeting produces documented results that are promulgated through committee Internet resources. This is also aimed at attracting interest in the project or strengthening existing co-operation among stakeholders (cf. Gabarro, 1990; Ocker *et al.* 1998).

6.8 Summary of IITS Process Functionality

6.8.1 Integrated Findings

The findings from the three levels of analyses in this part [2] of the analytic framework, namely environment, static and dynamic are integrated. **Figure 6-5** contains this integrated summary to demonstrate full understanding of the complex nature of the functionality of the current IITS process.

6.9 Summary of IITS Process Functionality

This section gives a sense-making summary of Figure 6-5. This diagram effectively makes a back loop cycle to where the solution proposal began.

First, this diagram is divided into **macro and micro perspectives** (cf. Pettigrew, 1997). underpinning the examined scope of functioning of the IITS environment and IITS process. Second, the integrated findings have been linked to these two perspectives. In doing so, the findings illuminate the various layers of context that are differentially shaped by the interaction between the IITS process and its environment. The contexts through which IITS process functions become clearer, allowing for exclusive analytic evaluation of its performance in the next chapter.

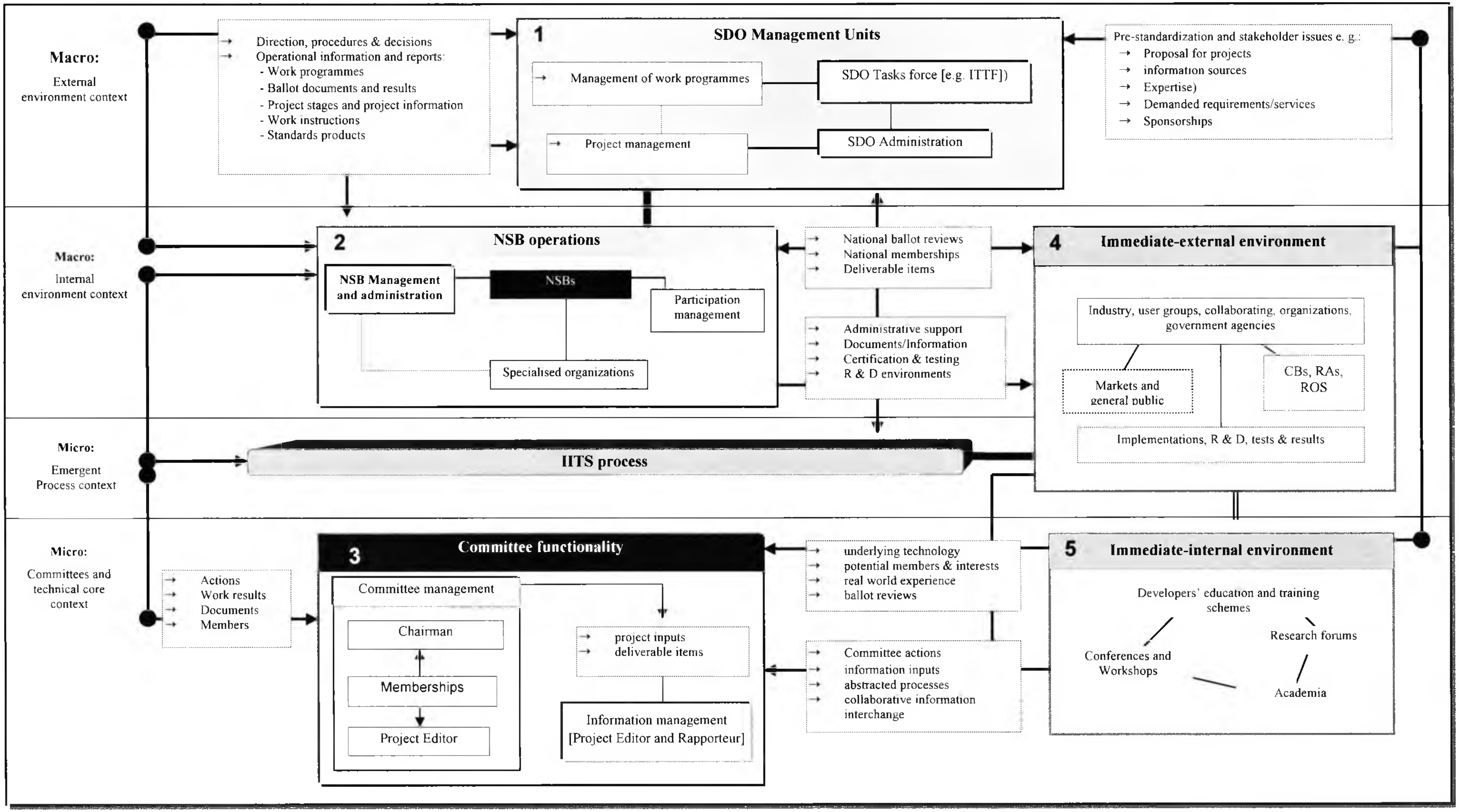


Figure 6-5: Summary of functionality of IITS process (based on inputs, operational co-ordination and results)
(Source: compiled by author)

Macro perspective

This perspectives is the current IITS environment. It embodies the 'external environment' and 'internal environment' contexts (Hackney *et al.* 2006, §6.2.2). To clarify clarity of epistemological assumptions underpinning IITS efforts, the external context has been reassigned for stakeholders as the 'immediate-external environment.'

Together, key features of this macro perspective (such as constitutional structure, SDO and NSB as functional units) greatly influence how the IITS process operates. This macro perspective depends upon cross-functionality (Ostroff, 1999) evolving, in many respects, from the co-operation required in the constitutional structure and functional units. In turn, this macro perspective generates operational activities that serve the IITS process.

This cross-functionality also has, as its basic element, interactions between the IITS process with its interdependent environments, namely internal, immediate and external. When streams of events occur concomitantly and over time, input into any part of the 'internal environment' leads to communication, co-ordination, information flows, strategies, actions and results, to include interlocked layers of context.

Micro perspective

Figure 6-5 indicates that this micro perspective by presenting two contexts:

[1] **Emergent process context:** The extant IITS process, as examined, is considered as an emergent context (cf. Hackney *et al.* 2006). As mentioned in the problem frame statement #1 (§5.4.1), the IITS process perceived in various standards literatures, has no formal framework. The definition of this process (Figure 6-4) has been constructed from the empirical evidence based upon the themes of the primary aspects (Table 4-12).

[2] **Committees and technical core context:** This context applies to IITS process project development. A defined IITS process structure strengthened the characterisation of the PDC and explanation of committee performance theorising from empirical evidence. The findings from dynamic analysis reveal the interplay of project inputs and relationships to committee interactions, practices, sub-processes and embedded contexts to give substance to the various project development pursuits and deliverable items.

[3] Variations in context evolving from project development create different kinds of **scenarios** that take account of multi-dimensional properties and abstruse performances concerns. This is the basis from which the problem statement is evaluated.

6.10 Chapter summary

In this chapter, the analytic framework has proved its value in providing rigour to characterise the static, dynamic and embedded qualities of the current IITS process. The next chapter is a comprehensive analytic evaluation of the current IITS process performance. It focuses on operationalisation of the research hypothesis by reconstructing this IITS process.

Chapter 7

Analytic Evaluation and Reconstruction

7.0 Chapter Summary

This chapter is the analytic evaluation of IITS process performance with regard to the problem statement. The analytic framework (Figure 5-2) provides the guidelines of evaluation which link parts [3] and [4] in two segments, as follows.

The first segment introduces the instruments (§7.1) focusing analytic evaluation of IITS process performance. The instruments are applied for the evaluation of the complexity on the current IITS environment (§7.2), IITS process performance (§7.3), leading to a comprehensive characterisation of the implications of the complexity (§7.4).

The second segment is operationalisation. This supports the analytic test of the research hypothesis by reconstructing specified core aspect of the IITS process within a CBD framework. The methodological reasoning behind the operationalisation procedure and interpretation of the results involves framing of requirements (§7.5) and of reconstruction actions (§7.6). The reconstruction exercise is demonstrated in five systematic stages (§7.7) to create a 'Standards Documentation Setting' (SDS) as a test case of the proposed component-based project development setting. Definition of the SDS functional design specifications, their solution options and choice are mentioned (§7.8, §7.9). A summary of results of the design effort frames the problem space and problem relevance (§7.10). A short summation section concludes this chapter (§7.11).

7.1 Introduction to Analytic Evaluation

7.1.1 Rationale of Analytic Evaluation

Integrated findings from the static and dynamic analyses characterised 'what the current IITS process is concerned with' (Figure 6-5). A step further is an analytic evaluation of its performance. Much of the literature (Born, 1994; Humphrey, 1989, 1997; Rossett, 1999; Rummler, 2001) suggests that process performance be called for when there is a need to fix an identifiable problem, to eliminate non-conforming elements or to design required solutions. Process performance would be evaluated against 'classification criteria of the aims of the improvement exercise: such as, costs, time and technology needs.

This evaluation is central the objectives of this thesis. It challenges analytically two main assumptions. One, the **problem statement** posing the supposition that IITS process performance has different contexts of complexity (§1.1.4). Two, a **predetermined solution proposal** exemplifies most clearly, how a CBD framework can help reduce the complexity of the IITS process and to also address the most relevant solutions for project development.

Against these two assumptions, this analytic evaluation greatly depends upon the quality of data gathering and interpretation of the findings. This researcher argues for a theory-driven evaluation of IITS process performance. OIPT as a lens helps to dimensionalise how non-specific complexity can be evaluated to also unravel other undiscovered phenomena.

Six questions in **Box 7-1** are used to give micro-focus on data gathering. Theorising from the empirical evidence, together with the use of OIPT as a lens adds greater analytic rigour to develop an equal basis upon which the data gathered, evaluated, thereby strengthening the reasoning of the results that legitimatise the characterisation of the IITS process performance. For example, contexts of IITS process complexity; implications of complexity; critical issues and core aspects. These are some of the findings from this analytic evaluation carried forward to the operationalisation of the research hypothesis and reconstruction of the IITS process.

Box 7-1: Questions for analytic evaluation of current IITS process performance
(Source: compiled by author)

[1]	What are the sources of complexity of IITS environment impacting on IITS process performance?
[2]	How well is the IITS process performing in its current state?
[3]	What are the challenges in the meaning of the details of IITS performance?
[4]	Which are the core aspects of the IITS process that give prominence to its performance?
[5]	What are the critical issues of the core aspects IITS process, for which solution options are needed?
[6]	Which core aspects of the IITS process can be reconstructed to bring about resolution of the concepts presented in the solutions proposal?

7.1.2 Instruments of Analytic Evaluation

This analytic evaluation fit into the scope of the analytic framework (Figure 5-2, Part [3]). It has intense elements central to the operationalisation exercise that also draws attention to qualitative and interpretive perspectives. Consequently, robust instruments must primarily support the analytic evaluation of IITS process performance. The instruments strengthen data gathering, theoretical, methodological and epistemological details of explicating various layers of contexts.

There are four main instruments depicted in **Figure 7-1,** namely: process framework (§7.1.3); dimensions from OIPT guidelines (Box 3-2); analytic questions to be addressed (Box 7-1) and decision criteria (§7.1.4). Given the non-specific nature of IITS process complexity as presented in the problem statement, this analytic evaluation is **qualitative** to question its performance.

Drawing on the findings, the **interpretive perspective** articulates distinctive meanings of IITS process performance. Meanings are located in the data gathered in which there are different contexts of complexity embracing other phenomena (cf. Corning, 1998). Together, qualitative and interpretive perspectives contribute to the underlying pursuit of contextual depth and uniqueness of items that are evaluated (cf. Pettigrew, 1997).

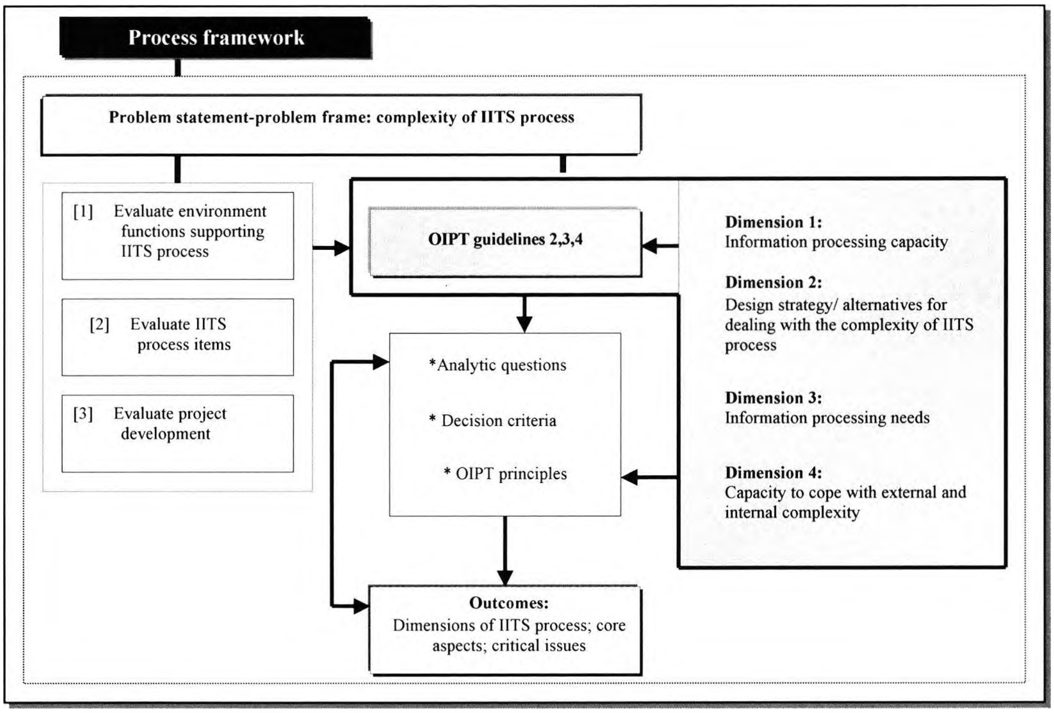


Figure 7-1: Instruments for Evaluation of IITS Process Performance
(Source: compiled by author)

7.1.3 Process Framework

The underpinning concept of this process framework in inspired from Checkland (1987: 27). He suggests that it is not possible to cope with complexity, because it has dense connections among its parts. Therefore, we are forced to reduce it to some separate area that can be examined separately. In the summary in §6.9, the IITS process has been identified as **scenario-based**, from the various contexts that are created in project development.

Focusing on identifiable 'scenarios' it is then possible to reduce IITS process spectrum of performance to a process framework presented in **Figure 7-2.** To make its scenarios transparent for this in-depth analytic evaluation, this process framework is divided into two levels, as follows:

[a] **Level 1** determined from Figure 6-5, has combined **operational scenarios** of the IITS environment macro perspectives impacting on IITS process. For example, SDOs and NSBs.

[b] **Level 2** portrays **scenarios** determined the IITS process features. The core process stages provide base definition of the process framework, because it is the feature that provides formal guidance to project development. PDC phases are used where it is necessary to define a complete scenario.

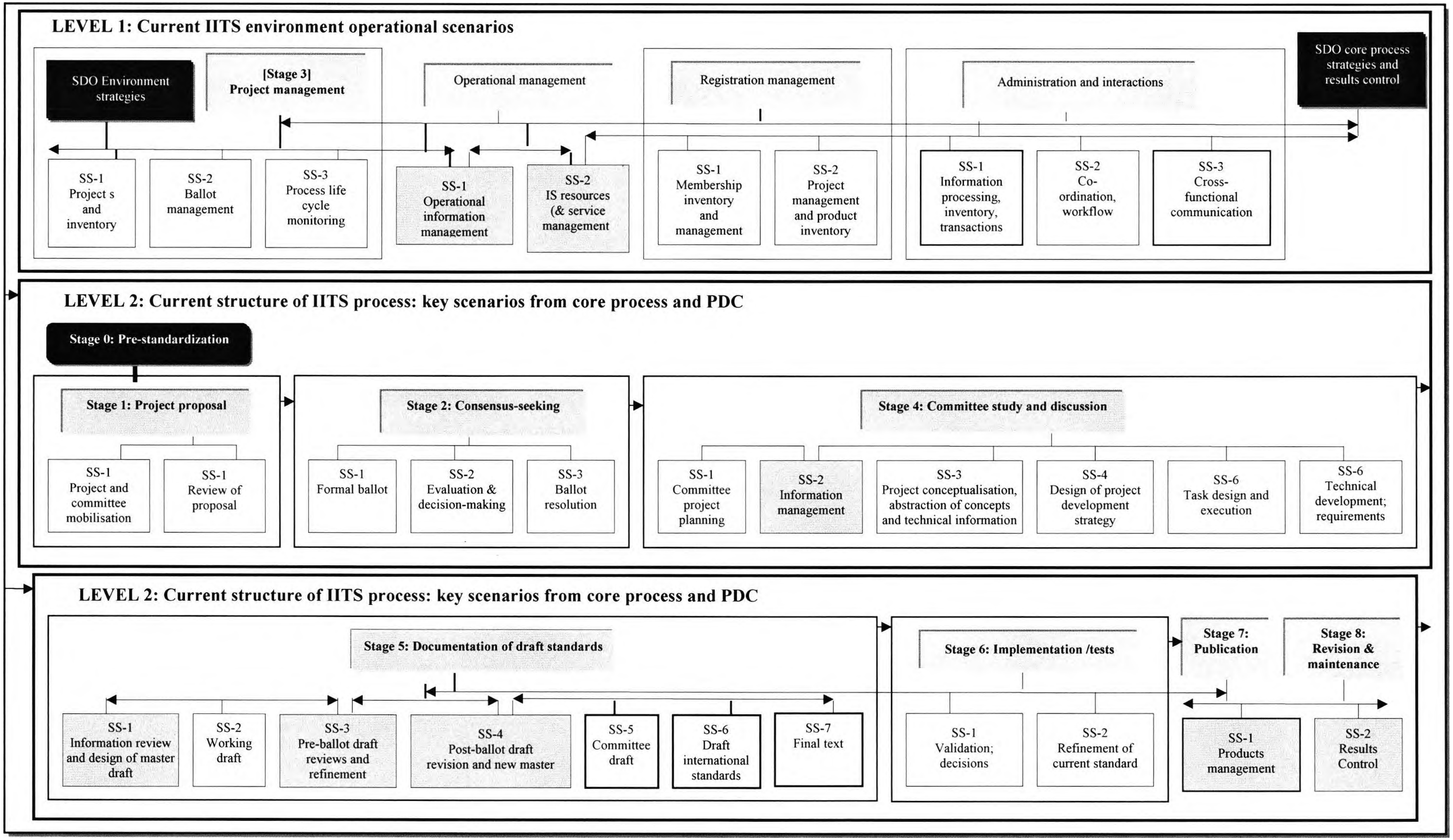


Figure 7-2: Definition of Process Framework
(Source: compiled by author)

In keeping with Kock and McQueen (1996) this process framework is only a graphical representation. It should not have more than 14 activity symbols. Thus, to keep this process framework to minimum symbols for evaluation, 'stage scenarios' have been subdivided in *sub-scenarios* (such as SS-1 and SS-2). This sub-division gives accurate representations of IITS process performance. At the same time, important contexts, as well as, conditions associated with IITS environment and project development are taken into account in the same framework. The accuracy of the process framework is verified by answering analytic questions in **Appendix 9 [Part A].**

7.1.4 Decision Criteria

This researcher has established that, reconstruction of a specified core aspect of the IITS process within a CBD framework is the approach to create a component-based PDS (§1.2.5). A core aspect represents a required set of features and functional concept of the IITS process. They must embrace some significance in their meaning to the IITS environment and IITS project development; otherwise they are not worth reconstructing.

Analytic evaluation is performed on the process framework. Four decision criteria described next, support analytic questions (Appendix 9 [Part B]) in theorising the depth of the meaning of the IITS process performance for the identification of potential core aspects. These criteria are salience, strategic importance, fundamental impact and potential value. With a few modifications, these criteria proved useful to classify other findings considered for reconstruction.

[1] Salience

Keen (1997: 16) describes salient processes as the most prominent ones that also relate directly to a firm's identity. Given the dynamic interplay of the operational, technical and social contexts of project development, in this process framework, the aim is to identify **salient dimensions** that can be given greater attention in the analytic evaluation. Salient dimensions illustrate IITS process performance challenges, together with the understanding upon which to define its critical issues and core aspects to be considered.

[2] Strategic importance

This criterion refers to the considerations that fit into pursuits of the IITS environment: such as goals, deliverable items, strategies, stakeholder needs, and other opportunities that drive project development (cf. Matheson and Matheson, 1998; Tidd, 1993). In the strategic sense, the IITS environment is a primary producer of standards that are binding on industries and organisations, in global contexts. Core aspects of the IITS process that are reconstructed should, therefore, be placed in this broader context of IITS environment **strategic pursuits** and the expectation of success in developing standards.

[3] Fundamental Impact

In this analytic evaluation, **fundamental impact** draws attention to the needs of the IITS process. Reconstruction of the IITS process is aimed at reducing complexity, so that solutions become transparent to the users of this process. Drawing on thesis argument #1 (§1.5.6), fundamental impact is judged upon the design results from the reconstruction of the IITS process and solutions that can be expected to bring positive consequences, such as enhancement of IITS process performance that might lead to successful project development. The design results and solutions have implementable value (cf. Benbasat and Zmud, 1999, Markus, 2004), from which fundamental impact will be evaluated to satisfy the needs that fit into the IITS environment strategic direction of the attainable future.

[4] Potential value

This criterion identifies with the broadest and all-inclusive **opportunities** that are likely to be attained from the results of the reconstruction exercise. Moreover, the intensity of the IITS process is such that reconstruction decisions draw upon all-inclusive **challenges** impacting on the solution options sought. For example, IITS process core aspects are chosen for reconstruction, because they are robust to withstand radical design challenges of utilising a CBD framework and the intended use of IS resources (cf. Davenport, 1993).

7.1.5 Dimensionalisation of OIPT lens

These instruments described above are supported with the selected features of the OIPT as a lens, ensuring grounding in theory of the analytic evaluation and interpretation of findings. The most arduous task that is also central to ensuring appropriate focus across the levels of analytic evaluation rests on the dimensionalisation of OIPT as a lens. **Table 7-1** shows this result.

Table 7-1: Dimensionalisation of OIPT guidelines and principles
(Source: compiled by author)

Refined OIPT guidelines	Areas of evaluation	OIPT principles
Dimension #1: Information processing capacity	**Environment:** [e.g. functionality]	- key relationships - dynamism - complexity
	IITS process: core process and PDC [e.g. information; tasks; processing; exceptions]	- ambiguity - variety - uncertainty
Dimension #2: Design strategy or alternatives for dealing with the complexity of IITS process	Relevant solution proposal views	- Solution options *fit* to context
Dimension #3: Information processing needs	Relevant project development settings features	- Success criteria of requirements - *Fit* to content and *fit* to context of solution options - Parameterisation of operational performance and requirements
Dimension #4: Capacity to cope with external and internal complexity	Dimensionalised solution options Reconstruction and design decisions	

7.2 Analytic Evaluation of IITS Environment

In this first part of the analytic evaluation, OIPT lens dimension 1: 'information-processing capacity' is applied to **Level 1** of process framework (Figure 7-2). Functions, structures, strategies and information have been identified as key aspects to answer **question # 1** (Box 7-1: Questions for analytic evaluation):

What are the sources of complexity of IITS environment impacting on IITS process performance?

7.2.1 Dimension #1: Information-Processing Capacity of IITS Environment

According to Galbraith (1973, 1974) the basic purpose of an organisation's structure is to create the most appropriate configuration for its functional or work units. The lateral relationships between functional units can increase the capacity to process information hence. The IITS environment constitutional structure presents these features. It also coexists with dynamism and complexity.

[1] Complexity of IITS environment functional relationships and functionality
In this dimension #1, the IITS environment constitutional structure (Figure 6-1) has been described as facilitating its functionality with SDOs and NSBs as its main functional units (§6.2.2). Importantly, this structure creates particular styles of information-processing capability, namely:

[a] **Inter-organisational relationships** between SDOs and NSBs follow traditional hierarchical referral strategies of goal setting, spans of control and observation of rules (cf. Galbraith, 1973).

[b] **Lateral relationships** between SDOs (such as ISO and IEC) and across NSBs are aimed at achieving some degree of formality of cohesive functionality.

Both inter-organisational and lateral relationships mentioned above apply hierarchical methods of reporting. This is a tacit response to the much-needed co-operation, collaboration, communication and participation sustaining IITS environment functionality (cf. Blunden, 1987; Willams *et al.* 1993). Agreed decisions and strategies that propel the IITS process performance are formalised, mobilised and controlled through various SDO functional units, such as ISO ITTF.

According to Blunden (1987), Keohane and Nye (2001) and Mackenzie (2001) **functional complexity** presents the difficulty of managing operational matters. In the IITS environment, this functional complexity evolves from the number of organisations that are expected to function together. With intertwined inter-organisational and lateral relationships, there is very little operational cohesion for continuance of meaningful communication. An immense amount of information is imperative to address a wide spectrum of operational matters and to decide on actions. On the other hand, interlocked inter-organisational and lateral relationships indicate that the ability to handle IITS process operational matters increases the need for relevant information, and information-processing capacity that SDO cannot provide effectively.

As illustrated in Table 6-2 (IITS environment operational principles), SDOs tend to respond to increasing operational matters by using different kinds of principles that attempt to counterbalance functional complexity. Formal procedures or rules that give justification to operational control need to support these principles hence. The procedures can be hindered, however, when there is a conflict that requires attention.

An example conflict from the empirical evidence involved extensive discussions to establish agreement on the use of similar word-processing applications that would be interchangeable across all NSBs. To many organisations that are not perhaps locked in inter-organisation procedures, flexibly to deal with conflict would be the answer.

However, several unforeseen deadlocked discussions ensued which rested upon applications preferences, due in part, to the different versions of Windows and DOS that NSBs used. This conflict required several meetings followed by formulation of new procedures and consensus agreements. In that time of negotiations, the lack of relevant procedures created uncertainty in meeting project development needs. Example terms of this uncertainty covered long time leads in information processing across NSB; time-wasting procedures for text conversion and delays in transacting documents to committees.

[2] IITS environment dynamism

Bensaou and Venkatraman (1995) describe forms of dynamism created through inter-organisational relationships. This includes the relationships between the organisation and its external environment. For the IITS environment, dynamism is a key source of uncertainty. It occurs at the highest level, within the IITS environment functional structure. This is reflected as the extent to which task-relevant characteristics and functional changes occur, because of the constant cause-and-effect of organisational relationships that it forms (cf. Bensaou and Venkatraman, 1995; Daft and Lengel, 1986).

Multifaceted inter-organisational relationships of IITS environment, on the one hand, demand a number of **control measures**. For example, the IITS environment **assigns responsibilities** to various organisations in its operational divisions, such as collaborative and professional liaisons (see §6.2.4). **Procedures,** such as those in ISO Guide 26 (2004) sustain separate functional principles underpinning how these liaisons apply. On the other hand, if IITS environment inter-organisational relationships are not sustained, many of the functions assisting IITS process performance can fall apart.

The implications of IITS environment dynamism are several. The important ones are that, control measures bring in added layers of operational matters. They distort the phenomena of IITS environment practices. With each new set of procedures can be ephemeral, because they need constant revision to keep up with ever-changing operational conditions.

Dynamism needs constant perseverance. As such, any other control measures put in place serve to confuse, rather than clarify a particular circumstance. Frequent meetings are needed to constantly exchange ideas, gather new information and assemble results from each organisation that might contribute to IITS process performance (cf. Blunden, 1987; Wagner and Hellenbeck, 1992). Eventually, these implications of dynamism do not only distort practices, but also limit the logical aggregation of inter-organisational information input. Requirements that propel practices become unclear and can not be interpreted correctly in the IITS process (cf. Humphrey, 1989).

[3] Structural complexity

The way in which the current IITS process is configured around layers of IITS environment functional units is one of the sources of structural complexity. Layers of sub-structures make it difficult to differentiate IITS process performance from project development or environment functions.

The two forums examined in the case study, namely the IEEE Computer Society on SES and ISO IEC JTC 1 exemplify this structural complexity. Both forums cater to, at least, 60 different committees specialising in different IITS subject matters. As depicted in Figure 6-2 (Abstract Structures of JTC 1 Committees), diversity in project subject matters often necessitates sub-structuring the committee for two reasons:

[a] To establish effective ways within the committee by dimensionalising the project subject matters among different sub-groups with relevant expertise.

[b] To ensure direct contacts with sources of information or to pool relevant information or knowledge bearing on the project.

This dimensionalisation of committee structures based upon assigned subject matters has the underlying assumption of interconnectedness in IITS process performance. In contrast, these structures and subject matters have several competing frameworks that create complex practices and uncertainty. A number of scholarly works (such as Polanyi, 1996; Quinn *et al.* 1997) suggest that such *complex* structural dimensions restrain important elements of project development.

In this example, project subject matters, information and knowledge are *embedded* in the social contexts of committee structures and operational perspectives. The more structural complexity that is permitted in committee structures, the greater is the *uncertainty* to manage project development effectively. SDOs and NSBs have limited provisions of IS resources for committee needs, such as gathering and management of technical information. More layers of mechanistic interactions evolve hence, to support collaboration, communication and co-ordination. Mechanistic interactions then expand extant committee structures to further sub-structures, such as WGs and subordinate committees requiring separate cohesion (see Figure 6-3: Structure of IEEE WG 1074).

7.2.2 IITS Environment Strategies

Keen (1997:130) describes strategies as styles defined in an organisation's plans to implement certain goals and other cultural factors that affect how things get done. IITS environment strategies can be thought of 'styles' which are implications of its internal functionality. The styles are akin to 'what it needs' in order to produce standards. The strategies can be direction and model plans that are perceived in liaison between SDOs, NSBs, and committee representatives.

The first implication of such operational styles is **goal diversity in strategies.** Typically, the 'external environment context' in which published standards are referenced brings requirements from IT markets and stakeholders (cf. Scholes *et al.* 2004; Watson, 1993). Goal diversity occurs, because the internal styles of SDOs and NSBs do not meet operational obligations to help understand and address the external environment as real markets, opportunities, stakeholders or trends. Defined strategies turn out to be unrealistic. They are not transparent and they do not match needs that are unique to IITS process. The results are reflected in the slowness of SDOs to respond to the scope and pace of issues from the IT market in which IIT standards are implemented (cf. King and Lyytinen, 2003; Krechmer, 2005).

The second implication is **goal diversity in operational practice** evolving from the dynamism of functions sustaining IITS efforts. SDOs and NSBs follow **participative styles** of operational practice and of management described in literatures, such as Mintzberg and Quinn (1991); Wagner and Hellenbeck (1992), and Williams *et al.* 1993). This is where registered memberships have the **reserved right** to contribute to IITS environment operational matters and IITS process activities.

In general, participative styles require strategic direction from a higher authority, with the goals of operation determined co-operatively from NSBs and other organisations' demands. While consensus principles are encouraged, differences in opinions and interpretations of issues from different parties can easily become sources of conflict. Policy requirements for operational practice often outweigh project development obligations or decisions, instead of judging them on the basis of identifiable IT market needs. When conflict happens in strategic direction and operational practice, questions of vulnerability and of uncertainty arise, such as: Do the projects meet SDO criteria of need or is policy the point of contention?

To answer this question, often, decisions to initiate certain projects are delayed when the results of the participative style discussions do not appeal to key parties. As a matter of fact, the original proposal of MPEG-1 was rejected for ballot processing, for IITS environment policies that did not allow 'open R & D activity' (see §3.6.3). The implication of the rejection of MPEG-1 project proposal is this. Parties that propose standards projects spend a great deal of time and financial resources compiling evidence to ensure the acceptance of the proposal for development. For MPEG-1, market surveys and R & D results that had supported the original proposal had to be re-examined, at a cost to the proposers.

At the same time, SDOs has a policy that R & D activity in the voluntary standards domain requires contractual licenses for products and proprietary knowledge (cf. Lemley, 2002). Current IITS environment policies permit R & D activity and acknowledge licenses with other external agencies. However, SDOs often take too long to reach contractual agreements with external agencies, such that vital information is lost.

The third implication is **goal diversity in the IITS stakeholder environment**. Galbraith (1977) suggests goal diversity as uncertainty in an organisation's external environment with regards to its final products that customers might buy. In the openness of representation in IITS committees (De Vries and Verheul, 2003; Olshefsky and Hugo, 2003), project stakeholders are major implementers of the IIT standard. Goals that guide IITS process represent stakeholder requests connected to the IT market, which is an external environment context. The requests can include proposals to develop a new project or to revise published standard. Stakeholders, requests, market issues and project development embrace goal diversity hence. New information must be processed and strategies be defined in order to provide relevant responses to stakeholder environment matters. Since these are unpredictable by nature, it can be argued that, timely production of IIT standards can minimise uncertainty, and not necessarily goal diversity.

7.2.3 Information Uncertainty

Snowden (2000) raises an important point that, in today's information age, uncertainty is the new reality involving among other things, design of organisations, methods of information processes and use of IS.

The IITS environment need information as its most central resource. Each standards organisation deals with a variety of global challenges to develop IIT standards in an effective manner. These challenges present complex forms of information: such as, market data, national legislation of essential requirements for standards, technology concepts and requests. In simple terms, **information uncertainty** is not having enough information. The IITS environment may have several information sources from SDOs, NSBs and stakeholders. However, the *uncertainty* is the complexity of the amount of data that has to be processed to create relevant information to be matched to IITS process strategies.

According to Arrow (1974: 37), this uncertainty also bears on the information-gathering channels, such as NSB and other agencies. These channels can easily be abandoned based on benefit, cost of processing or when they no longer sustain on-going work programs. The diversity of operational matters that propel IITS process means information uncertainty and complexity of processing create a shift in the focus of decisions. There is more focus on immediate contractual operational matters for projects in progress to meet targets, than on how to resolve information uncertainty hence.

7.2.4 Information Processing and Operational Complexity

Information processing impacts on all operational scenarios illustrated in Level 1, Figure 7-2: 'Definition of Process Framework. Galbraith (1973, 1977) connects the complexity of an organisation directly to its information-processing needs. Foremost, the empirical reality from the case study evidence reveals that, information processing in SDOs, secretariats and forums is approximately, 80% of IITS process operations. There is constant information gathering, processing, and presentation of information in documents and transactions. These elements of information processing reflect the extensive nature of the needs for information. What emerges is **operational complexity** identified in this evaluation as embracing five distinctive features:

[1] **Formal procedures** are employed to guide forums and secretariats on how information is handled, processed and transacted (http://www.iso.org/). These procedures seek to develop similar interpretations of operational activities across all functional units (cf. Blunden, 1987; Galbraith, 1977). As practice, each processed document is registered with a reference number and title: such as, 'JTC 1 SC 29 N067, SC plenary resolutions'. The documents are the means for communicating information. The reference number would be quoted in follow up committee actions or feedback transactions across various units in the IITS environment.

[2] **Committees** receive processed information as documents. They review the documents to search for information needed to accomplish project tasks. The bulky nature and variety of the documents create **information uncertainty.** This form of

uncertainty involves the difficulty of determining the quality of documented information, until it has been reviewed (cf. Wilson, 1997, 1999). While IS resources currently in use help to manage immense information processing and document transactions, their capabilities do not include defining **the specificity** in the information that committees need to perform project tasks (Ngosi and Braganza, 2006).

[3] **The 'geographical scope'** of IITS information processing is translated into transactions to numerous dispersed parties (cf. Ngosi and Braganza, 2006).

[4] These complexities of information processing create **embedded elements.** Registration of processed documents, projects, memberships and published standards are translated into separate **operational inventories**. Empirical evidence from the forums, ISO JTC 1 and IEEE Computer Society reveals that, at least 60% of the capacity of IS resources in use is taken up in inventory or content management of electronic documents. Repetitive processing, evaluation and redundant operational inventories become customary, such that they distort the content of the information created.

[5] **Managing inventories is an unpredicted operational element**. According to Kobert (1992) and Wild (2002), inventories can be decomposed into many more specific features attributable to complex operations. Empirical evidence shows that, there is **excess inventory**, whereby forums, NSBs and SDOs hold the same information on the same projects and published material. This excess inventory is also redundant data (cf. Wild, 2002). The other is **unsatisfactory inventory control** (Kobert, 1992; Wild, 2002). Where information processing is complex, human errors create inaccurate documentation of records. Eventually, operational inventories across several SDOs and NSBs converts into costs, under various conditions in which information is collected, processed, controlled for use and maintained (cf. Kobert, 1992).

7.3 Analytic Evaluation of IITS Process Performance

In this second part, OIPT dimension #1: 'information-processing capacity' is re-applied to evaluate the extent to which the IITS process has the capacity to perform correctly. Detail and dynamic complexity, and uncertainty are the evaluation criteria of OIPT as a lens supporting this dimension (see Table 7-1: Dimensionalisation of OIPT guidelines and principles).

7.3.1 Detail Complexity of IITS Process

In this thesis, **detail complexity** is a consequence of the variety of features of the IITS process. As depicted in the process framework (Figure 7-2), many of the stages and phases through which project development evolves become scenarios. In keeping with software engineering concepts (such as Dorfman and Thayer, 1990; Kazman *et al.* 1996; Leite *et al.* 2000) a scenario has an independent content. It has goals, actors, events, changes and outcomes. It can be a structured description of one setting that occurs in the real world with regard to how performance is expected to occur.

The results of this evaluation show that detail complexity of IITS process can be expressed as macro and micro scenarios with independent content, as follows:

[1] **Macro scenarios** are generated from IITS environment operations, such as information processing, membership management and project management. These operations increase in detail, because of the abstruse nature of the layers of other features required to co-ordinate activities and results, to include control measures necessary to support project development endeavours.

[2] **Micro scenarios** are concerned with details specific to the IITS process performance. They increase the variety of IITS process content features, because of the unpredictable variations in context bearing on events, practices and changes that occur in each project stages. For example, ballot resolution occurs when the committee identifies a high degree of contentious issues in the comments presented for a draft standard (see Appendix 7E). Information gathering, co-ordination, negotiations of comments within a formal meeting setting are some of the key *events* that occur in a ballot resolution. These events, in turn, require *practices* to be implemented, such as decision-making in ballot discussions and resolution of comments toward attainment of consensus agreement.

Together, these are content features bearing on the meaning of the conduct of a single event (ballot resolution). They can easily become subsets of both macro and micro scenarios with cumulative actions and changes. Over time, IITS process features and performance become difficult to define, recognise, manage or predict (cf. Maxwell et al., 2002).

Table 7-2 gives a summary of the impact of the detail complexity of the IITS process bearing on these descriptions.

Table 7-2: Impacts of detail complexity of IITS process performance
(Source: compiled by author)

Content of detail complexity	Description
[1] Intense interdependency	Between macro and micro scenario perspectives, to include their features that are in constant interactions with each other. There are no specific boundaries between macro and micro scenarios
[2] Multi-dimensional complex content	Ubiquitous overlapping IITS process features that can not be verified in performance.
[3] Ambiguity	When two or more IITS processes stages interact they share other forms of complexity: e.g. input states to the each stage increase; new events are creates to counterbalance unpredictable performance conditions.
[4] Equivocality:	Several competing IITS processes features at each stages and unpredictable performance conditions.
[5] Variety of content-rich elements	Information, project tasks, intertwined events and methods of standardisation relevant to each project.
[6] Uncertainty:	Intertwined events competing for the same information presented for consideration, and not having enough information to resolve issues.

7.3.2 Detail Complexity of Information

Project development relies on information categorised in this thesis as technical and operational.

[1] Technical information

Committees need adequate technical information to influence the project development strategy towards stated objectives. **Appendix 8A** illustrates the *processes* through which this technical information is acquired and their link to the design of the project development strategy, standardisation approaches and project tasks. These complex abstraction processes span several years and many, evolve begin in pre-standardisation stage. Across the five projects examined in the case study the content of the assembled technical information consists of evaluated technology concepts, methods, products to be standardised, specific requirements and implementation views. If technical information lacks these abstraction processes, the subject matters presented in the draft standard, and its quality are likely to be poor.

Technical information is accepted in the committee through *consensus agreements*. This suggests that, it is compatible with the properties of the problem context, project subject matters and model solutions sought in project development strategy (cf. Ngosi and Jenkins, 1993; Ngosi and Braganza, 2006). Each project development stage requires current technical information to be introduced to execute new tasks. Consequently, the information abstraction processes and adjustments to core elements of the project development strategy (such as methods, tasks and draft standards) are continuous until the project is completed.

The complexity of this technical information presents itself in study documents, draft standards and ballots. The DIS for project ISO 10646, for example, presented well over 250 000 character sets of major scripts from global languages. Almost 200 pages of collated national comments needed to be clarified in different contexts: editorial, technical implementability and policies concerning the presentation of the different language scripts. Two DIS ballots, followed by two ballot resolution meetings were required (see Table 6-3: Case study project milestones and time scales).

These ballot sessions involved documenting complex tables to develop implicit specifications of the character sets as cumulative technical information supporting the content of the DIS. The complexity of the information presented as comments in the DIS ballots necessitated intense harmonisation procedures. This harmonisation was the means to decide essential requirements from accepted ballot comments presented from both ISO SC 2 assigned with the project and Unicode Consortia, as a competing *de facto* arena. Because of the detail complexity of technical information and human effort of its selection, it took approximately, 38 months of post-ballot negotiations and intensive editing to agree on a final text.

[2] Operational information

SDOs, forums and secretariats provide operational information. Processed documents, membership records, project inventory, evaluated results of various activities and procedures are rich sources of this operational information. SDOs utilise this information to explain the challenges they face in ensuring operational alignment of work across NSBs (Ngosi and Jenkins, 1993). This incorporates instructive documented actions, observing requisite operational principles, co-ordination of work and reporting. What information complexity is useful for is to present the reality of IITS process performance and its results in line with these operational challenges, as follows:

[1] In both technical and operational information, the strategies employed have a high degree of *uncertainty.* This is because they evolve through layers of collaborative inputs from a variety of sources, semi-structured decision-making processes, experience and procedures, instead of exploiting the capabilities of IS resources (see §6.2.3, §6.2.4). In the case of project 10646-1, compilation of an immense character sets for the DIS was carried out on low cost PCs and word processing packages, followed by manual reviews by the developers. The uncertainty is therefore the human errors in the representation of the complex information, albeit the expertise that the developers might possess.

[2] Committees develop study and technical documents as a resource for information gathering information and control of evaluated material. Empirical evidence suggests that it takes several months for a committee to build a tangible information base to then, evaluate it and determine how it can be used constructively. In the writing draft standards, the detail of technical information together with committee reviews eventually build highly complex information infrastructures such as those Table 6.8 depicts. Committees therefore face the problem of how to process, review and manage complex technical information in a synergistic or cost-effective manner.

[3] SDOs, forums and secretariats use different kinds of methods for gathering, evaluating and managing information. Besides procedures, they lack a common basis from which to implement consistency or compliance conditions for rationalising administration matters that produce operational information subsequently. These elements lead to detail complexity in creating operational information across different functional units, and in the information that is selected for operational purposes. A number of questions need to be addressed separately in the future such as: What qualifies as IITS process operational information? Which functional units are responsible for categorising it or for determining its quality? How can it be controlled and managed effectively?

7.3.3 Dynamic Complexity of IITS Process Performance

This analytic evaluation illustrates that dynamic complexity of IITS process performance covers **overlapping elements** as sources of uncertainty and of dynamic complexity. Overlapping elements from various interactions among several features evolve naturally, over time (cf. Battram, 1999; Cillier, 1998). It is difficult to navigate through dynamic complexity hence. However, IITS process has two major sources of overlapping elements.

The first source, **the use of both the core process and PDC** as the main features influencing IITS process performance, creates these overlapping elements. The dynamic interplay of ubiquitous content features, practices and multi-dimensional performance contexts create varied changes. Inevitably, essential aspects of project development become convoluted representations. Consequently, the IITS process must handle a number of exceptions for meaningful performance to be achieved.

Galbraith (1977) describes exceptions, such as hierarchical spans of control, information, sub-goals and rules. For the IITS process the exceptions are the objectives pursued in both life cycles, exclusively. There is increased need for co-ordination of tasks to ensure that information is exchanged. Major implications of these exceptions on IITS process performance are its inability to co-ordinate meaningful objectives to guide action and to provide committees with relevant information.

The second source is the **project subject matters of different forums**. For example, the titles and objectives of the SES projects IEEE 1074 and ISO 12207-1 overlapped each other (see §4.1.4). Two public enquiry ballots were launched for the DIS texts. The first ballots were launched separately, almost at the same time. The results produced inconsistencies in the terminology and requirements for similar SLC processes.
To deal with these implications of the overlapping subject matters, a 'Harmonisation Group' was set up to resolve conflicting interpretations in both draft standards. The second DIS ballots produced some agreements on major revisions to the interpretations of SLC processes. Despite these revisions, these two standards could not be implemented in the same software industry sector, because of the inconsistencies in their recommendations.

These two examples illustrate that dynamic complexity from extensive overlaps creates irreversible and unintended 'knock-on effects.' For projects IEEE 1074 and ISO 12207-1, the implications are several. For example, to deal with coinciding issues for the two projects, the formation of the 'Harmonisation Group' is an additional structure. The verification of new issues presented to this Group adds more exceptions, such as increased collaboration and new time consuming problem-solving procedures, until the standard is published.

7.3.4 Dimensions of Project Complexity

Dynamic complexity of projects is associated with specialised characteristics of inputs, standardisation approaches and committee practices. **Table 7-3** that follows next contains a summary of empirical reality illustrating the dimensions of complexity of the GIITS projects ISO 1064-1, JPEG and MPEG-1.

7.3.5 Dimensions of Complexity of Project Tasks

The model in Appendix 7B (Components of design of project tasks and performances) illustrates how project tasks embrace multi-dimensional characteristics. This diagram also adequately describes the complex dimensions of the project tasks that would be embedded in the project development strategy, and as such further description is not necessary.

Table 7-3: Example dimensions of complexity of GIITS projects
(Source: compiled by author)

Complexity dimensions	ISO 10646	JPEG-1	MPEG-1
Project scope	Extension of ASCII 7-bit and 8-bit code character sets onto a 16 bit multilingual plane	Compression techniques for digital data, image and pictures; and for still-images)	Coding of moving pictures and associated audio for digital storage media
Content complexity	Definition of multilingual character sets; encoding of world-wide dialects	Definition of compression and encoding techniques: data, images and pictures	Input *de facto* systems products; methods; R & D results; technical research papers
Project methodology	Adoption of the coding techniques and character sets concepts from published standards	Adoption of the coding techniques and adoption of base standards	Technical conferences to generate project concepts and required information
	Adoption of *de facto* solutions developed in Unicode consortium	Development of image coding techniques; mathematical algorithms applied in the coding techniques to compress and to encode images	Adoption of *de jure* standard and *de facto* systems products
Specialisation complexity	Programming in the development of character sets concepts	R & D activity to develop relevant standardisation approaches and coding techniques	R & D activity to develop relevant standardisation approaches
	R & D activity to develop inputs	Development of coding techniques and mathematical algorithms	Implementation test-beds to verify coding techniques, requirements
	Development of systems architectures and coding techniques for the representation of characters of languages and dialects	Implementation test-beds e.g.: hardware implementations to verify requirements and systems products derived from the standardisation	Simulation approaches to specify mandatory requirements (e.g. MPEG 1, Part 5)
	Development of software systems to evaluate character sets derived from standardisation	Specialised evaluations to define *technical constraints* of conformance assured in the JPEG techniques	re-design of input products to take advantage of the proposals derived from MPEG 1
Contextual factors of participation	- Merging of *de facto* Unicode with voluntary standardisation - Intense resolution of conflicting views: Unicode and ISO 10646 - Harmonisation of requirements	- Merging of different technical backgrounds e.g.: broadcasting, imaging, database, photography, software, hardware, telecommunications - Implementation by early adopters → - Special R & D contracts, patents and IPR acknowledged in MPEG 1 standards →	Symposia to promote MPEG1 proposals of results; source relevant R & D results; promote redesigned products

7.3.6 Implications of Complexity of Project Tasks

The diffuse effects of the complexity of project tasks need mentioning to adequately interpret vital constructs of IITS project development. Scholarly works covering Byström and Järvelin (1995); Faraj and Sproull (2000), Järvelin and Wilson (2003) and Hackman (1969, 1977) provide well-established concepts for translation to add depth and detail of the interpretations. Task categorisations, alignment, variability, sub-processes and uncertainty are major the implications of complexity.

[1] Task categorisations

According to Jäverlin and Wilson (2003), **categorisation** is based on the priori determinability of the tasks (or their structuredness). Findings from this analytic evaluation reveal that, when a project is more complex by methods (Table 7-3); by the immensity of information needs (Table 6-8) and by the variety of task constructs (Appendix 8A), more decision-making conditions need to be observed to reason project tasks. It becomes difficult to define a clear representation of the tasks, especially when the information inputs are not easily accessible.

Table 6-6 (Sample project plan and task perspectives) illustrates example tasks that would be predetermined in the project plan and structured according to a defined scope of the projects. These are: concept exploration, requirements analysis, problem analysis and implementation. During project development, each stage yields such varieties of task categories, because of project content control, performance decisions and filtering of information are required for their structuring tasks. Committees focus on predetermining which task categories can help the search for technical information to meet the attributes of the task categories, thereby dealing with complexity as it emerges.

[2] Alignment of tasks

Task categories are aimed at aligning a project development strategy with performance or execution contexts (cf. Hackman, 1969, 1977). Recognising that each project stage has different sets of tasks that apply scientific methods, **alignment** creates complex task performance requirements (Hackman, 1969, 1977). This is evident in writing of draft standards. This depends upon well-defined formalities for individual developers to collaborate on similar tasks, followed by co-ordination and review of task results at committee level. On the other hand, committees need to constantly gather, process, and review information for the summation of results to determine different kinds of facts for designing evolving tasks. Alignment thus raises the question of **task visibility**: Are the tasks the focal points of the project, or, is it the approach that the committee is seeking to define as part of the standard?

[3] Task variability

These complex project tasks and how they are performed creates **task variability.** Bensaou and Venkatraman (1995: 1495) suggest that variability is akin to the frequency of unanticipated events during the execution of tasks and that require non-routine procedures.

Projects JPEG-1 and MPEG-1, for example, employed intensive R & D activity to develop baseline components of the project such as those depicted in Appendix 8B (Components of design of project tasks and performances, Level 2). The two SES projects IEEE 1074 and ISO 12207-1, on the other hand, employed scientific paradigms from IEEE MPSE (IEEE, 2001). These different approaches generate task variability drawing upon the choice of tasks, their categorisations and problem context to be examined for a particular project. Since task complexity, task variability and complex methods coexist within different stages, committees resort to procedures that can determine how well each project meets specified quality criteria, for example:

[a] Technical fit of the methods.
[b] Common understanding of essential technical information for designing tasks.
[c] Coping with unanticipated events emerging from the variations in context of each project stage in the dynamic interplay of practices and performance.

[4] Variety of sub-processes
The development of draft standard is a good example of **sub-processes** generated from combined clusters of tasks (cf. Tushman and Nadler 1978). Across the five committees examined, a draft standard begins as a series of chapter sections assigned to groups of developers. The writing naturally evolves as sub-processes that are characterised by features of the content of the chapter sections and underpinning performance elements of the project. In addition, collaborative writing tasks generate **split-level sub-processes** covering: information analysis, chapter reviews, editing and revisions, leading to a draft standard for ballot (also see Table 6-3: IITS process scenarios, sub-processes).

[5] Task uncertainty factors
Project tasks adopt the contexts in which they are performed. These contexts are co-ordination, co-operation and consensus applied in the summation of desired results (McGrath, 1984; Faraj and Sproull, 2000). Predominant uncertainty factors from these contexts are dynamic and transitional exceptions.

[a] **Dynamic exceptions** cover those described in Galbraith (1977) as co-ordination and procedures, which (McGrath, 1984) mentions as contexts. With these exceptions, committees develop study and technical documents containing processed information. These documents are part of task performance, whereby co-ordination and collaborative information exchanges among individual developers supports the review of these documents. Committee documents review processes involve several procedures that also overlap task performance and operational matters supporting processing and transactions. In these performance contexts **dynamic exceptions** are sources of uncertainty, inasmuch as, the need for varieties of information to cope with task complexity and additional procedures required in the different levels of co-ordination.
[b] **Transitional exceptions,** on the other hand, are concerned with committee practices utilised to support the alignment of the project development strategy. For example, technical practices apply to the abstraction of technical information, design of tasks and consensus. The other types are social and operational practices cover information processing, committee meetings and procedural interpretations that guide actions. In general, these practices are intermixed and transient, because of the changes that occur from the progression of the project from stage to the next.

7.4 Implications of IITS Process Performance

This section provides detailed definition of the implications that answer **question #2** (Box 7-1: Questions for analytic evaluation):

How well is the IITS process performing in its current state?

7.4.1 Classification of Implications

This researcher argues that, clarity and depth of IITS process complexity lay foundations for defining the reconstruction actions. The responses to question #1 are categorised as statement, providing a transparent epistemological scope of the implications that also support the results from this analytic evaluation.

[1] In its current form, the IITS process is not performing well.

Drawing upon the different elements of this analytic evaluation, it is concluded that the **IITS process is not performing well.** One of the reasons that also supports Jakobs (2000:8) is that, different contexts of the IITS environment need to be taken into account when trying to actually understand IITS process performance. While there is this need for the extant IITS process to have continual reference to the IITS environment functional units, this approach stymies its performance (see Figure 6.5: Summary of functionality of IITS process).

This reference does not give the IITS process a clear sense of identity or prominence. This reference is more of a functional relationship that creates sources of its complexity and uncertainty. It is important to identify those things that the IITS environment does well in; and those things that the IITS process should be doing well in. Otherwise, IITS process performance will remain vague and difficult to predict, manage or verify.

[2] Extant IITS process has no prominent performance framework.

No prior framework has been offered in the reviewed standards body of literature that gives a definition of the structure of the IITS process. A process that has this variety of specialised elements, but has no performance framework also lacks definitive criteria for fundamental understanding its focus, substance, requirements and actions (cf. Holdsworth, 1994; Humphrey, 1989). It is argued that this reconstruction exercise needs a focus on an IITS process framework as a transparent feature that can guide and influence project development to committees and NSBs, as its major users.

[3] Extant IITS process performance is disruptive

This analytic evaluation sums up IITS process performance and project development as complex contexts, unpredictable variety of elements, dynamic interlocked practices and diffuse uncertainty factors (see §7.2, §7.3). Detail and dynamic complexity clearly characterise extant IITS process performance as disruptive to project development. Performance evolves as *conflicting* and *unknown* requirements from its uncertain contexts. Humphrey (1989: 255) describes *unknown requirements* as, the users think they know what they want, but they discover that their real needs are not what they thought they would be. There is very little control over how to meet performance goals because the details of the IITS process are not understood properly or adequately resolved.

[4] IITS process performance creates competing elements

Variety in competing elements in the IITS process stymie performance. Competing elements evolving with changes that occur easily become scenarios with exclusive goals, actions, goals, conditions and outcomes (cf. Dorfman and Thayer, 1990; Kazman *et al.* 1996, Leite *et al.* 2000).

Theoretically, what SDOs and NSBs perceive is a project progressing through its formal stages. In reality, the scenarios that are generated through each stage are uncertain contexts that need management, over time. Uncertainty permits the use of non-conforming exceptions to meet unanticipated events, such as collation of ballot comments for resolution. Information and resource needs increase regardless of the results produced.

Table 7-3 that follows next, illustrates the magnitude items determined from the process framework (Figure 7-2) to also summarise IITS process performance. Altogether, there are 43 items equated as processes, scenarios, sub-scenarios and sub-processes. Decision criteria (§7.1.4) are applied to make distinctions between them. Recognising this difficulty of determining real scenarios or real processes among several other items, additional criteria of distinction are applied involving technical, operational and global.

[a] **Technical** is a criterion for the different types of content and performance expectations of examined projects.

[b] **Operational** involves groups of activities, methods of working and resources, which combined, convert inputs to yield products and services. Results from these operational matters provide inputs to the planning of activities, procedures and practices.

[c] **Global** applies to general sub-processes or scenarios linked to various types of strategic, operational, technical, management and performance aspects in the IITS environment. They create extended dependencies in supporting operational needs.

7.4.2 Challenges of IITS process Performance

The implications described lead to the definition of items that answer **question #3** (Box 7-1: Questions for analytic evaluation):

> What are the challenges in the meaning of the details of IITS performance?

This question is answered by consolidating combined results of static and dynamic analysis, analytic evaluation and empirically derived understandings of project development. As shown in **Table 7-4** next, this approach offers two complementary representations: definition of the *dimensions* of actual IITS process performance and, matched to the *challenges* giving justification for the need for reconstruction.

Each dimension has an identity that provides a basis for characterising the challenges in a constructive way. Guidelines for defining the dimensions of IITS process performance are taken from Table 4-11 (Criteria for data integration of the empirical case study) to ensure some degree of consistency in the relationships of the representations.

Table 7-3: Summary of IITS process scenarios, processes and distinctions
(Source: compiled by author)

Distinctions	Summary of processes concerning core process & project development cycle	Rank of evaluated merits					
		LOW		MED	HIGH		
		1	2	3	4	5	Notes:
Strategic importance [12]	[1] Adoption of standards				✓		[S], [XL]
	[2] Ballot management				✓		[B]
	[3] Design, management and maintenance of Internet content					✓	[B], [S]
	[4] Development of base standards and requirements [**]					✓	[S], [XL]
	[5] Information analysis, evaluation & management					✓	[XL]
	[6] Proposal management [e. g, inputs, product licences]					✓	[B], [S]
	[7] Publications				✓		[XL]
	[8] Registration management [of committees, projects, product licenses and IIT standards]					✓	[S], [XL]
	[9] Results control					✓	[S], [B]
	[10] Revision and maintenance of standards					✓	[S], [B]
	[11] Technical development [covering standardisation actions]					✓	[S], [XL]
	[12] IITS environment strategic planning and decision-making					✓	[B], [S]
Salience; Technical [17]	[1] Abstraction of project concepts & information inputs					✓	[S], [XL]
	[2] Ballot reviews, evaluations & resolutions					✓	[B], [S]
	[3] Development of scientific paradigms					✓	[S], [XL]
	[4] Development of standardisation approaches [**]					✓	[XL]
	[5] Documentation of study and technical documents				✓		[B], [S]
	[6] Documentation of draft standards					✓	[S], [XL]
	[7] Draft standard revision and editing					✓	[B], [S]
	[8] Information analysis, reviews and evaluations				✓		[B], [S]
	[9] Information control and management					✓	[B], [S]
	[10] Interpretation of draft standards					✓	[B], [S]
	[11] Project planning [and organisation of projects]				✓		[B], [S]
	[12] Project networking				✓		[B]
	[13] Requirements analysis, development & interpretation					✓	[S], [XL]
	[14] R & D activity, implementation & testing of model requirements *[off-line]*					✓	[S], [B]
	[15] Task planning and task design				✓		[B], [S]
	[16] Technical development [in R & D activity]					✓	[S], [XL]
	[17] Technical decision making [of results of R & D; implementations and interpretation of results]				✓		[B]
Operational; Fundamental Impact	[1] Administration [information processing, dissemination and committee management]					✓	[S], [XL]
[6]	[2] Ballot initiation and registration			✓			[B]
	[3] Evaluation of ballot response samples			✓			[B]
	[4] Membership processing and inventory management					✓	[B], [S]
	[5] Documentation and maintenance of procedures					✓	[B], [S]
	[6] Reporting and feedback					✓	[B]
Global; Potential value [8]	[1] Communication, collaboration and co-ordination					✓	[B], [S]
	[2] Co-operation and participation in IITS process				✓		[B], [S]
	[3] Document management					✓	[B], [S]
	[4] Global information management					✓	[XL,
	[5] Meetings [editorial, planning and plenary]					✓	[B]
	[6] Operational decision-making across NSBs and SDOs					✓	[B]
	[7] General transactions with stakeholders			✓			[B]
	[8] Work synthesis & work flow				✓		[B]

Note:
[B] = Sub-processes that are broad in content and consisting of competing activities and events.
[S] = Specialised scenario.
[XL] = Scenarios that are too large and consisting of competing sub-processes
[**] External processes linked to core process and PDC activities]

Table 7-4. Dimensions of IITS process performance and challenges (Source: compiled by author)	
Identity of dimension	**Challenges**
[1] IITS environment functional content:	**[Dynamic complexity; equivocality and uncertain contexts]** - Non-specific IITS process performance framework embedded in environment constitution and operational identities. - Co-ordination challenges with uncertainty contexts. - Operational and management challenges for exceptions.
[2] Content of IITS process:	**[Detail and dynamic complexity]** - Complexity of scenarios in life cycle instances. - Ambiguity, variety and complexity of unstructured IITS process features. - Unknown requirements that can be actualised in performance.
[3] PDC technical core:	**[Detail and dynamic complexity; variety, equivocality and uncertain contexts]** - Complexity of projects, project development constructs. - Variety in technical representations of information, knowledge, tasks, task performance, deliverable items driven by inputs and decision-making - Equivocality from lack of relevant information as the key challenge for the project development strategy and standardisation approaches - Challenge for uncertainty in project tasks and performance that rely on scientific methods developed outside the PDC.
[4] Specialisation:	**[Complexity; variety and uncertain contexts]** - Contexts in which a project is developed presents complexity challenges for committee team-based approaches. - Variety of specialised IITS process scenarios with sub-processes - Uncertain contexts from specialised needs e.g. R & D activity, development of draft standards and ballots.
[5] Operational:	**[Detail and dynamic complexity; variety, equivocality and uncertain contexts]** - Challenges for information processing, maintenance and transactions. - Alignment of inventories needed for processing, project management and transaction across SDOs and NSBs. - Information management for sharing operational information as resource. - Inter-temporal dependencies and conformance to the operational standards
[6] Social:	**[Dynamic complexity from uncertain contexts]** - All-encompassing typologies of explanations of IITS process performance. - Complexity and variety of practices e.g. collaboration, co-operation, consensus and meetings requiring different kinds of control procedures
[8] Use of technology:	**[Challenges for appropriateness of choices and fit of use of IS]** - Policy implications for linking IS resources. - Complexity of IS resources requirements for diverse operational and technical matters.

7.4.3 Characterisation of IITS Process Complexity

In keeping with Corning (1998) the degree of complexity that we use to classify a phenomenon depends upon the frame of reference for viewing it. Since the complexity of the IITS performance has been realistically evaluated, three categorises are described next that give an overall understanding of the problem statement (§1.1.4). Criteria that give explanatory characterisation underpinning IITS process critical issues have been determined as: general, extensive and wicked problems.

[1] General complexity of IITS process

The interpretive facts show that, in the general sense, forms of IITS process complexity have differentiated contexts that can be classified as detail, dynamic and static. This classification suggests that this general complexity can produce other phenomena (cf. Corning, 1998). For example, a complex project has intertwined features: phases of development, tasks, methods, practices and information (see Table 7-3).

General complexity attributed to the IITS process is about its details, namely multi-dimensional features and embedded contexts concentrated in a number of areas. **General complexity** becomes a critical issue, because the impact of multidimensional features in any area is diffuse, leading to split-levels of other phenomena as sources of uncertainty. According to Checkland and Scholes (1990) general complexity would also suggest that, there are problems that have not been solved.

[2] Extensive complexity of IITS process performance

Clearly, Table 7-4 shows that IITS process dimensions possess several challenges. Notable challenges are detail and dynamic complexity with systemic contexts of variety, equivocality, uncertainty and uncertain. In line with Battram (1999), Cillier (1998) and Maxwell *et al.* (2002), **extensive complexity** applies to the IITS process. This is because its different dimensions appear to be a result of 'cause-effect' relationships among different elements.

More so, combinations of these dimensions draw upon the dynamic interplay of human actions, performance and practices that also shift with time and context. As such, diversity in the detail of IITS process dimensions and dynamic interplay of elements connected to them are insurmountable implications of extensive complexity.

[3] *Wicked problems*

These are types of problems associated with the degree of impact of extensive complexity and variety of phenomena. In the IITS process, the contexts of complexity have become deep-rooted, over time. What is regarded as ambiguity, complexity or uncertainty becomes a *wicked and messy problem* (cf. Conklin and Weil, 1997; Checkland and Scholes, 1990). These problems have 'double-loop' and evolving set of interlocking issues that persist, despite efforts to solve them (Argyris and Schön, 1996). They are also difficult to resolve with any conventional method. A specific problem can not be defined (Brooks, 1987, 1996, Conklin and Weil, 1997).

7.4.4 Core Aspects of IITS Process

Table 7-5 presents the response to answer **question #4** (Box 7-1: Questions for analytic evaluation):

> What are the core aspects of the IITS process that give prominence to its performance?

A systematic 'walkthrough analysis' to review essential scenarios in the process framework (Figure 7-2) strengthens the details of the core aspects. Often, a walkthrough is associated with software process inspections to evaluate software elements, such as code, requirements and performance defects; and conducted by peers of the software developers (Dorfman and Thayer, 1990: 567).

Table 7-5: Summary of core aspects of IITS process (Source: compiled by author)	
[1]	Project management
[2]	Registration management
[3]	Project proposal
[4]	Consensus seeking (ballots)
[5]	Committee study and discussion
[6]	Documentation of draft standards
[7]	Implementation and testing
[8]	Publication
[9]	Revision and maintenance
[10]	Results control

In this exercise, however, the immensity of the interpretative facts resting on the accuracy of the specification of IITS process performance and its core aspects with various contexts, necessitates this walkthrough analysis. Lack of rigorous review and judgement of the process framework scenarios, otherwise, present unique challenges in establishing core aspects based upon just the facts from this evaluation. In addition, analytical questions (Appendix 9, [Part C]) and decision criteria (§7.1.4) are applied for clarity of theorising and judgement. **Appendix 9A** contains the spectrum of results of this walkthrough analysis. Based upon the results, a fact-based definition of the core aspects of the IITS process is as follows:

> High-priority areas that capture fundamental scenarios of project development. They also show typical representations that they can, independently, accommodate substantive inputs, activities and, differentiate variation in project development contexts to perform a specified IITS process action or function that yields an outcome.
>
> (Source: compiled by author)

7.4.5 Critical Issues of IITS Process Performance

Appendix 9A mentioned above serves another complementary purpose. In the systematic walkthrough, each core aspect is evaluated in its current state to reveal a reasonable set of **critical issues** that might help to reason the breath and depth of their reconstruction potential. These details in Appendix 9A therefore answer **question #5** (Box 7-1: Questions for analytic evaluation):

> What are the critical issues of the core aspects IITS process, for which solution options are needed?

The primary response to this question is a definition that can be verified by the interpretive facts, as follows:

> Critical issues represent explanations of the current difficulties that evolve in the content of the IITS process and its performance under varying conditions of complexity, dynamism, variability and uncertainty, over time. They embody details of unfulfilled IITS process performance requirements.
>
> (Source: compiled by author)

7.5 Framing of Operationalisation Requirements

This section is the foundation to part [4] of the analytic framework (Figure 5-2). Operationalisation provides the analytical test of the research hypothesis and reconstruction of specified core aspects of the IITS process. The operationalisation is unified through determining design strategy, design requirements and solution options. The key instruments are:

[a] OIPT Dimension #2 is applied as, 'design strategy or alternatives for dealing with the complexity of IITS process' (see Table 7-1; §7.5.1).

[b] OIPT dimension #3 is applied as 'information processing needs' linked to requirements dimensions to reasonably operationalise the concepts of the reconstruction actions (see Table 7-1; §7.5.3, §7.5.4).

[c] Explanatory constructs of the research hypothesis (Box 4-1) guide the assessment and definition of these items to also link them to core aspects (§7.4.4) and critical issues of IITS Process (§7.4.5).

7.5.1 Determining Design Strategy

Galbraith's design strategy (1987: 99) for information-processing capability concentrates on choices, such as creating autonomous or self-contained group structures and slack resources. Drawing upon a large body of knowledge (such as Adler, 1995; Herzum and Sims, 2000; Krieger and Adler, 1998; Szyperski, 1998; 2000; Veryard, 2000) relevant concepts underpinning component-based design (CBD) approach have been customised for this thesis. A CBD framework has been created for use as a design strategy (see §1.2.8).

Working from the features defined for the component-based solution proposal framework (Table 3-4) this researcher argues that, a conventional CBD representation might not be sufficient to deal with any of the core aspects defined for this IITS process. The preference is an open layered CBD framework. This is an incisive method to deal with core aspects (Table 7-5, Appendix 9A) that have intertwined concepts, scenarios with embedded features, differentiated levels of context and all-encompassing extensive complexity.

7.5.2 Determining Design Plan Concepts

The most appropriate reference of a design plan is taken from Hofmeister *et al.* (1999:4), as follows:

> A design plan is not a project plan...Instead, it is a structural plan that describes elements of a system, how they fit together, how they work together to fulfil systems requirements. It is used as a blueprint in development process.

In creating a project development setting, there are two main reasons to support this definition.

One, the core aspect of the IITS process has *unstructured* details and *unknown* requirements. A design plan defines a master representation of how a project development setting would appear. This covers its baseline design representation and design choice.

Two, the proposed design plan defines *fundamental concepts* that can be addressed, regarding the *design rationale* that fits into the scope of the open-layered CBD framework for reconstruction. The approach to then create a project development setting evolves by referencing justifications of the explanations of the design plan and assessed solution options that must also fit into concepts and functions under consideration.

Key concepts supporting the chosen design plan for an open layered component-based framework are explained next: structural design and functional views, boundary priorities, control measures, fit to context of solution options and design constraints.

[1] Structural design view

The starting point in this view is to ask the question: What characteristics should the proposed project development setting have? In response, a project development setting from core aspects of the IITS process can incorporate other elements. Thus, a CBD framework is the baseline structure for framing a project development setting. The *structural design view* can be extended to state the parameters within which various features of the project development setting and solution options must fit (cf. Starkey, 1992).

[2] Functional view

This view determines *functional intent.* It needs understanding of the *design rationale* (Lee, 1997) in terms of how well a project development setting can be designed to meet criteria for functionality and presentation of solutions. The IITS process has dynamic content and context interdependencies. For implementation in the practice and with regards to the reality in which IITS projects are developed, the *functional view* of the project development setting must have these content and context issues in the design.

Reconstruction within an open layered CBD framework open layered is the choice for expressing content and context-dependent attributes (see Figure 1-2). By its partitioning principles (Adler, 1995; Herzum and Sims, 2000), an open layered CBD framework is a better design strategy for reducing complexity, than just a CBD representation. Partitioning helps to develop domain components of the core aspects of the IITS process, because can isolate particular areas and associated critical issues, so that they can be addressed exclusively.

Through open layering a project development setting can have distinctive boundaries and contexts supporting the baseline structural design and attributes of the functional views, concomitantly. Open layering gives the reasoning behind the solution options that must be transparent in the design (cf. Simon, 1996: 132). Together, these elements (partitioning, structure, content, concepts and functional intent) have the advantage to make explicit, the design of a core aspect of the IITS process a distinctive autonomous component-based project development setting.

[3] Boundary priorities

The proposal therefore is a component-based project development setting that can handle a number of open layered boundaries, which differentiate operational contexts. The term **operational boundary** is used hereafter to indicate this partitioning principle. Open layering of operational boundaries allows **priority contexts** associated with applicable performance practices to be added to the design. Each operational boundary can only address a single concept or particular set of circumstances of functionality. However, in each operational boundary, different contexts help to address the fit between content features, their functional views and how they can be structured for fit to work together (cf. Herzum and Sims, 2000; Starkey, 1992).

[4] Control measures

A component based project development setting with differentiated or partitioned functional layers requires **control measures** to help the definition of processes and operational co-ordination, as some examples of IITS process performance practices. Operational boundaries offer this understanding of areas in which control measures are relevant and can work, or should be excluded from design.

[5] Fit to context of solution options

This is a concept of equifinality. Doty *et al.* (1993) mention that, for a given situation there may be more than one feasible design option or solution option, from which to choose. In part, the decisions for fit to context draw upon the level of fit between design and solution options considered. Design f*orm, fit and function* of each operational boundary are the most crucial elements for correct assignment of features, and of the parameterisation of assessed solution options (cf. Starkey, 1992: 190).

In the design plan, the structural view representing fit to content is extended to *fit to context* of solution options sought. The features assigned to each operational boundary must also fit into *both the content* and *contexts* in which a project development setting is expected to function. Separately, solution options must take into account *systems fit.* This helps to address interoperability within and across each operational boundary of a project development setting, and to determine requirements for operational interfaces (cf. Herzum and Sims, 2000; Malan and Bredemeyer, 2002; Krieger and Adler, 1998).

[6] Design constraints

These constraints are determined elements or factors ensuring that the design meets its desired objectives within realistic requirements. **Table 7.6** contains constraints considered for the component-based project development settings. The two categorises are primary and secondary constraints.

Table 7-6: Design constraints
(Source: compiled by author-adaptations from Galbraith, 1977, 2002; Starkey, 1992;)

[1] Primary constraints (Functional intent; requirements or solution options)	
	Summary
Design purpose	A component-based PDS is autonomous; it should have a focus regarding its functions that are defined in the design.
Design scope	Ability to vary the scope the PDS using partitioned operational boundaries.
Design flexibility	Component-based PDS to be designed for continual adaptation to differentiated contexts.
Performance	Component-based PDS designed for realistic performance contexts bearing on IITS process practices.
Committee teams	How committees can perform depending on design structure and resources of PDS.
Sustainability	Can CBD strategy support achievable requirements for upgrades, enhancements.
[2] Secondary constraints (operational factors)	
Environment functionality	Influences of parameterised IITS process requirements and operational circumstances of SDO and NSBs that might affect design of project development setting functions.
Social, political, ethical	Design and functions need some characteristics of how actors would be affected by the new arrangements (e.g. team work performance requirements; location of information resources).
Design form and fit	Dimensions and subject matters of open layered approach relevant for defining expected functionality use of IS.

7.5.3 Criteria of IITS Process Performance and Requirements

Project development settings will function within the reconstructed IITS process performance framework. For this reason, IITS process performance requirements are determined for the dimensions mentioned in Table 7-4 (Dimensions of IITS process performance and challenges). In keeping with other scholarly works (such as Leite *et al.* 2000, Maiden and Corrall, 2000; Sommerville and Sawyer, 1997; Sutcliffe *et al.*, 1998) this researcher elects to use these dimensions as scenarios from which to elicit and parameterise the requirements. The requirements have implications for the coverage of necessary functions that can be traced in the design of the choice of project development setting. Otherwise, it is easy to omit their embedded elements.

The model in **Appendix 10** presents how this parameterisation of IITS process performance and its requirements creates an operational framework (cf. Ngosi and Braganza, 2006). At the same time, the framework organises the definition and documentation of the requirements achieved through a systematic analysis of each IITS process dimension (Table 7-4). The requirements have the following three qualities:

[a] *Functional requirements* addressing broader characteristics of *what* the reconstructed IITS process would be expected do with regard to its specified performance dimensions.

[b] *Assumptions* underpinning the solution proposal and constraints of the specified dimensions. For example, process intelligence, information and knowledge management.

[c] *Non-functional requirements,* such as responsibilities for the specification or maintenance of requirements are stated as 'SDO business and strategic management level' and 'project team knowledge workers.'

7.5.4 Project Development Settings Requirements Dimensions

Table 7.7 illustrates how the requirements for consideration in the reconstruction exercise are determined.

Table 7-7: Foundations to requirements dimensions
(Source: compiled by author)

Requirements dimensions	Content of component-based solution proposal
[1] Design structure: (CBD and OIPT)	- Design parameters to optimise functional performance - Features realistic to project development e.g. constructs upon which committee activities are based
[2] Operational content: (CBD)	- Features that fit together to provide correct functionality - Representations of operational content
[3] Increase operational capacity: (OIPT)	- Connectivity between operational boundaries to IS resources
[4] Increase performance capabilities: (CBD and OIPT)	- Practices for connecting committees with IS resources - Performance evaluations.
[5] Information processing capability: (OIPT)	- Operational controls in processing; workflow - Management and sharing of information
[6] Reduce information and task uncertainty: (OIPT)	- Create information and knowledge - Connectivity of operational content features
[6] IS capability: (CBD and OIPT)	- Distributed computing environment

7.6 Framing of Reconstruction Actions

In this section details guiding the reconstruction exercise are stated and organised. Notably, checklist of core aspects, evaluation and selection of core aspects, and reconstruction decisions.

7.6.1 Checklist of Core Aspects Items

The core aspects representing key areas of IITS process performance (Table 7-5) and their critical issues (Appendix 9A) make judgement of their selection impossible. Primarily, itemised core aspects consisting of elements from the core process, PDC and other operational features are assembled.

In the evaluations that follow next, this is referred to a checklist of items (**Appendix 9B**), because they have not been assigned specificity of their fit into the content of any core aspect. This checklist gives an equal basis for evaluation and selection. IITS environment structural and functional units have been excluded from this checklist and the reconstruction exercise, because they require independent evaluations, as well, as treatment.

7.6.2 Survey of Checklist

This checklist (Appendix 9B) has **29 items** with unknown merits of importance. Quantitative analysis is the only means to present evidence for determining the importance of individual items, relative to the entire checklist. The starting point is to seek data samples to aid evaluation and decision-making. Data samples were obtained through a mail survey. The sample consisted of 100 individuals that had participated in the research case studies and were representative of almost the entire IITS environment groups (see Table 3-6: Case study survey participant categories).

The survey candidates were given the checklist (Appendix 9B, Column 1). They were requested to assign pre-set value points from 1 to 3 to the 'items' that they considered important to specify the core aspects of the IITS process:

[1] is high priority items
[2] is medium priority
[3] is low priority

The survey candidates were also provided a summary of the critical issues of the IITS process. In doing so, the information that the candidates were given for this survey helped understanding the impacts of the critical issues upon which to base their choice of items.

This survey data collection acknowledged the fact that these groups are the primary stakeholders of the solution proposal to create a component-based project development setting. As such, their opinions had importance in having the stakeholders accept whatever solution emerges, based on their involvement in this survey (cf. Conklin and Weil, 1997). A cluster sampling survey approach (Robson, 2002) was relevant to make the sample small and exclusive for evaluation. The representation of the sample divided into two groups, each consisting of 50 individuals, as follows:

Group A:	Consisted of SES developers from IEEE WG 1074 and JTC 1 SC 7.
Group B:	Consisted of GIITS developers from JTC 1 SC 2, JTC 1 SC 29 (JPEG-1 and JPEG-1).
Groups A & B:	Also consisted of a few chosen executives and senior managers from the forums, IEEE Computer Society on SES, ISO, JTC 1 and secretariats for the committees examined.

7.6.3 Quantitative Prioritisation of Checklist

Centesimal Dominance Matrix (CDM) is a well-established approach for determining design items (Starkey, 1992). This researcher preference for CDM is based on the fact that, it incorporates multi-criteria comparison including ranking quantitative prioritisation of the two separate survey response samples, according to the candidates' ranked preferences. The quantitative comparison and ranking reduces the uncertainty of the survey sample responses and other qualitative interpretative facts of the IITS process performance.

The survey response sample (Appendix 9B, Column 2) is divided into separate itemised Lists [A], followed by subdivisions in Column 4 [List B] and Column 5 [List C]. These lists are based upon the separate survey populations and topical views that the candidates added to support their choices. The items are treated in a random manner, as presented from the survey results.

CDM analysis comparisons are performed on Lists A, B and C exclusively. **Decisions** to choose any item draw upon calculated **priority ratings,** as their value of importance determined from the CDM analysis comparisons. Some of the items share the same priority rating. As such, filtering eliminates any coinciding priority ratings. The results are quantitatively prioritised items according their priority ratings hence.

7.6.4 Categorisation of Prioritised Items

Decision-making on the CDM analysis results focuses on 24 items: 13 technical and 11 operational. Items are selected to satisfy two or more conditions of analytic questions in Appendix 9 [Part C] and the decision criteria. **Table 7-8** contains prioritised items categorised as: explicit, tacit and not selected outright. This categorisation ensures correct assignment of items to specified core aspects and that critical issues associated with them are dealt with, in whole or in part.

Table 7-8: Categorisation of items results of CDM analysis (Source: compiled by author)			
Categorisation and items	**CDM priority/ rank**	**Interpretation based IITS process performance requirements**	**Decision criteria**
Category 1- Explicit items			
Technical development: [a] Abstraction of technical information [b] Implementation of draft standards [c] Requirements specification [d] R & D platforms	1, (0.685)	- It can be added to scope of Consensus-seeking and Documentation of draft standards.	Fundamental impact
Project proposal [a] Project proposal management [b] Registration management	2, (0. 467)	- IITS process needs a focal starting point. This can act as the front-end of IITS process	Salience Strategic Importance
Consensus-seeking (sub-scenarios and sub-processes): [a] Formal ballots [b] Collation of comments [c] Ballot resolutions [d] Technical decision-making	3, (0.459)	- A good candidate for demonstrating the reconstruction of complex aspects with variable performance states and diversity of conditions - It will consist of 'key technical' and 'core operational' matters	Strategic Importance
Documentation of draft standards	4, (0.238) 1, (0.923)	- Excellent candidate to demonstrate key draft standard documentation life cycles linked to: project planning, study and discussion, technical development and deliverable items	Salience Strategic Importance
Category 2 - Tacit			
Communication: (include co-ordination, committee group interactions, operational workflow)	1, (0.625) operational	- This will demonstrate the integration of IT-based activities in the IITS process. - Principal communication scenarios will be represented in the design of project development settings	Fundamental impact
Information control and management	2, (0.443)	- Can be linked to core operational scenarios in the design of project development settings	Strategic Importance
Results Control: [a] Technical [b] Operational	5, (0.156)	- Can exclusive project development settings to support control and evaluation of deliverable items	Salience
Project Management	6, (0.120)	- Need to be linked to Project Proposal Management to demonstrate criteria for project control	Strategic Importance
Category 3-Not selected outright			
Administration	Emphasis should be placed on operations that will support project development settings		Potential value
Publication of standards	Can be linked to Results Control in the delivery of products.		Salience
Revision and maintenance	Should be specified in the life cycle of the new IITS process		Fundamental impact
IITS environment decision-making	Should be specified in new procedures		Potential value
Membership Management	Can be linked to Registration Management allowing for expansion of membership management		Fundamental impact

The summary of the categories follows next:

Category 1: Explicit

Items in this category are **mandatory** to IITS process performance. They have a wide range of functional elements, requirements, practices and contexts (such as social and technical) that must be treated with regard to how the reconstructed IITS process is expected to perform. They consist of extensive contexts of complexity that stymie IITS process performance (see §7.4.3). Together, these considerations make mandatory items relevant 'test cases' to demonstrate how specified core aspects of the IITS process can be reconstructed.

Category 2: Tacit

This category consists of items that can be incorporated in the reconstruction of specified core aspects, optionally. Some of these items would be combined to satisfy certain requirements, without compromising specified design parameters.

Category 3: Items not selected outright

This third category is mentioned because it is concerned with items that are unlikely to have impact on decisions that are taken in the reconstruction exercise. The reasons for their rejection are mentioned in Table 7-8.

7.6.5 Selection of IITS Process Core Aspect

This section gives the answer to **question #6** (Box 7-1: Questions for analytic evaluation):

> Which core aspects of the IITS process can be reconstructed to bring about resolution of the concepts presented in the solutions proposal?

Potentially, all four items in Table 7-8,'Category 1 explicit items' are excellent candidates for reconstruction. 'Technical Development' has the highest **CDM priority ranking (1).** However, it is not robust enough to be a project development setting. In the long-term future, it would not present satisfactory representative-ness of the solutions that reconstruction is expected to offer.

'Documentation of Draft Standards' has CDM priority ranking (**4**). Nevertheless, elements central to 'Technical Development' support how draft standards are developed. A sensible consideration for fit to function is to incorporate 'Technical Development' into the scope of 'Documentation of Draft Standards.' The CDM priority ranking of the 'Documentation of Draft Standards' shifts to (**1**).

To answer question #6 hence, only one core aspect is selected. This CDM priority ranking provides the decision to choose 'Documentation of Draft Standards' as a core aspect for reconstruction. Another decision is that, draft standards have **strategic importance** to the IITS process in terms of the market opportunities that its stakeholders pursue (see §6.1.5). By combining other key elements from 'Technical Development' covering collaboration, communication and creation of information, 'Documentation of Draft Standards' can be demonstrated as a **salient core aspect.** The content and various contexts through which draft standards are developed can exemplify most clearly a test case for creating a content-rich component-based project development setting with salient dimensions hence.

7.6.6 Special Identity of Choice of Core Aspect

As presented in the solution proposal framework (Figure 3-4) component-based PDS need **special identities** to make distinctions between them. Standards Documentation Setting (SDS) is the special identity assigned to individualise the concept of creating an autonomous PDS focusing on the documentation of draft standards and other IITS process deliverable items. In addition, this special identity allows specificity of the SDS design plan, reconstruction actions and solutions that fit into its intended scope.

7.7 Operationalisation of Reconstruction Exercise

7.7.1 Operationalisation Stages

This section discusses part [4] of the analytic framework (Figure 5-2), the operationalisation of the research hypothesis and reconstruction of IITS process. Working from Jackson's (1994) adapted constructs (§5.2, Table 5-1) a systematic procedure is preferred. It strengthens the evolution of the operationalisation from very broad concepts to a reasonably concrete solution task bearing on the ideal state of the problem frame.

The procedure in **Table 7-9** has five stages that systematically articulate operationalisation as an analytic test of the research hypothesis. The stages also elaborate a particular set of circumstances to support this. The stages are referenced in the discussions that follow next.

Table 7-9: Stages of operationalisation procedure
(Source: compiled by author)

Stages	Summary of activities
Stage 1 Reconstruction and design decisions	Guidelines for the breath of the results sought
[Source data]	[Empirical models: draft standards documentation; technical development]
Stage 2 Content planning [outline proposal]	Review candidate elements in their current state specified in the source data models]
Stage 3 Design planning, modelling and structured analysis	Define CBD 'snap-shot' representation of the SDS: operational boundaries, key features, control and performance expectations Define structured source model of the SDS for analysis and reconstruction
Stage 4 Intermediate models and tailoring	Define reconstructed and structured models of the SDS for analysis, refinement [tailor SDS for design actions]
Stage 5 Design actions and specification	Define detailed functional design of the SDS from intermediate model Define choice of specifications of the SDS

7.7.2 Stage 1: Reconstruction and Design Decisions

In Stage 1, a central argument is that, utilising a CBD framework is an incisive method to reason how to reconstruct the IITS process to then, create the SDS. This has been achieved by defining a CBD representation that clearly interpret how draft standards are developed. The definition includes iterative analytic actions, modelling, evaluation and decision-making, leading to a definition of its expected functionality.

While the design intentions can be defined well, important facts can be lost through various levels of analytic actions and interpretations. Scholarly works on design studies (such as Beheshti, 1993; Lee, 1997; Lawson, 1997; Moran and Carroll, 1995; Starkey, 1992) suggest that these shortcomings can be avoided by establishing decisions underpinning the analytic actions, from one stage into the next. The decisions depicted in **Table 7-10** are purposefully selected from relevant interpretive facts. They are: IITS process challenges (Table 7-4), critical issues (Appendix 9A), design plan concepts (§7.5.2) and requirements dimensions (Table 7-7).

Table 7-10: Reconstruction and design decisions
(Source: compiled by author)

Decisions	Classification of decisions	Fit to content [What? Where?]	Fit to context [Which? How]
[1] Robustness	Fundamental	Design parameters need to define content DSDS	Functional and structural views: - Combined elements that create structure and functional forms - Size or capacity of the elements
[2] Transparency	Fundamental	Expectations of clarity in content of features and issues influencing SDS	Functional view: - Criteria of functionality, practices
[3] Adaptability	Intermediate	Design parameters and features	Functional view: - Dimensions that fit together to determine a function within SDS operational content and across other project development settings
[4] Analysability	Minor	Design features that must be visible to the users and can be analysed in intended performance	Functional and structural views: - Criteria of functionality, practices
[5] Connectivity	Minor	Features that must be connected in the design of SDS	IS, functional and behavioural views: - Dimensions of IS resources that aid integration for co-ordination, communication and workflow
[6] Control	Minor	Features to be controlled	Functional and behavioural views: - Methods of control in SDS operational content
[7] Simplicity	Minor	Features that must meet specification of performance; have simple appearance and in their meaning	Overall layout of design parameters and functional features. Can be altered and improved on in the design and in performance
[8] Specialisation	Minor	Areas that need customisation to specialise their content	Functional and behavioural views: - Dimensions of specialisation e.g. information management, interfaces
[9] SDS functional responsibilities	Intermediate	Types of accountability requirements in SDS: e.g. Stakeholders, committee chairpersons, NSBs, knowledge worker	Management views: - Visibility of roles and areas of fit

The classification of the design decisions underpinning the reconstruction actions is fundamental, intermediate and minor.

Fundamental decisions influence the success of the overall design actions and results sought. According to Starkey (1992:2) these decisions are made at the front-end of a design process. This researcher applies these decisions to provide criteria to create the component-based SDS illustrating:

[a] Design planning: 'to what extent a planned design structure of the SDS can deal with the complexity of the development of draft standards.'

[b] Design representation: 'which features can frame the functional content of the SDS'.

Intermediate decisions follow, and they are dependent on the fundamental ones (Starkey, 1992). Since the SDS will incorporate combinations of elements, these decisions help to manage a chain of known constraints that emerge from the various analytic, modelling and design actions (cf. Beheshti, 1993; Lawson, 1997). For example, modelling to create a structured content of the created SDS introduces known and unknown design variables, as well as, solution options sought. These decisions therefore permit understanding of design issues that can be resolved in the modelling actions, and where conflicts have been identified in the different levels of structured analysis.

Minor decisions are creative in the sense that they offer criteria to show the treatment of the analytic test of the research hypothesis. These decisions are grounded on objectives, solution options and optimality of features for describing details specific to the expected functionality of the SDS. Consequently, they have supremacy in determining responses to support its explanatory constructs.

7.7.3 Stage 2: Content Planning of SDS

In this thesis, **content planning** accords with creating the SDS. As a matter of fact, this is the initial reconstruction of the IITS process, because the planning involves extricating various features from other specified core aspects of this process. With reference to Table 7-8 (Results of CDM analysis), the content of the SDS will have combined features defining *how* draft standards are developed, namely:

[1] Committee study and discussion of project (Stage 4 of the core process).

[2] Documentation of draft standards (Stage 5 of the core process).

[3] Technical development and requirements analysis (Phase 3 of the PDC).

This initial exercise is determining the design structure of the SDS. This is achieved through defining the CBD framework and analytic understanding of the underpinning concepts, leading to the development of draft standards. The design structure becomes the basis for defining the SDS content features, context dependencies and their representation.

Typically, committee performance in developing a draft standard requires content of boundaries and settings. The boundaries include contexts of communication, information control and information management, and operational workflow. Content planning is thus imperative to clarify these foundation design issues as to how the SDS can be represented as a component-based project development setting. Working with guidelines with Starkey (1992: 166), the features that create the SDS are reviewed on an equal basis through analytic steps. To guide decision making, analytic questions (Appendix 9 [Part B]) and selected requirements dimensions (Table 7-7) are applied. The stages of content planning incorporate selection and assignment of SDS features, as follows:

[1] Baseline structure:	Primary constraints fitting the features composing the SDS are purpose, scope and designation of committee teams in the design (Table 7-6). An open layered CBD base structure defines the overall physical layout of the SDS and operational boundaries Primary constraints here are purpose and scope of SDS.
[2] Design structure fit:	Design parameters and candidate features that fit into the views of the solution proposal are assigned to the base constructs for SDS: structural, functional, behavioural, IS, and management issues.
[3] Operational content fit:	Primary constraints involving flexibility and scope help to determine resulting clarification of content issues (Table 7-6). Required features that fit into this content of the SDS, to include their fit to function together develop an operational content. Selected features are assigned to each operational boundary, observing decisions for: *robustness* of the design; *transparency* of assigned features and *adaptability* of conceptualised content scenarios.
[4] Operational conditions:	The SDS will draw upon the IITS environment functional principles. Secondary constraint of environment functionality (Table 7-6) applies in this regard to determine the circumstances in which the candidate features are expected to perform, to include their technical and social construction.
[5] Alternative designs:	They help to demonstrate decisions for support solution options, and other choices that are defensible.

7.7.4 Stage 3: Design Planning and Modelling

In this Stage, design planning and modelling of the created content of the SDS are carried out concomitantly. At this point, results of content planning can be regarded as an *unstructured* description, because there is only a layout of the basis structure and content of the SDS. The objective statement of design planning is to yield a fuller CBD representation of how the SDS is expected to function with the features that are assigned to it from content planning.

In any exercise involving this extensive reconstruction of a process, modelling assists in structuring descriptive interpretations of content features, performance contexts and elaborating required details (cf. Kock, 1995; Rock-Evans, 1992). Furthermore, Hall *et al.* (1993) suggest that it is important to define the breadth of improvement sought. This is defined in the modelling exercise to present levels of details of functional intent. The larger the breath of improvement, the less process detail is necessary.

The modelling of content details and of functional intent of the SDS yields a **structured content** from the original design plan to a **source model**. This model is too cumbersome to be included in this thesis. Nevertheless, it utilises BDDs and AFDs (Rock-Evans, 1992) as procedures for clarity of structuring required content, contexts and functional intent in specified operational boundaries of the SDS. Verification of the source model is achieved upon answering analytic questions in Appendix 9 [Part C]. At this stage verification of the source model also minimises design risk and documentation errors.

7.7.5 Structured Analysis of Source Model

Next, systematic structured analyses are carried out on the source model utilising **classification matrices** that offer discursive structured analyses of the content and context of design issues (Rock-Evans, 1992).

7.7.6 Reconstruction Actions

Structured analyses allow for extensive reconstruction actions to be carried out through different levels of the design content of each specified operational boundary. Because the source model is large, **error analysis** is a first step to help the identification of missing components; use of applicable terminology and connection of transactions. At the same time, precise attention is given to detailed analytic levels to identify areas that are critical to intended SDS performance and that are likely to present the highest degree of dynamic complexity.

In this regard, classification matrices proved useful for analytic discursive levels of reconstruction and refinement of the source model. The levels included:

[1] Determining **requirements** for expected performance.

[2] Identification of **anticipated problems** in the operational content of the SDS.

[3] **Structured content reconstruction** by eliminating specified excessive features, problems, sources of complexity, uncertainty and competing constructs. This content reconstruction pays attention draws attention to an array of factors to influence correct functional intent.

[4] Requirements, performance and problems evolve as issues that also need new decisions. Thus, minor design decisions for *fit* of the defined operational content are imperatives for transparency of the reconstruction actions and solutions sought. Minor design decisions, such as analysability, connectivity of features, control and simplicity of each specified operational boundary give justification to key assumptions of the representations of SDS. They help to clarify the breadth of the reconstruction actions (see Table 7-0).

7.7.7 Refinement of Reconstructed Source Model

Refinement of the remaining content details of the SDS design features is a systematic approach. Its key elements are **consistency checks** using classification matrices to help verify the accuracy of the items remaining in the structured SDS source model after its reconstruction.

Resolution of remaining items helps to review and reason the satisfactory completion of the design decisions applied, and to observe relevant design constraints (Table 7-6). Content details and operational matters are resolved against interpretation of the **research hypothesis** explanatory constructs in the design (Box 4-1). Together, the defined focus of the operational content and resolution of details of the hypothesis explanatory constructs refine the core concepts of the SDS. Where necessary, further reconstruction is carried on areas or items identified as having negative consequences on the SDS operational views, until the hypothesis explanatory constructs are completely fulfilled.

To summarise this refinement exercise, the original content of the structured source model of the SDS consisted of **125 items.** This number of items is from the fact that, details of how draft standards are developed, content and context-dependencies of other factors, invariably duplicate design features. The structured source model therefore includes multi-dimensional features, performance contexts and practices, leading to the spread of sources complexity and uncertainty.

Through two levels of structured analyses, reconstruction actions, consistency checks and refinement, **90 redundant items** have been eliminated from this source model. This reduction clearly reflects the extensive nature of the reconstruction actions to several areas considered as highly complex performance contexts. These eliminated items are characteristics of *wicked problems* that coexist with how draft standards are currently developed.

7.7.8 Stage 4: Intermediate Models and Tailoring

In this Stage, a refined SDS structured model is defined as an intermediate model. This is a model which provides a look at how the SDS design, as reconstructed and refined, satisfies specifications of content, functional intent, requirements and research hypothesis explanatory constructs.

Two separate intermediate models labelled Mark-I (MK-I) and Mark-II (MK-II) were developed. The models are so named, because they differentiate the levels of refinement articulating specific structured flow of operational details of the SDS after reconstruction actions). MK-I is the first stage of refinement from extensive reconstruction actions. To show operational details, AFDs are utilised to construct these models (cf. Rock-Evans, 1992).

Initially, reviews are carried out on the MK-I intermediate model. Tailoring is a relevant well-established procedure applied on 'operational flow-based models' such as those discussed in process and products systems (Basili *et al.* 1994, Martin and Martin, 1996; Welzel *et al.* 1995). Once again the use of classification matrices is advantageous to help tailoring analysis of the details of MK-I intermediate model. From the MK-I intermediate model AFD format, an explicit aim of tailoring is to rigorously demonstrate the following aspects:

[1] **Model consistency:** This is the goodness of *fit* of structure, *fit* to content and accuracy of the required operational details. For example, an operational boundary is tailored to adapt it for different types of project development competencies involving committee team structures, their connection to IT resources and draft development practices in the design.

[2] **Breadth of solution options:** These are assessed separately, because they involve decisions the definition of the functional design of the SDS (see §7.8). Some of the assessed solution options are included in the modelling of the structured source model and refinement actions. Through different level of analyses and refinement, the definition of the MK-I intermediate model changes.

[3] **Specification of solution options** become clearer and must be refined accordingly. Consequently, tailoring seeks to determine the breadth of solutions sought in the MK-I models against any changes made to specified requirements or context (cf. Hall *et al.* 1993; Martin and Martin, 1996).

[4] **Depth:** Tailoring demonstrates depth of the design details, focusing on specification of objectives, requirements, operational circumstances and control measures for each SDS operational boundary. Levels of refinement involve altering certain performance details (adding, elaborating, verifying or eliminating items), to satisfy objectives and requirements (cf. Martin and Martin, 1996; Welzel *et al.* 1995).

These levels of structured tailoring, refinement and verification end when the details of MK-I intermediate model are uncluttered. The resulting clarification is a MK-II intermediate model. Tailoring is repeated on this to characterise the uniqueness of the SDS, with the slightest distortions. Five criteria are applied that also verify the completeness of the overall definition of the MK-II intermediate model, namely:

[a] Goodness of fit of design representation of a component-based SDS.

[b] Relevance of design rationale of the specified features. For example, specificity of operational boundaries, obligatory features, control states for information details, operational workflow, and practices for and connectivity and transactions.

[c] S strength of 'fit' of the features to function independently or together.

[d] Coherence and simplicity of operational qualities.

[e] Implications of functional intent.

7.8 Stage 5: Definition of the SDS Functional Design

7.8.1 Design of Solutions

An explicit aim in this Stage is to develop a functional design of the SDS and a relevant alternative. The reconstruction actions carried out on the SDS and design of solutions have convergence on content. Both are executed from a positivist stance to yield a functional specification of the SDS.

A number of scholarly works (such as Starkey, 1992; Herzum and Sims, 2000; Parker and McGraw-Hill, 2002) suggest that design is always in the *functional domain* to satisfy functional requirements. The solutions sought are developed in the *physical domain* involving design parameters to satisfy functional requirements. Herzum and

Sims (2000) suggest that a CBD approach has capabilities for addressing both functional aspects and IS. In view of a functional design they suggest the following:

> The functional designer should not be concerned with the complexities technical complexities, such as locating objects on the network, how data is communicated from a client server, transactional boundaries, concurrency, event management, and so on.
> (Source: Herzum and Sims, 2000: 39)

Drawing upon these functional viewpoints, the MK-II intermediate model is carried forward as a reasonably stable foundation that has all the possible functional and physical building blocks for the design of the SDS. The design, however, needs to **harness special meanings of solutions sought** to fit into the content of the SDS. These meanings are described next.

7.8.2 Determining Dimensions of Operational Performance

The functional design process of the SDS begins with determining dimensions of intended operational performance. The OIPT dimension #4, 'Capacity to cope with external and internal complexity' is the underpinning guideline (Table 7-1). In the MK-II intermediate model, this dimension gives justification to the solution options that fit into functional design of the SDS. It helps to clarify design parameters, before making commitments of the functional and physical attributes.

The solution options define the minimum sets of requirements to be met in the functional design against the interpretation of relevant research hypothesis explanatory constructs. The explication of OIPT dimension #4 is connected to research hypothesis explanatory construct #1 (Box 4-1):

> Reduce excessive features, contexts of complexity and uncertainty that cause of problems in performance.

Reconstruction has greatly reduced the complexity of the SDS. The MK-II intermediate model indicates that the SDS can further reduce excessive features through constructive capacity to cope with external and internal complexity that might arise from its interactions. This association of OIPT dimension #4 and explanatory construct #1 yields **four options** deal with constructive capacity: information processing capability, increase operational capacity, increase performance capabilities and IS capability.

Option #1, information-processing capability

For this option, the SDS requires some **degree of consonance** within its operational boundaries, as well as, with other parts of the IITS process. The performance of the extant IITS process, however, imposes constraints on information processing capability through the variety of operational practices. Operational complexity and capacities required to meet processing, inventory management and transactions increase information uncertainty. Design decision for adaptability, transparency and connectivity (Table 7-10) are supported in this option to offer two dimensions for effective information-processing capability as follows:

[a] The SDS is designed as an *autonomous project development setting*. It will acquire, process and create information that fulfils its operational needs, and not several others. This autonomy is categorical to reduce the overload of complex information processing operations. More so, it is mandatory to give meaning to the definition of information resource and operational requirements specific to the SDS.

[b] The SDS must have the *adaptability* within its operational content that promotes information-processing capability. SDS features must fit together to perform various functions concurrently.

[c] The SDS is expected to have effective *connectivity* with other project development settings that will form the structural and functional 'backbone' of the IITS process. Effective interaction within the SDS and across other project development setting requires operational interfaces that can be shared to provide the same source of operational information. Co-ordination, communication and workflow can be defined to suit the needs of each project development setting.

Option #2, increase operational capacity

In this option, **the transparency of the SDS and control** of its actions are the main decisions for effective functionality that increases operational capacity hence. Open layered CBD framework utilising a partitioning principle has been applied in the design of the SDS (cf. Adler, 1995; Herzum and Sims, 2000). This partitioning principle is adaptable to parameterise and distribute the number of processes that can be defined in SDS.

Parameterisation through partitioned operational boundaries promotes greater *transparency* of operational details, at the same time, providing *control* of what takes place. Processes and events in each operational boundary can be assigned relevant procedures and tools. *Analysability* of processes increases operational capacity hence. Selected operational boundaries can be customised to resolve a host of issues regarding the entire SDS, such as processing and information management.

Option #3, increase performance capabilities

There are three dimensions for this option. One, the SDS is expected to concentrate on the activities that apply only to its **specified operational content**. Two, the autonomy of the SDS and of its **partitioned operational boundaries** reduce competing processes, unnecessary procedures and ambiguity in the interpretation of practices. Three, autonomy allows specification of **committee practices.** All three dimensions will increase performance capabilities hence.

In line with Brown (2000); Lesser and Storck (2001); Wenger and Snyder (2000) committees hone in their performance practices based upon the choice of IS resources that fit into project development constructs and that offer specialised capabilities, such as e-collaboration. Specialised committee teams can be assigned as integrating mechanisms that help conceptualise the content of use of IT artefacts (Mohrman *et al.,* 1995; Orlikowski and Iacono, 2001).

Option #4, IS capability

In this final option, are two dimensions: functional fit and distributed computing environment.

One, *functional fit* draws upon the concepts of the representation of a design and its parameters (cf. Doty *et al.,* 1993; Starkey, 1992; Sauer and Willcocks, 2003). A CBD approach has this advantage to create a design representation for functional fit of the content the SDS, rather than a fit to technology.

Two, as illustrated in the component-based solution proposal framework (Figure 3-4), project development setting needs a *distributed computing environment* to create effective IS capabilities(cf. Adler, 1995; Herzum and Sims, 2000; Krieger and Adler, 1998). If not more so, IS resources help to define representation the representation of SDS processes and qualities of the solutions that can be actualised in performance.

7.8.3 Parameter Design of the SDS

To adequately address how these four options can be characterised, parameter design is used in the design process, in line with following key steps from Starkey (1992):

[a] A number of features and operational factors are determined from the MK-II intermediate model.

[b] A definition of a functional design of the SDS is the goal. Moreover, a component-based design framework supports the use of IS as an imperative asset for cohesive functionality of the SDS. Functional and IS requirements are determined together to tailor the design parameters. In doing so, IS-related solution options can be demonstrated to build integration constructs.

7.8.4 Design Review

Table 7-11 next, contains the design review criteria applied. There are two functional designs of the SDS proposed for comparison. Both designs are reviewed to assure that they offer the solutions for which it they intended in association with specified criteria. The results of the review are then compared to make an appropriate choice for specification.

7.9 Design Specification of the SDS

7.9.1 Functional Representation of the SDS

The functional design specification of the SDS defines detailed features, functions and solution options that would be assured to satisfy specified needs, when it is fully operational (see Appendix 12). With design results presented for choice, the standard way is to review their details following set criteria such as MURRE or TELOS (Burch, 1992), and minor design decisions such as those described in Table 7-10. However, this review has been reserved for the synthesis of findings, applying only criteria that explains the solutions sought and their meaning (Chapter 8).

Table 7-11: SDS functional design review criteria (Source: compiled by author)		
Review criteria	**Description**	**Reference**
[1] Objectives	Functional completeness of the design with regards to its purpose and scope	- SDS requirements; dimensions of operational performance options; expectations, solution options. [§7.8]
[2] Design parameters	Correct assignment of features for form, fit and function in each operational boundary across the SDS	- Master design plan and SDS requirements and features [Source model, plan which are too cumbersome, §7.7.4, §7.7.5]
[3] Problem space and relevance	Objectives of the solution proposal	- Solution proposal views [Table 3-4]
[4] Decisions or reasons regarding desired functionality	Options critical to offer resolution of SDS operational performance issues	- Reconstruction and design decisions [Table 7-10] - Research hypothesis [Box4-1]
[5] External constraints	- Scope of reconstructed IITS process and expectations - Views critical to project development settings	- IITS process performance and requirements [Appendix 10]
[6] Advantages and limitations	- Design quality - Design implementability - Solutions	-----------

7.10 Summary of Results: Problem Space and Relevance

This chapter has demonstrated that, unless IITS process performance is analytically evaluated using the OIPT as a lens, the problem statement and solutions sought can not be challenged realistically. The design results for choice include problem space and problem relevance as follows:

Problem space: This accords to the symbolic representation of the problem. In this regard, the representation is akin to the clarification of the problem statement, examined as the complexity of IITS process (§1.1.4), that it does indeed exist (cf. Newell and Simon, 1972; Simon, 1996). This problem space has been characterised as implications of extensive complexity, challenges of IITS process performance and critical issues (see §7.4). Moreover, five stages of the operationalisation of the reconstruction of the IITS process clearly characterised the problem space to eliminate identifiable sources of complexity, so that solution options can be reasoned effectively.

The properties of the problem space bearing on the design results are described in **Table 7-12,** next. This means, problem space and problem relevance are considered together to provide important themes underpinning the explication of the design results. This approach includes the resolution of the solution proposal framework the guided the conceptualisation of the reconstruction exercise in the first place.

Problem relevance is akin to developing solutions to important and identified problems (cf. Hevner *et al.* 2002). The focus on reconstruction and design exercises has been on the problem relevance. As a solution sought to reduce the complexity of the IITS process, the development of draft standards has been singled out for reconstruction as a core aspect of the IITS process. The open-layered CBD framework produced a component-based Standards Documentation Setting (SDS). This is the design result that helps to clarify the *problem relevance.* It demonstrates fundamental understanding of the attributes of *problem space* (Table 7-12) and critical issues (Appendix 9A).

Table 7-12: Problem space of IITS process
(Source: compiled by author)

Problem relevance parameters from solution options	Problem space issues
[1] IITS process operational infrastructure:	- Lack of IITS process performance framework - Project development performance uncertainty contexts
[2] Context of IITS process:	Critical issues of design representation of PDS and of IITS process solution framework within guiding views e.g.: structural and functional
[3] Operational distinctions in component- based PDS:	Critical issues of design rationale of PDS - Complexity of functional challenges operational layers - Information-processing capability - Information overload - Uncertainty in processing and operational communication
[4] Process distinctions in component-based PDS:	Transparency of project development process functions: - Analysability of features - Analysability of operational details
[5] Performance capability and practices:	Performance ambiguity in committee practices - Committee relations and interactions - Uncertainty of information and knowledge - Visibility of intrinsic practices e.g. collaboration
[6] Operational capability:	Performance and operational features - Information sharing - Requirements support - Specialisation - Policies and operational principles to be observed
[7] Technology/IS:	Complexity of IS resource needs and structuring e.g. for:. - Communication, information management. - Applications support - Services and service operations
[8] Resources:	Unknown resource needs e.g. - Key resource requirements based on practices

7.11 Chapter Summation

These views of problem space and problem relevance form a basis for the synthesis of findings. The next and penultimate chapter, is a discussion of the design specifications of the SDS carried forward for synthesis.

Chapter 8
Synthesis and Specification of Results

8.0 Chapter Summary

This synthesis of results draws upon a set of instruments through which decisions are determined (§8.1). The specification of declared results covers the reconstructed IITS process (§8.2), followed by the SDS (§8.3) and integrative solution framework (§8.4). Next, are sets of solutions for the reconstructed IITS process (§8.5). Operational capabilities describe tacit strategies linked to the declared results and solutions (§8.6). Items contributing to the enhancement of IITS process performance and successful project development are discussed. There are recommendations for proposed project development settings (§8.8), ending with a discussion summary (§8.9).

8.1 Instruments of Synthesis of Results

8.1.1 Rationale of Synthesis

Three instruments influencing the explanations of this synthesis exercise are, result specification framework, design specification parameters and criteria for solutions. The works of Hirschheim (1989, 1992) and Lyytinen (1991) suggest the need to conduct design matters in **positivist stance**. Much of the reconstruction of the IITS process has been carried out in the positivist stance to create the component-based Standards Documentation Setting (SDS).

This researcher's positivist stance, however, adds depth and detail to the explanation of design issues. It has included a predetermined CBD solution proposal (Figure 3-4) which guided the reconstruction exercise and definition of the created SDS (Appendix 12). Theory-driven reasoning through the OIPT as a lens, design decisions and dimensions of solution options also provide the basis upon which empirical evidence has been applied to develop relevant design definitions.

This synthesis of results pays particular attention to the SDS designs presented for choice, as well as, the resolution of the reconstructed IITS process. Lawson (1997: 35-38) characterises synthesis as: moving forward from the design phase to create a response to a *problem;* it is the generation of a *solution.* This synthesis exercise blends in well with Lawson's view. The underpinning factor is that, while a theory-driven reasoning has been applied in the reconstruction exercise, the design results are derived from other fundamentally different approaches. For example, process modelling and tailoring of the design applied BDDs and AFD all leading to definition of the SDS. Because of these different approaches, the relationships in the design results presented for consideration and solutions sought are difficult to appreciate. Consequently, this synthesis shifts from the positivist stance to an **interpretive paradigm**.

This researcher designed a result specification framework as a proactive tool. It brings declared design results, their exclusive details into the same frame for synthesis, reconciliation and decision-making. The interpretations based upon the decision-making justify the acceptability of the declared results and solutions to support them. This synthesis approach connects three parts defined in the analytic framework (Figure 5-2), as follows:

[1] Part [4] dealt with the reconstruction exercise producing the SDS and reconstructed IITS process features. These results are carried forward for synthesis.

[2] Part [5] connects design results for choice and solutions sought. This connection influences the resolution of the design results with regards to the CBD solution proposal that guided the reconstruction exercise.

[3] Part [6] pays attention to the details of declared results that also influence decisions to specify solutions. Moreover, this connection of parts [5] and [6] is a decision boundary within which explanations of results and solutions together, can answer thesis question #3 (see §8.7.1).

8.1.2 Result Specification Framework

The lack of a coherent synthesis approach has flaws, when it comes to explaining the importance of the design results and solution choices. To reduce perceived flaws a result specification framework is applied to capture the synthesis approach and to connect well considered decisions parameters. **Figure 8-1** presents this framework.

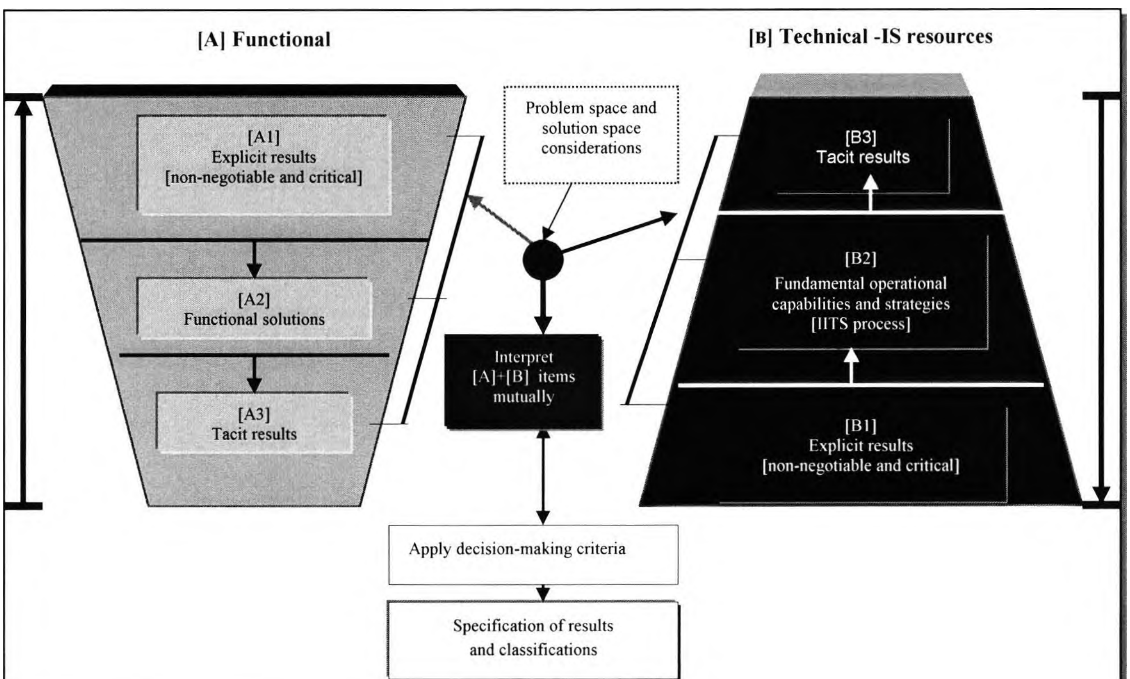


Figure 8-1: Structure of Result Specification Framework
(Source: compiled by author)

The appropriate focus of this framework is **the concept of optimisation** which states: there is more than one set of result presented for consideration and decision-making (McGraw-Hill, 2003; Starkey, 1992). The objective of optimisation is to differentiate the most favourable choices presented for evaluation, in some defined sense, and subject to constraints imposed in the decision-making process (cf. McGraw-Hill, 2003).

Optimisation procedures tend to use quantitative comparisons of the designs presented for choice. Decisions are based upon calculating process cycle time scales from input to output and cost control measures. This result specification framework focuses on a **qualitative optimisation**. It grounded in the interpretive paradigm resting attention on explanations of meanings in the declared results, their relationships to solutions determined from them and contexts in which they will be implemented.

This interpretive paradigm rests attention on the Klein and Myers' (1999) principle of multiple interpretations for two reasons: One, design results of the reconstruction exercise are qualitative. Two, the solutions sought are derived from these qualitative design results. They will in turn, be implemented in the IITS environment embodying IITS process and project development qualities embedded in cultural, social and technical contexts. In this interpretive paradigm, therefore, this result specification framework offers **sensitivity** to reconcile the results and differences in the interpretations of their meaning bearing on the embedded in contexts mentioned above. The solutions derived from the declared results are expressed as the most appropriate for resolving the complexity of the IITS process and some strategies for practice.

8.1.3 Content of the Result Specification Framework

The result specification framework has been constructed as a 'funnel-shape.' This creates **top down systematic synthesis** with separate decision levels. First, the design results of the SDS and reconstructed solution proposal of the IITS process are presented for choice and resolution. Second, the framework then offers coherence in arranging the classification of findings from the synthesis and resolution actions. The decision levels in this framework guide explanations to support declared results and solutions in different contexts of 'fit' to the expected functionality of the SDS, as well as, the reconstructed IITS process.

In reference to Figure 8-1, the funnel-shape result specification framework operates on these two closely connected themes: [A] Functional and [B] Technical-IS resources . These themes pay particular attention on the baseline contexts in which the SDS and reconstructed IITS process are expected to operate within a CBD framework. Focusing on these themes, criteria through which synthesis and decisions are determined are as follows:

First, **'Functional' [A]** is the upright position of this 'funnel shape'. Categorically, reconstruction of the IITS process within a CBD framework has helped to reason 'how' to reduce diverse contexts of complexity as sources of uncertainty and *wicked problems* impacting on its performance. As result it is possible to focus on defining correct functionality.

The SDS as a test case component-based project setting together with the reconstructed IITS process have been designed primarily to demonstrate this functionality. Foremost, the SDS as a test case component-based project development setting. It is an **explicit result [A1]** of the reconstructed IITS process upon which its features can be used to explain the themes underpinning correct functionality. **This result is non-negotiable.** Besides interpretations of functionality, solutions are determined from this explicit result hence.
The solutions are necessary to guide how IITS process performance can be enhanced and how successful project development can be achieved, as a result of this reconstruction. Without component-based project development settings such as the SDS, anything after **[A1]** falls apart and should not be mentioned. Anything concerning 'Technical-IS resources' **[B]** would also be redundant. The next level **[A2]** are 'Functional Solutions' covering detailed descriptions of the chosen designs for the SDS, new IITS process, and solutions that apply to them. The guidelines for level [A2] are design specification parameters (see §8.1.5).

Second, **'Technical-IS resources' [B]** has this 'funnel shaped framework' in the invented position. By virtue of the fact that a CBD framework has been applied, both the SDS and reconstructed IITS process utilise IS resources, without which, it is not possible to leverage cohesive functionality of their content and context features. Thus, the inverted position of this funnel shaped framework makes it possible to interpret mutually, items determined for functional [A] and technical-IS resources aspects [B]. This is an explicit approach to connect the definitions of the design features, whose explanations of the relationships between them help to determine operational capabilities, solution expectations and strategies.

Third, **'Decisions'** regarding the mutual interpretations of functional [A] and technical-IS resources [B], lead to non-negotiable functional solutions **[A2]** and explicit technical-IS items **[B1]** for the SDS, and reconstructed IITS process. Well-established design framing concepts are adopted from areas covering systems design (Senn, 1989); component-based development (Adler, 1995) and software architectures (Bass *et al.* 1998; Hofmeister *et al.* 1999). These concepts help to define the decision criteria guiding the systematic synthesis of functional and technical-IS features. Their mutual connection draws attention to the definition of content and operational details of the declared design results, as well as, solutions.

For consistency, decision-making criteria (§7.1.4) that guided the selection of IITS process items for reconstruction are reapplied to define classifications of the solution choices and their fit to context for practice. Relevant explanations to support the decisions bearing on the classifications are depicted in this result specification framework as: Fundamental operational capabilities **[B2],** Tacit results **[A3]** and **[B3]** accord to strategies achievable for practice within the constraints of both functional [A] and technical-IS resource aspects [B].

8.1.4 Design Specification Parameters

In this thesis, a design specification is an explicit result declared as part of the research outcomes. It is the source from which to determine solution choices. After a design choice is determined, **Figure 8-2** is applied to capture comprehensive descriptions of its details, such as: 'what the specification is to achieve'; 'how it is to function'. These details lay the foundation for deciding how the design choice fits into the classifications of result specification framework.

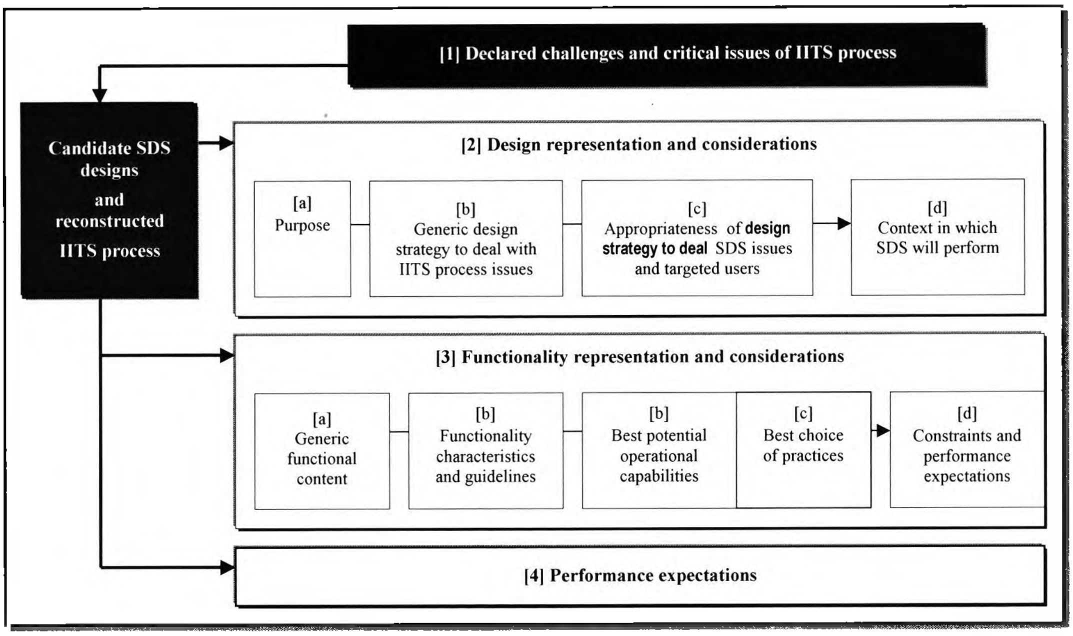


Figure 8-2: Criteria for Design Specification Parameters
(Source: compiled by author)

8.1.5 Classification and Specification of Results

Following each level of the result specification framework, synthesis ends with the classification of the choice results. This classification is in the top-down detail akin to the synthesis and decision-making approach. It aims to demonstrate how the declared *results* are linked to *solutions* and *strategies*. While categories of 'functional [A] and technical-IS [B]' can differentiate the declared results, explanatory primacy is in the qualities of their meaning to the SDS and IITS process (cf. Bruner, 1993; Flick, 1998; Pettigrew, 2001). In the interpretive paradigm, therefore, the synthesis exercise generates questions regarding IITS process issues that need reconciliation and resolutions to give meaning to the declared results. Example questions are:

[a] What is the focus of this result or solution?
[b] Why is this result or solution important to IITS process or SDS?
[c] What is the IITS process or SDS aiming to achieve?
[d] How and where will this result or solution be used?
[e] Who is going to be involved in managing this result or solution?

Another important theme underpinning the interpretive paradigm of this synthesis approach is the **problem space,** to which the declared results and solutions are referenced. In keeping with Newell and Simon (1972) and Simon (1996) attention to the problem space provides **sensitivity** to individual dimensions located in the declared results and other items connected to them. Responses to these questions above become important instruments to:

[a] Encourage clarity of the interpretations underpinning the suitability of the results, leading to the context to understanding relevant solutions.

[b] Frame explanations of the problem and solutions of how it can be solved with regard to the meaning of design results. Framing the meanings of the contexts in which the results and solutions can be applied supports this. Importantly, *fitness* in the context of 'Functional' [A] and 'Technical-IS resources' [B] is dealt with, because the problem space and solutions sought co-evolve, by connecting the interpretations of the meaning of the results (see Figure 8-1).

8.1.6 Criteria for Solutions

The characteristics and consequences of the complexity of the IITS process (§5.4, §7.4) stress the need for fundamental solutions. With the SDS (§8.3) and resolution of the solution proposal (§8.4), what makes sense is to describe solutions that can explain fundamental results and the influences of their expectations in performance. Such solutions meet four criteria: design contribution, complete solutions, context to 'fit' and, salient features and implementable.

[1] Design contribution to solutions

Galbraith (1994, 2005) suggests that an organisation's ability and success in solving complex problems will depend largely on managing associated issues of design. In this view, the CBD framework as a design strategy has helped to define the context in which solutions sought must fit. It makes significant contributions by drawing attention to more effective ways of functionality across the IITS process, which can articulate solutions to be pursued.

[2] Complete solutions

There are a number of scholarly works on organisation capabilities (such as Eisenhardt and Martin, 200; Stalk and Hout, 1990; Ulrich and Lake, 1990) and techno-change (Majchrzak, 1991; Markus, 2004) that provide insightful underpinnings of complete solutions, as follows:

One, the problem space parameters are carried forward from Table 7-12. This problem space shows a range of issues requiring explicit attention in the synthesis of results.

Two, the SDS design specification exemplifies clearly that instead of resolving just the complexity of the IITS process, the principles of a CBD framework can effectively resolve a variety of other issues embedded in its performance. In this regard, solutions for the IITS process are consistent with a complete set of integrated results that deal with a diverse set of issues, associated with its performance, embedded or otherwise.

Against this, complete solutions harness **fundamental benefits** bearing on the relationships between specified features and embedded conditions. Benefits from the utilising IS resources are fundamental. Adequate information processing; tools for information provision and sharing are just the few examples of fundamental benefits expected when the SDS is fully operational. These benefits are by virtue of the relationships between specified features and embedded conditions, and functionality of a component-based PDS. These benefits become the sum of the expected completeness and success of the solutions in the areas in which they demonstrate the meaning of required functionality, as well as, to harness new combinations of capabilities.

[3] Solutions present context to 'fit'

The concept of *'fit',* the underpinning theme of the OIPT guideline #3 (Box 3-2), is important to the definition of solution expectations. There are two points to note:

[a] *'Fit'* is foremost a criterion for explaining potential solutions. From the interpretations of this guideline, four solution options were applied in the reconstruction of the SDS and its design results. The options helped to determining dimensions of operational performance (see §7.8.2). Since the solution options have been adequately assessed with the scope of the OIPT as a lens, they provide the best workable *fit* to draw upon specificity of the solutions sought.

[b] An overall solution expectation is to bring IITS project development in line with other challenging frameworks developed in the reviewed literatures. The point of reference is Figure 2-2 illustrating project development trends from reviewed literatures. Relevant dimensions from these trends are associated with the parameters of the integrative solution framework as a resolution of the reconstructed IITS process. This combination offers *'fit* explanations', in terms of solutions that can deal with IITS process problem space issues, guided by and associated with, pre-determined criteria from other frameworks illustrating best practices that can drive project development successes.

[4] Solutions have salient features that are implementable

The OIPT as lens makes the assumption that results interpreting *fit* between requirements, capability and capacity to obtain or predict optimal performance are implementable. In other studies on techno-change (Markus and Keil, 1994; Markus, 2004), implementation is mentioned with regards to the challenge to select a complete solution that is likely to be adopted and used. In view of these suggestions, fundamental solutions are specified with the intention that they will present salient features that can yield positive consequences in areas of the IITS environment for which it is intended. Salient features are determined as positive implications for practice hence.

8.1.7 Summary of Declared Results

Table 8-1 that follows next, gives a summary of declared items (results, solutions and strategies) and classification structure. In the discussion in the sections that follow this, these items are numbered for ease of reference and for coherence in their separate presentations.

Table 8-1 : Summary of declared results and classification structure
(Source: compiled by author)

Results presented (top-down structuring)		Content
[1] Explicit results		
Result #1:	New IITS process of life cycle	Focus of performance framework
Result #2:	Draft Standards Setting (SDS)	Major concepts of SDS design specification
Result #3:	Integrative Solution Framework of reconstructed IITS process	Resolution of solution proposals
[2] Functional solutions from results		
Solution #1:	Operational infrastructure of reconstructed IITS process	Resolution of reconstructed IITS process
Solution #2:	Distinctions in component-based PDS	Resolution of reconstructed IITS process
Solution #3:	Technical, fundamental solutions	Resolution of reconstructed IITS process and IS constructs of SDS
[3] Tacit items for operational capability: strategies from results and solutions		
Strategies:	Strategy1-Information processing capability Strategy #2-Operational capacity Strategy #3-Performance capabilities Strategy #4-IS integration capabilities Strategy #5-functional integration strategies	Meanings of solutions in IITS process

8.2 Reconstructed IITS Process

8.2.1 Specification of IITS Process Results

The reconstructed IITS process falls in the category of an **explicit result**. Table 8-1 shows three main results [#1, #2 and #3] for the reconstructed IITS process. For these results, **problem space #1** is determined from Table 7-12 (Problem space of IITS process). It enhances the explanations of the specification of these results and acts as a measure of how well the alternatives satisfy the solution focus.

Problem space #1: IITS process has high-level technical projects involving specialised practices and procedures that need the guidance of a formal process life cycle to address common basic elements of its performance expectations.

8.2.2 Result #1: Life Cycle Framework of New IITS Process

Prior to its empirical definition and analysis in this thesis, the IITS process had no established performance framework. This contributed to the ambiguity of its features evolving from competing aspects of the core process and PDC that are difficult to verify.

The new IITS process life cycle presented in **Figure 8-3** qualifies as an explicit result. It is recommended as a framework, because the core aspects reconstructed to create the component-based SDS were taken from the combined features of the core process and PDC (see §7.7.3). The IITS process as defined in Figure 6-4 (Features of IITS process) for this analytic study and reconstruction exercise will, therefore, no longer be viable for use its current form.

This synthesis of results for the reconstructed IITS process applies to restructuring the remaining features. Because of the radical nature of the reconstruction exercise, this researcher stresses the importance of showing the expectations that would be transparent to all users of this new framework of the IITS process life cycle.

It has been designed to draw together new principles that give justification to the expectations of the new IITS process, in line with the SDS and other component-based project settings recommended to complete the reconstruction exercise (see §8.8). This researcher's empirical definitions and design results indicates that, SDOs will decide the implementation of this life cycle, with minor modifications to any of its stages.

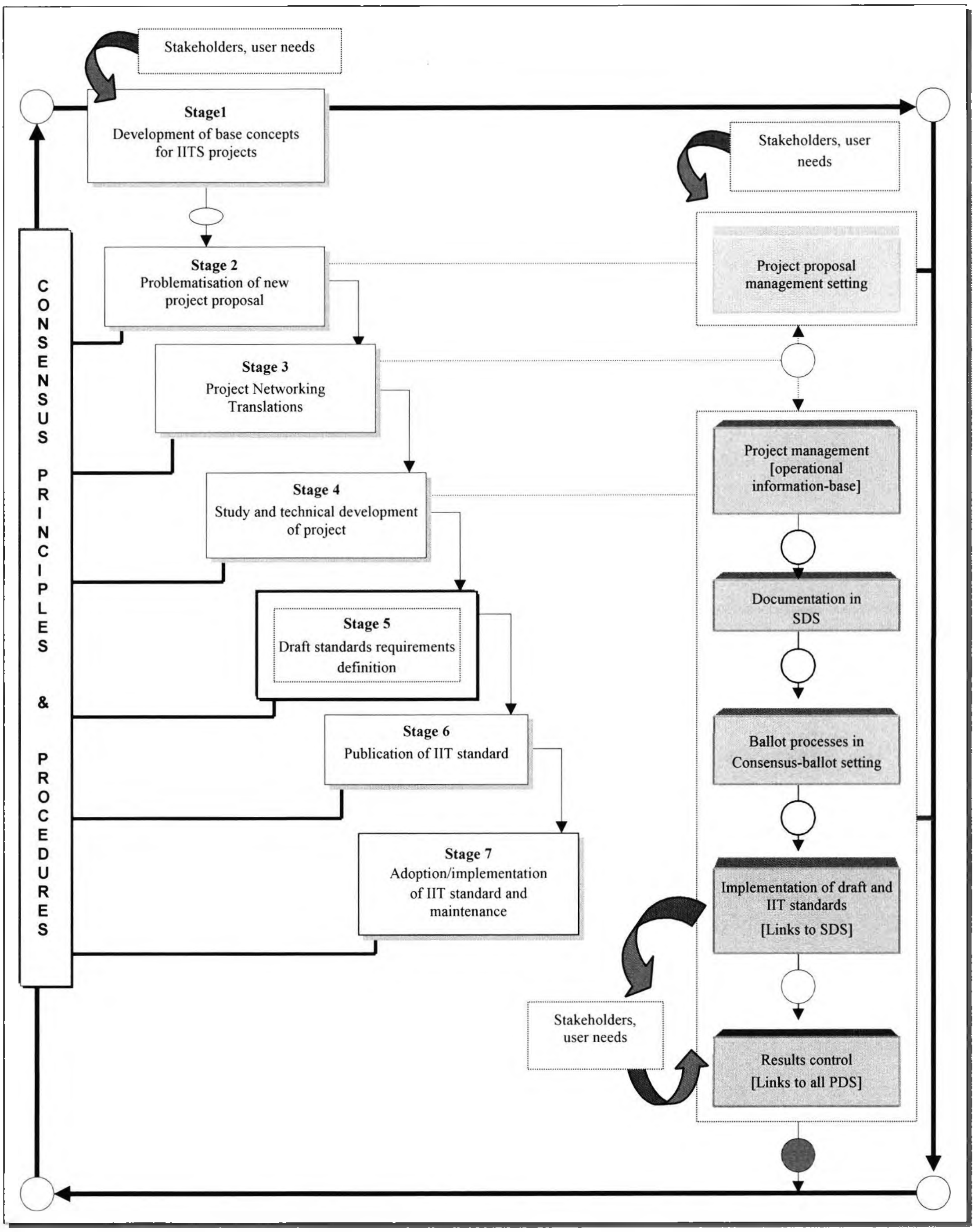


Figure 8-3: New IITS Process Life Cycle Framework
(Source: compiled by author)

8.2.3 Framing Concepts of IITS Process Life Cycle

Four questions that emerge from the synthesis of results are applied to encourage clarity of framing of the concepts underpinning this new life cycle:

[a] What is the IITS process aiming to achieve?
[b] Why is the life cycle framework important?
[c] Where will it be used?
[d] Who will be involved in managing it?

[1] What is the new IITS process aiming to achieve?

The definition that follows gives basic elements to focus the response to this question:

> The new IITS process provides an approach to guide project development; to produce and to maintain IIT standards through stages that support a collection of processes, procedures and resource usage. It contributes directly and materially to the objectives pursued in the IITS environment, and to some value perceived by its stakeholders. The process is entrusted to the responsibility of a single authorised owner with representative expertise in the IITS efforts.
>
> (Source: compiled by author)

[2] Why is this life cycle framework important?

Focus, universality and eliminating risk summarise the justifications for the importance of this new IITS process life cycle framework.

The focus of a process communicates to its users, a life cycle addressing common basic elements of expected performance. This IITS process life cycle framework has an important consideration to **make transparent** 'how things should be done' to build the logic of required performance (cf. Holt, 2005). New IITS process expectations, such as strategic direction, goals and objectives that SDOs will define, will fit into the hierarchy of this life cycle framework to guide its actions. Furthermore, Dorfman and Thayer (1990) and Holdsworth (1994) indicate that focus and 'how to' are achieved by organising the content and underlying conditions in which the new IITS process is expected to perform.

Second, this life cycle framework is expected to promote **universality** in project development, while simultaneously, enhancing the choice of performance practices and procedures. In particular, committees need to view and understand 'what is going on', so that they can develop project development phases that can be aligned with this new IITS process life cycle and its goals. Essentially, approaches taken in a particular project can be separated into distinctive phases to define the project development strategy or methodology to be executed. For example, design of project tasks, requirements analysis and specification of standard. Project development specifications would vary according to the content of a project. Such specifications can become templates for other projects, for repeated use.

Third, for standards development bodies, the impact of this new process life cycle framework is to **eliminate the risk of ambiguity.** Clearly, this thesis has demonstrated that multi-dimensional aspects of the extant IITS process and in project development matters are difficult to manage with any reasonable consistency. This is one sign that there is risk of uncertainty in performance and in the results produced.

[3] Where will it be used?

This life cycle framework (Figure 8-3) has seven stages presented alongside proposed component-based PDS. This is an important connection indicating that, this life cycle framework will be used across the new IITS process features to guide performance. The life cycle framework needs promulgation through SDO Intranets sites to make it transparent for universal use.

[4] Who is going to be involved in managing it?

Strategic thinking from Keen (1997) and Watson (1993) suggests that responsibility for this new IITS process life cycle framework will draw from domain-specific expert knowledge in IITS project development, project management, management of standards and strategic direction. This researcher's preference is to assign this life cycle framework to the expert knowledge of ISO JTC 1. This is because it currently oversees IITS efforts. It has experience in IITS project development, which is a fundamental responsibility. It will therefore be expected to provide core strategic leadership competencies that drive change toward best practices and legitimacy of resources needed to support the new IITS process.

Moreover, the immensity of the features of the reconstructed IITS process is another factor for well-considered management requirements to enhance the operational scope of project development. Spread of concerted expert knowledge is necessary for innovative approaches. Other personnel would be selected from NSBs to work in transparent consultation with ISO JTC 1. The responsibilities of these personnel will include distinctive technical competencies upon which the IITS environment will depend to address accountability for the IITS process approaches; managing its needs, results achievements and for customising agreed solutions (see Appendix 11).

8.2.4 Major Concepts of the New IITS Process Life Cycle Framework

As illustrated in Figure 8-3, this new life cycle framework will evolve through seven stages. In keeping with Dorfman and Thayer (1990) and Holt (2005), the terminology in this life cycle framework is chosen specifically, because it is already used in the IITS environment. Similarity in terminology ensures that this life cycle can be easily connected to the central principles of IITS efforts. In brief the major concepts of the stages are the following.

Overall, this life cycle will be applied in context of the **due process requirements** applied in voluntary IITS efforts. Key requirements adopted from Baron (1995), Cargill (1989, 1995) and Jakobs (2000) involve consensus principles approved in SDO procedures; openness to establish agreements where actions, practice and results and end value of the IIT standard need to be reconciled (see §2.3.7). If not, these principles a high degree of integration, so that the new IITS process can be facilitated to bring continuity and consistency to in its performance.

Stage 1: Development of base concepts for IITS projects

This stage is now the starting point of the new IITS process. In the current IITS process Stage 0 (Pre-standardisation) is treated separately, to include its independent procedures. An immense amount of information is often lost faster than it is created.

This new stage 1 expands the scope of the new IITS process by connecting it to the sources of concepts, technical information and methods that project development depends upon. A major contribution of connecting the 'development of base concepts' is to eventually reduce effort of debating about the need to develop base standards or methods and how they will be adopted. The connection increases the chances of gathering relevant information, defining uniform practices and for continuity of the IITS process performance in a synergistic manner.

Stage 2- Problematisation of new project proposal

This stage ensures transparency of committee reviews of approved projects. Problematisation gives the committee focused proactive planning, as well as, more *tactical* application of inputs adaptive to design the project development. In particular, stakeholders would need to see problematisation that clearly characterises their role in committee project planning action. Project plans must be actioned not only as documents for reference, but also as tools defining the project development strategy. The results of problematisation will therefore give answers to questions aimed at making the project development strategy transparent and integrative of committee performance, such as:

Information:	Which information is relevant to this project?
	What are the sources of information (such as methods, input products)
	How can this information be created and managed at committee level?
Project scope:	Are the defined objectives, scope and phases of this project consistent with agreed 'committee-stakeholders' imperatives?
	What financial and IS resources are available to support these committee decisions to mobilise the execution of the project development strategy?

Stage 3: Project Networking Translations

In this stage, *project networking* is consists of a specific set of tasks that supports the transformation of the project development strategy into reality. Project networking needs systematic stakeholder identification, as an important step to understanding project needs, contributions of inputs and openness of representations (cf. De Vries and Verheul, 2003).

Project networking translations described in static content of the IITS process, mobilise fundamental opportunities from problematisation stage (also see §6.5.6). Example elements of project networking already described in detail in this thesis are project inputs; industry coalitions or alliances and multi-vendor market considerations that can propel the project development strategy, in line with agreed committee objectives (cf. Axelrod, 1995; Baxter, 2000; Gabel, 1987).

[a] Other important considerations involve the fact that all five projects examined in the case study needed the positioning in an IT market sector where the published IIT standard would be implemented, subsequently. Prominence of project networking translations in this new IITS process life cycle framework gives essential meaning to

the reality of project development and context in which the results apply. For example, compatibility of systems, networking of technologies achieved through standardisation and IT market influences in the implementation of standards (cf. Besen and Farrell, 1994; Gabel, 1987, 1991).

[b] Issues that arise from this stage help to define solutions for policy issues that often emerge during project development. Typically, contracts for R & D activities, licenses for patents and adoption of proprietary practices. More so, transparency of stages 2 and 3 can be expected to bring these project development considerations into the mainstream of SDO strategic programs for alignment. This approach helps to deal with conflict and, to verify the management of the new IITS process performance and its results, subsequently.

Stage 4: Study, discussion and technical development of project

This stage poses a crucial question: What is IITS project development without study, discussion and technical development aspects? The response to this question is simply, project development that lacks the core knowledge behind the work, as well as, rigorous and appropriate methodology. Study and technical development embody requirements for the project development strategy, analysis, review and definition of acquired information. These are some of the imperatives for clarifying the problems being examined and for developing draft standards.

Stage 5: Draft standards requirements definition

The SDS has been designed as a component-based PDS dedicated to the development of draft standards (see §8.3). This stage is specified in the IITS process life cycle framework, because draft standards need to be acknowledged as its interim results. The draft standards are expected to facilitate, among other things, ballot reviews, implementations, assessment of performance and control of results.

Stage 6: Publication of IIT Standards

All international standards are published through SDOs. It is current practice that NSBs and other organisations publish the same international standard, under the same reference notations, such as number and title. The SDS is designed with an interface that will serve to reduce the printing of IIT standards and promulgation time cycles, from drafts to final text to publication.

Stage 7: Adoption/Implementation of IIT standard and maintenance

In this final the stage, the publication of an IIT standard is the formalisation of its adoption and implementation in its intended sector or market. Results of implementation would be used in maintenance of the IIT standard, until it is no longer viable for use.

8.3 Result #2: Standards Documentation Setting

8.3.1 Overview of SDS Design Results

The SDS is declared as an explicit result, and a test case of the proposal to create component-based project development settings. The creation of the SDS has been carried out in the functional and physical domains (Starkey, 1992; Parker and McGraw-Hill, 2002).

The design results presented for synthesis are two options for functional design and, two representing the use of IS. These designs have been adequately reviewed (see §7.8.4). Where necessary, each design has been modified to prepare for this synthesis decision-making exercise.

8.3.2 Empirical Reality of Documentation of Draft Standards

Empirical evidence from the five committees examined in the case study indicates that documentation of draft standards take several years of discussion, technical development of the project, information gathering, concept building, evaluation and consensus negotiations.

Each draft standard (WD, CD, DIS and final text) goes through an independent documentation life cycle embracing these key elements above, to include a variety of scenarios and split-level sub-processes that are treated in different ways. Against this empirical reality, **problem space #2** highlights the issues the SDS can be expected to resolve:

> **Problem space #2:** The development of draft standards is currently achieved in piecemeal methods. Despite the rules in the directives, *documentation processes take considerably longer* to complete, because of the *complexity* of the projects; *ambiguity*, in the independent *documentation cycles* and in the *principles of standardisation* connected to them. *Uncertainty* of the adequacy and relevance of technical information are embedded in the in independent documentation cycles. *Unknown requirements* and *complicated operational matters* cause considerable exceptions.

8.3.3 Major Concepts of the SDS Design Specification

Appendix 12 contains a detailed specification of the SDS. The major concepts described here give an overview of constructive explanations of the SDS, drawing upon the resolution of problem statement #2. Criteria for the specification of the design results (Figure 8-2: Criteria for Design Specification Parameters) are applied in this resolution. Where necessary, the four questions determined from the synthesis of results provide clarity of the framing of the concepts.

[1] Purpose: what is the SDS aiming to achieve?

The SDS will provide dedicated development of draft standards and other IITS process deliverable items. It will incorporate well-established aspects of project development that contribute to the development of draft standards. These aspects have been determined empirically as study and discussion, technical development, drafting and meetings, all contained in one setting.

[2] Design representation considerations

Design representation covers considerations in Figure 8-2 items 2 [b, c and d].

[a] In the scope of OIPT as lens, this component-based design of the SDS is consonant with Galbraith's (1987:100) strategy of creating self-contained units that he describes as follows:

> The design choices are the basis for the self-containment structure and the number of resources to be contained groups. No groups (or units) are completely self-contained or they would not be part of the same organization.

[b] In terms of **self-containment** the component-based design of the SDS has the capability to function as an independent project development setting, unconstrained by IITS environment performance issues. Autonomy gives special prominence to the core concepts of functionality bearing on the development of draft standards.

[3] Functional representations

Representations of the functionality of the SDS refer to Figure 8-2, item 3 [a, b] (Criteria for Design Specification Parameters). Four key representations are operational imperatives, content autonomy, modulated levels and connectivity.

[a] The SDS utilises an open-layered representation based upon the partitioning principle (cf. Adler, 1995; Herzum and Sims, 2000). As result, the content of the SDS addresses **operational imperatives**. For example, this open-layered content creates operational boundaries that help to parameterise content features, functional scope and resources. Parameterisation can be expected to reduce operational content complexity.

[b] Partitioned operational boundaries offer **content autonomy.** This is concerned with lateral self-containment of SDS functions within analysable operational boundaries, to include, the exclusive treatment of objectives, inputs, activities, needs, outputs and IS resources. Each operational boundary can be facilitated to complete specified process cycles and evaluation of results, to satisfy set objectives. Results from one operational boundary are transferable to another, based upon actions and needs relevant to the SDS.

[c] Open layering creates **modulated levels of functioning.** The SDS operational boundaries created from open layering approach have modulated levels that can reduce excessive features that can cause complexity and uncertainty in the execution of documentation processes. Such modulated levels can be customised and singled out to address specialised issues. For example, committee meetings, communication, creation of information, review of draft standards (see Appendix 12).

[d] The technical-IS content of the SDS develops **connectivity of operational boundaries.** Integrated processes increase the chances of using the similar interpretations of the information necessary to develop draft standards. They reduce equivocality, such as having several competing documentation frameworks that are currently in place. The SDS will have mutual links with other PDS, without compromising its operational content or performance.

8.3.4 Functionality Expectations

Table 8-2 describes eleven functionality expectations of the SDS bearing on the design decisions applied.

Table 8-2: Summary of principles of the SDS
(Source: compiled by author)

Principle	Justification
[1] Provide documentation life cycle to developers and users	- This life cycle helps to provide instructive support for process execution, e.g.: to specify requirements and to define clear expectations of each draft standard cycle. - Take into account legitimate expectations, based on the type of projects and committee project plans
[2] Provide transparent and comprehensible core elements of standards documentation processes	- Excessive features compound the risk of not achieving timely delivery of IIT standards and SDO documentation objectives. core elements
[3] Provide distinctive operational boundaries to support task domains	- Documentation processes should be distinctive to show how the draft standards are developed. Operational aspects should be separated from documentation processes to avoid redundant contexts. - Distinctive operational boundaries provide control so that the users of the SDS can determine relevance of objectives and requirements for only one operational boundary. - Operational boundaries can be used for specific definitions of processes. They reduce the risk of incorrect association of processes.
[4] Allow adaptability of information and task domains	- The SDS address unambiguous task performance that allows the developers to observe consistent methods and reduce excessive features in the different aspects of documentation processes.
[5] Provide sufficient communication to support information and task domains	- Documentation processes needed to be connected to reduce redundant features; information and task uncertainty. Connectivity avoids interactions that are in excess of the objectives. - Connectivity can eventually be the basis upon which to build integrated processes that also save developers' effort.
[6] Customise specialisation aspects	- Documentation processes are specialised in terms of information needs, methods and task performance. - Specialised aspects can be customised to learn the practices that can create relevant information, knowledge and collaborative mechanisms that enhance performance.
[7] Provide adequate access to information sources and resources	- The SDS must adjust to the creation, provision and sharing of information. The use of IS helps with the commitment to gather and evaluate information that is needed to develop drafts standards. - During the development of the project, there is a need for explicit procedure of information that can be made publicly available.
[8] Provide user environment where committees can access requests, information	- Development of draft standards attracts a wide range of interested parties and implementers. Transparency of a user environment in the SDS creates a 'natural information source.' It provides communication between committee and of interested parties.
[9] Provide adequate and flexible instructions that support interactions and protocols	- The SDS will have ongoing interactions between processes, procedural and feedback. Defining well-structured protocols and procedures that will change constantly is futile. Flexible instructions can be put in place for each operational boundary to support interactions (collaboration, co-ordination and communication) and protocols for all users.
[10] Provide adequate applications and skills to support information and task domains	- Documentation processes require IS applications to solve consistency and interaction problems. Skills involve say, knowledge workers that can support information gathering, information processing and collation of task results.
[11] Refinement and maintenance	- The SDS needs problem identification, which aid refinement of processes and maintenance.

8.3.5 Salient Implications

There are four implications of the SDS design representation described next. The are: facilitated approaches, specialised practices, same process definitions and operational capabilities.

Facilitated approaches: Dynamic interaction is an asset to the development of draft standards. The component-based SDS addressed unique dynamic interactions from systems application integration. Potentially, an integrated CBD framework can adapt its IS resources to various changes. Integrated features in the SDS lay the foundation for the best approach for **facilitated committee team approaches** combined with new synergistic ways of working and new logic (see §8.6.4).

In contrast, at present committees have mediated interactions through SDO and NSBs or between individual memberships, stakeholder representations, such as government agencies and user groups (cf. Strauss, 2002). These interactions do not, however, include clear principles of collaboration that can guarantee effective technical development and documentation of draft standards.

Specialised practices: The content autonomy of the SDS is necessary for developing specific practices that pull in technical skills. For example, defining draft standards naturally involves collaborative actions for information and knowledge creation (cf. Mohrman *et al.* 1995; Quinn, 1997). Other skills include those covered in Appendix 11. Committees would, in many respects, be located where they can effectively align their activities with developing such specialised practices.

Same process definitions: The autonomy of the SDS helps to define processes fitting specified constructs of the development of all draft standards. Same process definitions enhance visibility of performance, making it easier for committees and SDS managers to create customises solutions. Same process definitions reduce task and information uncertainty. More so, integrated processes drawing upon same definitions, can be expected to become more structured to actualise how they can be conducted in a consistent cross-functional way. It will be easier to collaborate information and task results, thereby enabling the projects to maintain a sharp focus on the most critical issues.

Operational capabilities: The development of draft standards presents operational challenges. Because of the high integration in the SDS of applications and platforms, this draws attention to an array of concepts upon which to develop potential operational capabilities, such as:

[a] Developing meaningful SDS approaches that **harness solutions** for creativity.

[b] The SDS is connected to relevant **interfaces** to encourage consistent operational issues: information processing from same source data; information management with facilitated sharing; inventory management; task co-ordination and workflow.

8.4 Result #3: Integrative Solution Framework

8.4.1 Summary of Resolution of Solution Proposal

Figure 8-4 is the point of reference to clarify the resolution of the component-based solution proposal framework described in Figure 3-4. This resolution has important epistemological principles underpinning the definition of solution expectations of the design results, themes and the problem. In the absence of this diagram, the content of these resolution items is impossible to appreciate.

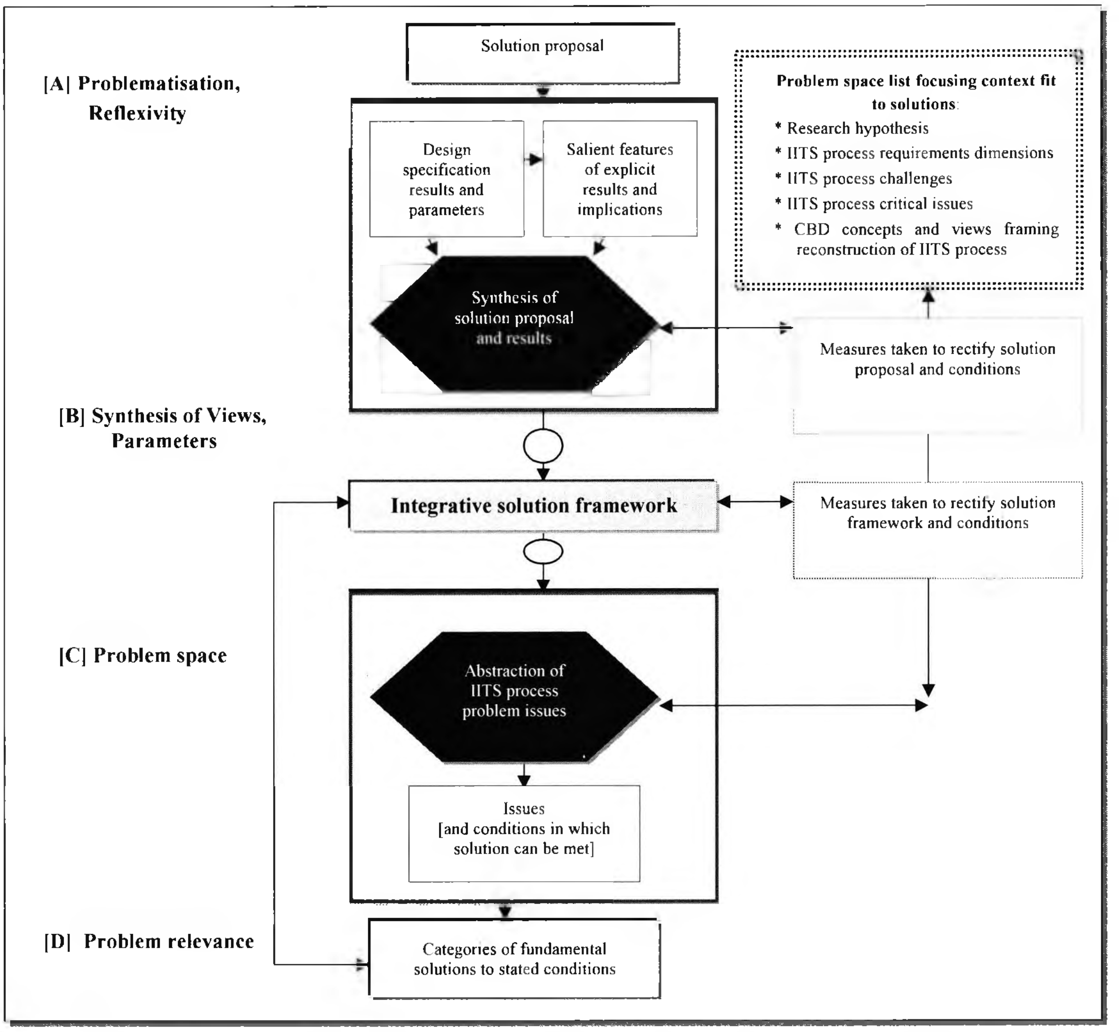


Figure 8-4: Problematisation of Solution Proposal (leading to solutions)
(Source: compiled by author)

8.4.2 Problematisation of Solution Proposal

Four main parts of Figure 8-4 are summarised, namely problematisation, synthesis views, problem space (representation of the problem) and problem relevance, leading to an integrative solution framework of the reconstructed ITTS process.

Problematisation [A] addresses the realities of the IITS process with an explicit aim to determine its **problem space [C],** in which phenomena of interest have been examined. According to Newell and Simon (1972), in the problem space, the problem solver has available repertory of methods that help control his or her problem solving behaviour under different conditions. This is followed by solution expectations to stated important and relevant issues concerning the **problem space [D].** In the absence of a problem space and its boundary conditions, there will be several solutions, and no distinctive ones that can satisfy desired results (cf. Simon, 1996).

As illustrated in Figure 8-4, this researcher's the starting point to problematisation is reflexivity to the solution proposal and explicit results derived from it. Retrospectively, the decision to reconstruct the IITS process rests attention on reducing its ubiquitous content features and performance contexts, as sources of complexity, uncertainty and *wicked problems*. The solution proposal framework (Figure 3-4) helped to understand not only the solution needed, but also to view the totality of the complexity of IITS process as the perceived problem. In keeping with Conklin and Weil (1997) and Simon (1996) this solution proposal framework provided parameters within which any solution must fit, based upon the operationalisation of reconstruction exercise.

Against this, reflexivity adds to understanding all possible features necessary to frame the IITS process problem space, from the empirical realities of its performance and assessed solution options. Thus, working within a defined problem space gives the representation of the problem, which serves to isolate solutions sought and their expectations.

In Figure 8-4 a list of features is drawn up in [A] 'Problem space list' focusing context fit to solutions. These features take into account other empirically determined results that help to define *boundary conditions* of the problem space. Some of the features from this reflexivity become data in their own right, to which the interpretations of the issues of the problem space and resolution of this solution proposal are referenced.

8.4.3 Synthesis and Reconciliation of Views

Amongst the key strengths of the solution proposal framework are five views underpinning the design rationale of the proposed component-based PDS. The views are Structural, Functionality, IS, Management and Behaviour.

At some stage in the problematisation and reflexivity [A] there is synthesis of the issues that impact on these five views. The resolution of 'problematised items' also yields emergent views. Through synthesis and reconciliation, fundamental relationships between the list of features and views are analytically determined.

The *context fit* of the results under consideration alters the perceived problem space and solutions. The results of this synthesis and reconciliation in **Table 8-3** next, show **unified specific concepts**, because problem space issues and solution sought co-evolve in the process of determining *context fit.* The results covering parameters and, emergent and predominant views help the resolution of the solution proposal hence.

Table 8-3: Parameters and views of integrated solution framework (Source: compiled by author)		
Parameters	**Descriptions**	**Emergent [E] and Predominant [P] views**
[1] Operational infrastructure	- Representation of containment of reconstructed IITS process and its core features	- Structural [P] - Management [P]
	- Concepts suggesting common operational matters to resolve IITS process challenges and critical issues	- Functional [P] - Architecture [E]
[2] Distinctions	- Representation of PDS and their distinctive dimensions: features, functions and resources	- Structural [P] - Process [E] - Project development [E]
[3] Practices	- Subject matters of recurring IITS practices and distinctions between them - Parameters that might encourage framing of performance approaches	- Functional [P] - Behaviour [P] - Management [P] - Project development [E]
[4] Operational capability	- Operational expectations based upon content of SDS and IS	- Behaviour [P] - Functional [P] - Information [E] - Management [P] - Process [E] - Project development [E]
[5] Technology/IS	- Representation of universal concepts the use of IS that can to resolve IITS process challenges and critical issues (as in operational content of SDS)	- Architecture [E] - Behaviour [P] - Information [E] - Management [P] - Project development [E]

In brief, **parameters** [Table 8-3, column 1] provide the level of detail to substantiate the expectations of the reconstructed IITS process in three ways.

[1] These parameters are grounded in the same views and contexts as those applied in the component-based solution proposal framework (Table 3-4). For this reason, they contribute to fuller understanding of the underpinning themes of the resolution of the reconstructed IITS process, and neglecting any differences that may be present in the solution proposal framework.

[2] Parameters provide the **boundary conditions** within which the solutions must fit, drawing upon resolved views.

[3] They help to differentiate understanding of the problem space issues that must be taken into account in order to reach well-considered decisions regarding resolution of the solution proposal and solution expectations.

In the synthesis of design results, however, **emergent views** have been identified [Table 8-3, column 3]. For example, each PDS will have similar component-based structure representation and closely connected operational details. These similarities help to address common solutions across the IITS process. For example, a 'project development view' has been identified as an emergent view drawing particular attention to why component-based PDS have been created, and to the context in which the settings will operate.

Another strength of the parameters is the **trade-offs in the relationships** between the five views underpinning the solution proposal and emergent views from the SDS design results. These trade-offs are necessary to bring out **predominant views.** In this regard, both the parameters and predominant views draw attention to the properties of the problem space of the IITS process (see §7.10, Table 7-12: Problem space and issues). Importantly, emergent views (such as information, process and project development views) confirm the accuracy of the empirical evidence (see Table 4-11: Criteria for data integration). Against these trade-offs, resolution has been achieved on these views which parameterise the IITS process problem space and issues connected to the resolution of the solution proposal.

8.4.4 Problem Space of IITS Process

The point of reference for the problem space is Figure 8-4: Problematisation of Solution Proposal [C]. The problem space has been determined through problematisation, reflexivity and, synthesis of views and parameters. Table 7-12 presents the interpretations of the problem space drawing upon from the critical issues dealt with in the reconstruction exercise to then, yield the parameters and views mentioned above.

8.4.5 Characterisation of Integrative Solution Framework

The resolution process ends with an integrative solution framework of the reconstructed IITS process presented in **Figure 8-5** following next.

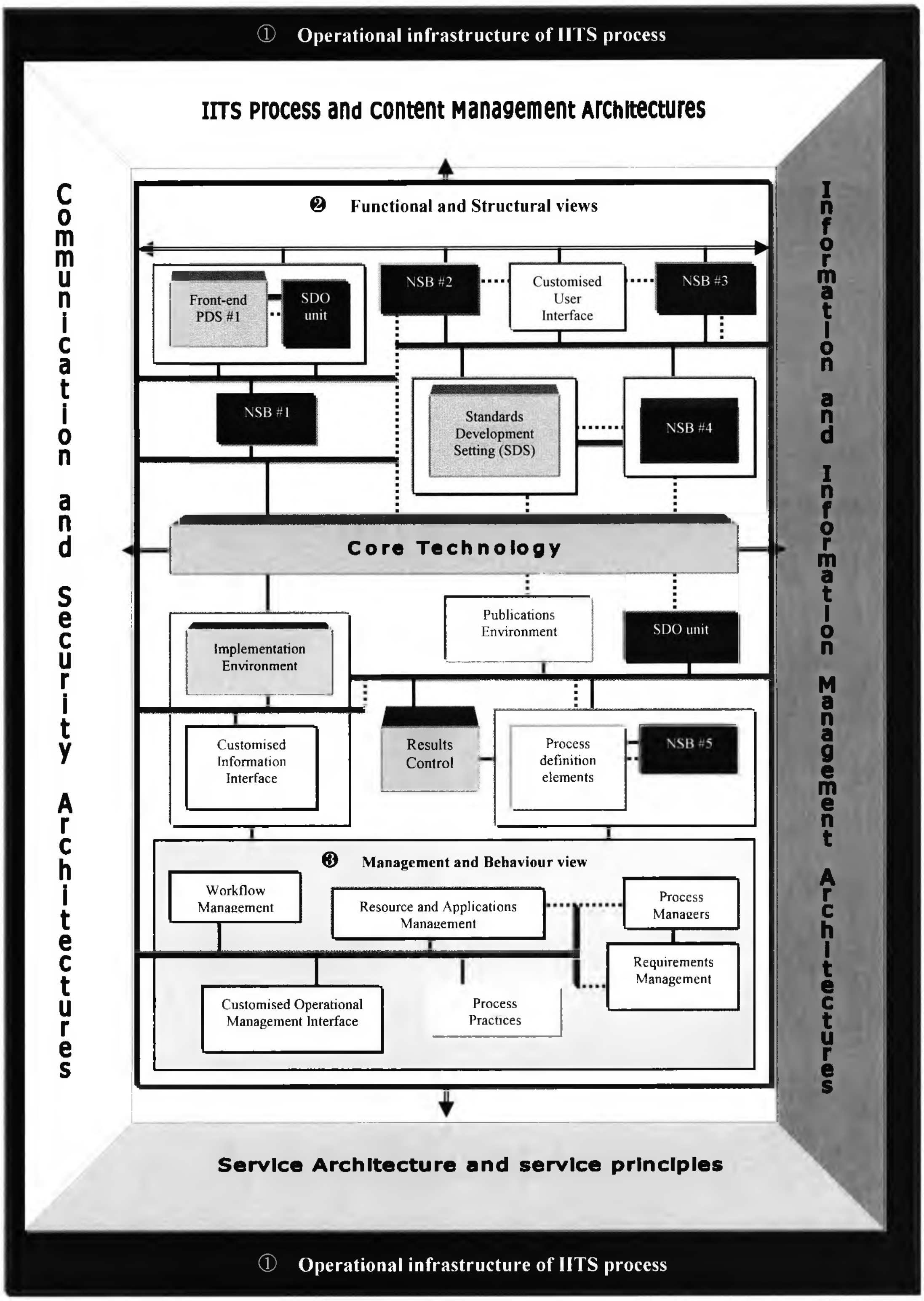
To summarise, this integrative solution framework presents how the reconstructed IITS process, its independent component-based PDS and IS resources will inter-operate in the same frame of reference. However, this is **not** a framework for conformance to performance requirements that the implementation of these declared results will seek to specify.

Clearly, there are similarities between the solution proposal framework (Figure 3-4) and this integrative solution framework. These similarities confirm that solution proposal was an appropriate and robust foundation for expressing the problem relevance of the IITS process. The integrative solution framework can resolve research hypothesis explanatory construct #2 (Box 4-1), cohesive functionality distinguished according to the following salient features:

[a] Integrated operational content of new component-based IITS process within distributed computing environment.

[b] Views underpinning context to fit of solutions and fit to function of autonomous self contained component-based PDS.

[c] Key drivers to creating customised solutions and practices, such as core technology, operational infrastructure and architectures.



Key	
◄═►	Inter-connection to core technology within distributed computing environment
▬▬	Connectors to communication links
——	Communication links between features, on core technology
…………	Internet Network links on core technology

Figure 8-5: Integrative Component-based Solution Framework
(Source: compiled by author)

8.5 Specification of Solutions

8.5.1 Summary

In this section, solutions are described with reference to problem relevance (Figure 8-4: Problematisation of Solution Proposal [D]). An important point to reiterate is that, project development is the core pursuit; if not more so, the core business of the IITS process. The decision to reconstruct the extant IITS process rest attention on the solutions that make a commitment to project development with regard to the IITS process problem space issues. Without due attention to link *problem space* and *problem relevance elements*, the contribution of the design results and solutions determined from them, is somewhat negative. Whereas, this link should bring out positive consequences for project development and IITS process performance.

In the interest of coherence, the solutions presented are numbered and described in descending order of importance. Classifications in the result specification framework (Figure 8-1) are applied. In addition, criteria of the solutions (§8.1.6) and interpretations of the SDS design results (Figure 8-2: Criteria for Design Specification Parameters) are applied to support justification of stated solutions. There are three **functional solutions** that satisfy the criterion of design contribution: operational infrastructure, streamlining hierarchies and distinctions in the PDS. In addition, there are two **technical solutions** for cohesive functionality and architectures defined in the integrative solution framework.

8.5.2 Functional Solution #1: operational infrastructure

This solution draws upon standards scholarly works (such as Cargill, 1989, 1995; Jakobs, 2000) debating that the extant IITS process is complicated and descriptive. The IITS environment has been described as the constant point of reference to what goes on n the IITS process (cf. Jakobs, 2000). Results of the analytic evaluation of the extant IITS process performance support these views (see §7.4.1).

By this extensive reconstruction, the focus is now on *how* the new IITS process can be enhanced for project development. As a way forward to the attainable future, the design results show that an **operational infrastructure** is necessary to harnesses wider qualities of solutions for the new IITS process. This is because the integrative solution framework creates an operational infrastructure that is fully equipped to deal with complexity and uncertainty, to include crosscutting issues embedded in IITS process performance. No other integrative solution framework can fully support capabilities of the IITS process.

Solution Expectation #1-1: purposeful unity

As a design contribution this operational infrastructure represents purposeful unity through which the IITS environment can pull together its strategies from various organisations. According to Holdsworth (1994: 173):

> Without a unified purpose there can be no streamlining, and no simplification. Without a unified purpose, complexity prevails because everyone's individual interpretation of purpose tugs the organization in different directions simultaneously.

Solution Expectation #1-2: transparency

Literatures such as Matheson and Matheson (1998); Kerzner (1998); Neufield *et al.* (2001) place emphasis on managing challenges as: assuring alignment of projects with the organisation's strategy, and co-ordination across the various organisational functions that have a stake in the project. Against this, the most important feature of the reconstructed IITS process is the fact that this CBD framework clearly addresses **transparency** of its content and context features. The operational infrastructure supported through distributed computing, creates transparency of all possible representations of new IITS process. In addition, the operational infrastructure forms **purposeful operational unity,** as to how the new IITS process can function effectively.

Together, transparency and purposeful unity provide the 'yardstick' for alignment of project development issues. For example, SDOs, NSBs and committees need purposeful unity for determining mutual strategies and approaches suitable for IITS project development. Transparency of the new IITS process features and its operational infrastructure can therefore strengthen understanding of what this process needs, in terms of:

[a] Determining the right kind of **project development priorities**.

[b] **Creating custom solutions** and implementing them to bring consistency in project development.

[c] **Creating committed focus** to commission **relevant strategies** intended to enhance performance.

Solution Expectation #1-2: multifunctional containment

Multifunctional containment is another important theme underpinning the use of the operational infrastructure in this integrative solution framework.

[a] The fundamental argument is that the IITS process needs structured and aligned functions. This operational infrastructure adds depth to the containment of new IITS process performance. This form of containment is an excellent foundation to understand functional challenges. It allows for core concepts of the IITS process to be structured, so that requirements can be determined with reasonable consistency.

[b] In taking the integrative solution framework as a whole, there is an added multifunctional containment of the views through which the new IITS process is expected to perform. Example views are behaviour (practices), information and management. Containment of these multifunctional views within such an operational infrastructure helps to address, among other things, effective co-ordination, information flow and task performance.

[c] This multifunctional containment is aimed at aligning autonomous PDS. Different PDS can draw upon a defined strategy to develop relevant approaches and practices that are unconstrained by SDOs and NSBs the functional challenges.

8.5.3 Functional Solution #2: micro management

Traditionally, the IITS environment has focused **macro management** of the IITS process. This approach creates an institutional infrastructure that also bundles separate functions and practices. It ignores essential solutions.

The component-based IITS process lays the foundation for developing **effective micro management approaches.** Expectations of micro-management bearing on the results of this reconstruction are: harnessing solutions for high performance, salient capabilities, needs and best practices.

[1] The SDS as a test case PDS has been designed for **high performance**. This is akin to the continued simplification of the operational content of the SDS to keep its practices consistent; well-constructed projects; leveraging the right investment; providing essential resources and providing conditions for efficiency through integrated IS (cf. Neufeld *et al.* 2001:46). In this scope, micro-management, therefore, concentrates on ongoing and situated actions in the PDS to provide a much greater range of conditions that represent **'how to' effectively harness solutions** that also fit into the privileges that high performance can bring.

[2] Micro-management practices that are adopted bring **salient capabilities**. For example, each PDS will manage its own its processes, information and, human, investment and IS resources. In doing so, it can concentrate on creating value-adding activities for generating relevant information and knowledge through practices that apply (cf. Orlikowski, 2002; Zack, 1999).

[3] Project development depends on **understanding generic and specific needs** that meet IITS process strategies. Distinctions in the PDS operational boundaries offer the advantage to understand scope of conformance to specified needs. Example needs that necessitate special treatment in operational boundaries are information, execution of processes, representation of functions, resources and, performance metrics covering costs and times scales. It is then possible to establish methods to address, manage and respond to those needs through effective practices that draw attention to long-term goals.

[4] The new IITS process performance strategies need a focus on **best practices**. Micro-management is the foundation to capturing best practices through specified approaches that apply to each PDS. In Watson's definition (1993:259) best practices are:

> Superior performance within an activity, regardless of industry, leadership, management, or operational approaches, or methods that lead to exceptional performance.

Since the component-based PDS approach give special prominence to IITS process core concepts, overall, the need is to go beyond 'the how to' enhance performance. Micro-management can therefore foster best practices, by distributing selected successes from each PDS to develop how to enhance performance hence.

8.5.4 Functional Solution #3: streamlining unnecessary hierarchies

Central to the success of the component-based IITS process, is a new operational paradigm shift: from IITS environment functional hierarchies to autonomous self-contained PDS that will function in an integrated infrastructure.

Solution Expectation #2-1: autonomous functionality
Autonomous PDS are expected to promote incentives to streamline unnecessary management and functional hierarchies that support the current IITS process. The current hierarchical functional relationship between the IITS environment and IITS process increases information uncertainty, because of the divergent nature of the operational matters that are mobilised from SDOs to NSBs and to committees.

This autonomous functionality presented in the PDS helps streamlining of functions. Autonomy introduces lateral or horizontal forms of functionality that can reduce power differentials among SDOs and NSBs (cf. Paton, 1987). If not, more so, autonomous functionality of each PDS ensures a level of certainty of observance to objectives impacting its performance and faster delivery of results, than a linear IITS process structure.

8.5.5 Technical Solution #1: cohesive functionality of IITS process

This solution resolves the research hypothesis explanatory construct #2 (Box 4-1). In the scope of component-based concepts, all IITS process PDS will operate in a distributed computing environment, thereby leveraging their integration and offering specifications for cohesive functionality that bring several solutions:

Solution expectation #1-1: process definitions
The scope of distributed computing environment introduces same process definitions already mentioned with regards to the SDS (also see §8.3.4). The new IITS process operational matters, which potentially create split-level sub-processes, require similar principles, such as for document processing, information management and inventory management. Distributed computing has the salient implications for clarity in the representations of the IITS process and to make PDS process easier to define.

Within the scope of individual PDS, process definitions need to be similar to create conditions for using operational information from a common source. In particular, document inventory processes that utilise operational information for numbering and transactions. New modules can be added to the PDS as operational interfaces, thereby enhancing accessibility of processes and information. The interfaces can also be upgraded allowing for split-level sub-processes to be executed effectively, without disrupting content of the PDS. The IS resources applied in the operational interfaces ensure that split-level sub-processes are performed in a uniform manner. Eventually, similar process and interface definitions increase information sharing. They can reduce operational costs, and excess inventory which equates to redundant data (cf. Wild, 2002).

Solution expectation #1-2: sharing of common IS resources and applications
IT applications that fit into the context of the IITS process document processing can be categorised as off-the-shelf packages commonly associated with word or text processing. The variety in documents and their technical content requires more sophisticated applications that can actually offer fit to context. The starting point is to decide which resources and applications provide fit to context of project development

pursuits. Then, integration can provide comprehensive incentives for sharing the choice of resources and application, because they are used widely across all aspects of project development.

This IITS process integrative solution framework has been designed with cohesive sharing issues in mind. The IITS process IT architecture places emphasis on the fact that there may well be different kinds of technologies that need to be integrated. Central to performance enhancement, IS applications can be integrated on appropriate platforms for sharing information. Integration helps with the resolution of diverse needs and multi-dimensional practices across IITS process PDS (cf. Tapscott and Caston, 1993). Key dimensions supporting committee work approaches can be customised. Applications such as GDSS, provide can be integrated effectively for sharing information across PDS. This software offers multi-functional practices relevant to support committee activities: for example, e-collaborative brainstorming, collaborative multimedia documentation, e-meetings, e-collaboration for the review of documents, and group decision-making (Laudon and Laudon, 2000).

8.5.6 Technical Solution #2: IITS process architectures

It has been suggested that implementing IT resources in today's complex organisations without an architecture framework is like constructing a city without plans for rights of ways, utilities and a wide range of other services (cf. Microsoft Solutions Framework, 1998). Bearing in mind diversity in the IITS process problem space issues resolved through this reconstruction exercise (Table 7-12), this integrative solution framework needs architecture considerations. They help to parameterise the new IITS process performance expectations, as follows:

Core technology: Cohesive functionality across the IITS process depends upon a core technology (or technology backbone), such as Internet technology with capabilities to hold all the 'pieces' together (cf. Laudon and Laudon, 2000). As a 'backbone' to this integrative solution framework, core technology helps the definition of architectures. Besides supporting integration, the choice of core technology must provide conditions for resolution of IITS process features and definition of required cohesive functionality hence.

Process and content management architectures: The component-based PDS in this framework will observe specifications of the new IITS process for strategies and performance. It is necessary, therefore, to define architectures for the content management of the IITS process. Content items that need to be transparent and accessible to all users can include: strategic plans to benefit multiple projects; definition and content management of project development life cycles, taxonomies of procedures and, models for information creation and management (cf. *Munkvold et al.* 2003). In addition, process and content management architectures have strategic importance qualities equated from Ould (1997). His approach is of deriving *process architectures* from the essential entities of a business, identifying the units of work which the organisation must handle, to include modelling those processes. The eventual process architecture would harness different sets of structured functions and solutions.

Communication and security architectures: From a macro level, cohesive functionality of the new IITS process rests attention on patterns of operational interactions that an architectural structure can support. From micro level, committee work approaches covering facilitated collaborative actions, communication and workflow are example features requiring integration and definition through communication architecture (cf. Tapscott and Caston, 1993). With proprietary information shared across the IITS process, security practices are paramount to all communication, information transactions and information management. Thus, this communication architecture combines recommended practices for operational unity, principles of distributed computing impacting on committee work approaches and security protocols.

Information and information management architectures: In general, an information architecture is a logical view of the organisation or process. Comprehensive information architectures provide a map of entire work a process is supposed to carry out: such as process models, events, transaction data, state descriptions and management of information (cf. Spewak, 1998). More so, the new IITS process has specifiable information-dependent features integrated in the PDS interfaces, and across the PDS. Three examples that apply to this integrative solution framework are customised information interface, customised operational management interface and results control (see Figure 8-5). These interfaces require distinctive functional rationale of how they interact, and how they provide information access to PDS.

Service architecture: The need for IITS process infrastructure systems to share data across PDS boundaries will increase. Based upon this need, the new IITS process will provide various services to its users and stakeholders. This architecture can assist in restructuring extant critical operations to new technologies with capabilities for service delivery mechanisms. This architecture can bring opportunities that harness different sets of measurable solutions for extant services (Tapscott and Caston, 1993; Spewak, 1998). Typically, document transactions, information gathering from external sources, ballot management, defining service methodologies and establishing a unified approach for computing across IITS process features.

8.6 Operational Capabilities

8.6.1 Content of Capabilities

Operational capability is the term applied to the reconstructed IITS process and its key core concepts of expected functionality. The capabilities hinge on the solutions described in the preceding section to also provide resolution to research hypothesis explanatory construct #3 (Box 4-1):

> Create combinations of functionality and operational capabilities that match IS requirements.

Referring to the result specification framework (Figure 7-1), the expectations of the capabilities are described as **tacit items**, notably: strategies that are achievable in practice within the constraints of the functional [A3] and IS resources [B3].

8.6.2 Information Processing Capability

The new IITS process will have information processing needs from its activities spread across a number of PDS. Categories of information that will be common across all PDS cover strategic, operational, technical, tactical and unstructured data from inputs, announcements and reports. These are empirically determined categories from the five projects examined in the case study. The categories are, however, not explicitly represented in the current environment, nor are the different types of information defined.

Tacit strategy #1: modularised functions

Extant IITS process information processing is high risk. Among the reasons are complexity of operational matters, project task variability, unanticipated events and volumes of information that are co-ordinated in the life span of various projects (see §7.3.6). On the hand, much of the information input to NSBs and SDOs is currently submitted as documents, in specified formats that can be obtained from Internet sites (http://www.iso.org). A typical processing cycle covers intense organising of different documents, selection, cross checking, instruction processing and information management, followed by transactions to various parties. These items are, in fact, indiscriminate and unstructured functions that are also riddled with excessive processing.

In the interpretation of OIPT as a lens, one of the strategies is to reduce the need for information processing (Galbraith, 1973, 1987). As illustrated in the SDS design specification (Appendix 12), the open-layered design proved useful for partitioning operational boundaries with highly modularised processing functions. Open layering is designed for over capacity processing, rather than under capacity. Each operational boundary has partitioned modules that can address explicit representations of modulated functions with varying actions carried out at different levels, for example:

[a] One level would carry out input gathering functions.

[b] Next, would be processing, document management inventories and transactions.

[c] Then, input evaluations follow which can establish required information, its quality, its relevance and control for repeated use.

Against these modularised levels, separate functions produce information, complete actions and results that contribute to on-going events. The actions performed do not necessarily contribute to an overall end result for a function, such as review of documents that committees receive. The completion of a cycle of actions is the important factor that determines the need for processing or to decrease information asymmetries for performing the same functions.

Tacit strategy #2: customisation of modules

The PDS modules can be customised for activity-intense processing and for promoting the value for capturing information needs. Document-processing cycles, for example, require direct links to inventory management and file maintenance. By linking processing cycles to IS resources, each module potentially reduces excessive processing.

Efficient document inventory management is the solution that provides conditions for determining value-adding activities, such as generating consistent document numbers across all PDS. Such value-adding activities can reduce excessive processing cycles and costs through defining consistent inventories. The IS applications applied in each module must include procedures capable of supporting repeated actions (cf. Laudon and Laudon, 2000).

Tacit strategy #3: structured functions

This strategy focuses on universally accepted interpretations of organisational information processing (such as Galbraith, 1977, 1974; Tushman and Nadler, 1978). A fundamental argument is that, unstructured processing functions cause information uncertainty, delivery delays, costly duplications and poor co-ordination.

Open layered component-based process constructs should not ever be complex or unstructured. This is because the partitioning principle that creates operational boundaries helps to **structure highly modulated functions** (see tacit strategy #1). As an characteristic feature of operational capability, structured functions can be created from the fact that each PDS has been designed to operate in modulated way. It is designed to operate within a distributed computing environment leveraging structured features and functional contexts. Any form of structuring of the PDS would be aligned with:

[a] **Simplification strategies applied to information processing:** Kock (1999) suggests that, if activities can be grouped together, their execution could be achieved concurrently using the same resources.

[b] **Developing universality of work practices across PDS:** In particular, methods and procedures for major functions can be established to ensure accuracy of processing and of faster delivery of results. Universality of work practices requires criteria for operational adherence to achieving milestones covering consistency, completeness of processing cycles, reliability of records for inventory (cf. Laudon and Laudon 2000:506). Enhanced capabilities would focus on milestones that have unpredictable processing obligations, such as the co-ordination of task-critical information, with fewer delays.

8.6.3 Operational Capacity

Galbraith's information processing model (1987:100) uses two strategies for increasing the capacity to process information, namely: investment in vertical IT resources and creation of lateral relations. Although these two strategies are important to the PDS, the important factor is the CBD representation of the PDS that helps to address the uniqueness of its commitments. In this regard, a symbolic representation to summarise operational capacity expectations of the PDS as:

> The fit of content of the work programs assigned to the PDS compared to: content of fit of its features; concept of its functional intent; its needs; strategies guiding its work; IS resources and human capabilities, all ensuring a level of certainty to support performance in a constructive way.
>
> (Source: compiled by author)

Tacit strategy #4: lateral operational detail of PDS

This strategy draws attention to the design details of the PDS. As applied in this reconstruction exercise, an open layered CBD offers greater functional representations and better trade-offs among various features, than perhaps a simple component-based design that groups processes to say IS resources. The PDS functional representations, in particular can be supported through more lateral operational detail to reduce the extant IITS environment-IITS process hierarchically controlled relationships.

Lateral forms of operational detail in the PDS are important to committee co-ordination of work, because project development creates multi-dimensional processes. Creative approaches to execute these processes benefit from lateral than hierarchically controlled performance. The lateral approach has implications on micro management of certain situations across contexts and over time. Typical draft standards reviews would be performed in lateral forms of co-ordination of information, together with micro management of information and decision-making processes. In the current IITS process, these lateral operational details are not evident, because of the hierarchical committee structures and embedded contexts.

Tacit strategy #5: functional rationality

Overall, IITS process project development is costly because of the highly technical nature of actions that span other boundaries, such as diversity in subject matters, R & D activity, information evaluation and documentation of results. In terms of operational capacity, highly integrated IS resources provide functional rationality. They can be adapted to project development constructs that may be diverse, highly technical or they may be contextual setting with and have dynamic interplay of practices.

Tacit strategy #6: planning capacity

Planning accounts for actions to ensure the robustness of assertions about set goals and results (cf. Watson, 1993). In the current IITS environment SDOs and NSBs have various levels in which planning is called for, in order to define strategies and operational matters impacting on the IITS process. Component-based PDS introduce macro management. This has the advantage to incorporate planning, ensuring accountability for action and delivery of results, only for its operational matters to be aligned with the new IITS process strategies. Plans for operational scope would establish a complete picture of activities, costs, resources, schedules, risk factors, measurable performance results and value of functions (cf. Holdsworth, 1994; Keen, 1997).

Tacit strategy #7: project development and project management

This tacit strategy reinforces the fact that a component-based PDS has been designed to give special prominence to project development. Each PDS will manage two or more phases of the development of individual projects. If a few phases are assigned to individual PDS, this increases the chances of creating conditions for specialised approaches for committee work. Fewer phases reduce complexity when project development shifts in contexts, over time.

The specialisation of these projects requires a move toward contemporary project management practices to address unique project development imperatives, and ensuring efficiency. Trends described in Figure 2-2 (Literature Dimensions of Project Development) have been singled out for their contribution to widely shared project management practices that apply to the operational scope of the PDS. Moreover, the work of the PMI (1996) emphasises the need for increased focus on project management practices, for example:

[a] Project Integration Management: project plan development, project plan execution, and project change control

[b] Project Quality Management: quality planning, quality assurance and quality control.

[c] Project Communications Management: communications planning, systems planning, information distribution and performance reporting.

[d] Project Time Management: activity definition and duration estimating, schedule development and schedule control.

Tacit strategy #8: evaluation capabilities

Each PDS and its operational boundaries offer evaluation capabilities. The supporting argument to support is that, being rigorous about **planning for capacities** requires understanding of the dynamics of each operational boundary, instead of the PDS in its entirety. The evaluation practices would include information that is gathered from each operational boundary, aligned with on-going performance factors for delivering results. Deeper levels of analysis of cumulative information from each operational boundary help to determine **specific needs** underpinning the operational scope of the PDS, and for sustaining those needs in line with stated its objectives. Information necessary to perform PDS functions would then be matched to established capacity for managing it and for customising solutions: such as, service provision.

8.6.4 Performance Capabilities

Results of the reconstruction of the IITS process offer three tacit strategies that can increase performance capabilities, as follows:

Tacit strategy #9: from self-managing committees to high performance

Empirical reality suggests that IITS committees are self-contained, because they manage almost all the crucial technical aspects of project development. JPEG and MPEG are examples that are acting as ‘self-managing’ committees. However, the IITS environment infrastructure does acknowledge self-managing committees, because they are assigned to secretariats that execute SDO formalities.

All five committees examined in this case study show that, their project development practices resemble product groups or project teams such as those described in Galbraith (1987, 2002); Mankin *et al.* (1996), Metcalfe and Miles (1994) and Mohrman *et al.* (1995). These committees develop product-push projects dealing with specialised issues from IT markets. They have close industry liaisons around the projects and implementation of the intended IIT standards. These liaisons are sources of technical information. With a component-based PDS, however, the focus is on influential factors that can propel performance capability from self-managing committees to high performance. Three factors central to the design results are the following:

[a] **A major way forward is to remove committees from IITS environment structural hierarchy**. Since a component-based PDS is designed for containment, the committee structure becomes part of the design of the PDS. The committee can tailor self-managing principles necessary for high performance. Principles, such as developing team capabilities by providing access to relevant information resources and organising projects around intellectual flows, and not control practices are some of the factors necessary high performance (cf. Mankin *et al.* 1996; Quinn *et al.* 1997).

[b] **A component-based PDS clarifies committee structures to encourage cross-functional or lateral team approaches** (see tacit strategy #4). A number of literatures emphasise lateral approaches that also take into account the need for creating new logic of teams practices (cf. Galbraith, 1973, 1987; Katzenbach and Smith, 1993; Kerzner, 2000; Mohrman *et al.* 1995; Pasmore, 1998). In principle, committees have teams of experts assigned to work on the same project, at the same time simultaneously (see Figure 6-3: Structure of IEEE WG 1074). Toward high performance, containment of a committee structure within a component-based PDS helps to redefine extant lateral team approaches and contexts in which they are embedded. Instead of threatening hierarchical structures, this redefinition comes from IS resources that can help to establish lateral integration. Through IS facilitated collaboration and communication lateral team approaches become permanent, because they will occur constantly.

Tacit strategy #10: high performance practices

This final tacit strategy sums up high performance practices that committees are expected to adopt in a component-based PDS. These are technical ownership alignment and functional alignment.

[1] **Technical ownership:** Each IITS project spans several years that bring many challenges. As committees are professional experts, technical ownership gives them a strong focus to influence the success of individual projects (cf. Mankin *et al.* 1996; Pasmore, 1998; Quinn *et al.* 1997). Access to relevant information and IS resources, for example, create performance capabilities for technical ownership of the projects they develop, methods they use and processes that they design. Technical ownership also drives the culture of accountability for action, performance effectiveness and quality of the results produced all co-located in the operational scope of the PDS.

[2] **Alignment:** As essential attributes of high-performance, a component-based PDS is designed for integration within distributed computing contexts. Consequently, PDS **features, functional intent and practices are aligned with IS resources**. In the SDS design, for example, this alignment gives the best possible representation of committee practices bearing only on the development of draft standards. The practices draw upon two of the four factors mentioned in Quinn *et al.* (1997: 514), namely:

[a] *Locus of intellect*, where deep knowledge of the committee's particular core competencies primarily lies. In the SDS, study and discussion sessions depend upon locus of intellect to facilitate relevant practices for creating information and knowledge. Each committee would create opportunities for developing and managing the cumulative intellect resources of the experts, from which it can define its practices.

[b] L*ocus of customisation*, where intellect is converted to novel solutions. The SDS offers a basis for defining the breadth of the capabilities. In turn, committees can tap into these capabilities to customise solutions for practices closely fitting the uniqueness of project development constructs, such as networked collaboration and product-push.

8.6.5 IS Capability

This concept of *fit* connect parts [5] and [6] demonstrated in the analytic framework (Figure 5-2). This connection is now defined as the capabilities that IS resources can provide to support committee practices. A component-based PDS places strong emphasis on functional *fit* to content and *fit* to form.

First is functional fit to content. In keeping with Doty *et al.* (1993) this is a fit criterion in the design representation of the component-based PDS, its detail of content and functional features. In terms of functionality, *fit to content* is expected to make required performance strategies prominent. Typically, the open layered approach is a crucial concept, whereby it can address IS resources in the operational content of the PDS, instead of across the IITS process. A layered operational content gives differentiated distributed IS contexts that can reduce various contexts of information complexity and uncertainty hence (cf. Galbraith, 1977; Tushman and Nadler, 1978).

The second is fit to form of the context in which each component-based PDS is expected to perform. Capabilities that IS resources harness solutions. Typically, modularised and structured functions (§8.6.2) do not just happen. They need explicit representation of the rationale of IS aspects, ensuring that all possible features are properly controlled and managed (cf. Laudon and Laudon, 2000). Solutions that can be developed through fit to form of the context are several. However, the following four describe the critical points from which SDOs can determine their tacit strategies:

[1] A component-based PDS is capable of optimising the **controllable factors** of committee performance. 'Control' has yet to be achieved in the extant IITS process. In the PDS, control fits into the design rationale through the open layered operational boundaries that also apply the partitioning principle.

[2] In the integrative solution framework (Figure 8-5), distributed computing can draw upon on a core technology to create **differentiated 'fit' of IS resources**. In relationship to a core technology, Intranets and autonomous information repositories accord to differentiated fit of IS resources (cf. Laudon and Laudon, 2000; Nezlek *et al.* 1999). These resources can support committees project tasks with multi-dimensional views, such as information gathering, documentation and decision-making, leading to information management. Moreover, collaboration,

communication and workflow would be distinguishable at all levels in the PDS operational boundaries, and across the PDS.

[3] **High-level integration** in the component-based PDS is representative of fit to form. This is particularly advantageous for defining typologies of clusters of processes in separate operational boundaries. Segregated process functions can then be expected to become more flexible and transparent. Unique contexts in which any specifiable process can be performed can also be supported through conventions of performance.

8.7 Synthesis of Themes

8.7.1 Summary

This section is a synthesis of the results declared in this chapter as new IITS process life cycle framework (§8.2), SDS (§8.3), integrative solution framework (§8.4), specified solution (§8.5) and tacit strategies (§8.6). This synthesis produced themes responding to **thesis question #3:**

> Which fundamental solutions can effectively enhance IITS process performance and leverage successful project development?

This question has two distinctive parts. One, fundamental solutions to effectively enhance IITS process performance. Two, leveraging successful project development. This researcher argues that, themes provide reasonable aspects to differentiate the understanding and explications of the responses to the two parts of this question.

8.7.2 Themes for Enhancement of IITS Process Performance

Themes to answer the first part of question #3 suggest that enhancement of IITS process performance has the following features: prominence of core aspects; fit to purpose and fit to function; and alignment.

Theme #1: core aspects of IITS process

Complexity and uncertainty are not likely to be achieved in IITS processes, because the projects are by nature highly technical, specialised and they depend upon various embedded factors. Applying a component-based design strategy to the IITS process is the foundation to enhancing its performance. Autonomous settings give special prominence to understanding: what the core aspects of the IITS process are; what they represent; how they fit into the spectrum of performance of the IITS process.

Without exception, if IITS process core aspects are not parameterised, anything concerning its performance can not be verified. As a salient implication of enhancing performance, component-based PDS are expected to become the most prominent core aspects. Instead of some generalisation, IITS process performance can be tailored to specifiable features. Individual PDS must be treated with regard to their functions and needs.

Theme #2: fit to purpose and fit to function

A component-based design has a unique representation that accords to fit to purpose and fit to function. In defining the PDS, this representation develops a number of strong arguments about enhancement of IITS process performance, as follows:

[a] Enhanced performance evolves over time. This will be the result of starting with correct functions and fitting the right kinds of solutions to identifiable representations of IITS process performance, which the component-based PDS facilitate. In practice, fit to purpose and fit to function can be expected to capture the reality of performance and enhancement strategies.

[b] Performance also places strong emphasis on the 'fit' of relationships for maintaining the completeness of IITS process. For example, features are connected to functioning, practices and understood requirements (cf. Humphrey, 1989). Integration of appropriate IS resources represents the necessary step toward understanding how SDOs, NSBs and committees can address needs that have not been realised in IITS process performance. IS resources support all possible functional matters and solutions that can be verified in performance, in order to determine fit of requirements. These separate criteria of 'fit' (purpose, IS, functions, solution and requirements) can provide goals towards enhancement.

Theme #3: alignment

This theme is in line with tacit strategy #10 (§8.6.4). Enhanced performance is expected to strengthen strategies that satisfy a specified purpose of the new IITS process. Primarily, these strategies need alignment with interdependent IITS process aspects. For example, individual component-based PDS will have operational objectives aligned with specified IITS process goals to bring continuity and consistency to functions and practices.

The other is alignment of the use of IS and IITS process features (such as PDS, SDO and NSB teams assign to manage the PDS). This alignment facilitates solutions to be integrated, mobilised in the right places and to foster core capabilities that enhance of its IITS process performance hence.

These two forms of alignment (strategy and IS), create conditions for addressing performance needs across the IITS process and emerging operational challenges. Consequently, functional interventionist strategies would be implemented to assess challenges. Appendix 11 illustrates interventionist strategies from a number of scholarly works (such as Ahire and Dreyfus, 2000; Harmon, 2003; Holdsworth, 1994; Holt, 2004; Laudon and Laudon, 2000), and which apply to the IITS process to support its alignment issues. These strategies can be extended to facilitate pro-active action, ensuring that key performance deliverables are met in the scope of objectives, requirements or set metrics.

8.7.3 Themes for Project Development Success

This second part of thesis question #3: leveraging successful IITS project development has three themes. A number of literatures often discuss project success in relationship with project management.. Project management applies approaches to support project development (see tacit strategy #7, §8.6.3). Kerzner (1998:37) makes a point worthy of consideration:

> Successful implementation of project management does not guarantee that individual projects will be a success...Companies that have excellent project management still have a fair share of project failures. Should a company find that 100 percent of its projects are successful, then that company is not taking enough business risks.

Theme #1: 100 percent commitment to implementable solutions

Against this statement, IITS is a multi-project environment. It is a multi-stakeholder environment. The declared results and solutions are foundations for creating success in project development. The best approach for the IITS environment is to make this '100 percent commitment' to implement these results and to exploit the solutions to full advantage. This is also in keeping with Newell and Simon (1972) who suggest that, implementation seeks rational solutions. It tries to justify that the solutions proposed as the optimal solution. As such, implementation will be committed to enhanced IITS process performance, because it comes hand in hand with expressing explicit project development practices. This is the important point for '100 percent commitment.'

Theme #2: integrated solutions

Earlier in this chapter, it has been suggested that component-based PDS fit into the criterion of facilitating *complete solutions* (§8.1.6, [2]). On the other hand, this researcher argues that, successful IITS project development rests attention on *integrated solutions* to focus on those key parameters that PDS are expected to offer. For example, IITS projects bring several assets, such as expertise, information, requirements from IT markets and stakeholders. In this context, integrated solutions increase awareness of the dynamic relationships on key influences of project development (as in its core assets) and of IITS process performance (cf. Quinn *et al.* 1997).

When practice comes into the picture, PDS are expected to clarify the completeness of integrated solutions. **The learning capability** of the IITS environment can only drive change that can leverage successful project development, based upon the completeness of integrated solutions. Moreover, failure to appreciate the dynamics of the relationships between IITS process strategies, PDS operational scope, management of assets and practices can become obstacles that will ultimately have a negative impact upon any solution.

Theme #3: committee approaches

It can be argued that project development can be successful with commitment to approaches that can build upon performance capabilities and logic for sustaining them (see §7.6.4). Component-based PDS will bring commitment to approaches to communities of practice:

[a] Committees already utilise some of the concepts of communities of practice (Brown, 2000; Lesser and Storck, 2001; Wenger *et al.* 2002). For example, they work as teams that endeavour to share expertise, common information and knowledge, and what the IITS process offers to support the delivery of IIT standards. Key to project development success, a PDS increases the potential for

creating communities of practice involving consonance of practices, with expectations of added value, cost-savings and the consistency of results.

[b] Communities of practice have their own identifiable baseline characteristics, as well as, principles that become meaningful in the contexts in which they are applied. Emerging collaborative technologies need to support characteristics such as creation of information and customising solutions, and practice principles. Successful project development would mean these characteristics and principles are introduced synergistically. They draw upon specified standards of performance or capabilities for creative approaches.

[c] Three, challenges for committee approaches are several. Organising information and interactions that influence creativity in project development are some of the challenges. In this regard, the work of Orlikowski (2002) offers an insightful contribution that, for any approach to be defined as creative as such, it needs to demonstrate how it can be actualised in project development constructs. Knowing the 'how to', linked to organising, sense making and practice would contribute to successful project development. The reproduction of the knowing generated in committee practices constitutes knowledgeability (or creativeness of practice), over time and across performance contexts (cf. Orlikowski, 2002: 253).

Theme #4: success criteria

Project development adopts specified success criteria that applies to the individuality of the operational content of each PDS. **Table 8-4** contains example criteria from various scholarly works (such as Archibald 1992, 2003; Clark and Wheelwright, 1997; Kerzner 1998; Mohrman *et al.* 1995). These criteria help to integrate the themes underpinning the results, solutions and tacit strategies described in this chapter.

Table 8-4: Sample success criteria for IITS process performance
(Source: compiled by author from reviewed literatures)

Criteria	Features contributing to success
[1] Cohesiveness in operational framework:	Representation to make IITS process dimensions and core features transparent, to include technology.
[2] Distinctions of PDS:	Operational framework gives some representation of the distinctions of component-based PDS, as a necessary dimension of micro management and commitment to enhanced performance.
[3] Process definition:	Process life cycle and its operational parameters guiding performance to include commitment to reducing the excessive and complex features.
[4] Project planning (transparent and verifiable)	The essence of project planning is determining 'what needs to be created to deliver the project objectives and deliverables items within what constraints of time and IS resources.
[5] Definition of projects and project development strategy	As necessary tools to understand the IITS process strategy, or at least that part of the strategy being facilitated by the project.
[6] Project management	Wider and localised project management needed across PDS, to include intervention methods for process management.
[7] Operational capability:	Requirements framework demonstrates operational capability expectations in IITS process performance through IS parameters
[8] Committee performance:	Methods facilitating people management is needed.
[9] Process measures:	Measurement needs relevant metrics, such as: cost, value, quality of standards and process time cycle

8.8 Recommendations for New IITS Process

8.8.1 The Problem

Overall the results and solutions declared in this chapter support wisdom from a number of scholarly works (such as Conklin and Weil, 1997; Rittel and Webber, 1973; Newel and Simon, 1972; Simon, 1996). That is, 'you don't understand the problem until you have developed a solution that is good enough'. Rittel and Webber (1973) also mention that, while attempting to solve a *wicked problem*, the solution of one of its aspects may reveal or create another, even more complex problem.

Against these views, recommendations for the new IITS process need to be legitimised with a definition of the problem to which the results and solutions declared in this thesis would be referenced. This researcher's preference is the *problematisation* of the solution proposal (Figure 8-4 [A]), whose explanations influence understanding of 'the problem' in relationship with the results declared in this chapter. At the same time, problematisation adequately parameterises the IITS process problem space (Table 7-12).

This problem space clearly confirms the **problem** of the IITS process as its complexity. This is stated in the problem statement that guided the investigation in the first place (§1.1.4). Results of the analytic evaluation of IITS process performance legitimised forms of this complexity as extensive with variety of phenomena (§7.4.3). With this confirmation of evidence, complexity is now formally stated as the problem to which the extant IITS process performance and project development are referenced hence.

8.8.2 Project Development Settings

The recommendations described next draw attention to the resolution of the problem statement (§1.1.4), which redefines complexity of the IITS process as the problem. In addition, thesis argument #2 (§1.5.6) is now the connection to this problem and recommendations focusing on the integrative solution framework (Figure 8-5). In brief, this framework contains five component-based PDS recommended to complete reconstruction of the IITS process. These PDS have the merits of salient, strategic importance and fundamental impact on the delivery of project development (see §7.1.6).

[1] Project Proposal Management (PPM)

In this first recommendation this researcher posits that **the reconstructed IITS process needs a front-end component-based PDS**. The identity of this PDS is **PPM,** with the merit of *strategic importance* and salient implications. Similar trends are followed in product innovation studies (such as Fleischer and Liker, 1997, Smith and Reinertsen, 1998). The concept is that a 'front-end' to a business or organisation process provides effective scanning of inputs creating information that would be aligned with strategies, customer needs and product development.

There is general consensus in standards literatures (such as Chiesa *et al.,* 2002; Jakobs, 2000; Krechmer, 2005; Mähönen, 2000) that SDOs are taking far too long to meet stakeholder requests for developing IIT standards or to deal with today's IT problems. The IITS process has cross cutting matters. Multiple stakeholders, product-push projects

IT markets needs and legislation are some of the diffuse matters requiring well-considered decisions in the early stages of the proposal of many projects.

This researcher strongly encourages special attention to these diffuse matters at the front-end of the IITS process. The PPM as this front-end essentially adds value to establish the building blocks of IITS process performance. Projects, strategies, stakeholder networks and opportunities for potential inputs would be established in the PPM and aligned with project development.

[2] Standards Documentation Setting (SDS)
The second recommendation is the SDS, which has been created and described as a test case component-based PDS. The SDS has *strategic importance* to the production of draft standards and other deliverables (Appendix 12).

[3] Consensus Seeking Setting (CSS)
The third recommendation is the CSS and the merit of *strategic importance*. A major concern under constant discussion in the IITS environment is to implement effective e-ballots. In part, the IEEE Computer Society and ISO JTC 1 utilise e-ballot mechanisms consisting of broad operational matters (http://www.ieee.org/; http://www.iso.org). Going by the empirically determined reality of ballot conventions (Appendix 7D, 7E) creating a consensus-based e-ballot facility is only a resource. Comprehensiveness of how e-ballot technologies currently in place can match, and improve the 'behaviour attributes' of the reality of committee ballot scenarios is yet to be achieved.

Dedicating a CSS to the new IITS process aims to address ballot scenarios with unique to processes, practices and requirements. In order to create custom solutions, this researcher recommends that the CSS be interfaced with operational links to other PDS. Typically, the PPM (projects, stakeholders and strategies), SDS (draft standards) and RCS (results control) need to work in transparent mode with integrated approaches.

The CSS can capture a wide range of interdependent scenarios, such as: inventories of draft standards exchanged for review; comments compilation; technical documents as inputs for reference and ballot workflow. At the same time, the CSS can be expected to deal dynamic collaborative exchanges with real time access to information required for reference in draft standards ballots.

[4] Implementation Setting
This fourth recommendation has *strategic importance* and *salient implications* to support various draft standards and IIT standards. With calls for implementation of standards within the scope of the IITS process (cf. Jakobs, 2002). Overall, this PDS has three important facets: IITS process-external relationships, specialised contexts and assets.
One, this PDS gives special prominence to the need to create an interface of the **relationships** between the IITS process efforts with its external elements. **In the IITS process,** implementation cases will provide a basis for determining requirements that should be included in, or excluded from draft standards in progress and IIT standard. Results from the implementation of a draft standard would assist committees in technical

decision-making, requirements integration and ballot reviews. For external elements the implementation of a published IIT standard in the IT market will bring critical requirements for revision and maintenance.

Two, IITS process projects have **specialised contexts for determining the dependability of the IIT standard.** It is increasingly important for implementation to be transparent in IITS process to develop criteria by which physical, technical qualities of products, processes and service can be assessed. Implementation aspects involving testing and certification already exist as 'business operations' in the scope of the IITS environment (http://www.iso.org; http://ieee.org/)..

The links between these aspects and actual implementation processes for developing criteria, such as compliance or compatibility related to tangible products still needs attention. This PDS therefore has capabilities to create conditions for assessing specialised implementation issues, for developing measurable criteria (such as compatibility and compliance) and for producing well-defined procedures.

Three, implementation processes in this PDS are expected to bring **fundamental assets** bearing on IITS process performance. Typically, implementations that take place are key sources for creating of technical information, knowledge and best practices for project development. Co-operating parties that are likely to perform in the Implementation Setting cover approved Certification and Testing Bodies; Specialised Societies; R & D environments; and Registration Authorities and User Groups. Exclusively, this co-operation is an asset that can improve IITS process performance, because it will bring the best available investments, methods, technology and a wide variety of real-world elements upon which project development depends.

[5] Results Control Setting (RCS)

This fifth recommended PDS has the merits of *strategic importance and fundamental impact*. Individual PDS have a function that control and evaluates performance results. Nevertheless, diversity in IITS process technical and operational matters now demands categorisation of the different types of results produced and their qualities. This RCS is strongly recommended as 'central point' for translating results evaluated from each PDS for decision-making. It will manage consolidated results that can help to develop approaches, plans and strategies for enhancing IITS process performance. It will include specifications of how IITS process results can be managed and exchanged. Project productivity variances; performance measurement programs and success factors for projects will apply.

8.8.3 Recommendations for Operational Roles

Component-based PDS are expected to enhance the IITS process' capability to perform effectively. Success in project development is part of enhanced capability. These two aspects rest attention on operational roles that can focus on creating required capabilities. With the growing importance of **leadership capacity** to drive change rapidly and to implement effective solutions, each component-based PDS addresses key roles. **Figure 8-6** gives some recommended roles responding to the synthesis question:

Who is going to be involved in managing the PDS?

This diagram also takes insightful roles from a number of literatures that are covering project teams and product development (Cleland, 1996; Galbraith, 1994; Mankin *et al.* 1996; Mohrman *et al.* 1995); organisation process issues (Pettigrew, 1997; Galbraith, 2002, 2005) and networked enterprises (Laudon and Laudon, 2000). Since a PDS is an autonomous unit of the new IITS process, these roles become an 'integrated package' of each PDS.

The scope of 'integrated roles' covers: recognition, understanding and accountability for addressing needs, cross cutting concerns and creating solutions. Another strong recommendation is for these roles described in this diagram to be distributed mostly, among SDOs, NSBs and committees as key users of the PDS. The links between the roles is a lateral approach allowing better co-ordination and liaisons.

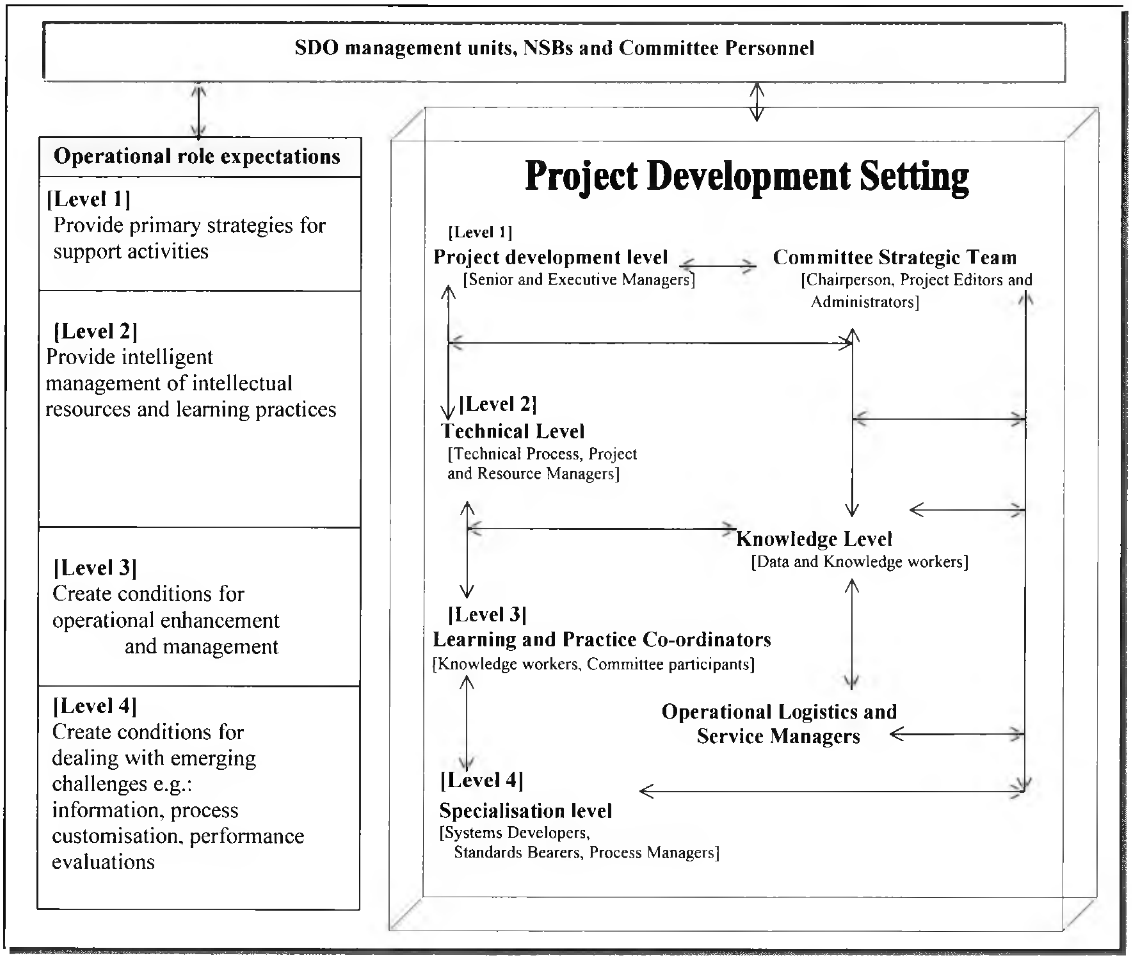


Figure 8-6: Project Development Settings Operational Roles
(Source: compiled by author)

8.9 Chapter Summation

This penultimate chapter has established prominent results and solutions to resolve the complexity of the IITS process. Explicit results, solutions, solution expectations and tacit strategies have been presented through an interpretative synthesis approach, which adds depth to look for the qualities of their meanings in the context of the IITS process. Next, the final chapter discusses some of the distinctive contributions of this research, together with key conclusions.

Chapter 9

Research Discussions and Conclusions

9.0 Scope of Discussions and Conclusions

The focal subject matter in this final chapter is conclusions fitting the research purpose, body of knowledge and its results. A discussion on four key areas yields the conclusions, as follows:
One, research philosophy addressing influential criteria by which to discuss conclusive items (§9.1). Two, reflexivity of the research effort helps to reasons relevant conclusions (§9.2). Three, in-depth conclusions are discussed on content of the study covering declared results (§9.3), research methodology (§9.4), contributions to the body of knowledge of the research (§9.5) and set goals (§9.6). Four, a framework is defined, which provides insightful consolidation of the research effort through themes linking the thesis arguments, research goals and conclusions (§9.7). The chapter ends with an agenda for future research (§9.7), and a summary of the overall thesis.

9.1 Reflexivity of Research Philosophy

9.1.1 Criteria of Judgement

In the IS community 'calls' have been made for evidence of critical awareness that the underlying assumptions (Garcia and Quek, 1997: 445-446) or questioning philosophy underpinning the methods (Galliers, 1997:142). This researcher applied a 'philosophy' outlined as the way in which the research process is executed (Chapter 3, §3.1.3). This includes the instruments of the research methodology developed and applied in examining the core subject matters, a solution proposal and case study questions, toward set goals. This is one version showing that there are many ways in which research philosophy or its variants can be defined to suit one's research purpose. Since philosophy has epistemological assumptions underpinning the research process, it must also be questioned in order to link it to the conclusions.

In this evaluation, reflexivity on the philosophical aspects of the executed research process is the approach taken to determine conclusions that also establish its efficacy. One explanation for reflecting on philosophy is that research evidence and declared results are judged as acceptable when the research reinforces extant 'values' in its field of reference. If not more so, the qualities of the declared results need judgement of validity of their acceptability, meaning and relevance, based upon philosophical aspects or epistemological assumptions underpinning the research process. This means, the philosophy of the research process and its efficacy can then, be explained explicitly as a coherent whole of the research effort (cf. Walsham, 1995).

Relevant criteria for judgement of this research process fits into 'truth value' perspective described by Lincoln and Guba (1985: 290), where by efficacy serves to:

[1] Demonstrate *credibility* that the research effort. For example, how the research has been executed in a way that ensures that its subject matters refer to identifiable phenomenon of interest in its field and are operationalised with reasonable accuracy.

[2] Legitimatise the researcher's understanding of the *epistemological justifications* associated with the conduct of the research with regard to its results.

[3] Demonstrate *transferability* of the research results and their implications for practice.

[4] These three criteria (credibility, epistemological justifications and transferability) have important themes underpinning the recognition of what is learned about the *contributions* of the research. Contributions rest attention on the *meaning* of the research results, such as how they can be applied in the general body of knowledge in the field.

It needs to be stressed that this research process has *philosophical attributes*. Results that are declared would also hold *value-laden meanings* and epistemological justifications forming the basis of the *conclusions.* Without a philosophical perceptive to the evaluation of the research process, efficacy as in goal accomplishment and validity of the knowledge (results, contributions or implications for practice) lacks epistemological support. To apply these criteria, therefore, this chapter starts with a one question that remains to be adequately answered in search of those value-laden meanings:

> How is IITS and IS linked in this research effort, so as to demonstrate credibility, epistemological justifications for grounding the validity of the knowledge and formulation of conclusions?

9.1.2 Linking IS and IITS

This is the first part of the question above. In response, defining this link between IITS and IS has an important aim of the *credibility* of this research. This is described in terms of its originality and legitimacy by relevance.

The development of IIT standards is a specialist subject domain in its own right. In recent years, however, academic research on IITS has found a 'home' within the IS community. Research efforts in both IITS and IS have co-evolving matters. For example, both areas address organisational problems and technological issues across scholarly subject diversity (cf. Benbasat and Weber, 1996; Benbasat and Zmud, 1999).

In defining the research goals, primarily their plausibility draws upon a critical literature review about IT standardisation, such as economics and ICT (see §2.3, §2.4). The focus has been on both theoretical and empirical scholarly works that would make contributions to understanding not only the purpose of this research, but also stimulating ideas from looking into the empirical reality of IT standardisation (Chapter 4). The reviewed standards literatures suggested an interdisciplinary model to this research effort that is attributable to the dynamic nature of IT standardisation and central aims of the IS community.

Across a number of studies thus far, there are no identifiable methods for IITS research. By virtue of the link of the research goals (§1.4.1) and core subject matters (§2.2) to the IS community, their combined elements easily become criteria upon which to choose relevant methods. On the other hand, IITS as a subject area is particularly complex with a wealth of challenges that have barely received empirical attention. Any method chosen by reference to research goals or by defined subject matters can also easily threaten the breath and depth of the research effort, and quality of the results. As a principal part of the credibility of this research effort, it has created its own individual link between 'IITS and IS' that could lead to other synergies in future research. Justifications of this link draw upon two insightful themes from this research:

Theme #1: Intellectual pluralism
Although closely connected to the IS community, the area of IITS is still in its infancy. Reference to the IS community, in particular the use of research methods in this research effort is an important one which creates this link through intellectual pluralism (see §8.1.4).

Theme #2: Scholarly attention
Scholarly attention increase the chances of arriving at defensible conclusions of the research. Typically, the combined use of IS research methods and theory lens proposal strongly encouraged consistency in the empirical case study. A major result confirming this consistency is the empirical definition of the IITS process. Drawing upon the empirical evidence, an integrated analytic framework (Figure 5-2) was then designed to add explanatory legitimacy of the analysis and reconstruction of the IITS process, toward problem-solving (cf. Newel and Simon, 1972).

It can be concluded, therefore, this researcher's attention to produce a strong set of empirical evidence (see §5.1.1) and the use of a CBD framework as an incisive problem-solving method adds allegiance to scholarly attention. This scholarly attention imparts on the declared research results. This is because they make positive contributions for translation in the IS community in which this research would be referenced, to include the IITS environment in which they will be implemented for practice.

9.1.3 Originality of the Research

The second part of the philosophy question (§9.1.1) is originality of this research. This research has been carried out with the City University of London, where this thesis is also examined. Academic standards in research studies for the City University of London indicate the axis of doctoral studies as, pursuing original research in the field (City University, 2006/7:21).

In response to the second part of the philosophy question, the originality of this research effort is based upon the **epistemological justification** of the novelty of the claims made in this thesis. Criteria by which to characterise originality have been adapted from four sources that share similar guidelines to the followed in this research. These are: Benbasat and Zmud (1999: 14) 'recommendations to attain relevance' in research publication in IS journals; Gregor (2002, 2006) 'the nature of theory in information systems'; Hammersley (1992:64) 'criteria for theory development in qualitative research' and Newel and Simon (1972) human problem solving.

The justifications involve subject matters, phenomena of interest, reconstruction of IITS process and relevance of the results.

Subject matters: This research is different from others in the standards scholarly literatures, because it has, as its focal subject matters IITS project development and IITS process performance. While there are a number of consortia standards studies about IT standardisation (see §2.3.9), there is a distinctive lack of studies on the IITS process. As a breakthrough, this research is an original work that provides an integrative comprehensive empirical study of the IITS project development, analysis and reconstruction of the IITS process. For these subject matters, originality rests on the fact this research will make the IITS process known to the scholarly public through the IS community.

Phenomenon of interest: The complexity of IITS process has been examined as the phenomenon of interest (§1.1.4). The research effort focused on two domain questions posed in line with Gregor (2006:611):

What phenomena are of interest in the discipline?
What are the core problems or topics of interest?

Within the IS body of knowledge, this research is one of the few to address; if not more so, to unravel IITS process complexity through the OIPT as a lens. It is in this regard that the originality of this research impresses, by addressing timely, enduring criticisms of IITS process complexity and 'calls' for solutions (see §1.3). It has defined the contexts and impacts evolving from this complexity (Chapters 6, 7), leading to results that have both empirical significance and implications for practice (Chapter 8).

Reconstruction: This research has responded by reconstructing the IITS process within a CBD framework and to produce results surpassing the solution proposal that has been applied for guidance (cf. Hammersley, 1992). This CBD framework has well-established concepts in the areas of software development (Szyperski, 1998; 2000) and architecture development (Malan and Bredemeyer, 2002). This researcher has clearly demonstrated that these CBD concepts are extendable to the reconstruction of the IITS process, leading to explicit results fitting IITS project development. Two of the explicit results are the SDS presented as a component-based PDS (Appendix 12) and an integrative solution framework providing resolution of the reconstructed IITS process (Figure 8-5).

Relevance of the results: Claims of the novelty of these research results rest upon the fact that, they have been developed to deal with real world concerns of the performance of a real process. Emphasis on real issues is a distinguishing feature of the originality of the results that they have salient implications to influence practice (Benbasat and Zmud, 1999: 14). Instead of mere significant findings, the declared results are supported by design specifications demonstrating *how to* solve the problem of the complexity of the IITS process. As such, these results are expected to make a positive contribution to the improvement of the IITS process.

9.1.4 Legitimacy by Relevance

In this research process, philosophy also incorporates a belief about the way in which **knowledge** about a phenomenon is assembled, analysed, evaluated and utilised. In part, the process of knowledge production allows for the epistemological assumptions encouraging clarity of the research purpose. Relevance emerges by focusing on the research purpose and, without being subsumed in the instruments and methods applied in the research process.

In keeping with Keen (1991: 27-28) relevance implies a clear conception of the target scholarly audiences that the researcher wishes to influence. It is based upon the treatment of the research and implications of its outcomes. *Legitimacy by relevance* is the conclusion that gives an identity of where this research and its results fit. In philosophical evaluations, therefore, three perspectives make important distinctions for defining legitimacy by relevance of this research and its results.

The first perspective revisits convergence on content (Markus, 1997) and trans-disciplinary (Galliers, 2003) that guided the treatment of the research effort (§2.2.3). Emphasis has been placed on the IS community for scholarship attention to include the intended reference discipline of the research effort; choice of methods and theory lens, and criteria for achieving synergistic outcomes.
By examining the IITS process, however, this research effort is also embedded in the standards body of literature. This is to bear in mind that the subject matters examined have created a link between IS and IITS which are separate areas (§8.1.2). Legitimacy by relevance has been established by crossing disciplinary boundaries hence. This has helped to develop greater analytic rigour of the knowledge production. More so, understanding disciplinary boundaries encouraged clarity of epistemological assumptions underpinning the research process to develop relevant thesis core subject matters (§2.2).

The second perspective is that this research clearly crosses a number of methodological boundaries. Prominent examples of this are describing the IITS process through the *analytical lens of OIPT;* utilising *a CBD framework* to reconstruct it and design of solutions. In seeking depth, the trans-disciplinary approach can give rise to rigidly defined research boundaries, because of pre-determined bias of several disciplines.

Garcia and Quek (1997: 445-446) raise this bias by arguing that the relative immaturity of the IS field has lead to borrowing a number of theoretical approaches and methods from other subject areas, often with little regard for the associated baggage of underlying assumptions. This researcher argues that, where there is convergence on content, *cross-fertilisation* of methodological mechanisms and knowledge production of a qualitative research process will adopt these pre-determined biases regardless of any reasoning.

Without this *cross-fertilisation*, the result is inconsistency from the need to integrate disciplines, methods, theoretical base and themes. The research results are also exposed to multiple accountability to the different methods and subject matters examined. There is a need therefore to develop a basis from which to challenge inconsistency and the dominant position of the research process. Other scholarly work that present similar discussions have also reached these conclusions. For example, theory-practice (Bhaskar, 2002), philosophical and methodological paradigmatic knowledge (Khazanchi and Munkvold, 2002, Weber, 2003).

The third perspective is gives greater attention to context of *cross-fertilising* methodological mechanisms. The definitions in the SUPRA network report (1999) make a stronger explication compared to debates on convergence on content (Markus, 1997) and trans-disciplinary (Galliers, 2003):

> [1] *Multidisciplinary research* approaches an issue from the perspectives of a range of disciplines, but each discipline works in a self-contained manner with little cross-fertilisation among disciplines, or synergy in the outcomes. ...Thus, multi-disciplinary research involves low levels of collaboration, does not challenge the structure or functioning of academic communities and does not require any changes in the worldviews of the researchers themselves.
>
> [2] *Interdisciplinary research* similarly approaches an issue from a range of disciplinary perspectives but in this case the contributions of the various disciplines are integrated to provide a holistic or systemic outcome. The processes designed to achieve this are dependent on the type of interdisciplinary model and the purpose for which it is being undertaken.

Against these three perspectives, an interdisciplinary approach worked best for this research, because of its embeddedness in standards body of knowledge together with scholarly requirements of the IS community. Reflecting on the research effort and quality of the results (their credibility, novelty claims and implications for practice), a conclusive position of legitimacy by relevance has been adopted from Keen's (1991: 38-39) argument for 'standards of research in a community':

> This research effort has legitimacy of relevance to the IS community through an interdisciplinary approach that applies intellectual pluralism focused on: a target community (and audience), and appropriate proactive action to find solutions for challenging real world problems. It is based upon appropriate fit of methods as a measure of effectiveness in research action and of the outcome. It is driven by an identity of theme bearing on the research goals, intellectual questions and practical importance of the results.

9.2 Organising Research Results

9.2.1 Reflexivity of the Research Effort

Reflexivity is the researcher's preference to organise results for discussion, and to hone in fitting epistemological justifications leading to conclusions. According to Schwandt (2001: 224) reflexivity is used in a methodological sense to refer to the process of critical self-reflection on one's biases, theoretical predisposition, preferences, and so forth. Flick (1998:6) also applies reflexivity to reflect on researcher's actions and observations in fieldwork. In this regard, the reflections become data in their own right forming part of the interpretations that are documented in research dairies for establishing validity of accounts of social phenomenon.

This reflexivity takes a methodological approach to account for research actions in line with three set goals described in Figure 1-3. The five operational objectives complementing these goals have been adequately dealt with in the empirical case study. As such, they are not included in this reflexivity approach. By focusing only on the research goals, this approach emphasises clearly the importance to enhance knowledge to demonstrates the researcher's accountabilities for:

[1] Declared results, in terms of their contributions and implication for practice.
[2] Contributions of the research and results to relevant body of knowledge.
[3] Successful attainment of set goals.
[4] Conclusions of the research.

9.2.2 Reflexivity of the Research Process and Goals

Three research goals (Figure 1-3) guided the research process in shaping its actions and conditions underpinning the empirical study. In this reflexivity only the key phrases of these goals are used to draw conclusions on the results that can be declared:

Goal #1: Understanding the IITS environment.
Goal #2: Empirical study of project development connected to the analytical evaluation of the IITS process.
Goal #3: Solution proposal framework.

In goal #1, the IITS process has been shown to rely on in the IITS environment that has impacts upon inputs, project development, strategies, stakeholders, IT markets and society at large. In arguing for successful project development (§1.5.6) a central aspect of this goal has been the depth in understanding the IITS process within the scope of its infrastructure (cf. Pettigrew, 1997; Yammarino and Dansereau, 2004). This is because the dynamic interplay of project development could not be understood independently, from the contexts in which they are embedded. The research results are expected to impact not only the IITS process. However, the IITS environment is an 'infrastructure'. It depends upon IITS process results bearing on IT markets expectations and legislation matters that need fulfilled directly or indirectly.

Depth in understanding the relationship between the IITS environment and IITS project development has been adequately supported with an empirical study of two forums and five NSBs (Chapter 4). This empirical evidence has been included in the analytic evaluation of the IITS process (Chapters 6, 7). The resulting clarification involves the link between challenges and critical issues of the IITS process to the IITS infrastructure (Chapter 7). By this link, solution options likely to lead to successful project development have been incorporated in the reconstruction actions (Chapters 7, 8).

Goals #2 and #3 have a strong connection through the component-based solution proposal framework (Figure 3-4). **In goal #2,** complexity of IITS process has been analytically established from empirical evidence and from the same phenomena. This approach strengthens the theoretical focus to connect IITS project development to IITS process performance challenges and critical issues. These elements can be summed up as a *problem space* (cf. Newell and Simon 1972; Simon, 1996). This component-based solution proposal framework then enhances the extent to which assessed solutions can resolve these elements of the *problem space* with regard to the component-based solution proposal framework.

Concomitantly, **goal #3** influences problem solving. Its underpinning theme is *problem relevance* (Hevner *et al.* 2002; Newell and Simon 1972; Simon, 1996). That is, to develop a component-based PDS can only be a solution that has practical relevance to deal with IITS process problems associated with its complexity. Again, this component-based solution proposal framework has developed stronger theoretical focus to analytically challenge *problem solving* within the scope of *problem relevance* where there are separate aspects entwined in the *problem space.* These elements of problem solving develop themes underpinning the declared results, and whose explanations address special issues of the reconstructed IITS process (see §8.7.3).

9.2.3 Reflexivity of Thesis Goals

This reflexivity is similar to that of the research goals. The thesis goals (§1.1.6) dealt with the analyses of an empirically defined IITS process, its complexity as the phenomena of interest and reconstruction actions. Only the key phrases of the thesis goals are used here for ease of reference:

Goal #1: - Reconstruction the IITS process;
- Component-based project development setting.

Goal #2: - Integrative solution framework (as a resolution of the reconstructed IITS process and solution proposal framework).

In keeping with Vickery and Vickery (1992), the analytic evaluation of the IITS process performance (Figure 5-2) produced new knowledge to explicate the reconstruction actions. The combined operationalisation of the research hypothesis and reconstruction of the IITS process, in particular, offered greater analytic rigour to devise a problem frame and a methodological solution task (cf. Jackson, 1994).

Without such an integrated operationalisation approach, separate tests would be required for the individual research hypothesis statements (Box 4-1), and for theorising the reconstruction actions. This integrated operationalisation approach embraces the effectiveness of the synthesis of results (Chapter 8), because there is solution task which is the focus. Thus, synthesis of results evolves naturally within the context of this operationalisation approach. Knowable elements are specified and integrated in the patterns underpinning the reconstruction actions (*the how*). These elements also address *why* certain solution options, and not others make an impact on IITS process complexity with regard to the research hypothesis statements (Chapter 8).

9.2.4 Contextualisation

These separate reflections need a point of convergence between: research process, its goals and thesis goals. Contextualisation ensures that the underpinning trade-offs between the goals are bought to balance, to exclude biases or inequalities from the research results. It needs to be mentioned here that, in the principle for conducting and evaluating interpretive field studies to which this research makes reference, Klein and Myers (1999) use the principle of contextualisation (see Table 1-1: Research methodology perspectives).

This principle requires critical reflection of the research setting (social and historical backgrounds), so that the intended audience can see how the current situation under investigation emerged. The main difference in the type of contextualisation applied in this reflexivity of set goals. A relevant adaptation is from Nowotny *et al.* (2001: 253), as follows:

> This contextualisation means that the knowable and unknowable elements of the results and context of their application (planned or knowable) have been embraced through the integrative themes of research and thesis goals.

9.2.5 Integrative Themes

In light of this definition, this goal reflexivity seeks identifiable trade-offs that provide *knowable elements* to organise the research results. These trade-offs have been organised as **integrative themes** providing depth in the explanations from which to draw relevant conclusions about the results declared. Four themes are presented:

Theme #1: Content of declared results
Design specification is the central theme of the content of the results declared from the reconstruction of the IITS process. In keeping with Dorfman and Thayer (1990), and Starkey (1992), a design specification would be regarded as a product that gives concepts of 'what problem the design is expected to solve.' Furthermore, such as specification is expected to be a valuable tool to guide implementation, as well as, to develop practices in the environment in which design is intended.

Theme #2: Context of use of declared results
Context in which the results will be implemented has been developed through the empirical study of the five projects. The empirical evidence linked the analysis and reconstruction of the IITS process to the IITS environment as an infrastructure, thereby providing explanation of the outcomes (cf. Pettigrew,1997: 340). The context of use of declared results clearly indicates that the reconstructed IITS process will have an impact of the IITS environment as an infrastructure. The declared results must not be treated as though they will exist or will be implemented in a vacuum hence.

Theme #3: Decision criteria

The interpretations of the declared results draw upon four decision criteria applied throughout the research effort: salience, strategic importance, fundamental impact and potential value (see §7.1.4). These criteria also frame the different contexts to understand the uniqueness of the results and imperative solutions, as supported in the result specification framework (Figure 8-1).

Theme #4: Implications for practice

Implications take into account the consequential implementations of declared results. They embrace the knowable and unpredictable consequences present in the knowledge about the results (cf. Nowotny *et al.* 2001: 253).

9.3 Conclusions on Research Results

Reconstruction of the extant IITS process within a CBD framework produced two main categories of findings, namely functional and technical-IS resource (see Figure 8-1). Further delineation of these two categories yielded specifications involving explicit, functional solutions and tacit described in some detail in Chapter 8. The discussions that follow next centre on the four integrative themes for the declaration of research results and their implications for practice.

9.3.1 Content of Declared Results

In view of theme #1, the three prominent design results are declared. They have been placed in **Category 1** of the result specification framework: **explicit results** that are also non-negotiable. These results are expected to contribute to the enhancement of the reconstructed IITS process performance toward successful project development. The results are:

[1] Specification of the life-cycle framework of the new IITS process (see §8.2.2).

[2] The SDS design specification (see §8.3, Appendix 12).

[3] Integrative solution framework of reconstructed IITS process (see §8.4).

9.3.2 Discussion of *new IITS process life cycle framework*

This framework in Figure 8-3 is as a design feature demonstrating the new IITS process life cycle. Epistemological justification for this result draws upon two of the case study projects JPEG-1 and MPEG-1, local area networks (LAN) and current IITS guidelines.

One, the standards that evolved from JPEG-1 and MPEG-1 projects have been shown to be excellent examples of how IIT standards can guide the emergence of new technologies, to include tangible products and services (cf. David, 1995; Hawkins, 1995). As mentioned in the case descriptions (§4.1), the standards and technologies derived from them, produced highly commercial competitive multimedia market segments (cf. Lesk, 1997; Taubman and Marcellin, 2002).

Two, other examples from standards studies are local area networks, UNIX and, Internet and World Wide Web. In these studies, Hurd and Isaak conclude that standards can expand markets with an overall impact that can be measured in billions of dollars over an extended period of time (Hurd and Isaak, 2005: 68-69).

Three, this researcher's empirical evidence agrees with findings from Jakobs (2000:33) that, all SDOs have well defined rules in place to guide committees from deliverable to deliverable (see http://www.iso.org). However, very little is available in terms of guidelines for the management of the actual work in the committees.

Theme #2, context of use argument: JPEG-1, MPEG-1 and LAN standards are example cases that implore an explicit requirement for the effective performance of the IITS process. If project development is to be meaningful and successful in terms of effective performance, the priority is to facilitate this with a definition of the IITS process life cycle. If not for presenting the focus or purpose IITS process then, guiding unique project development elements. As suggested in Holdsworth (1994) and Holt (2005), without a life cycle that indicates 'what is going on', the manipulation of a process can be a very difficult. If the process is not captured accurately and effectively, it will be impossible to reproduce the results of a process.

Theme #3, decision criteria: This life-cycle framework has strategic importance in the IITS environment towards successful project development. Strategic importance also takes into account the operational value that the IITS environment will gain from defining the approaches that can be carried out in the new IITS process based upon this life cycle.

Theme #4, implications of practice: In the IITS body of literatures are competing *de facto* standards process models such as those described in Table 2-3: Literature classifications of IT standards. This life cycle has been empirically determined to guide 'what take place in the IITS process', and not to invalidate other models of standards development. By designing the life cycle as a framework, committees can flexibly determine the way in which they can design their activities through a well-defined IITS process. SDOs can effectively use this framework to organise and manage IITS process pursuits.

This life-cycle framework does not contain management specifics for SDOs. It will be usable as a learning tool, because it needs trial cases to leverage its underpinning concepts in project development and IITS process performance. Information obtained from the trial cases will form the basis for creating a concise IITS process life cycle that can incorporate up-to-date strategies, responsibilities or performance approaches impacting on project development. Legitimate performance metrics (such as for cost, time and quality of results) can be implemented alongside this framework, to include other specified procedures.

9.3.3 Discussion of *SDS design specification*

Creating autonomous component-based PDS is an explicit result of the reconstruction of the IITS process. The design of the SDS as a test case (Appendix 12) has been based upon the strategic importance of development of draft standards through which committees address core standardisation issues. In declaring the SDS as an explicit result, the decision impact of its strategic importance to the IITS environment is still valid.

Theme #1, content of declared result: The SDS will have salient implications already described in detail (see §8.3.5). In particular, the design specification provides an excellent framework to introduce a component-based PDS that can effectively contain the development of IITS process deliverable items.

Theme #2, context of use: The SDS provides fuller understanding and management of its critical issues. Especially, its objectives, activities, information, performance, requirements and resources. SDOs, NSBs and committees will need to agree on the assignment of the positioning of the SDS, and relevant functional responsibilities for its management. Positioning is important in terms of focusing SDS performance priorities that can be fully developed. A NSB, for example, will have a standing chance to manage the SDS based upon **core competence**, as in skills and roles that are unique to develop the scope of the SDS, and its practices.

Indeed, NSBs or SDOs may have advantageous competence that does not rest on just managing the SDS. Among some of the advantages that need to be evaluated separately are:

[a] Drive to take on **leadership capacity** and facilitation of commitment to drive change (cf. Hamel and Prahalad, 1996).

[b] **Experience** in IITS strongly supports management practice that helps to harness solutions effectively (cf. Katzenbach, 1998; Quinn *et al.* 1997).

[c] **Relevant technology trends** go hand in hand with a **flexible infrastructure** (cf. Hamel and Prahalad, 1996; Sauer and Willcocks, 2004). In particular, the reconstructed ITTS process needs to go beyond any current IITS technology trends

[d] **Investment programs** that NSBs are already engaged in. Consistency in investment programs permits innovations to grasp opportunities that the SDS will bring.

[e] **Location of the SDS** needs an environment that recognises the importance of effective committee work and capabilities for project development.

9.2.4 Discussion of *integrative solution framework*

This integrative solution framework qualifies as research result, because it is the representation of the resolution of the reconstructed IITS process (Figure 8-5).

Theme #1, content of declared result: Characterisation of this framework and its intended operational infrastructure are described in great detail (§8.4.5).

Theme #2: context of use: The framework is assigned decision criterion of fundamental impact in the IITS environment. This decision illuminates two advantages, which are template for reference, essential unity and solution framework views described next:

[1] Template for reference has two distinctive purposes:

One, as presented in this thesis, this integrative solution framework is theoretical. It must in logic be a template of reference, because it has yet to be implemented. As a template, therefore, its key strength is to magnify the **unique qualities** of component-based PDS that can be expected to give special prominence to IITS process core aspects

(§7.4.4). Recommendations for other component-based PDS to complete the reconstruction of the IITS process are described in §8.8.2.

Two, as a template of reference this integrative solution framework is translated in the **'internal environment context'** (cf. Hackney *et al.* 2006). Through this framework IITS process performance and project development have been placed in the same frame of reference to deal with 'internal environment context' issues, for example:

[a] It will help to resolve IITS process critical issues (§7.4.5), because it addresses solutions for project development.

[b] The internal environment context actualises strategies. However, IITS process transformation imperatives covering inputs, committee actions, practices and stakeholder demands constantly add pressure on IITS environment strategies guiding IITS process performance. This integrative solution framework therefore prepares the foundation connecting IITS process performance to be matched to the IITS environment strategic focus for project development. This connection magnifies those solution opportunities that the PDS will bring to the IITS process for understanding and addressing relevant strategies.

[c] This framework has sound IS-enabled approaches that can harness performance capabilities and manage requirements to deal with operational challenges. IITS environment strategies guiding the IITS process would then provide indicators of achieving effective performance: for example, cost-effectiveness and timely delivery of standards.

[2] This integrative solution framework represents essential unity:
What the IITS process can derive from this integrative solution framework is essential unity of bearing on both functional and IS perspectives. In the functional perspective, component-based PDS have autonomous operational scope for dealing with broad and specific aspects that bring continuity to core functions or work assigned to the IITS process.

In the IS perspective, there is essential unity cross the IITS process. End-to-end IT enabled integration is the basis for this essential unity. It makes the necessary trade-offs between individual PDS, IS resources and architectures to magnify solutions for dealing with complex issues of IITS process performance (cf. Adler, 1995; Hofmeister *et al.* 2001). This essential unity also takes into account strategic attention, workable practices, as well as, future scenarios that have the promise to make project development successful. It opens opportunities for reuse and that can be exploited to advantage across the IITS process.

[3] Different sets of views guide the definition of integrated solution framework.
Views such as structural, functional, management and IS suggest that, the context of application in this framework is much wider (see Table 8-3: Parameters and views of integrated solution framework). Beside containment of the definition of various features, these views impress upon capacity of operational scope of component based PDS; integration; lateral forms of committee actions and micro management.

As the IS infrastructure and architectures develop through implementation, some of the views presented in this framework can be customised to rationalise IITS process performance challenges. Essential unity described above, could be achieved most appropriately to encourage clarity of emergent context affecting IITS process practices. Therefore, this integrative solution framework will be eventful to articulate any other emergent views to match IITS process contexts exclusively (cf. Hackney *et al.* 2006).

9.3.5 Implications of Practice: *IITS process and project development*

Drawing upon the SDS and integrative solution framework this summary focuses on implications for practice that have strategic importance. This researcher's attention is on the EU Commission Report on 'Collaboration@Work' (2004) which highlights a vision that is central to the theme of utilising a CBD approach in the IITS process. In brief, this report suggests a key objective to effectively leverage the competencies of people working together, in next-generation working environments. The report further indicates that such working environments are expected to create collective intelligence needs to be matched with the IS tools that can also deliver added value to workers, managers and networked work processes.

In fact, this researcher read this report after reconstructing the IITS process within a CBD framework. The design results involving the SDS and integrative solution framework have a parallelism. The implications that follow also enhance the value of the research results, because they coincide with the EU Commission vision, as well as, the body of knowledge that has guided the reconstruction of the IITS process to create autonomous component-based PDS.

The first implication is the functionality of the component-based IITS process. This CBD framework promises facilitated 'breakdown' of the institutionalised IITS environment functionality that persistently imparts negative complex matters on the extant IITS process. The institutionalisation of standards development bodies is debated widely from different angles. Hawkins (1999), Schmidt and Werle (1998) and Werle (2001), for example, mention institutionalisation of consensus rules, inclusiveness of committees and procedures. Egyedi (2000) mentions standard setting as shaped by the beliefs, values and assumptions embedded in the standard organisational procedure. This ideology as identified in this research also regulates the committee actions, IITS process and shapes other rules. Once institutionalised functionality is lessened, the more toward a component-based IITS process can reduce complexity and its link to institutionalised functionality.

The second implication is the well-advanced aspects of utilising component-based PDS. This CBD framework can be customised toward 'next-generation working environments,' because it helps to address gaps that exist in within the IITS process performance and scope of committee work. It has great potential for in areas where extant IITS process complexity continually masks unique and specialised qualities. It is expected to benefit areas, such as project proposal management, ballots and draft standards reviews that also have content-rich constructs. Technical development of projects, collaborative practices and creation of information, for example, have embedded content-rich constructs. They require specialised capabilities to deliver real results to the IITS process.

Toward 'next-generation working environments,' therefore, these content-rich constructs can be defined and tailored through IS resources. This can be achieved by: type of committee actions; by project development phase (cf. Mankin *et al.* 1996); by locus of intellectual resources within one PDS (cf. Quinn *et al.* 1997), and not across various levels of the IITS process where they can not be managed well. By these definitions, 'next-generation working environments' would create real committee communities of practice for added value to committee activities, cost-savings and faster delivery results.

The third implication applies to the committees. The SDS as a test case component-based PDS will facilitate highly integrated committee approaches. Empirical evidence from the five projects reveals that committees need well-designed communication support for successful collaboration, such as in face-to-face meetings, study and discussion and consistency of the content of work. This finding is in agreement with other reviewed literatures (Kock and Nosek, 2005; Strauss, 2002) suggesting that, high integration can provide well-designed communication and facilitated collaborative methods.

However, core technology supporting functional and IS infrastructure imperatives to the definition of integrated approaches and relevant content of the environment in which committees perform (cf. Adler, 1995, Herzum and Sims, 2000; Laudon and Laudon, 2000). Fundamental solutions can be actualised within a CBD framework on the basis of its organised design features, integration and appropriation of architecture views.

9.3.6 Implications of Practice: *new IITS process life cycle framework*

As suggested in Nowotny *et al.* (2001: 253) other implications go much wider to embrace unintended or unplanned consequences (see §8.2.5, theme #4). The new IITS process life cycle framework demonstrates this category of unplanned consequence. Categorically, this framework has the unplanned consequence as an instrument for dynamic 'customer-provider-partnerships', for IITS change programmes and operational matters (cf. Ackoff, 1999; Tidd, 1995). Major actors and stakeholders that see the drive toward the transparency of the IITS process, such as its performance capabilities, its strategy, its management and verifiable quality of its results will influence support for its pursuits. In this regard, this researcher supports the recommendation from the International Institute for Sustainable Development (IISD, 2004: 5):

> IISD believes that sustainable development standardization in ISO will be unsuccessful-and perhaps disruptive-unless ISO also extends the scope of its partnerships and the flexibility of its processes. There is a large and growing community of international, regional and national organizations working on sustainable development issues. ISO needs to proactively reach out to this community and find ways to ensure that they can participate effectively and consistently in all stages of the standardization process. This will not be easy.

9.4 Conclusions on the Research Methodology

9.4.1 Summary

The rationale of the research philosophy established two aspects from which to categorise the contributions of this research effort: link between IS and IITS (§9.1.2), and legitimacy to relevance (§9.1.4). An additional aspect that Keen (1991) mentions is the contributions bearing on the value judgement of *legitimacy to relevance.* This is applied here as the underpinning aspect of the purpose of this research and its contribution to the IS community. The first step in presenting purpose is to give a classification of the research methodology reflecting upon how it has been executed.

9.4.2 Reflexivity of Research Methodology

Qualitative research supported by methodological pluralism in the interpretive stance has been applied to characterise the research process. These approaches draw upon methodological concepts from Lincoln and Guba (1985); Klein and Myers (1999); Mingers (2001). Qualitative research, however, is not based on a unified theory and methodology (cf. Flick). This reflexivity is the opportunity to evaluate the research process to question the philosophy underpinning the methods applied (Galliers, 1997:142). The results in the next section establish the formal identity of the classification of the research methodology, which also makes that link between IS and IITS. The classification of the research methodology legitimises the credibility of research contributions and the results declared hence.

In this reflexivity it is useful to recall two classifications originally proposed by Machlup (1973) which show how this research is qualitative or otherwise. There is basic and applied research.

Basic research Machlup (1973: 146-147) describes basic research that has its philosophy ingrained in systematic study of an area in which there is a perceived phenomenon (or the problem is known). As shown in this research process, systematic study is needed, because basic research does not impart the solution method or solution to the problem. The primary aim is fuller understanding to build up the explanation of the core subject matters and phenomena of interest being examined, rather than practical application.

Applied research: this research process has a significant outlook to applied research. This researcher's methodology, for example, has been directed toward creating knowledge to explain complexity of IITS process (the phenomena of interest), as to how it can be characterised to then, apply a solution method (Jackson, 1994) bearing on predetermined solution proposal (cf. Machlup, 1973). This, in many respects, is a problem-solving methodology. It takes legitimacy of the practical relevance a solution proposal by confirming it as the solution to address the problem and its resolution. The solution that is developed needs to be implemented in practice. According to Machlup (1973) these problem-solving views of applied research mean it is expected to develop solutions for practice or to add something new to the scientific knowledge base in a particular field.

With various developments in the IS body of knowledge, it is argued that basic and applied research are more appropriate for defining purpose, relevance and general principles governing the root of one's research methodology. Both basic and applied research have a clear philosophical history, which qualitative research lacks because of methods that are borrowed from other subject areas (cf. Garcia and Quek, 1997).

By using these guidelines of basic and applied research, a qualitative approach play an important role defining the assumptions adopted from the choice of methods and paradigms. Whilst in basic research, the case study for example, applied qualitative paradigms: such as, ontology (Yin, 2003), epistemology (Greco, 1999; Hirschheim, 1985, 1991) and construction of meanings of examined reality in the pursuit of knowledge (Bruner, 1993; Flick, 1998; Pettigrew, 2001; Robson, 2002). To add to this, the study of the IITS process by its reference to problem solving is implicitly in both basic and applied research. As described by Fitzgerald and Howcroft (1998), this study also embodies 'soft' aspect (such as processual analytical study of the IITS process) and the 'hard' aspect (reconstruction actions).

Clearly, these separate instruments underpinning the positivist (Yin, 2003) and interpretive stances of the research philosophy (Galliers, 1991; Klein and Myers, 1999) give an overall perspective indicative of how method and paradigm pluralism can evolve. They show that basic and applied research classifications present a pattern of reality of the approaches that apply to a particular research process applies. When the research methodology has 'hard' and 'soft' aspects to debate, this includes the philosophical assumptions of this research methodology from basic and applied research constructs. Entwined in the research philosophy would be *reality* aspects that co-evolve from evidence building, answering questions or developing a solution method.

The research philosophy has to be questioned hence, because different paradigms or positions inevitably located in the methodology and evidence can be equivocal. The research methodology adopts contra pluralist position in both the methods and paradigmatic views (Mingers, 2001), especially the depiction of prominent dichotomies. For example, subjectivism-objectivism; interpretive-positivist; soft-hard aspects all embedded in research methodology in the context of research philosophy.

9.4.3 Classification of Research Methodology

Ideally, the classification of research occurs at the front-end of planning its purpose and approaches. The planning of this research presented in the roadmap supports this (Chapter 3). The research process (Figure 3-2) has been executed as the plan of the investigation categorised as qualitative. Research methodology can now be defined as the result of successfully implementing the planned research process to accomplish set goals and allowing resolution of its philosophical underpinnings. Against the results of this reflexivity, a formal classification is as follows:

This research falls in the category of basic research. The methodology fits into basic research because it applies qualitative IS research guidelines of interpretive and positivist paradigms. In this regard, a qualitative approach is the 'engine' through which this researcher could deal with the methodological reasoning of conducting intelligent investigations. An advantageous feature that is often ignored in basic research is the importance of the use of a theory lens for grounding and theoretical focus (cf. Pettigrew, 1997, 2000; Weick, 1995).This researcher stressed the importance of a theory-driven research methodology utilising OIPT as a lens. This lens provides greater description and explication as conditions necessary for efficacy (cf. Pettigrew, 1997, 2000; Weick, 1995).

The epistemological justification of this research methodology rests upon the **constructive research paradigm**. This is because this theory-driven research methodology is value-laden with the relevance to 'hard' and 'soft' aspects. For example, analytic description of IITS process; developing a solution method to drive problem-solving towards a defined a solution proposal; explicating how a CBD framework as the choice of design strategy can yield results that have practical implications. Working across and within interpretive, positivist and constructive positions, this theory-driven research methodology collects different kinds of evidence requiring synthesis and reconciliation bearing on the lens. Contextualisation therefore brings a balanced view in the processes of knowledge production, in the knowledge and results produced, and for the resolution of inconsistencies.

In conclusion, **Table 9-1** contains a summary of the features that frame the classification of this research methodology. This is achieved through two paradigmatic views (interpretive-positivist), which help the resolution in eight levels. This Table supersedes the research process and choice of approaches described earlier in Table 3-3.

An important fact of credibility is that, this reflexivity reveals that a theory lens and framing of the original research process were relevant in the first place. This is because minuscule changes have been made in the features of the research methodology. As presented in Table 9-1, only a clarification is necessary to establish a solid basis for accounting for action.

The role of this researcher as instrument is the central feature that locates the constructive research paradigm within this research methodology. This paradigm was not present in the research process, as its development was evolutionary toward reconstruction and design to which this paradigm can be referenced. Other applications of constructive research paradigm supporting these concepts can be found in IS development (Iivari *et al.* 1998) and design science approaches (Hevner *et al.* 2004).

Table 9-1: Reflexive classifications of the research process (Source: compiled by the author)		
	Research stance, paradigmatic views	
Levels:	Interpretive	Positivist
[1] Phenomenology	Interpretation of complexity of IITS and IITS process from exploratory study .	The problem statement is has a positivist stance, because it is a materially based theory of commitment toward research action to examine phenomena of interest.
[2] Ontological and Phenomenology	Understanding the reality of IITS as rich and ambiguous social phenomena through case study. Isolate assumptions to quality phenomena of interest toward empirically derived meanings.	Longitudinal multiple-case study to provide comprehensive process of knowledge production, and understanding of the dynamics of IITS project development.
[3] Epistemological and Phenomenology	Understanding of social phenomena generated from a focus group with structure corresponding to the analytical perspectives and meanings handled in the interpretive processes of the empirical findings.	Discovering research hypothesis through constructed meaning of the empirical findings.
[4] Theoretical focus	This is redefined as perceived enduring and current problems of IITS project development project (based on escalation of criticisms in the standards body of knowledge).	Defining solution proposal and method to deal with specifiable central issue of the problem with IITS project development.
[5] Theory in use	Use of OIPT as lens and its interpretative framework for generative mechanisms for identification and explication of phenomena.	Knowledge is generated and evaluated through theoretical focus, explication about theorising to also encourage clarity of epistemological assumptions underpinning the research process.
[6] Theory of phenomena of interest	Interpretive research hypothesis depicting method for a solution (e.g. utilising a CBD approach)	Theory building from meanings handled in the interpretive processes of the empirical findings.
[7] Methodological focus	Qualitative study seeking subjective meanings of social phenomena in the empirical findings through investigative constructs of scientific principles:. identification, description, explanation-generation, explanation, evaluation, control of data and understanding	Analytic obligation to the research questions, data evaluation and understanding of association to primary concept of designing a solution to an empirically determined problem.
[8] Researcher as instrument	**[Interpretive methodological ideology]** Objective and value-laden in the meanings of the interpretive processes of the empirical findings.	**[Constructive research paradigm]** Change agent, value-laden with intentions to provide a solution and influence expectations of the use of the results.

9.5 Contributions of the Research

9.5.1 Categorisation of Contributions

There are three categories as follows:

Category #1: Contributions to IS body of knowledge, whereby this research effort places scholarship attention to the IS community. The contributions cover the classification of the methodological features applied to support research goals, in line with the aims of the IS community.

Category #2: Contributions to theory with attention to the use of the OIPT as lens.

Category #3: Contributions to standards body of knowledge by embeddedness of this research, as well as, the implications of the results.

9.5.2 Category #1:Contribution to IS Body of Knowledge

In this category, a contribution is the research methodology that has been applied to study the IITS. This research has been carried out with an appreciation of IITS as a highly technical subject area, together with heterogeneous features, dynamic processes, practices and problematic issues. Therefore, judgement of the credibility of this methodology has been made on its capabilities to take different positions and to differentiate understanding of various perspectives of IITS consistently through the OIPT as lens (see Table 9-1).

As a contribution to knowledge this research methodology addresses identifiable gaps in knowledge of present debates.

[a] Theory and practice (Pettigrew, 1997; Gregor, 2002, 2006; Trauth, 2001; Weick, 1995).

[b] Competing paradigms (Guba and Lincoln, 1994), leading to inconsistency and dichotomy in qualitative IS research practice (Fitzgerald and Howcroft, 1998; Khazanchi and Munkvold, 2002; Mingers, 2001; Weber, 2003).

To make the contribution of this research methodology explicit, two problems identified from the debates are used as guidance: inconsistency and dichotomies. **Figure 9-1** presents the methodology of this research effort. The initial research process for studying IITS project development (see Figure 3-2) applied different types of methods and paradigmatic views, due in part, to the perceived complex nature of IITS. It was therefore necessary to conduct the research in terms of distinct subject matters allowing for the study of a phenomenon of interest in separate stages. However, the underpinning aspect of logical intelligent investigations has been the unity of the research process and its core subject matters.

9.5.3 Resolution of Methodology Practice

Figure 9-1 clearly shows that, through methodological and paradigmatic pluralism, the investigation process generates criss-cross mechanisms. This gives a depiction of equivocality, which can lead to inconsistencies in methodology practice. This resolution gives the opportunity to address enduring concerns of methodological practice, inconsistency and dichotomy which current IS body of knowledge seems not to resolve. This resolution further articulates the application and contribution of the integrated research methodology. The question to be answered here is:

> How does is integrated research methodology attempt to resolve these identified concerns within its underpinning philosophy and to address its contributions to knowledge?

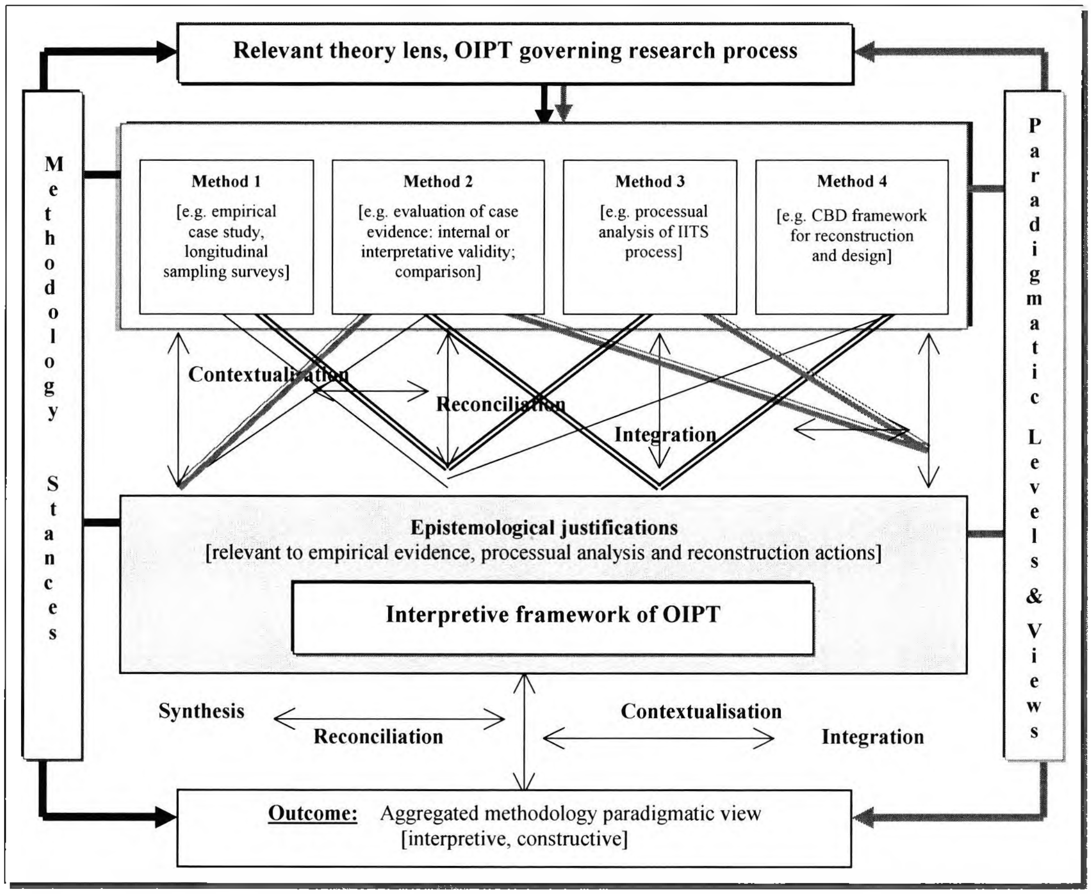


Figure 9-1: Integrated Research Methodology
(Source: compiled by the author)

Methodological practice in the realms of the investigation: This is an enduring discussion, especially the use of a theory lens in research. The implications of a theory lens has many uses suggested as: for choosing research methods (Garcia and Quek, 1997; Trauth, 2001); theoretical focus and explication in process studies (Pettigrew, 1997).

In taking this integrated research methodology as whole, an implication of OIPT as a lens is efficacy of the outcome demonstrated in the investigation and declared results. Overall, OIPT as a lens helped to develop relevant methodological considerations that fit into the theoretical framework of this research and its mechanisms, as opposed to framing the investigations (cf. Trauth, 2001). It has helped to reduce potential inconsistencies and practice contradictions evolving different types of methods, paradigmatic views and their combined contra pluralist positions.

Methodological reasoning: Nowotny *et al.* (2001:143) argue for contextualisation as an important aspect to help methodological practice:

> Contextualisation is a consequence of at least three conditions, which may operate at different levels and not at of which have to be present at the same time: the overall shift (or drift) from a model of 'segregation' to one of integration; the selective retention of certain potentials which arise as result of greater variation; and the place accorded to 'people' in our knowledge, be it as actively involved in its production or conceptualized as either objects of the research…

As shown in Figure 9-1, the criss-cross mechanisms in the structure of the research methodology evolve from knowledge production by different methods and by paradigms. This may lead to equivocal explanations. OIPT as a lens together with contextualisation play a crucial role by redressing and elaborating methodological reasoning. It is argued therefore, that the combination of a lens and contextualisation helps to cope with uncertainty of dichotomies in methods, paradigms and knowledge production. The final result is an integrated research methodology.

The analytical framework (Figure 5-2) that integrated the analysis and reconstruction of the IITS process is an explicit form of the contextualisation. Categorically, this framework helps to *rebalance* any disparity in the methodological mechanisms, paradigm shifts, segmentation of the study of the IITS process, to include theory and knowledge dichotomy.

Contextualisation is extended in the result specification framework (Figure 8-1). Variety of knowledge presented in the research results generated uncertainty. Through this framework, synthesis and decision-making of results provided the means to logically determine knowable and unknowable elements, to include context of application and implication of practices (§9.2.4; cf. Nowotny *et al.* 2001).

Inconsistency: In this research, inconsistency has been perceived from different angles, such as theory-practice (Bhaskar, 2002; Gregor, 2002, 2006; Watson, 2001); methods-theory (Weber, 2003) and, articulation in the methodology (Fitzgerald and Howcroft, 1998; Khazanchi and Munkvold, 2002). Combining methods, paradigms, theory focus and evidence from different levels in the research effort are all key sources of inconsistencies. When there is no conscious attention to contextualisation in the process of knowledge production, inconsistency can give rise to incompleteness in the desired outcomes. In particular, the purpose of this research is a design result, from which to determine a set of solutions to the problem examined. Coherence in the methodology is of central importance to the evidence that leads to design intentions hence.

Dichotomies: From the contra pluralist position summarised in Mingers (2001) dichotomies that exist between the empirical-analytical; interpretive-positivist paradigm can be considered as valid in qualitative IS research. However, dichotomy in the process of knowledge production is potentially contradiction and uncertainty in the body of evidence.

9.5.4 Potential Areas of Application of Research Methodology

Two potential areas have been identified.

The first area is the IS community to which this research is referenced. This theory driven research methodology has turned out to be adequately powerful. It has connected four segments of the study of a particularly complex IITS process, namely: phenomena of interest, empirical case study, transition to analytical study and reconstruction of the IITS process, and design of solution options. The potential use of this research methodology is the IS body of knowledge, where studies about IITS and relevant methods are not readily available.

The second potential area is process studies. A number of process studies reviewed in the body of research literatures are in diffuse areas, with equally profuse subject matters. Examples are improvement (Kock, 1999; Kock and Murphy, 2001), business process integration (Davenport, 1998; Herzum and Sims, 2001), radical process change (Braganza, 2001; Harrison and Pratt, 1993), management and organisation studies (Pettigrew, 1997, 2000), IS role in capturing process information and knowledge (Braganza, 2004; Malone *et al.* 1999) and business and process modelling (Dietz, 1994; Holt, 2005, Ould, 1995). These subject matters have the exclusivity of the use of different kinds of methods fitting the scope of particular processes.

This research is no exception. This integrative research methodology fits into the study of the IITS process. By its effectiveness in this study, an analytic framework (Figure 5-2) has been developed. This framework is an *unplanned consequence* connected to this methodology through empirical evidence, and from the need to develop analytic rigour to study a process with multi-dimensional issues. Exclusively, this analytic framework gives greater explanatory power to the conception of the process being examined, challenges to be resolved and explanation of outcomes. These qualities would be possible in other process studies hence.

Process studies need to focus on the fact changes through reconstruction, redesign or IS are likely to be radical in the long term. These process changes and their requirements bear on future scenarios of coping with complexity, uncertainty or new form of functionality, rather than merely changing current issues. Moreover, Pettigrew (1997) alerts researchers to the fact that, process studies often are undermined, because of the lack of theoretical framework. This integrative research methodology and the analytic framework together are encapsulated in a theory lens. In process studies, therefore, this integrative research methodology can be powerful tool.

[a] **This methodology** can be taken separately for empirical cases involving the study of processes to capture their dynamic real life and embedded elements.

[b] **The analytic framework** as a crucial component of this research methodology has three main qualities. One, its *robust features* designed from a *theory lens* can embrace analytic, descriptive and interpretive constructs of process analysis or process design. In particular, organisation processes are embedded in mercurial challenges of social contexts, whereby differentiation in understanding performance is imperative for any change. Two, robust features in this framework provide *comprehensiveness* in the study of processes to be changed by any other approach, beside a CBD framework. Three, it has the *flexibility* to allow identification of specific issues to be changed and to enhance solutions sought (cf. Braganza, 2001: 246). Consequently, the qualities make this framework a dependable candidate for repeated application in other areas in its own right.

9.5.5 Category #2: Contribution to Theory

In this second category, a logical discussion is to link the use of the OIPT as lens to the research methodology. This use of this lens in this research has been qualified as one for analysing and describing (§3.3.2; Gregor, 2002, 2006), resting on features expressed from four seminal model representations, namely: principles, decision parameters and guidelines (§3.3.5, Appendix 1). In keeping with Gregor (2006) a crucial question to pose is:

> What constitutes a contribution to knowledge with theory lens of this type, based upon its context of use in the research?

To response to this question, the contribution to knowledge is **extension of OIPT** as a lens in the study of IITS process. In Goodman's philosophical views of meanings (1988: 71-72) extension of theory involves transfer of meaning into a new schema. This extended meaning depends upon the original meaning of the theory or lens applied. This researcher describes this extension as by use of selected features of OIPT as a lens to govern the explication of this research methodology and analytic framework. The theory, OIPT and its original representations remain constant.

The basis for contribution to knowledge is from the fact that OIPT as a lens has an extended meaning and interpretation, which meet both the theoretical focus and methodological requirements for this research grounded in very different paradigms. By its use in this research, OIPT as a lens has acquired a new context of use that can improve with practice in other IITS studies or analytic process studies for that matter, without changing its existing characteristics or definitions.

9.5.6 Epistemological Contribution to Theory

As an epistemological justification, the extension of OIPT as a lens in this research supports the **dynamic orientation of its use** (cf. Newel and Simon, 1972). This is by virtue of the fact that this extension goes beyond the original meaning of 'content scope' as implied in the analysing and description taxonomy by Gregor (2006). 'Content scope is restricted to characterising individual organisational areas and hence, the possibility of making generalisations.

Dynamic orientation of this extension of OIPT as a lens has a more appropriate focus for studying complex matters presented in this research, than perhaps combining a number of methods that possess different paradigmatic views. The methods would rest attention on characterising static and dynamic features, without defining the meanings located in embedded items patterns or relationships unfolding with context and time. OIPT as a lens has proved how approaches applied in different levels of this research can be better integrated, so that appropriate meaning can be constructed.

To conclude, OIPT as a lens makes contributions to empirical cases, process and design studies. Emphasis on its extension in this research is on theoretical grounding, understanding of meanings. It has been extend from content scope to dynamic application involving: framing the case study, answering the questions posed and problem-solving. Comprehensive strategies of its use are demonstrated in the aggregation of complexity through its criteria, ideation of CBD as a design strategy, assessment of solution options, analysis and reconstruction of the IITS process. This is the dynamic scope of the OIPT as a lens, which is also evident in the quality of the results, declared in this research. The results involving the SDS and integrated solution framework demonstrate far greater explanatory supremacy of the examined phenomenon of IITS process complexity, than it is possible with combining different methods.

9.5.7 Category #3: Contribution to Standards Body of Knowledge

In this final category, the contributions involve the embeddedness of this research in the standards body of knowledge. Embeddedness looks into how this research has managed to address a specified gap in knowledge, so that it makes a contribution by implication of the declared results. Previously in §1.3.4, three main items have been identified as the gap in knowledge in the standards body of literature: lack of definition of IITS process, empirical study about IITS project development and solutions for practice to resolve criticisms about IITS process.

Definition of IITS process and project development: Drawing upon the research results, this thesis has illustrated major contribution to close this gap in knowledge by providing an empirical definition of the IITS process. This definition would help to add depth and detail in the grounding of the process of IT standardisation that has been debated widely in standards literatures (such as Baron, 1995; Cargill, 1989, 1995; Jakobs, 2000; Reilly, 1994). This is because the empirical evidence from this research generated not only an empirical definition of the IITS process, but also constructed reality of IITS project development. This empirical definition gives the IITS process an factual identity that it deserves, if not more so, for the fact this process produces globally impacting IIT standards that are binding on organisations and industries.

Solutions for practice: This research has acted on current and enduring criticisms about the IITS process with a more coherent approach that examines complexity as an identifiable problem. Instead of a reason for conducting the research about IT standardisation and arguing the need for solutions (such as Krechmer, 2005; King and Lyytinen, 2003) the proactive action is the reconstruction of the defined IITS process. Fundamentally, reconstruction within a CBD framework closes the gap in knowledge on the challenges for seeking solutions that otherwise turn out to be ephemeral. As research results, component-based PDS are expected to add revolutionary thinking to the standards body of knowledge in terms of dealing with the complexity of IITS process. These results provide a solid foundation upon which to build solutions to enhance IITS process and its practices through implementation.

9.6 Conclusion of Set Goals

9.6.1 Summary of Goal Accomplishment

Reflexivity of this research indicates its interdependencies among the core subject matters examined (Table 2-1). The crucial link to these core subject matters is the set of goals as examined (Figure 1-3) that become embedded in the methodological reasoning, knowledge production processes and in the results.

It is argued, therefore, taking a basic research perspective that combines an interpretive methodology stance and constructive research paradigm (Table 9-1) should question whether the set goals have been achieved. Goal accomplishment bears on the criterion of confirmability (Lincoln and Guba, 1985), which is largely a matter of personal judgement to present accountability of the researcher's actions.

The first judgement is that the credibility of the declared results. This credibility focuses on, and is indicated three of the integrated goal themes: content of the declared results, their context of use and implications for practice (§9.2.2, §9.2.3). An epistemological justification of this credibility is the fact that the theory-driven research methodology has placed emphasis on empirical and analytical strategies to incrementally understanding IITS process and project development. The comprehensiveness of the analytical strategies in turn ensure a style of rigor, leading to results that are expected to provide solutions to a problem (cf. Machlup, 1973). The integrated goals associated with understanding and problem solving have been accomplished, because the quality of the declared results surpasses the challenge of the set intentions. The implications for practice also incorporate tacit strategies that can be expected to deepen knowledge of the implementation of the declared results and solutions connected to them (§8.6).

The second judgement is goal completion drawing upon the consistency of the claims in the empirical evidence and those of the declared results (cf. Hammersley, 1992). Goal has been accomplished, because this research produced accounts that addressed the right problem (§1.1.4) and questions (§1.5.7). In particular, it has taken an IITS topic that has barely received empirical attention to bring its scholarship attention to the IS community and the standards body of knowledge. Against this, goal completion would require implementation to confirm the validity of the declared results and their implications for practice in the IS community and IITS environment. This implementation is a form of external validity by the stakeholder of the results to which the research makes a contribution (cf. Lincoln and Guba 1985).

The third judgement is the epistemological justification of the credibility methodological approach. The set goals were defined clearly, such that it has been possible to apply appropriate methodological mechanisms across different types of subject matters and differentiated segments research process (cf. Flick, 1998). Here, appropriateness also refers to the fact that different types of methodological mechanisms strongly complemented each other within the framework of OIPT as a lens, thereby developing greater analytic rigour in the delivery of results. According to Keen (1991:28) a theory lens does not create rigor. By contrast, the extended use of the OIPT as a lens to this research has addressed **efficacy** as a stronger element ensuring the style of rigor, leading to goal completion demonstrated in the knowledge presented in the methodological approach and research results (see §2.9.1).

The fourth judgement is of accountability for effectiveness of the theoretical and methodological approaches. Foremost, this researcher utilised evidence from different segments of the investigation, material from several literature sources and methods. Prior to the investigation this researcher strengthened the theoretical and methodological foundations of the research. This added depth to understand the needs of the investigation process and to improve on perceived inconsistencies. In keeping with Denzin and Lincoln (2002); Flick (1998) and Robson (2002), these are core elements of this research akin to **triangulation styles** that help to enhance credibility of methodological mechanisms. Accountability for effectiveness is justified hence, because the use of a lens, theory-driven methodology approaches as its foundations, and a CBD framework increased the standards of **scholarly attention** given in the treatment set goals. This research has been executed in a **coherent manner** with an appropriate body of principles and practices from the IS community as the field of reference.

Fifth is of accountability for actions judged upon the transferability of declared results. Criterion for judging this accountability rests on the transferability of the research methodology and declared results (also see Table 2-11: Guideline to evaluation of research). Transferability is used in the sense of the question posed in Lincoln and Guba (1985:290):

> How applicable are the methodology and these declared results to another setting or group of people?

[a] **The transferability of the integrated theory-driven research methodology** (Figure 9-1) has been demonstrated, because it gives clear definition of the kinds of concepts with which to make problem solving possible. Especially, this methodology is transferable for use in the IS community because it addresses an identifiable gap in knowledge about use of theory lens in IS research practice (Garcia and Quek, 1997; Trauth, 2001; Weick, 1995), and in process studies (Pettigrew, 1997). It has added value implications for practice. It has an unplanned consequence in resolving issues of inconsistency and dichotomy in qualitative IS research practice (Fitzgerald and Howcroft, 1998; Khazanchi and Munkvold, 2002; Mingers, 2001; Weber, 2003).

[b] **Design specifications** involving the SDS, integrative solution framework and new IITS process life cycle framework can be transferred for implementation in the IITS environment, with a few minor modifications. The modifications, however, take into account that SDOs and NSBs need to establish their strategic vision and decisions to drive the implementation programmes forward.

9.7 Discussion of Research Conclusions

9.7.1 Framework of Conclusions

The conclusions of this research have been placed in a framework covering **themes** that provide greater depth of their discussion. The axis of the framework is in the thesis arguments #1, #2 and 3 (see §1.5.6) linked to the set goals, problem statement and implications of the declared results.

The themes focus on key phrases of the thesis arguments pointing to consequential aspects of this research effort, from which sets of recommendations are established, that might otherwise be ignored. Relevant material from reviewed literatures and findings from the research help to pull together concise themes on which the study of IITS has been based. Thesis arguments, themes, literatures and findings thereby enhance this link to the conclusions. Altogether, the conclusions consist of three themes and five recommendations that are intended to be interpretive, not prescriptive.

9.7.2 Theme #1: IITS process pursuits

> **Theme #1:** IITS process pursuits need to be defined clearly providing a basis upon which to establish strategic aims that guide its performance and to determine requirements to be met.

This research has concentrated on the development of five projects through the IITS process. The findings clearly reveal that project development is the core pursuit of the IITS process. Different sets of projects can include: a fresh proposal for development as a program of work in the IITS process, certification, implementation and testing of certain products and publication of standards with special needs. According to Katsoulakos (1993: v):

> The standardization and certification process involves the development of standards, the development and application of assessment techniques to evaluate project against those standards, and certification when compliance is demonstrated.

Drawing from reviewed literatures on project and program-based organisations (such as Archibald, 1992, 2003; Cleland, 1996; Neufeld *et al.* 2001) IITS qualifies a multiple project-based environment. The projects have the distinctive uniqueness in the use of scientific methodology approaches, specialised knowledge and collaborative conduct to deal with technical problems. The results of project development are technical standards that can be expected to provide solutions such as technology innovation. In many respects, the technical details presented in IIT standards are hardly suitable for the comprehension of the general public.

Recommendation #1: The starting point to embracing the opportunities that the research results bring, is a precise strategic declaration clearly stating project development as the focus of the IITS process. The strategic declaration is the substance from which the aims underpinning successful project development can be defined, refined and implemented alongside these research results. For SDOs and NSBs, this recommendation is also in keeping with *axiom 3* by Braganza (2001:243):

> Radical process-based change is more likely to be achieved people recognise that organisational elements, namely strategy, structure, people's responsibilities and appraisal criteria, collaborative behaviours, and information systems, will change and these elements should align to a function *and* process orientation.

9.7.3 Theme #2: Implementation of the research results

> **Theme #2:** The implementation of declared research results is an urgent requirement. Proactive action is imperative in order to deal with challenges that the IITS environment faces constantly in project development.

There is a great deal of diversity in the empirical challenges that the IITS environment faces by not taking proactive action in dealing with IITS process issues. These challenges have been described in considerable detail (see Tables 7-4; 7-5). Other findings from reviewed literatures (such as Archibald, 1992, 2003; Kerzner, 1998; Mohrman *et al.* 1995; Neufeld *et al.* 2001; Quinn *et al.* 1997) suggest that multiple projects present several unique problems for any organisation.

The IITS process deals with large projects that present greater complexity and uncertainty, because or their evolution spanning several years. Problems associated with complexity and uncertainty breed what the researcher listed in her personal case study notes as 'ineffective project development problem themes from reviewed literatures'. For example, poor co-ordination and collaboration; lack of strategic direction; under-resourced teams; inappropriate IT tools and project management methods.

These 'ineffective problem themes' co-exist with criticisms of IITS process inadequacies, such as slowness (Rada, 1999; Gosain, 2003), poor management (King and Lyytinen, 2003) and billions spend on an inadequate technology (Sheriff, 2002). The biggest challenge is that of juggling various 'ineffective problem themes' and evolving issues is:

> The perceived high level risk associated with the lack of 100 percent commitment to take proactive action toward positive changes (cf. Kerzner, 1998:37).

Recommendation #2: The declared research results have been designed to create far-reaching and superior solutions for IITS process that those currently in place from various IITS environment improvement efforts. In the absence of the right solutions, unsolved problems impact on wider issues. For example, how to deal with highly technical complex projects, a multi-stakeholder environment and, the intellectual assets of information and knowledge in an unstructured IITS process.

Recommendation #3: The implementation of the declared results is now an urgent requirement for SDOs deal with these IITS process problems incisively. Through implementing these research results, the future of IITS process project development can be expected to harness capability-effective solutions.

Recommendation #4: SDOs and NSBs now need to be linked to the professionalism associated with implementing the right solutions. Their role in the urgency for proactive action is to create accountability for ensuring all means possible to enhance the effectiveness in IITS process performance for successful project development, and timely delivery of the standards. In keeping with Simon (1981, 1996) a delay in solving a problem is itself a cost in terms of foregone possibilities of action and forgone opportunities. Integrity of the new IITS process, leadership capacity, learning and excellence in project development practices are some of the values toward the creation of effective solutions.

9.7.4 Theme #3: Future of IITS process

> **Theme #3:** The IITS process is no longer sustainable with soft approaches that mask deeper problems, and dissipate what could be its most valuable intellectual assets.

This final theme draws upon a key objective of this research, which is to reconstruct specified core aspects of IITS process within a CBD framework. This created create autonomous component-based PDS.

Arguments for this more novel design approach to IITS process project development have been described as clarity, transparency and combinations of capabilities for enhancement of IITS process performance through IS.

Drawing upon the implication of institutionalisation (§9.3.5), this theme rehashes the examined problem statement e that soft and conventional approaches are not suitable for the IITS process (§1.1.4). While institutionalisation could be an advantage to co-operation in the IITS environment, it is also the greatest obstruction to progress. Borrowing from Cleland (1996:23):

> Projects enable an enterprise to come up with an enhanced capability, a product and a process that best fits the organization's overall strategy. Projects provide a rigorous test of the enterprise's ability to integrate its resources and position itself for the future.

Recommendation #5: What Cleland describes is reflective of how the IITS process, operating within a CBD framework, would be. The best fit of the overall strategy for IITS process project development is a CBD framework that creates conditions for the development of solutions. Large and complex IITS process projects can be tailored to their specific needs. Committees can be expected in the future to have, at hand, accessible up-to-date information, managed knowledge and facilitated collaboration (see §9.3.5) Categorically, these expectations of the component-based PDS and IITS process thus provide a rigorous test as to whether SDO can truly harness imperative capabilities. Projects can be executed projects alongside strategies for improving committee performance through providing adequate information and IS resources.

Recommendation #6: Clearly SDOs and NSBs need to breakdown the negativity of institutionalisation, because basically, it is no longer fitting for technical projects that need the locus of its intellectual assets and novel solutions (cf. Quinn, 1997: 514). When properly operationalised, component-based PDS will create the most valuable intellectual assets of the IITS process. It will that ensure requirements, strategic aims, practices and solutions are consistently tailored to fit in with the types of project under development. In grasping these opportunities, cost-effective, enhanced capability and success implies meeting contemporary trends for project development such as those summarised in Figure 2-2: Literatures dimensions of project development.

9.8 Limitations of this Research

This section takes reflection on the research process to illuminate its key limitations.

9.8.1 Work Experience and Research Connection

This research evolved through working in a NSB (§2.1.1). The doctoral study was carried out on a part-time program. Such research focuses on real world problems to which some solutions must have practical importance to the area of work. As this researcher has demonstrated, there are sufficient grounds to suggest that different kinds of important and topical issues of IITS require this scholarly attention at doctorate level.

Drawing upon this work experience, one major limitation is tackling separate challenges from two distinct axes (work and research) and making sense of it all. On the one hand, IITS is a complicated area to study. IITS process as a topic that has barely received attention requires fresh theoretical or empirical outlook. If not more so, *scholarly originality* is a central aim to address its real world problems with implementable solutions. Work, on the other hand, is an on-going career upon which the part-time doctoral research depends, such as experience, finance, skills and stability. It has its own unique imperatives of fully engaging in the organisation's goals. Performance can not be impeded, because there is a doctoral research linked to work.

Conventional wisdom suggests that *the limitation* is that the two axes of work and doctoral research never meet. Although output from the research can be measured, consistency is not achievable. The process of delivering research outcomes is slow moving. The process is typical of chaos embroiled in uncontrollable and uncertain elements while balancing both axes to drive for continuity and effectiveness, toward one's set goals. These challenges make one develop a clear appreciation of the conditions that lead to a focused research; synergistic decisions that benefit both work and research.

9.8.2 Revisited Ethical Considerations

This research is based on ethical considerations, because of the link to study an area of work. Consent, empirical data sources and transferability of the results are some of the example items included as important ethical considerations (see §3.8). The conduct of the research required agreements on rules set between this researcher, doctoral supervisor and employers. This link between university and this researcher's employer required relationships to be effectively installed and executed.

Standards bodies, in particular, maintain their own legitimacy of which kinds of research have substance to contribute to their endeavours. As this research got underway, ethical considerations presented their own time-consuming intense discussions and resolution processes. For example, the employers argued for their vision to be included in this research. From an academic point of view, the employer's vision can change the research proposal. In this regard, ethical consideration is not something written about in the thesis. What is often overlooked is that, research needs a 'home' in which the results would be implemented and tested.

Scholarly works (such as Hirschheim and Klein, 1994, Robson, 1993, 2002; Stahl, 2004) focus on two aspects: the ethics of doing research and ethics as a research subject. Because of this research, more scholarly works need to examine ethical considerations for cases where the research framework falls into an area of work. In perceiving the shortcomings of my research, guidelines are needed as to what is accepted in such work-related study.

In IS research subject areas, the ethics guidelines go beyond just conducting the research. Professionalism of the conduct one's research and in the presentation of the results are of pivotal importance in mapping further studies, and hopes to attract other researchers (§9.9). Thus, universities need to develop guidelines, other than intellectual property, where employers and employed students can draw attention to ethics issues impacting on work related study early on in the research proposals.

9.8.3 Research Time Scale

Another key limitation of part-time doctoral study is that, it is double the time and treble workload of full time programs. Especially, this study presented untamed challenges, such as relevant literatures and methods from the IITS domain.

[1] Standards literatures tend to take economic and ICT perspective that are clearly outside the realms of this research (see §2.2.2). When the basic body of literature to which the research is referenced does not build a relevant investigation. When comparative work can not be located, this widens the debate about the topic being examined. The only route to follow is identifiable criticisms presented in the area of study (§1.3.2). Developing relevant methodological mechanisms became time consuming hence.

[2] The IITS process needed to be defined through empirical study and themes focusing on project development. With a life cycle determined as approximately 6½ years for each project (Table 6-3: Case study project milestones and time scales), time is spend not only on the case study, but also developing a robust methodology fitting the scope of the research. Because of the complex and unique features of IITS process, primarily, a number of methods needed to be tried out to determine their suitability. One of the methodologies this researcher tried out is SSM (Checkland and Scholes, 1991). Despite its wide acceptance, SSM was unsuitable for this research. It did not present the integrative methodology to analytically challenge IITS process complexity, leading to reconstruct through a CBD framework.

[3] The study of complexity has a strong emphasis on issues of its conceptualisation with meta-theories (such as Battram, 1999; Corning, 1998; Galbraith, 1973, 1977). Typically, component-based design approach has formalities (such as Allen, 2001; Herzum and Sims, 2000; 2000; Szyperski, 2000; Whitehead, 2002) presenting the complexity of customising the approach for application in a given problem context (see §1.2.8). The intense analysis of the extant IITS process, radical reconstruction and design work through customised approaches is time-consuming. Lengthy research time scale is the consequence of studying complex issues. Hover, over and above, this work has scholarly originality, together with timely response to topical issues and implementable solutions with positive consequences.

9.8.4 Conclusion to Research Limitations

In conclusion, while this part-time research has these mentioned limitations, this research would not have been possible without its connection to the work experience. It is the researcher's experience-related belief that one can only understand dimensions of IITS phenomena in the light of prior knowledge as a standards developer practitioner or by profession within SDOs and NSBs, to include research. In line with scholarly discussions on 'wicked problems (cf. Conklin and Weil, 1997):

> A part time doctoral research program dealing with a complex topic and wicked problems is a non-linear process. This non-linear process is not a defect; it is not a sign of stupidity or lack of training, but rather the mark of a natural learning process. It suggests that humans are oriented more toward learning (a process that leaves us changed) then problem-solving (a process focused on changed or surroundings).

Overall, the IITS environment slow rate of response to change was an advantage. This researcher was able to conduct this research as a systematic inquiry without fast moving changes in this environment. This presented an opportunity to learn, experience and specialise broader research skills. Designing visionary results that are expected to harness incisive solutions would otherwise not be possible, if this environment were assertively competitive.

9.9 Future Research

This research has been addressed to the IS community. Jakobs (2003: ii) in his Editorial Preface for the Journal of ITSSR highlight a reason why academic topics on IIT standards are few:

> Part of the problem, quite possibly even its origin, is the fact that standards research is not exactly a high-profile topic, and it is certainly a very arcane one for most. "I'm doing standards research" in response to a question on what exactly I am doing at the very least requires additional explanations – "I'm with a computer science department" doesn't. Add to this the problems associated with multi-disciplinary research in general (more difficult to get funding, lack of proper publication outlets, etc.) and you will get a reasonably good idea of why there are so few standards researchers out there. And, of course, the research done at a university has repercussions on the subjects taught (at least at the postgraduate level). My-not really educated guess would be that the grand total of students worldwide who are working on standards-related theses is in the low three figure range.

9.9.1 Agenda of Research

In response to Jakobs (2003), this research has created a solid foundation that makes IT standards an academically current, as well as, refreshing subject matter. Academically, the challenge for future research has to be subject matters embedded in this research. The subject matters are not going to deal with the conceptualisation of IITS. This research covered, beyond the boundaries of a detailed empirical study, such as analysis of IITS process, its reconstruction, design of process functions and IS, solutions, methodology and theory.

In general, IITS has a wealth of issues that barely receive academic attention. This research has methodologically generated a coherent study of the IITS process. Hence, the epistemological justification bearing on this future research agenda draws upon the in-depth empirical study of the IITS process achieved successfully in this research effort. The agenda aims to unravel other undiscovered phenomena. Three questions to be addressed in this agenda include:

[1] Which theory lens is best suited for IITS?

[2] What are the best ways to develop IIT standards within component-based PDS?

[3] Can IITS process harness collaborative work and intellectual assets of professionals, scientific methods and specialised products in component-based PDS as a vision of next-generation working environments?

Against these questions, this agenda for future research can include:

Research building: This item is a response to the question [1]. There is more empirical research on the IITS process that is deeply rooted in and builds upon this research effort. The OIPT has been shown to be robust and dynamically oriented as a lens. From its use in this research OIPT is particularly relevant to more process studies that address the dynamic interplay of practices, performance, human interaction, and functionality and IS solutions. Research building hence, will take the OIPT as a lens to drive any other methodology. The research will then define other terms of the OIPT as lens in other areas of IITS.

Implementations of research results: In response to question [2], the declared research results are implementable. This strongly encourages the fact that the future of IITS project development is through component-based PDS, as illustrated in the specification of the SDS (Appendix 12). As a recommendation, the implementations are best are carried through academic institutions regardless of where they might be located. Academic institutions exercise strong measures covering research methods, analytic approaches, evaluation of results and professionalism upon which these implementations depend. There is emphasis on continuity in learning for other researchers and building upon knowledge that can be documented as scholarly works (academic journals and textbooks) as empirical reference.

Effectiveness of IITS process: This is in response to questions [2] and [3]. Initially, other studies are needed to develop and evaluate the scope of the implementation issues within the IITS environment. Thereafter, implementation studies can be linked to developing best ways for the development of IIT standards within this CBD framework. Concomitant implementation and practice gives greater attention to determining **clear measures** that can help SDOs and NSBs to cultivate the effectiveness of IITS process. Effectiveness, achieved through practice of the solutions available from implementations would also suggest how the new IITS process can harness **strategies** for successful project development that can be measured in terms of: thriving communities of practice and IITS process knowledge cost-effective delivery IIT standards. The next stage is for the IITS environment to execute this vision of a component-based IITS process, towards next generation working environments.

Priority research issues: A number of debates in the standard body of knowledge focuses on the need for timely delivery IIT standards (cf. Baron, 1995; Gosain, 2003; Rada, 1999; Sherif, 2003). The design specification of the SDS has not overlooked this priority. Greater attention and more elaboration to the assumptions underpinning the use of these component-based PDS are what the IITS process needs the most. Typically, a project time scale may be an irrelevant factor against information needs. This researcher recommends the following priority research issues that academic research needs to develop:

[a] Implementations of component-based PDS.
[b] Creation of project knowledge base and information.
[c] Management of information and knowledge.
[d] Practice of working in the implemented component-based PDS.
[e] Developing process IT infrastructure for complex projects
[f] Project development effectiveness through facilitated IT infrastructure services.
[g] Change management.

9.10 Summation of Chapter

This final chapter has questioned the research philosophy. In doing so, the conclusions on the results of the research, methodology and contributions to knowledge have answered the delivery of this thesis in terms of: credibility, epistemological justifications for grounding the validity of the knowledge. The limitations of the research illuminated the complexity that exists in the study program, treatment of the subject matters and thus posits a reality of the challenges overcome. The conclusions on the results have included their transferability and implementability, and agenda for future research.

9.11 Summation of Conclusions of Thesis

This conclusion gives due attention to one of the fundamental ideas of *chaos theory* as means to connect four axes: the work experience, the research and its scholarship attention and presentation of the results in this thesis. Chaos theory is discussed widely in various subject areas, such as: planning (Cartwright, 1991), information processing (Nicolis, 1991), re-thinking science (Nowotny et al. 2001) and management of organisations (Zuiderehoudt 1990). In chaos theory, this research has what is commonly known as the 'butterfly effect' which states:

> The flutter of a butterfly's wings in China could, in fact, actually effect weather patterns in New York City, thousands of miles away.

The quality of this research and results has explanatory principles that can be translated in the context of this butterfly effect: A 'very small' occurrence such as the study and reconstruction of the IITS process can produce unpredictable intense results that can trigger a series of increasingly significant events. Sufficient scholarly attention to the research methodology, contributions to knowledge and practical implications of the declared results outweighs the complex nature of the subject matters and research time scale.

On a last note to the IITS environment as potential stakeholders of the results: proactive action is a key to success. It is imperative to solve IITS problems with the results declared in this research. Action will depend upon SDOs and NSBs developing an international concerted focus for proactive change that will be in line with specified IITS priority issues. In keeping with two extracts from *axioms* #6 and #7 by Braganza (2001: 246-247), the IITS environment has these tasks:

[1] Identify the specific issues from the declared research results, which need to be managed.

[2] Radical process-based change is more likely to be achieved when both radial and evolutionary implementation methods are adopted depending on the individual issue being managed. Proactive action will, therefore, work hand-in-hand with a strategic vision that helps to propel change efforts, to include environment-conscious management, leadership capacity in implementing and in changing processes.

As a personal goal, the most significant event in the future is what it would mean to have the IITS environment transform itself into a butterfly, while it cultivates the solution that that these results will bring.

Explanatory Summary:

This specification describes the content of the **component-based standards documentation setting (SDS).** This is a design test case representing a component-based project development setting of the reconstructed IITS process. This specification also contains design results defining functional and technical-IS aspects of the SDS. It provides a basis for the mutual understanding between this researcher, intended readers of this thesis and IITS environment as intended users of the SDS.

Recommendation:

This researcher recommends that design results in this specification be employed as frameworks to guide planning of the implementation of the SDS. Functional and technical-IS aspects should be implemented together to provide the foundation for determining an explicit operational content of the SDS: its definition, representation and manipulation of processes, and IS resources.

Table to contents

1. Introduction to SDS

The SDS has been designed as a component-based project development setting. It is dedicated to the development of draft standards and other IITS process deliverable items.

All international standards are written, defining preliminary requirements and model solutions to a perceived or examined problem. Project development produces a series of interim results, which are draft standards. The development of these draft standards has been defined in the thesis as 'Documentation' involving independent life cycles, leading to: working draft (WD), committee draft (CD), draft international standard (DIS) and final text. On approval of this final text, the international standard is published.

Against this background, the design of the SDS exploits to full advantage, *an open layered component-based design (CBD) framework* for the containment of its functional and IS features. Open layering offers partitioned operational boundaries. It allows layered parameterisation of the operational content of the SDS.

The SDS will embrace key *technical aspects* contributing to the independent documentation life cycles, namely: technical development of the project, study and discussion, requirements analysis, information gathering and information evaluation. Each draft standard goes through independent committee reviews to establish agreements on its content, prior to ballot reviews. The SDS incorporates *contexts* that help the delivery of results covering committee meetings and reviews of draft standards. Communication, co-ordination and collaboration assumptions in the design of the SDS take into account the intended facilitation through IS resources for lateral committee integration.

2 Content of the SDS

The design described next is in **Figure 1:** functional content of the SDS.

2.1 Goals of SDS

Two goals for the DSDE are:

[Goal 1]: To provide the SDS with a comprehensive functional definition as a foundation for developing, integrating and maintaining documentation processes facilitated through relevant distributed computing.

[Goal 2]: To introduce transparent practices for the documentation of draft standards, ensuring effective decision-making, collaboration, communication, co-ordination and creation of technical information.

2.2 User Definition

Approximately 4 000 users are expected to have daily access to the SDS for enquiries; information; published draft standards; review of draft standards; submission and retrieval of documents. Four categories of users have been established as :

[i] International committee memberships engaged in developing projects.

[ii] NSBs that will act as operational environments.

[iii] Registered stakeholders involved in the development of the projects. They will include approved R & D environments; consulting agencies and organisations that supervise specialised activities.

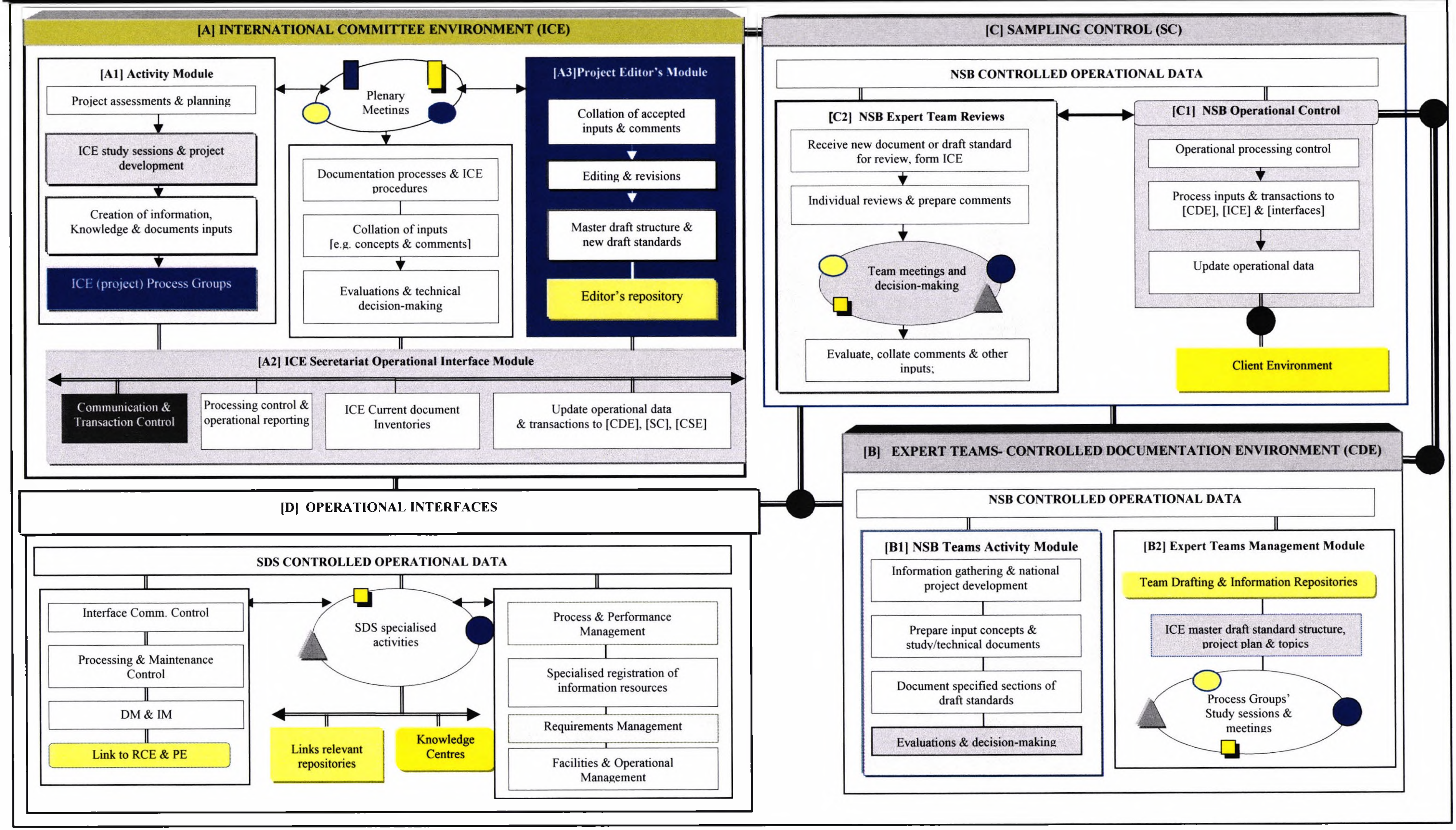
[iv] Specialised agencies (e.g. Registration Authorities).

[v] Registered interested parties that wish to contribute the development of the projects and stand to benefit from the results produced.

[vi] Teams, involving Management, Expert and Knowledge responsible for the activities and promulgating the results.

[vii] General public.

Figure 1: Main Choice SDS functional design
(Source: design by author)



3. Operational Boundaries

The SDS consists of **four main operational boundaries**:

[A] International Committee Environment (ICE)
[B] Controlled documentation environment (CDE)
[C] Sampling control (SC)
[D] SDS Operational Interfaces (OI)

Further, ICE operational boundaries have three open layered Modules making its actions and practices clearer.

[A] International Committee Environment (ICE)

This is created as a major operational boundary in the SDS. The term 'environment' is used here to stress emphasis on the expansive nature of the *functional views* of committee performance. Furthermore, 'environment' takes into account the proposals for extending ICE responsibilities to *strategic direction and co-ordination* of project development, namely:

[i] Focus on ICE *capacity leadership* for all technical aspects of project development.

[ii] *End-to-end management* of the development of assigned projects. It will determine requirements for specialised activities that to be performed. The results of specialised activities will contribute technical information to be utilised in ICE activities.

[iii] *Specialisation* based upon creating transparency of its activities, information, project development practices and product push of projects.

[iv] Focus on *functional interventionist* strategies influencing documentation of draft processes.

[v] Control of ICE technical information, knowledge and direction of intellectual flow. ICE will specify methods for: acquiring and creating information; analysis; evaluation; classification; documentation; quality control and management.

[vi] It will be concerned with matters to *improve the overall performance* of the SDS. This will include defining, redesigning and maintaining SDS processes; developing best practices and procedures to achieve consistency in areas that provide information as a resource in the SDS.

[Practices underpinning ICE responsibilities are described in Appendix 11 covering process management, project management, requirements and stakeholder identification].

[A1] ICE-Activity Module

This Module has important aspects of planing of committee activities, systematic production of information, defining of draft standards requirements through study sessions. Transparency of the activities performed in this Module and its results would achieved through Intranet integration. The operational scope of this Modules covers the following aspects:

[i] **A Process Group approach** has been incorporated in the functional content of ICE to establish transparent practices, as well as, to introduce 'locus of intellect' where activities require integration to relevant information, and location of core competencies.

Process Groups will provide the means to organise diverse project subject matters, definition, representation and execution of SDS processes. ICE will specify these Groups and assign the processes to knowledge or expert teams to function in the SDS operational boundaries. Process Groups will be self-managing, only reporting to ICE for scheduled plenary meetings. They will produce study and technical documents; sections of draft standards that contribute to ICE information base.

[ii] **ICE plenary meetings** are central to planning, evaluating contributions from various Expert Teams and results from Process Groups and defining project development strategies and those for Process Groups. ICE meetings will establish decisions and conclusions of each project development stage and draft standards based upon ballot results.

[A2] ICE Secretariat Operational Interface Module

This Module is assigned in ICE to support its operational activities, such as administration, information processing and transactions. ICE will retain current practice of Secretariats to manage operational matters, until workable operational logistics fitting the SDS can be defined.

The main contrast with current practice, however, is that in the SDS Secretariats have extended management scope of performance. Secretariats will have prominent roles for creating conditions for operational enhancement (see thesis Figure 8-6: Project Development Settings Operational Roles), and for functional interventionist strategies (Appendix 11). Example conditions cover developing methods for the creating and managing SDS operational information; service provision through SDS operational interfaces; localised project management and developing solutions for specialised operational activities.

[A3] Project Editor's Module

This Module can be extended to an exclusive operational boundary of the SDS. The main theme of the Module is *analysability and visibility* of Project Editors' activities, to include their responsibilities in the delivery of draft standards. Project Editors are accountable to ICE for the preparations of draft standards and evaluation of input information. They will be responsible for the review and revision processes of draft standards. They work with ICE Chairpersons, Draft Co-ordination Committees and Project Referees and knowledge workers ensuring that not only the documentation life cycles are co-ordinated, but also the required information is connected to this Module.

[i] During the development of the project, NSB Expert Team assigned to ICE Process Groups will report to the Project Editor. This approach provides the means to persistently review, collate and structure the information that is gathered from various project development activities or study sessions.

[ii] One or two members of the Expert Teams established for each Process Group would be chosen to attend critical collation and editing meetings.

Table 1 next, contains a breakdown of ICE functions, according to empirically determined documentation life cycles and project development phases. The activities in this table are by no means a complete list. They illustrate those matters that ICE will deal with, in order to execute and to connect documentation processes.

[B] Controlled Documentation Environment (CDE)

This is an operational boundary designated to the documentation of draft standards and other processes contributing to it. Contrary to the functional control in extant IITS environment, this `Controlled Environment' aims to reduce excessive documentation processes. Where possible, documentation processes will be integrated to 'controllable' combinations of capabilities and creative approaches.

This operational boundary thus stresses emphasis on requirements for locus of customisation, where information is created, documentation processes are integrated and intellect is converted to novel solutions. Functional links between ICE, CDE and other SDS interfaces. The CDE will have two open layered Modules described next:

[B1] NSB Teams Activity Module

[B2] Expert Teams Management Module

Table 1: Summary of ICE functions
(Source: compiled by author)

Project development cycle phases [connected to documentation processes]	**ICE activities [connected to Project development cycle]**
[1] Conceptualisation of project [ICE]	- Review of approved projects, project plan (from PPE) and abstraction of concepts - Design of content of project, project cycle, objectives, actions and procedures - Project task planning and design of tasks
[2] Problematisation and organise project [ICE]	- Abstraction of project concepts and problems - Conceptualisation and requirements setting - Conceptualisation and development of standardisation approaches - Feasibility studies with approved representative Organisations; R & D environments - Plan of master draft standard to guide writing processes
[3] Study sessions [Process Groups and individuals]	- Problem and requirements analysis - Information gathering, analysis and evaluation - Study and Technical documents ⊖ Specialised activities to contribute to project development ⊖ Control of ICE information, management of knowledge base, maintenance of information and knowledge
[4] Project development [ICE; CDE] [Representative Organisations] [R & D environments, Alliance firms]	- Technical development of inputs and standardisation approaches - Requirements analysis, evaluation and definition - Specialised activities to contribute to project development - Technical decision-making of available results through meetings - Input draft sections to master draft standard ⊖ R & D activity; analysis and validation of requirements ⊖ Results from representative Organisations; R & D environments ⊖ Harmonisation and integration of requirements through ballot resolution or plenary meetings ⊖ **Project Editors:** Structuring of master draft standard, reviews and editing
[5] Controlled documentation [Process Groups]	- Evaluation and selection of ICE information/knowledge base - Requirements evaluation and definition - Writing of draft standards (in series of WD, CD, DIS and Final text) - Reviews and evaluations of series of draft standards for ballots - Technical decision-making of available results through meetings - Harmonisation and integration of requirements through ballot resolution or plenary meetings ⊖ **Project Editors:** Structuring of master draft standard, reviews and editing; Revision of draft standards, after ballots ⊖ [Reviews and evaluations of ballot draft standards through CSE]
[6] Specifications [ICE, CDE] [Implementation Environment IE] [R & D environments, Alliance firms]	- Testing, implementation and validation - Requirements specification; integration of (ballot) agreed requirements and model solutions; harmonisation matters ⊖ **Project Editors:** Submission of final text to SDO

[B1] NSB Expert Teams Activity Module

Main features of this Module are the following:

[i] It will execute subject matters and activities assigned to ICE Process Groups. For example, study of the projects, creation of information, technical development, requirement analysis, implementation of draft concepts and evaluation of results.

[ii] Expert Teams will promote liaison activities with national collaborating parties covering and approved R & D environments, Certification Bodies, user groups and Registration Authorities. Through NB Expert Teams, collaborating parties will contribute interpretations of the implementation of concepts written in the various draft standards. The implementations provide facts that assist ICE in technical decision-making processes, specification requirements and writing of the draft standards.

[iii] Individual NSB Expert Teams will co-ordinate with others cross the SDS, striving for greater forms of *lateral performance approaches* This takes into account the need for effective co-ordination, communication, decision-making and integration assumptions underpinning the different layered levels of documentation life cycles.

[iv] This Module is likely to also adopt *organic performance approaches*. This is by virtue of the fact that each documentation life cycle deals with rapidly changing IT market needs and material contributed from various parties involved in the project. A combination of organic and lateral performance approaches is more effective to reduce uncertain contexts hence.

[v] Expert Teams will be encouraged to develop *best practices* that suit the processes executed for assigned Process Groups, for the accomplishment of project tasks assigned in ICE. Such practices will involve establishing and documenting methodologies for use in specific projects or project subject matters. On approval in ICE, these methodologies will be integrated in the project development activities and documentation processes. Methodologies assist in simplifying ways perfuming activities. Eventually, some of the methodologies will be repeatable in processes influencing elements connected to documentation of draft standards.

[vi] NSBs will provide IT resources for ensuring that Process Groups are well co-ordinated to perform to specified requirements an produce desired results.

[B2] NSB Expert Teams Management Module

This Module is assigned in the 'Controlled Documentation Environment' to take into account workable management approaches to be designed for Process Groups and Expert Teams. Overall, NSB Expert Teams will manage information assembled through various national activities. Each NSB Expert Team will evaluate their results for processing and management. Beside, co-ordinated NSB Expert Teams, Process Group approaches to be established in ICE will involve management at five different levels: project development strategy, methodology, ICE planning, performance practice and, meeting discussions and feedback. Management will also involve

[i] **Project-oriented practices:** budgets, process definition and process management; requirements management, event-based management of expert teams' information repositories and information management.

[ii] **People-oriented practices:** skill, problem solving, performance measurement and success factors

[C] SAMPLING CONTROL (SC)

This is an exclusive operational boundary of the SDS designed for the review of completed draft standards and other deliverable items, such as technical documents. Draft standards will be reviewed at national level. Process Group approaches can be useful to leverage relevant information, skills and continued cycles of the preparation of draft standards and review processes.

Core themes underpinning the [B] 'Controlled Documentation Environment (CDE)' and this operational boundary are:

[i] Effective performance approaches created to contribute to high-quality documentation and quality standards.

[ii] Locus of intellect in the review of draft standards, especially fostering information, knowledge competencies to produce high-quality results.

[iii] Definition of the process of SC work, and of the organisation needed to manage information; to facilitate effective collaborative exchanges and local decision-making, leading to incisive rectification of the draft standards prior to ballot.

The SC will combine different types of processes of the work and results derived from them. An important link is between the SC to [B]-Controlled Documentation Environment (CDE) to reinforce simpler lateral forms of co-ordination of NSB Expert Teams' work, as follows:

[i] Results from CDE processes will contribute to the preparation of chapters or sections of draft standards assigned by subject matters to different committee memberships. When a draft standard is completed, [A]-International Committee Environment (ICE) will transact this to the SC for review and editorial discussions.

[ii] NSB Expert Teams will provide national views of draft standards and comments. Project Editors Module [A3] will use the collective national views to structure the master draft standard and to integrate different types of requirements through editing meetings.

[iii] Decisions to submit draft standards for ballot would be established in [A] ICE plenary meetings.

[iv] Explicit and implicit requirements, such as conformance and compatibility properties to be included in the standard will be specified through ICE technical decision-making processes.

[C1] NSB Operational Control Module

For now, NSBs will be operational environments for the SDS. Controlled Documentation Environment (CDE) and Sampling Control (SC) will therefor share the NB Operational Control Module illustrated in the functional configuration as [C1]. As such, this Module will provide a 'point of contact' for operational matters.

[D] Operational interfaces

These interfaces provide support for SDS operational and systems matters. Knowledge workers appointed in the NB will support Expert Teams management activities covering information gathering, analysis and evaluation to results, and co-ordination of work (see thesis Figure 8-6: Project Development Settings Operational Roles).

4. Summary of Documentation Practices

Principle SDS practices cover documentation life cycles information gathering; collaboration; documentation; preparation for ballot; revisions and decision-making

4.1 Specification of Draft Standards Documentation Life Cycles

Figure 2 next, illustrates how the documentation of each draft standard has an exclusive life cycle. These life cycles provide the foundation for establishing the functional content of the SDS and for describing appropriate practices.

[i] International Committee Environment (ICE) is responsible for specifying the master structure of the intended draft standard. This master structure guides information gathering, project development, study and documentation. Individual developers are then assigned to document results of their activities to contribute to the master structure, chapter by chapter.

[ii] The Project Editor is accountable for every aspect of documentation process. Contributions from individuals would be accepted through meeting reviews, evaluations and validation processes. Accepted material is combined to produce a single output that is likely to contribute structure the subject matters of the draft standard. The Project Editor produces a complete draft standard from various approved sections.

[iii] A ballot review concludes each draft standard documentation life cycle.

4.2 Complementary SDS Technical Practices

Information gathering, collaboration, decision-making, documentation, preparation for ballot and draft revisions are technical practices supporting the documentation of each draft standard.

[i] **Information gathering exercises** are associated with technical activities that contribute to problematisation of the project proposal to interpret relevant concepts, problems and requirements, technical information. Table 1 contains a full list of these activities.

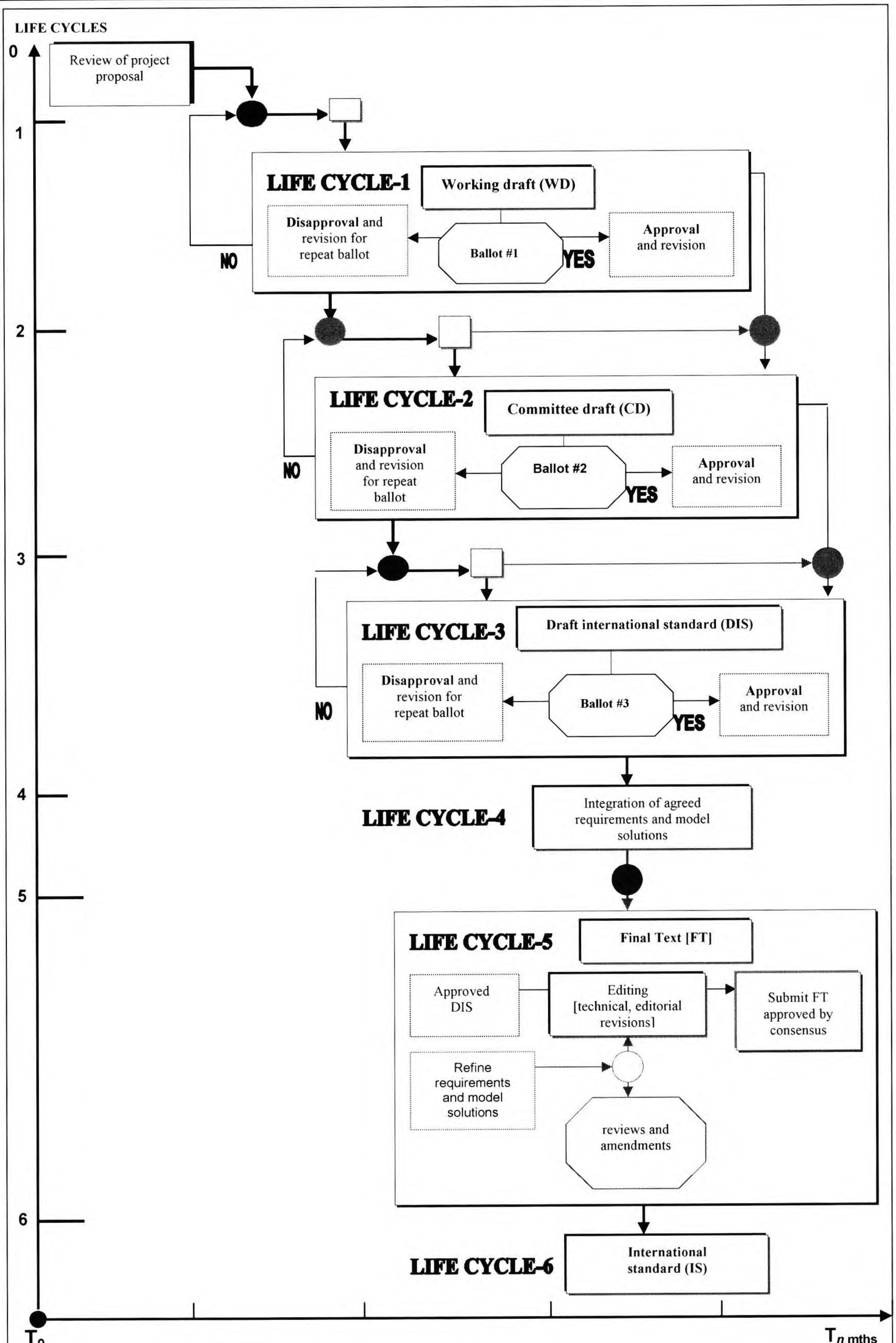
[ii] **Collaboration** is the only method of communication in the development of the project and documentation of draft standards. SDS collaborative exchanges among individual developers would be as semi-structured allowing for execution of tasks and sharing ideas. Facilitated collaborative exchanges will involve the use of relevant IS applications.

[iii] **Decision-making** is incorporated in every aspect of the documentation life cycles. This is included in meetings across the operational boundaries for integrating various results contributing the draft standard in progress.

[iv] **Preparations for ballot** involve the review of a complete draft standard to minimise technical and editorial errors that might be caused by collaborative efforts. These reviews help to identify potential conflicting requirements, new concepts and technical constraints in the development of the project. Comments evaluated from the Sampling Control (SC) reviews are given to the Project Editors to modify the draft standard in preparation for a relevant ballot.

[v] Upon ballot approval and recommendations from ICE, the Project Editor revises the current draft standard to incorporate reconciled comments. When the revised draft standard satisfies committee validation procedures and depending on positive ballot results, the project can be progressed to the next stage. A new draft standard and its documentation life cycle are activated.

Figure 2: Illustration of Draft Standards Documentation Life Cycles
(Source: compiled by author)



expected TIME SCALES based on documentation, study, project development, ballot, results integration processes

KEY	
	Standardisation activities: Technical development; requirements analysis and specification; technical decision-making; concept integration phases.
	Study and creation of ICE Information base: Production of technical documents; evaluation of information contributing to project development and documentation processes
	Integration processes for ballot results, new information and requirements

4.3 Deliverable Items

Table 2 contains the main categories of SDS deliverable items with regard to its operational boundaries.

Table 2: Summary of deliverable items
(Source: compiled by author)

Operational boundary	Categories of deliverable items
[A] INTERNATIONAL COMMITTEE ENVIRONMENT [ICE]	- Draft standards in progress - Technical information - Information, study and technical documents - Evaluation reports (comments, resolutions and decisions) - Technical and educational documents from specialised activities - ICE operational information, operational plans and performance reports
[A3] ICE- PROJECT EDITORS MODULE	- Draft standards for review and for ballot registration - Comments collation reports, editing decisions and technical documents
[B] TEAM-CONTROLLED DOCUMENTATION ENVIRONMENT [CDE]	- Sections to draft standards and project proposals for consideration - Technical information - Information, study and technical documents - NB information and reports from specialised activities - NB operational reports and requirements - Operational work procedures for review
[C] SAMPLING CONTROL [SC]	- Comments from reviewed study documents and draft standards - Information documents from reviewed specialised activities

4.4 Operational Content Control States

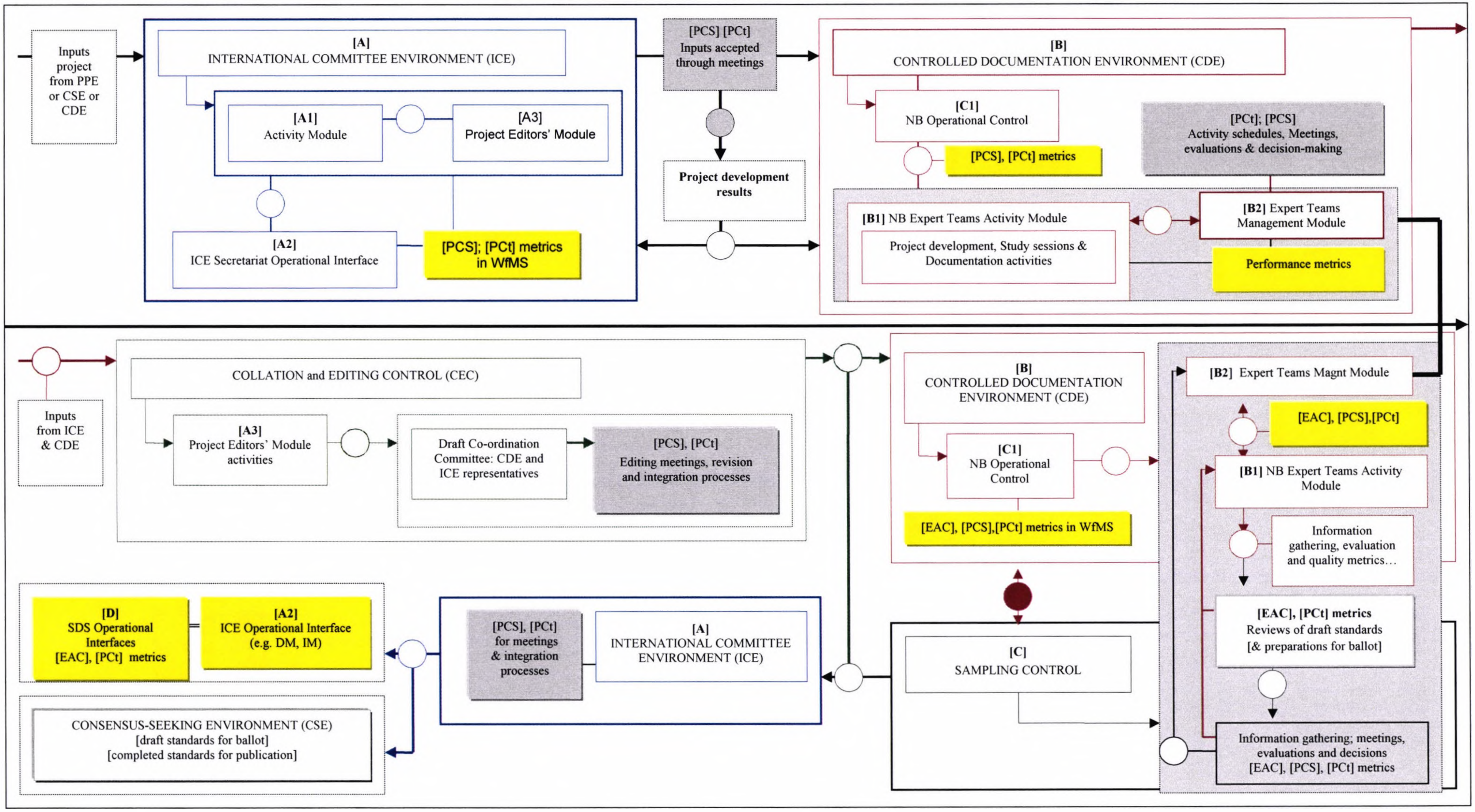
Figure 3 (next page) illustrates the SDS operational content in AFD format. This diagram also shows prominent control states in areas where performance needs to be measured. Three types of control states are EAC, PCS and PCt.

[i] **Error avoidance control (EAC)** illustrates the fact that, committees always endeavour to minimise unnecessary errors in their activities. EAC will be implemented in two operational boundaries: Controlled Documentation Environment (CDE) and Sampling Control (SC). Three situations in which EAC applies to evaluations of information and task results; draft standard reviews and editorial meetings to normalise votes and comments. EAC specified time scales for any review processes leading to an outcome.

[ii] **Proportional Control States (PCS)** are needed in area concerned with intense administration, operational and management activities. However, PCS can be applied in any part of the SDS operational boundaries in areas where primary and support operational activities should be analysed or evaluated. Typical areas are communication, documents processing, and meetings. Workflow management will be activated on relevant systems to assign, prioritise and communicate the status of activities. Where necessary, **EAC and PCS** can work together in situations where critical information needs to be created, evaluated reconciled, or implementation results need to reviewed before a decision is taken regarding its value to the development of the draft standard in process.

[iii] **Process Control Time (PCt)** is a control state for assigning performance time scales to particular activities. ICE will assign separate time scales relevant to the reviews of draft standard or project development phases linked to the documentation life cycle.

Figure 3: Level-1 AFD showing SDS Functional Content ~ sequence of operational boundaries and ~ operational control states
(Source: design y author)



5. Scope of SDS Technical-IS Design

The SDS is designed to provide IS-facilitated draft standards documentation and operational matters. **Figure 4** next, shows the Technical-IS design features.

5.1 SDS Systems Modules

The SDS has systems Modules that relate to the main operational boundaries [A], [B], [C] and [D] as follows:

[A] ICE

[A1] ICE Operational Interface Module [Secretariat VPN; Comm. Transaction and Operational Control

[A2] ICE Activity Module

[A3] Activity Management Module

[A4] Meeting Module

[B] Teams-CDE

[B1] NB Operational Control [NSB VPN; Comm. Transaction and Operational Control

[B2] ICE Process Groups Activity Module

[B3] Sampling Control and Evaluation Module

[C] CEC

[C1] Project Editor's Module

5.2 Goals of Systems Environment

Two relevant systems goals for the DSDE are:

[Goal 1]: To provide systems capabilities for creating performance competency and effective approaches for managing documentation life cycles through distributed computing approaches.

[Goal 2]: To introduce interfaces that provide solutions for:
Document management, creation of technical information and knowledge, information and knowledge management; sharing information and competency in operational practices.

5.3 Summary of IS Design Features

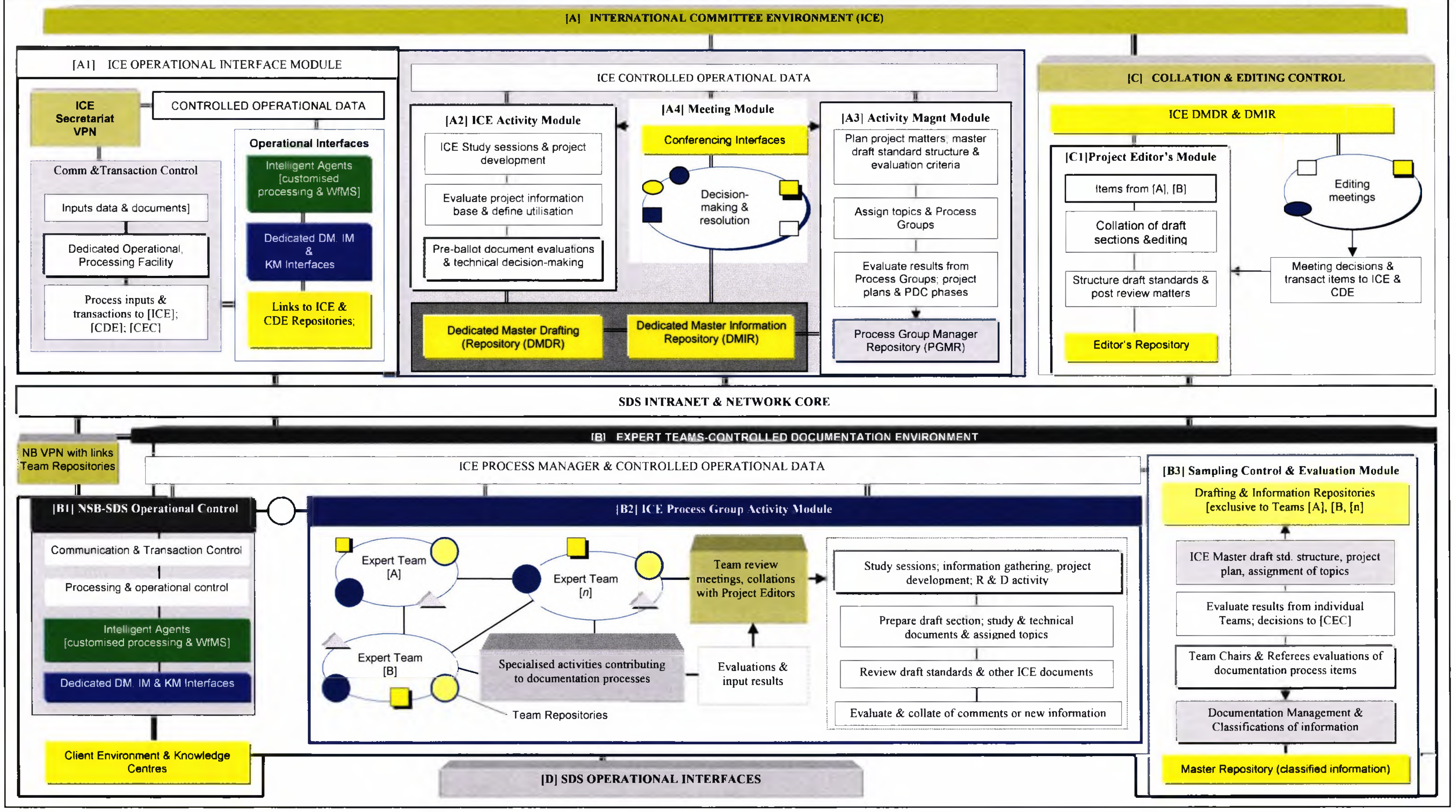
The SDS-IS design in Figure 4 next, adopts the representations of the open layered operational boundaries of the functional design (Figure 1). Thus, the IS operational boundaries are similar to those of the functional design:

[i] The SDS will operate on Intranet and Network Core; the technology backbone to connect and frames its open layered operational boundaries to offer highly integrated functional aspects.

[ii] The Intranet and Network Core will support distributed computing and communication approaches relevant to facilitate collaborative activities. Common applications can be linked across SDS to provide customised solutions for communication, processing, transactions and workflow using information from the same source.

[iii] These partitioned Modules can create layered IS resources to provide maximum connectivity of as many functional aspects as possible. Each Module will support different styles of operational patterns; connectivity to common sources of information and integrated electronic methods of working. Because of the distributed computing and communication approaches, the Modules will make some commitment regarding the definition and execution of processes.

Figure 4: Main Choice SDS Technical-IS Design
(Source: design by author)



5.4 Overview of Scope of SDS-IS Content

Operational boundaries depicted in Figure 4 are summarised to present the recommendations for the scope of the SDS-IS content.

[A] ICE Operational Interface Module

This Module is shared between an assigned Secretariat and ICE. The Secretariat will manage ICE systems resources and services. Components of the Operational Interface Module are stated as recommendations that can be implemented, optionally: Secretariat VPN; Communication Transaction Control and Operational interfaces.

[Recommendation #1]: Secretariat Virtual Private Networks (VPN)

With the SDS Intranet and Network Core, Secretariat IT systems and service provisions can be connected to **VPN nodes** that have become increasingly useful to enterprises seeking high-level integration. A major advantage of a VPN node is to connect ICE to the Secretariat enterprise databases for providing applications, operational data and communication links to registered Committee Information Repositories.

[Recommendation #2]: Communication and Transaction Control

This can be used as a Module for dedicated electronic control of ICE transactions and co-ordination of work. It will support a **Dedicated Operational Processing Facility** for Secretariat primary activities involving:

[i] Receiving and processing input documents or information from CDE and CEC.

[ii] Registration of documents to be disseminated to ICE memberships or Process Groups for information or review.

[iii] Maintaining ICE membership contact details that assist in the dissemination of documents or other operational matters.

[iv] Management of ICE inventories of registered documents and membership.

[v] Processing ICE information to be published.

[vi] Providing the delivery of services and operational cohesion across SDS operational boundaries.

[Recommendation #3]: Dedicated Interfaces for ICE

Interfaces can be assigned to Activity Modules for service provision and to satisfy requirements for the continuity of ICE and Secretariat activities.

[i] **Intelligent Agents [for customised processing through Workflow Management application].** Agents can provide a variety of customised workflow management solutions for processing. The solution can include automated methods for registration of documents; cost accounting; transaction and maintenance of operational data.

[ii] **Dedicated Document Management (DM)**

ICE will deal with varieties of in-coming and out-going documents that need processed. This interface is dedicated to manage documents or files. It will complement the Dedicated Operational Processing Facility to also manage communication, processing, printing and transactions.

[iii] **Dedicated Information Management (IM)**

This will provide data storage for the results obtained from primary activities performed in the Secretariat.

[iv] **(Creation of Knowledge) Knowledge Management (KM)**

ICE will gather technical information through various phases of project development and documentation draft standards or specialised activities. This information will be evaluated exclusively to create ICE information base and knowledge, for repeated use in various activities. This interface supports systems that are necessary to establish information creation processes at ICE, CDE and SC operational boundaries. Typical software systems are Artificial Intelligent (AI), GroupWare and GDSS applications that can be linked to knowledge based databases for information gathering, analysis and evaluation.

[v]**Links to ICE and CDE Repositories**

The Secretariat Operational Interface Module will provide links to the Repositories managed in ICE and in the CDE:

[Recommendation #4]: ICE Activity Module

This Module with activities listed in Table 1 will have dedicated Repositories: Master Drafting Repository, Master Information Repository and Process Group Manager Repository.

[i] **Dedicated Master Drafting Repository (DMDR)**

This will support ICE study sessions for information gathering, study and technical documents and approved technical information. Since it is master repository, DMDR can be formatted to design different types of Modules that provide options for organising and structuring its content: such as, management of draft standard and information and software applications for remote access. ICE Personnel (Chair, Project Editor, Knowledge workers and selected skilled developers) will have the responsibility to manage the content of DMDR, and to make approved changes to its Modules.

DMDR and DMIR must be implemented as robust facilities. It should reside on an Internet-accessible server to allow the developers to have access in particular, to download ICE reference material to their individual systems. The developers would be able to review the master draft standard, amend sections and provide comments that would be transacted back to the DMDR

[ii] **Dedicated Master Information Repository (DMIR)**

DMIR will contain evaluated information and knowledge that is exclusive to ICE memberships, to access for reference.

[iii] **Process Group Manager Repository (PGMR)**

With the recommendation for ICE is to establish **Process Groups** in the CDE and SC operational boundaries, the starting point is to **install a PGMR.** This Repository simply functions as a **'Process Manager'.** It will support design of how these Process Groups and their processes can be defined, executed and managed to create transparent collaborative practices and to multitask ICE activities.

To summarise, the SDS requires facilitated collaboration to be developed through practice. Creating transparent collaborative practices is the responsibility of ICE and its memberships that participate in the project. It takes time to establish approaches that will work. The practices will depend on the IS resources that are available to ICE for use and common goals that would be supported by each participant. Often, collaborative practices become complicated when more participant memberships are created and as the project matures.

- There is a need integrate **DMDR and DMIR** to allow ICE to provide common software applications; to define criteria for evaluating assembled information and for structuring required uses in SDS.
- Matters contained in the DMDR and DMIR would be evaluated through ICE meetings to allow consensual decision-making on the range of information contributing to the development of the project.
- The degree of integration of these Repositories will depend on the software systems that are available to ICE for use in its collaborative activities. GroupWare and Group Decision Support Systems (GDSS) software especially, have many of the features that will integrate and support such diversity in the collaborative practices. Typically, GDSS will support collaborative draft preparations, decision-making, electronic meetings, information exchanges and management.

[Recommendation #5]: Meeting Module

This Module provides a facility for evaluating ICE project development matters, integration of requirements, negotiation, decision-making and resolution. With the variety of information required to facilitate constructive plenary meetings, this Module will be accessible through links to ICE Master Repositories; Secretariat Operational Interface Module.

- **Dedicated ICE Master Repositories** (such as DMDR and DMIR) will contain structured and unstructured comments to be analysed, evaluation and processed through plenary meeting discussions.
- **A Conferencing Interface** has been assigned to support plenary meetings. A practical approach would link this interface on the Secretariat VPN to allow remote access to controlled operational data, approved documents and applications that would assist in these meetings.

[Recommendation #5]: Process Groups

[i] **Process Groups** only work because they are encapsulated in IS resources regardless of their functions. SDS can function more effectively with Process Groups, because they support collaborative exchanges, co-ordination of work and performance of activities. Process Groups can also help to define the representation, execution and integration of required documentation processes,

[ii] **Expert Teams** can exchange information performing related subject matters for other Process Group processes. Expert Teams in the CDE and SC operational boundaries will be regarded as members of different types of Process Groups. They examine assigned project subject matters. They co-operate on the same objective specified for their relevant Process Group.

[iii] Individual Process Group can consist of processes concerning **subject matters** for a single project. Defined processes hold the same information concerning executed activities. Examples of the processes can include information gathering to produce input study and technical documents; writing assigned chapters of draft standards and review of draft standards.

[iv] Within a Process Group, two or more Expert Teams can convene at the same time, to present the summation of their results and to collate results bearing on similar project subject matters. This approach provides lateral decision-making of Expert Teams spread across a number of NSBs. Evaluated results and contributions from individual Expert Teams would be pooled together to provide a summation. The results can be downloaded to ICE Master Repositories as structured data to be processed or requiring plenary decisions.

[v] In the cases of a draft standard, this summation of results is input to the master draft standard. Lateral decision-making at Expert Team level can expedite the structuring and editing of the draft standard. Skilled representatives of Expert Teams would be invited to CEC editing meetings to present their results and to structure submitted draft chapters or sections.

6. Summation of SDS

6.1 Main advantages of SDS

[i] The SDS has distinctive and overlapping activities (Table 1). The open layered CBD framework satisfies the need to **introduce clarity in the content of these activities.**

[ii] **Open layered operational boundaries** help to simplify performance through partitioning complicated contents of SDS functions. Clarity in the content of individual operational boundaries requires a combination of best performance practices and relevant time management approaches to yield significant time reductions.

[iii] Creating Process Groups is an aim of **time reduction efforts** in the individualised draft standard documentation life cycles (Figure 2). The use of IS in Process Groups processes can not be compromised hence.

[iv] All SDS operational boundaries has been designed for **high-level integration** of IS resources. Integrated SDS functional features create conditions for performing separate activities or processes concurrently, in different locations. Processes will appear as though they are performed indivisibility or in a seamless manner. Another consideration is to greatly reduce unnecessary processes, ambiguous practices, opting for electronic methods of working that are traceable across the SDS.

[v] **Operational cost reduction** will be the direct result of efficient performances and practices. A good starting point is that the SDS operational boundaries will perform an exclusive domain of activities. Each boundary will be required to account for those performances that satisfy its set objectives and requirements. Costs will be tracked through financial analysis of processing, systems resources and personnel matters. Time reductions will cover analysis of measurable performance cycles; service responses to customers and product delivery schedules.

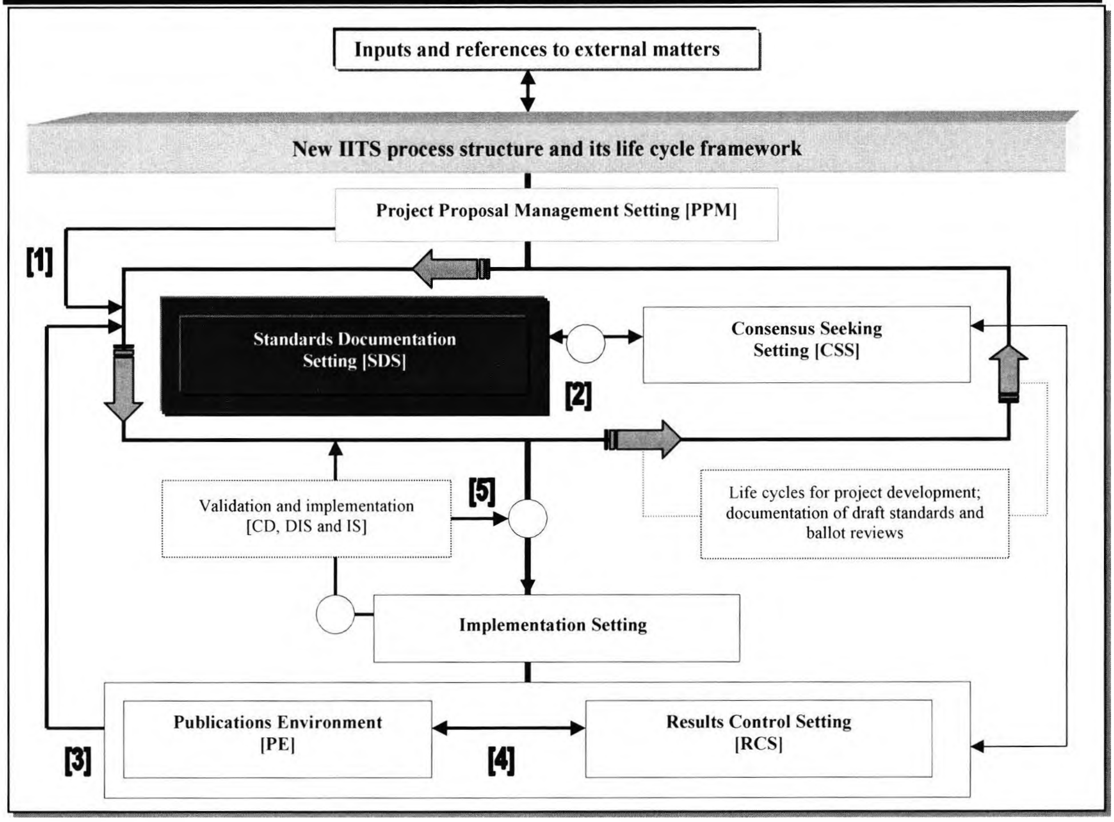
6.2 Limitations

The only foreseeable limitation is that lack of commitment on the part of SDOs and NSBs to take control of the unique advantages and opportunities that the SDS will bring.

6.3 Boundaries of Operation

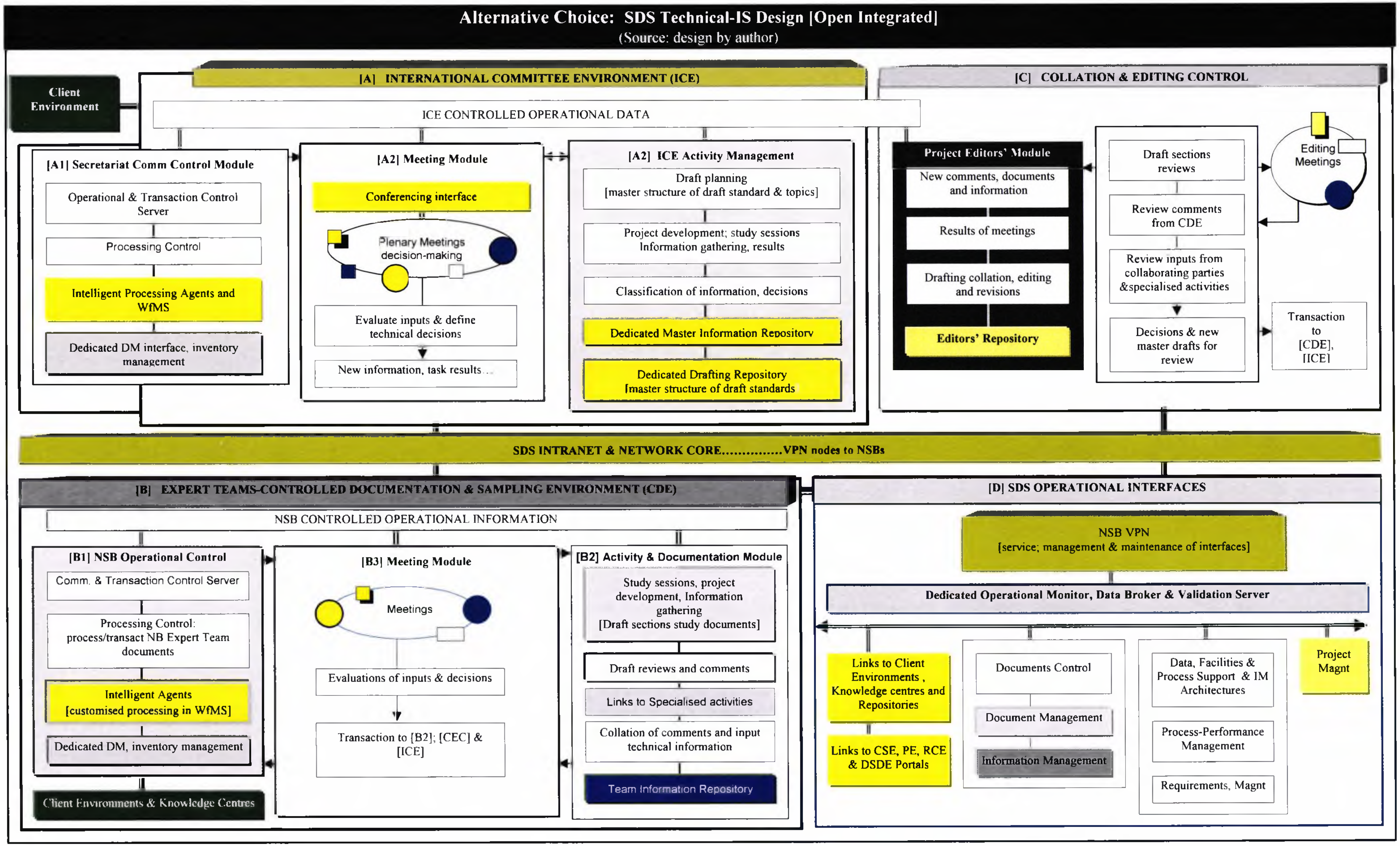
Figure 5 illustrates relevant boundaries within which the SDS will operate, with respect to the Integrative Solution Framework of the reconstructed IITS process (thesis Figure8-5).

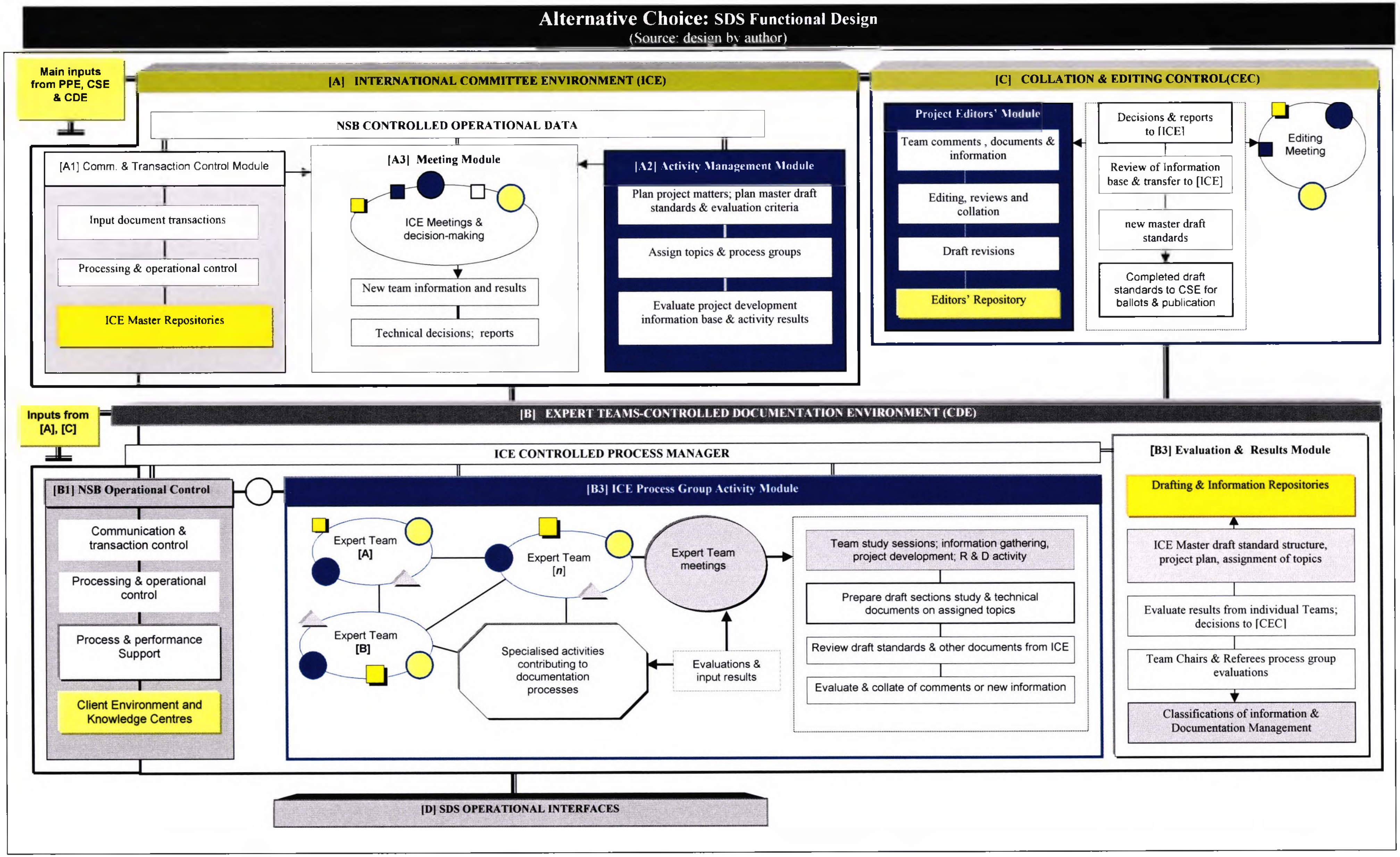
Figure 5: SDS Boundaries of Operation
(Source: compiled by author)



6.4 Alternative Designs

Two alternative designs for the SDS are offered for choice. One is functional, and the other is a technical-IS design.


Alternative Choice: SDS Technical-IS Design [Open Integrated]
(Source: design by author)
Client Environment
[A] INTERNATIONAL COMMITTEE ENVIRONMENT (ICE)
ICE CONTROLLED OPERATIONAL DATA
[A1] Secretariat Comm Control Module
Operational & Transaction Control Server
Processing Control
Intelligent Processing Agents and WfMS
Dedicated DM interface, inventory management
[A2] Meeting Module
Conferencing interface
Plenary Meetings decision-making
Evaluate inputs & define technical decisions
New information, task results
[A2] ICE Activity Management
Draft planning [master structure of draft standard & topics]
Project development; study sessions Information gathering, results
Classification of information, decisions
Dedicated Master Information Repository
Dedicated Drafting Repository [master structure of draft standards
[C] COLLATION & EDITING CONTROL
Project Editors' Module
New comments, documents and information
Results of meetings
Drafting collation, editing and revisions
Editors' Repository
Draft sections reviews
Review comments from CDE
Review inputs from collaborating parties &specialised activities
Decisions & new master drafts for review
Editing Meetings
Transaction to [CDE], [ICE]
SDS INTRANET & NETWORK CORE...............VPN nodes to NSBs
[B] EXPERT TEAMS-CONTROLLED DOCUMENTATION & SAMPLING ENVIRONMENT (CDE)
NSB CONTROLLED OPERATIONAL INFORMATION
[B1] NSB Operational Control
Comm. & Transaction Control Server
Processing Control: process/transact NB Expert Team documents
Intelligent Agents [customised processing in WfMS]
Dedicated DM, inventory management
Client Environments & Knowledge Centres
[B3] Meeting Module
Meetings
Evaluations of inputs & decisions
Transaction to [B2]; [CEC] & [ICE]
[B2] Activity & Documentation Module
Study sessions, project development, Information gathering [Draft sections study documents]
Draft reviews and comments
Links to Specialised activities
Collation of comments and input technical information
Team Information Repository
[D] SDS OPERATIONAL INTERFACES
NSB VPN [service; management & maintenance of interfaces]
Dedicated Operational Monitor, Data Broker & Validation Server
Links to Client Environments, Knowledge centres and Repositories
Links to CSE, PE, RCE & DSDE Portals
Documents Control
Document Management
Information Management
Data, Facilities & Process Support & IM Architectures
Process-Performance Management
Requirements, Magnt
Project Magnt



Alternative Choice: SDS Functional Design
(Source: design by author)
Main inputs from PPE, CSE & CDE
[A] INTERNATIONAL COMMITTEE ENVIRONMENT (ICE)
NSB CONTROLLED OPERATIONAL DATA
[A1] Comm. & Transaction Control Module
Input document transactions
Processing & operational control
ICE Master Repositories
[A3] Meeting Module
ICE Meetings & decision-making
New team information and results
Technical decisions; reports
[A2] Activity Management Module
Plan project matters; plan master draft standards & evaluation criteria
Assign topics & process groups
Evaluate project development information base & activity results
[C] COLLATION & EDITING CONTROL(CEC)
Project Editors' Module
Team comments, documents & information
Editing, reviews and collation
Draft revisions
Editors' Repository
Decisions & reports to [ICE]
Review of information base & transfer to [ICE]
new master draft standards
Completed draft standards to CSE for ballots & publication
Editing Meeting
Inputs from [A], [C]
[B] EXPERT TEAMS-CONTROLLED DOCUMENTATION ENVIRONMENT (CDE)
ICE CONTROLLED PROCESS MANAGER
[B1] NSB Operational Control
Communication & transaction control
Processing & operational control
Process & performance Support
Client Environment and Knowledge Centres
[B3] ICE Process Group Activity Module
Expert Team [A]
Expert Team [n]
Expert Team [B]
Expert Team meetings
Specialised activities contributing to documentation processes
Evaluations & input results
Team study sessions; information gathering, project development; R & D activity
Prepare draft sections study & technical documents on assigned topics
Review draft standards & other documents from ICE
Evaluate & collate of comments or new information
[B3] Evaluation & Results Module
Drafting & Information Repositories
ICE Master draft standard structure, project plan, assignment of topics
Evaluate results from individual Teams; decisions to [CEC]
Team Chairs & Referees process group evaluations
Classifications of information & Documentation Management
[D] SDS OPERATIONAL INTERFACES

Appendix 1: Methodological considerations of the use of OIPT features
(Source: compiled by author)

Analytical units of organisation infrastructure	Level of analysis of OIPT	Decision parameters influencing level of analysis [analysis, data collection and data analysis]	Analytic principles [analysis, data analysis, evaluation of items and resolution of findings]
[A] MACRO LEVEL	[1] Environment	Conditional factors (e.g. changes, demands, heterogeneity). Inter-relationships with organisation.	Complexity; uncertainty. Dynamism (e.g. sources of inputs, interactions, relationships, information flow).
	[2] Organisation	Organisation assumptions (e.g. inputs, customers, markets). Size of organisation. Design of structural features: components, reporting & control. Inter-relationships with environment.	Interdependencies of organisation structures. Structural control (e.g. departmentalisation of structures, teams).
	[3] Organisation functions	Purpose & differentiation of functions. Components & boundaries of functions. Functional strategies for achieving set objectives (e.g. tasks, methods). Functional practices (e.g. operational, technical & management).	Complexity of conditions of functioning. Complexity & dynamism functional practices. Patterns of functional elements. Relationships between organisational functions & environment. Relationships between inter-organisational functions.
	[4] Social constructs	Interactions. Performance. Responsibilities in the organisation.	Groups (members) & styles of group functioning. Governed behaviours & practices (e.g. communication, co-ordination, rules). Cultural aspects governing behaviours & practices.
[B] MICRO LEVEL	[1] Information	Content & types of information. Amount of information available to organisation. Context of use of information. Information assumptions (e.g. acquisition, creation, dissemination).	Complexity of sources & of inputs. Dynamics of use of information. Relationships between information, performance & practices used in organisation. Uncertainty of information.
	[2] Information processing	Assumptions of information processing (e.g. use, management, exchange). Methods of processing within functions. Organisational functional factors of information processing. Results of information processing & interpretations in tasks.	Complexity of information processing activities & practices. Uncertainty of information processing. Organisational functional control of information processing.
	[3] Tasks	Task inputs Tasks variety. Links of tasks to information.	Complexity of content of tasks & results. Task uncertainty.
	[4] Task performance	Human actions. Task & processes in production of results & content of results. Task performance practices (e.g. groups/teams & resources). Performance measures (e.g. time, objectives, results).	Analysability, variability & interdependencies in tasks. Complexity of content of tasks compared to results. Organisation goal diversity compared to tasks. Task performance exceptions(e.g. co-ordination, decision-making & interpretations)

Appendix 1: Methodological considerations of the use of OIPT features

(Source: compiled by author)

Analytical units of organisation infrastructure	Level of analysis of OIPT	Decision parameters influencing level of analysis [analysis, data collection and data analysis]	Analytic principles [analysis, data analysis, evaluation of items and resolution of findings]
[C] DESIGN and SOLUTION LEVEL	[1] Requirements	Organisation information needs. Task performance needs. Technology.	Complexity of information & processing requirements. Complexity of information processing strategies (e.g. processing capability). Alternatives for dealing with complexity of required strategies & uncertainty. IS/technology requirements.
	[2] Design strategy & choice	Design of organisation functions in relationship with to information & performance. Organisation processes in relation to groups, information & performance. Organisation processes & exceptions (e.g. co-ordination, information flow). Design of information systems.	Alternatives for dealing with complexity organisation of functions, processes & performance. Alternatives for dealing with information & information processing needs. Capabilities for reducing complexity, equivocality & uncertainty.

Appendix 2: Case study operational plan (Source: compiled by author)	
Reference research Goal #1 [Chapter 1, Figure 1-3]: To examine the **environment** in which IIT standards are developed, describing critically, its representations of functioning.	**Reference research goal #2** [Chapter 1, Figure 1-3] To examine **selected projects** that can demonstrate the reality of how IIT standards are developed and the set of phenomena they represent with regard to the solution proposal
[A] Area(s) of research study: Forums, secretariats for chosen committees. - GIITS: France, Italy, Japan, USA (private organisations) - SES: Canada and USA (private organisation). - [Policy Delphi Questionnaires for global environment: SDOs (CEN-CENELEC, IEEE, IEC, ISO and ITU); ISO JTC 1, ISO ITTF and active NSBs.	**[A] Area(s) of research study:** [1] Generic IT standards (GIITS) and provide a contrast with SES projects.
[B] Case study objectives: [1] To study how SDOs and NSBs operate. [2] To study operational practices bearing on project development. [3] To compare the finding and develop profiles of operational approaches.	**[B] Case study objectives:** [1] To study how technical standards projects are developed through their life cycle covering processes, standardisation approaches and information. [2] To study the committees that develop the standards covering their performance practices. [3] To compare the case findings from GIITS and SES projects so as to establish reasonably accurate representations of standardisation processes.
[C] Sampling parameters, core investigation: [1] Organisational and operational structures [2] Operational content [3] Operational practices across forums and NSBs. [4] Operational links across SDO, forums and NSBs. [5] Operational difficulties	**[C] Sampling parameters, core investigation:** [1] Committees chosen for study matching the projects. [2] Content of technical standards projects chosen for study covering their subject matters and characteristic features. [3] Content of the project development cycles. [4] Standardisation approaches relevant to the projects Performance of committees (e.g. participation, activities, conditions of performance, procedures). [5] Standardisation practices employed in the committees. [6] Other representative elements of standardisation concerning approaches, processes and project content.
[D] Methodological perspectives: [1] ***Macro perspective:*** Global environment functionality [2] ***Macro perspective:*** Operational content project development vs. environment functionality [2] *Epistemology of interpretations:* Comparison of case findings from forums and secretariats, and explanations.	**[D] Methodological perspectives:** [1] *Ontology:* Phenomena of project development in real life committee settings. [2] *Micro perspective of project development:* project subject matters, procedures, committee performance. [3] *Micro perspective* through predetermined project development stages: committee inputs, content of tasks, information, project development practices. [4] *Epistemology of interpretations* - Comparison of case findings. - Construction of examined reality and explanations.

Appendix 3: Integration for framing of study of projects

(Source: compiled by author)

Core project elements from reviewed proposals					
GIITS projects			SES projects		Predetermined project development stages
ISO 10646	JPEG-1	MPEG-1	ISO 12207-1	IEEE 1074	Proposal / Committee study / Ballots / Draft standard / Publish Standard
Base standards review	Baseline methods	Baseline methods	Survey of SDLCP evaluations	Primary SLC processes	xxxxxxxx
Character Codes	Baseline sequential codec; DCT based methods for "lossy" coding of images	Selection of base standards	List of life cycle processes and models	Concept exploration	xxxxxxxxx xxxxxxxxxxxxxxxxxxxxxxxxxx **< Map project items >**
Selection of base standards	Digital source image	Patents & selection	Selection of processes	Software project models	xxxxxxxxxx xxxxxxxxxxxxxxxx
Adoption of base standards	Application definitions	Application parameters and requirements	Selection of processes	Survey and evaluations of SLC processes	xxxxx xxxxxxx xxxx
Structure of character codes and scripts	Base standards review	Coding schemes dependent on applications requirements	Organization processes for SDLP	Concept exploration of SLCP from surveys	xxxxxxxxxxxxxx xxxxxxxxxxx xxxxxx xxxxxxx xxxxxx xxxxxxxxxxxxxxxxx
Encoding formats	Modes of operation [coding] [encoding]	Terminology requirements	Levels of SDLCP assessments and interpretation	Project objects and plan	xxxxxxxxxxxxx xxxxx xxxxxx
Applicatio n profiles	Video coding algorithms	Subjective test; source models and verification	Levels of unified concepts for SDLCP	Master draft structure of proposed standard	xxxxxxxxxxxxxx xxxxxxxxxxx
Draft structure of adopted concepts and scripts	Coding parameters	Concept definition based on test results	Prioritisation and categorising of SDLCP	Requirements analysis	xxxxxx xxxxxxxxx xxxxxx xxxxx xxxxx xxxxxxxxxxxxx xxxxx
Character parameters and sequences	Draft standard structure	coding schemes [layers 1-2 etc] and compression methods	Draft structure	Support methods and tools for SLCP	xxxxxxxxx xxxxxx xxxxx xxxxxxxxx xxxxxx xxxxxxxxxxxxx
Structuring of draft	Draft writing and review plan	Draft structure of adopted concepts and concept development	Terminology requirements	Draft review plan and ballot results management	xxxxxx xxxxxxxxx xxxxxxxx xxxxxx xxxxxxxxx xxxxxx xxxxx

[Reviewed literature concepts of translation e.g.: sociology of translation, group performance and practices; SWEP]

Internal perspective of PDC [and committee project development phases]	Level 1: technical core of project development Level 2: technical development Level 3: knowledge and tasks; Level 4: human activity and methods of working Level 5: control procedures.	xxxxxx xxxxxxxxx xxxxxxxx xxxxxx xxxxxxxxx xxxxxx xxxxx xxxxxxxxxxxxxxxxx **< Map project items >** xxxxx xxxxxxxxx xxxxxxxxx xxxxx xxxxxxxxxxxx xxxxx xxxxxx xxx xxxxxx

Appendix 4: Summary classifications of feedback on global study items

Distribution of items	Characteristics of appraised items	No. of key issues
Environment level: 18 items from SDOs ➡ [CEN & CENELEC, IEEE, IEC, ISO, ITU]	Environment structural constructs	9
	Environment functional constructs e.g. communication & co-ordination	12
	Main processes for IITS efforts	15
	Major stakeholders for IITS efforts across SDOs & NSBs	25
Organisation level: 22 items from secretariats 25 items from NSBs	Expertise to support IITS activities	24
	Information availability	10
	- Operational, strategic, tactical information	18
	- Operational practices across SDOs	36
	- IT systems out-of-date systems	6
	- Poor management of environment resources/operations	45
	Process management, operations management	12
	Standardisation performance matters: processes, time,	45
	Process requirements & their visibility	34
	Diverse operations, difficult to control	46
Committee level: 45 items from developers	Compatibility of IT standards based on diverse processes	34
	Visibility of importance of processes	16
	Process alternatives	5
	Costs of IITS activities	23
	Visibility of developers' performance	39
	Simplification & visibility of processes	27

Clarification guidelines on exploratory study items

Please indicate in this questionnaire that the items listed represent the following evaluated concepts:

[A1] The correct terms that apply across all SDOs listed.
[*Please indicate any modification to terms where it applies]
[A2] The categories of operations that SDOs and NSBs perform.
[A3] The correct categorisation of information and where it applies.
[A4] The categories of consensus principles listed & where they applies.
[A5] The categories of functional responsibilities across SDOs & NSBs
[A6] The correct categorisation of operational practices.
[*Please indicate any modifications to terms for operations matters]
[A7] The correct designation of the processes you listed.
[*Please indicate any modification to terms that apply in the model provided in Attachment #1: Processes across SDOs]
[A8] The categories of operational difficulties as correct and up to date.

Appendix 4A: Forums and Secretariats questionnaires
(Source: compiled by author)

INTRODUCTION

Following my introduction letter to this survey, this questionnaire aim to collect material regarding the **committee management practices**. Your survey responses will be used to establish **universal practices** across forums and NSB-secretariat covering administration, costs, operational requirements, information needs, operational procedures and difficulties.

Questionnaire A1
Content of committee management practices

Notes: This part consists of 1 section with questions, **[A1]** to **[A11]**. Please respond to as many questions as possible, so that I can have wide adequate data to make my evaluations.

PART A: Committee Chairmen, secretariat project managers [AFNOR, CELT, USA, JISC] &forum senior managers [IEEE SES & JTC I to respond to these questions.

[A1]: Please summarise your CURRENT SECRETARIAT RESPONSIBILITIES that apply to the committees I have listed on the cover page as my case study.
[*Please provide documents with these responsibilities or any additional information f the history of the committees]

[A2]: As a **Committee Chairman**, what are the KEY MATTERS of managing the committee that are you are currently responsible for.

[A3]: How are your Chairmen responsibilities connected to the committee Secretariat or forum as in IEEE or JTC 1.

[A4]: Please itemise the ACTIVITIES that are performed by a Secretariat.
[* Please rate the activities according to rating scale [1]……[2]……[3]……[4]……[5]…….]

[A5] How many MEMBERS OF STAFF are currently managing Secretariat duties for the committee hat you are assigned to & what are their the SKILLS (e.g. secretarial, technical mangers)

[A6] With reference to my **Attachment #1: Researcher's Secretaries activities from JTC & IEEE SES documents.** Please ADD OR DELETE ITEMS that do not relate to your current activities in the management of the committee that you are currently responsible for.

[A7]: Please itemise the requirements for taking on Secretariat responsibilities. What are the BENEFITS & DISADVANTAGES on the part of the NSB?

[A8]: Please list DIFFICULTIES that you experience in managing the committee that you are currently responsible for.

[A9]: What are DELIVERABLE ITEMS of your Secretariat activities & how do they contribute to the committee?

[A10]: **As Secretariat manager,** please itemise YOUR VIEWS OF THE STANDARDISATION PROCESS according to committee projects for which you are currently responsible.

[A11]: Please list KEY POSITIVE CHANGES that you would like to see in the activities that are performed by a Secretariat.

Questionnaire A2
Content of operational content & practices

Notes: This part of the survey is intended to collect information regarding operational processes & practices that you employ in your Secretariat. This part consists of 1 section, **[B1]** to **[B14]**. Respond to as many questions as possible.

PART B: Secretariat project managers; Forum senior managers and technical mangers to respond to these questions.

[B1]: Please itemise the TYPES of OPERATIONS that are relevant to a Secretariat in managing committees (not the operations of the NSB).

[B2]: How are these OPERATIONS defined to contribute to the management of the committee?

[B3]: Please itemise the OPERATIONS that would be regarded as complete processes?
[A complete process equated to input, transformation of actions & outputs]

[B4]: From your list of operational processes, please tick items that are key processes contributing to committee project development.

[B5]: Please itemise the TYPES of OPERATIONAL PRACTICES that are relevant to the committee that are you are currently responsible for.
[*Please provide documents to support this]

[B6]: Please itemise the REQUIREMENTS of these PRACTICES

[B7] Who determines these requirements?

[B8]: Please describe exclusively, PRACTICES for information processing, project management & document management. How are these practices achieved?

[B9]: Please list the types of information that you process for committee.
[*Please provide documents to support this]

[B10]: What types of TECHNOLOGIES & OTHER IT FACILITIES are available to your Secretariat to assist in managing committees?

[B11]: Please describe the MAIN EXPENSES for running a Secretariat.
[*Please provide cost-expenditure documents]

[B12]: How are the Secretariat OPERATIONAL PRACTICES evaluated & what would be the MAIN results of these evaluations. [*Please provide reference documents]

[B13]: Please list the key groups of parties (national or otherwise) that sponsor your Secretariat functions (not the committee).

[B14]: *Please provide documents to support OPERATIONAL CAPACITY REQUIREMENTS for information processing and document dissemination.

Appendix 5: Committee case study questionnaires ~ content of project & approaches

(Source: compiled by author)

Questionnaire A1~global questions
Content of projects & project development

Notes: This part of the survey is intended to gather information regarding the content of projects & their development phases. This part consists of 1 section with questions, **[A1]** to **[A10]**. Respond to as many questions as possible.

PART A: IEEE WG 1074, JTC 1 SC 2, SC 29, WGs 1 & 11 to respond to these questions.

[A1]: Please describe the content of the SUBJECT MATTERS of the project that your committee is currently developing.
[Please rate the technical content of these subject matters according to rating scale provides as :[1]……[2]……[3]……[4]……[5]………]

[A2]: Please itemise the OBJECTIVES of this project & the types of REQUIREMENTS being standardized. [*Please provide documents with these objectives & requirements]

[A3]: Please itemise the DEVELOPMENT PHASES for this project you described in [A1]. [*List provide a model of these phases relevant to each project]

[A4]: With reference to my **Attachment #1- IITS project development life cycle,** please ADD OR DELETE ITEMS that do not relate to the projects that your committee is currently developing.

[A5]: Please list KEY PROCESSES regarding each project development stage that you have mentioned. [*Please list these processes or provide a document describing them].

[A6]: If you have provided a model in **[A3]** of the project development stages for your project, please indicate TARGETED OBJECTIVES & ACTIONS against each stage that I need to review.

[A7]: Please list KEY MATTERS that link the content of these projects, to the phases & processes you have described? Are there any other planned KEY MATTERS for each project stage that I need to review?

[A8]: How are the results of ACTIONS & PROCESSES of each project stage EVALUATED in your committee? [*Please list these processes or provide a document describing them].

[A9]: What are the DELIVERABLE ITEMS from each of planned stage?

[A10] Please itemise the methods employed to evaluate these deliverable items in the committee?

Questionnaire B1~ global questions
Standardisation approaches

Notes: This part of the survey is intended to collect information regarding the standardisation approaches that you employ in your committee for the projects that are currently being developed. This part consists of 1 section, **[B1]** to **[B12]**. Respond to as many questions as possible.

PART B: IEEE WG 1074, JTC 1 SC 2, SC 29, WGs 1 & 11 to respond to these questions.

[B1]: Please DEFINE the term STANDARDISATION APPROACH with regards to the project that your committee is currently developing.

[B2]: What are the OBJECTIVES of these standardisation approaches in each project phase?

[B3]: Please itemise the types of STANDARDISATION APPROACHES your committee is using in the development of these projects.
[*Please provide documents to support this]

[B4]: What is the MAIN CONTENT of these standardisation approaches you have listed in [B2]? [*Please provide reference documents]

[B5]: How are these APPROACHES chosen or developed within the committee? What are the other sources from which these approaches are acquired?
[Please list the development processes for these approaches exclusively]

[B6]: Please list the STANDARDISATION PRACTICES that are employed to develop the projects, as opposed to standardisation approaches. [Please list the main differences in *practice and approaches*]

[B7]: How are the standardisation approaches evaluated?
[*Please list typical evaluation criteria or provide documents to support this]

[B8]: What are the DELIVERABLE ITEMS from the development of these standardisation approaches?

[B9]: What other factors contribute to the development of these approaches & the projects? [*Please list these processes or provide a document describing them].

[B10]: Is the development of these approaches mutually exclusive to the development of the project? *How?*

[B11] Please summarise THE KEY PLAYERS, GROUPS OF INTERESTED PARTIES involved in developing the standardisation approaches.

[B12] Would you say, your project has adequate (or inadequate) representation to meet set objectives?

Appendix 5: Committee case study questionnaires ~ project development stages

(Source: compiled by author)

Questionnaire C1: Developers' requirements
CASE 1-SE S projects
CASE 2-GIITS projects

<u>Notes</u>: This part of the survey is intended to gather your items regarding the **developers' requirements** with reference to responses evaluated from questionnaire 1 & 2. This part of the survey has questions, **[A1] to [A10]**. Please respond to as many questions as possible.

PART A: Developers of IEEE WG 1074; SC2, SC 7 & SC 29 to respond to these questions.

[A1]: Please itemise the TYPES OF ACTIVITIES that your perform in development standards, for the projects that you are currently developing in your committee

[A2]: With reference to **Attachment #1, project development cycle,** please itemise PERFORMANCE REQUIREMENTS that your committee needs to accomplish each phase.

[A3]: With reference to **Attachment #2, core process**, please itemise PERFORMANCE REQUIREMENTS that your committee needs to accomplish each stage.

[A4]: Please describe the RESOURCES that are available to your committee for each phase in **Attachment #1 & how are they acquired?**
[*List provide documents describing these resources]

[A5]: What RESPONSE TIMES would you require to collect information in your committee e.g. processing, transactions & delivery for actions?

[A6]: What TECHNOLOGY CAPABILITIES would help to expedite these response times?

[A7]: What TECHNOLOGY REQUIREMENTS would you regard as necessary to accomplish set actions for each phase in **Attachment #1.**

[A8]: What acceptable or desirable IMPROVEMENTS IN TECHNOLOGY RESOURCES would you like to see in the future?

[A9]: Please itemise the AREAS in which TECHNOLOGY would help committee performances.
[please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[A10]: Please itemise the BENEFITS that you expect from using technology (e.g. cost effective information management)

Questionnaire C2: International perspective of developers' requirements
(generic international committees for IEEE & JTC 1)

<u>Notes</u>: This part of the survey is intended to collect your views regarding **the requirements that will make the developers to perform their activities efficiently.**
Please refer to the model of the core process in **Attachment #2.** The questionnaire consists of <u>1 section</u> with questions, **[B1] to [B10].** Respond to as many questions as possible.

PART B: SDOs & NBs Committee to respond to these questions.

[B1]: Please itemise the OPERATIONAL ACTIVITIES that are exclusive to the core process specified in **Attachment #2.**
[*Please provide reference documents]

[B2]: Please itemise the ACTIVITIES that are performed in your NB or in the SDO to support the performance of committees.

[B3]: Please itemise PERFORMANCE REQUIREMENTS that your committee or NB needs to accomplish each stage of the core process.
[please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[B4]: Please itemise the OPERATIONAL REQUIREMENTS that your committee or NB needs to accomplish each stage of the core process.
[please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[B5]: How often does your NB or SDO review stated COMMITTEE PERFORMANCE REQUIREMENTS & how are these results utilised in the core process?
[*List provide documents describing the most current committee performance requirements]

[B6]: Please itemise TYPICAL FACTORS in your NB that impede efficient committee performance.

[B7]: Please itemise the TYPES of TECHNOLOGY RESOURCES that you currently utilise in the core process to support the performance of committees for each stage specified in **Attachment #2**. [*List provide documents describing these resources]

[B8]: Please itemise the AREAS in which TECHNOLOGY would help the performance of the committee.

[B9]: Please itemise the AREAS in which TECHNOLOGY would help the performances of the core process.
[please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[B10]: Which Management Groups in your NB or SDO are responsible for technology resource requirements? (e.g. analysis, resource purchase, development)

Appendix 5: Committee case study questionnaires ~ project information & requirements

(Source: compiled by author)

Questionnaire C3: Project information & requirements

CASE 1-SE S projects

CASE 2-GIITS projects

Notes: This part of the survey is intended to gather your items regarding the content of information for **the universal project development cycle** I have presented to you in **Attachment #1.** This based upon my evaluations of the evaluated data you provided in SURVEYS 1 & 2. This questionnaire consists of 1 section with questions, [A1] to [A10]. Respond to as many questions as possible.

PART A: Developers of IEEE WG 1074; SC2, SC7 & SC 29 to respond to these questions.

[A1]: Please itemise THE TYPES of INFORMATION that your committee requires for the project.
[*List also tick the types of information & other ingredients that are universal to the development of your projects]

[A2]: What are the TYPICAL SOURCES of this information & HOW IS IT OBTAINED?

[A3]: How is this information managed in the committee?

[A4]: Which METHODS or CRITERIA do you employ to evaluate, select & classify this information. How are they applied?

[A5]: With reference to **Attachment #1,** please itemise TYPICAL INFORMATION INPUTS for the project stages marked in this life cycle.
[*List tick the project stages that you have selected to focus on & provide supporting documents]

[A6]: How do you determine INFORMATION REQUIREMENTS necessary for the project stages that you have chosen from the project development cycle in **Attachment #1.**
[*List provide documents to support these requirements]

[A7]: Which STANDARDISATION PRACTICES from survey 1 are linked to gathering or developing these information resources?
[*Please provide a document describing these practices].

[A6]: For each item that you have listed in [A4], please RATE OF IMPORTANCE of these requirements.
[Please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[A7]: What types of REFERENCE MODELS are employed to abstract information & concepts to be used in the project development cycle?
[*List provide documents for these models]

[A8]: Please list INFORMATION PROCESSES regarding each stage of the project development cycle.
[*Please provide a document describing these processes].

[A9]: What are DELIVERABLE ITEMS from these INFORMATION PROCESSES?

[A10]: What DIFFICULTIES you encounter in obtaining this information.

Questionnaire C4: Content of PDC & information requirements

CASE 1-SE S projects

CASE 2-GIITS projects

Notes: This part of the survey is intended to collect data regarding the content of information for the **core process model** in **Attachment #2**. This questionnaire has 1 section with questions, **[B1] to [B11]**. Respond to as many questions as possible.

PART B: Developers of IEEE WG 1074; SC2, SC7 & SC 29 to respond to these questions.

[IEEE Computer Society SES & ISO JTC 1 to also respond to these questions]

[B1]: How accurate is this CORE PROCESS for IEEE SES and JTC 1-GIITS projects listed on page 1?
[Please made modifications to the model according to IEEE and JTC 1 spaces provided in this questionnaire]

[B2]: Which PRACTICES are employed in this core process?
[*Please provide a document describing these practices].

[B3]: Please RATE OF IMPORTANCE of these practices you have listed.
[Please indicate the rating scale as [1]......[2]......[3]......[4]......[5].........]

[B4] Which REQUIREMENTS are exclusive to this core process specified in **Attachment #2**.
[*Please provide reference documents]

[B5]: Which TYPES of INFORMATION propel this core process for each stage in **Attachment #2**.

[B6]: Please list KEY SUB- PROCESSES regarding each stage of this core process.
[*Please provide reference documents]

[B7]: How is the performance of this core process EVALUATED within SDOs?
[*Please provide reference documents & evaluation criteria]

[B8]: What are the DELIVERABLE ITEMS of each stage of this core process & METHODS OF EVALUATION?

[B9]: How is the project development cycle linked to this core process & which are the linking attributes?
[*Please provide reference documents]

[B10]: What TYPES OF INFORMATION is developed, analyse, evaluate for this core process?

[B11]: How is this INFORMATION controlled for reference?
[* Please describe typical resources that are available to the committee].

[B12]: What factors contribute to this core process?

[B13]: What other factors contribute to the use of core process information?

[B14]: What DIFFICULTIES do you encounter in developing, obtaining, analysing or evaluating the information that you utilise in core process?.

Appendix 6A: Macro perspective scope of study and categorised raw data for analysis

(Source: compiled by author)

Sub-units of analysis	Objective	Data collection strategy	Analytic focus	Categorised findings for analysis: subject matters in data range (forming focused views of functionality)
GLOBAL IITS ENVIRONMENT **(SDOs & NSBs)**	of IITS environment - Verify assembled aspects of IITS environment	*Literature reviews on IITS* *Exploratory study:* - Documentary analysis of operational operational documents - Policy Delphi survey of assembled findings - Stratified random sampling, key candidates	Within IITS environment	**[1] Environment infrastructure physical characteristics e.g.:** - Constitution of structures and components, functional units in structures - Core functions of functional units, functional boundaries. **[2] Social construction characteristics e.g.:** - Actors, stakeholders (how they are organised) - Functional responsibilities across organisations - Organic relationships: communication between components **[3] Management characteristics e.g.:** - Environment strategies, policies, operational matters - Goals, functional practices, procedures **[4] Operational characteristics e.g.:** - Operational approaches: information processing, registration - Operational identities in approaches: control, division of work, locations - Operational scenarios: between organisations of functional units - Operational practices across organisations: co-ordination, workflow, - Operational procedures and rules **[5] Actors and stakeholders participation characteristics e.g.:** - Membership categories/configurations: active, sponsors, liaison - Membership rules and procedures **[6] Technology and uses e.g.:** - Types of technology resources - Strategic, technical and operational uses
FORUMS: **[a] IEEE-SES** **[b] ISO JTC 1**	Identify important aspects of forums and functional themes, and compare	*Documentary analysis*: - Operational documents - Publications (budgets; work programs) - Review of forum web-site information *Questionnaire survey:* - Stratified random sampling for key responsibilities - Interviews	Across selected projects	
SECRETARIATS: **[a] SES projects** **[b] GIITS projects**	Identify important functional themes and compare		Across selected projects	
COMMITTEES **[a] SES projects** **[b] GIITS projects**	Identify functional aspects; themes; performance contexts and circumstances in which projects are developed; compare	*Literature reviews on group performances* *Questionnaire survey:* - Stratified random survey by committee representation profiles - Interviews - Cluster sampling ***Documentary analysis*:** - Project operational plans - Study documents - Draft standards *Longitudinal study-field work*	Within committees and across all projects	**[1] Structural and functional characteristics e.g.:** - Committee structures: SC, WGs - Committee responsibilities: chairperson, project editors, managers **[2] Content characteristics e.g.:** - Subject areas, results, - Standardisation methods **[3] Representation and participation characteristics e.g.:** - Membership categories **[4] Contexts across project development stages:** - Technical practices: R & D, decision-making, communication - Social performance practices: communication, collaboration - Operational practices

Appendix 6B: Example empirical evidence-forums and secretariats functional view

(Source compiled by author)

EVALUATION DATA RANGE [based upon open and selective coding procedures; minimal comparisons across examined forums and secretariats]			
Levels of functions	**Categories of predominant subject matters of practices**	**Concepts/themes; responsibilities:**	**Embedded and emergent factors**
Environment **Infrastructure** **Functionality** **[Forum and NSB levels]**	[1] Strategic co-ordination [JTC 1, IEEE Standard Board] - Objectives/goal alignment with SDOs - Stakeholder management (payments, incomes) [2] Tactical operations - Administration: - Information processing (documents) - Transactions - Information, document management - Registration, control and maintenance operational inventories (projects, documents, memberships) [6] Operational co-ordination - Hosting meetings - Reporting of project development actions - Sharing information [3] Project co-ordination: - Project stages monitoring - Review of draft standards - Reporting to SDO on successes and failures of committee work results	[1] Ensuring SDO objectives and procedures are followed: e.g. co-operation and collaboration [2] Ensuring committees' meet work targets set by the SDOs e.g. reviews on draft standards. [3] Operational management to meet requirements of committee activities [4] Co-ordinating ballot processes with wider audiences. [5] Consultation on development of procedures [6] Co-ordinating SDO decisions to committees/NSBs [7] Connecting national and international committees [9] Identification and resolution of conflict [10] Project management [11] Definition of operational requirements, methods of working [12] Implementing required IT systems	[1] NB as a major participant in international standardisation activities [2] Stakeholder identification [3] Specialised organisation at national level e.g. testing, certification [4] Connecting national and international committees [5] Promoting standard business domain nationally [6] Promoting participation of national firms [7] Participation in policy making [8] NSBs operational boundaries [9] Development of national standards [10] Nominating committee chairpersons, project editors [11] Levels of authority in functional units e.g. IITS and IEEE

[Example analytic questions for Categorisations]	
[Q1]	Are the **subject matters** of Secretariat responsibilities for the examined Secretariats? (What are similarities or differences**?)**
[Q2]	What are the **common subject matters** of committee management practices across the projects examined and Secretariats?
[Q3]	What are the characteristics committee management practices and common **methods of working** across the examined Secretariats and committees?
[Q4]	What factors emerge? (e.g. Secretariat performance, problems)

Appendix 6C: Summary of example contrasted themes of operational content and practices

(Source compiled by author)

EVALUATION DATA RANGE [based on maximal comparisons of case findings across 5 Secretariats]

Similarities [minimal comparisons]			
Key operational processes [and sub-level processes]	**Functional views of operational practices**	**Common elements of operational matters**	**Key similarities in practices, depending on:**
[1] Information gathering and evaluations [2] Information processing [3] Project management [4] Document processing e.g.: - Document numbering - Registration and inventory - Specification of committee actions [5] Document management - Storage for retrieval and reference - Registration of meeting documents - Registration of document actions - Requirements definitions [6] Meeting: - Meeting agenda - Meeting reports (minutes) - Comments on meeting reports - Conduct of meetings [7] Consensus-seeking: - Processing draft standards - Logging of ballot comments - Collation and processing comments [8] Interactions: - Oral communications - Document distributions/transactions - Logging correspondence and transactions - Responding to enquiries [9] Administrative decision-making	[1] **Content :** - Informative: formal and informal - Communicative and Decisional - Planning: tactical and strategic - Evaluation- based practices - Transactional and activity-based - Sensitive and confidential [2] **Content:** - Specialisation (e.g. IM, DM) - Operational structures, re- environment - Operational conditions and procedures - Operational performance levels - Operational technology-based [3] **Context perspectives** [a] *Social* (e.g. power and politics in functions) - Ideology-based functioning of SDO/NSB e.g. hierarchical reporting, co-operation, controlled performance [b] *Cultural* - Networking of projects through NBs - Co-ordination and collaboration of operations - Professionalism of forums/NSBs [c] *Performance* - Procedural - Operational principles of work - Control of work results and of workflow	[1] Acquisition (e.g. reports) [2] Assimilation (e.g. meetings) [3] Integration (collation) [4] Co-ordination (e.g. dissemination) [5] Communication and reporting [6] Consultation (e.g. procedures) [7] Decision-making links [8] Feedback	[1] Size of Committee [2] Complexity of projects [3] Requirements and resources [4] NSB methods of working, based on SDO procedures [5] SDO policies and procedures [6] Methods of cost accounting [7] Types of committees [technical/process standards projects] [8] Sponsorships available to committees and Secretariats [9] Skills available to secretariats [10] NSB leadership styles (proactive and reactive) [11] NSB participation status

Appendix 7A: Case findings for projects and project development

(Source: compiled by author)

Summary of merged global items from responses to Questionnaires A1, B1, C2 and C3

Project subject matters [with high technical content rated 4 and 5]	Core content items across GIITS and SES projects	Project development phases emerging from committee actions	Standardisation approaches
[1] Coding of data [2] Coding of character sets, encoding [3] Coding techniques [4] Compression, decompression techniques: Data, image, sound [5] Encoding of digital data, images, video [6] Broadcasting and telecommunications [7] Core computing (e.g. databases) [8] Software engineering [9] Computational techniques: algorithms, Simulation, programming, subjective tests [10] Engineering practices	[1] Review of project proposal [2] Adoption and definition of coding methods [3] Definition of coding of character sets [4] Definition of how to program character sets [5] Information gathering and analysis [6] Definition of standardisation approaches and methods [7] Abstraction of project concepts and inputs from participating Organisations (practices, model products and model processes) [8] Requirements analysis, evaluation decision-making and documentation [9] Requirements specification [10] Product evaluation and product design [11] Technical decision-making [12] Testing and implementation [13] Evaluation of R & D results [14] Specifications of development of draft standards [15] Writing of draft standards [16] Reviews and evaluations of draft standards [17] Evaluations of comments from committee documents	[1] Review of project proposal [2] Requirements setting and conceptualisation [3] Problematisation of project, based on inputs [4] Definition of base requirements and methods [5] Study and discussion of project inputs [6] Information gathering and management [7] R and D activities (off-line) [8] Technical development and requirements development [9] Testing, implementation and validation (off-line) [10] Technical decision-making [11] Integration and harmonisation of requirements [12] Resolution of draft concepts [13] Documentation and draft standards specifications	[1] Abstraction of concepts and inputs [2] Abstraction of project development actions [3] Product selection, design and development [4] Simulation and prototype development [5] Modelling techniques [6] Technical decision-making criteria [7] [Descriptions of choice of approaches] [8] Project development articulation [9] Problem solving heuristics

[Example analytic questions to survey material for Categorisations]

[Q1] Are the subject matters of these projects connected or different?
[Q2] What are the project development phases across the three projects?
[Q3] What phases are repeated or overlap?
[Q4] What phases are universal across these projects?
[Q5] Can overlapping or repeated project phases be simplified or eliminated?
[Q6] What are the characteristic features of these development phases across the projects surveyed?
[Q7] What are similarities or differences in the standardisation approaches, in contrast with SES?
[Q8] What factors emerge for each stage? (e.g. performance, events, participation factors)

Appendix 7B: Summary of contrasted features for GIITS and SES projects

(Source: compiled by author)

EVALUATION DATA RANGE [based on minimal and maximal comparisons of case findings for processes, project development phases, approaches]

Similarities [global minimal comparisons]			**Key differences [maximal comparisons]**
Key processes [and sub-level processes]	**Content of project development phases and approaches**	**Content of committee performance and practice matters in PDC**	**[Processes, project development, approaches]**
[1] Review of project proposal	[1] Organisation and planning of project	[1] Participation and memberships	[1] Size of processes, based on subject matters
[2] Abstraction of concepts and inputs	[2] Project management	[2] Meetings	[2] Differences in subject matters
[3] Study and discussion of projects:	[3] Task planning and evaluations	[3] Liaisons and networking	[3] Complexity of projects and project matters
- Committee meetings	[4] Conceptualisation of project	[4] Collaborative interchange	[4] Project time scales
- Editorial meetings	[5] Abstraction of products, concepts and inputs	[5] Liaisons and networking	[5] Numbers in committee of subject matters
- [Professional Conferences]	[6] Product design and re-design	[6] Group-work and interactions	[6] [SDO policies on sensitive projects]
[4] Information gathering and evaluations	[7] Views of requirements and concepts:	[7] Information flow and work flow	[7] Sensitivity of projects and standardisation approaches
[5] Technical development:	- Business, Industry, Organisation and market view	[8] Administration	
- Requirements analysis and evaluation	- Customer view	[9] Co-ordination	[8] Critical and sensitive nature of key processes based on subject matters, need of standard
- Requirements definitions	- Process and products	[10] Communication	
[6] Documentation of requirements and results [Study and technical documents]	- Engineering principles and practices	[11] Committee tasks	[9] Committee procedures, based on the planned actions
	- Standardisation	- Task designs	
[7] Writing of standards:	[8] Information control and management	- Assignment of actions and tasks	[10] [SDO project prioritisation methods]
- [Master Draft Standard]	[9] Results control and management	[12] Participative decision-making	
- Working draft	[10] Problematisation	[13] Environment decision-making	
- Committee draft	[11] Project, technical and requirements development		
- Draft international standard	[12] R & D activity (concept and product development)		
- Revision of balloted draft standards	[13] Concept building; concept bonding		
[8] Consensus-seeking:	[14] Verification and validation		
- Committee draft reviews	[15] Decision-making		
- SDO ballots	[16] Requirements and results specifications		
- Ballot resolutions	[17] Testing and implementation		
- Reviews of comments			
- Collation and integration of comments			
[9] Technical decision-making:			
- Definition or model and alternative solutions			
- Harmonisation and integration			
- Results control			
- Requirements specifications			

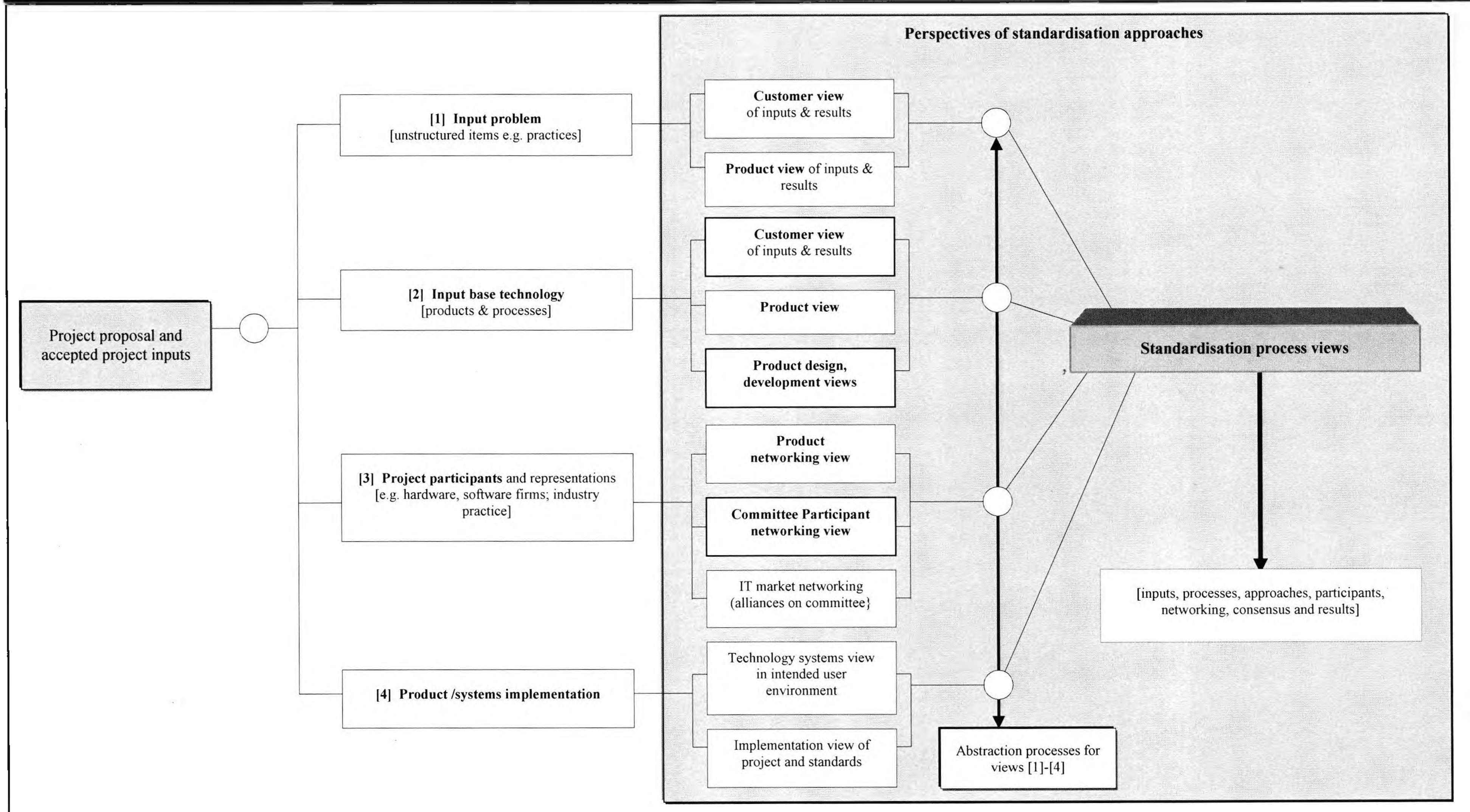
Appendix 7C: Categorisation of case findings for processes in PDC phases

(Source: compiled by author)

EVALUATION DATA RANGE [based on minimal and maximal comparisons of case findings]			
Similarities [global minimal comparisons]			**Key differences [maximal comparisons]**
Key processes [and sub-level processes]	**Content of project development phases**	**Content of committee performance and practice**	**[Processes, project development, approaches]**
[4] Review of project proposal [5] Abstraction of concepts and inputs [6] Study and discussion of projects: - Committee meetings - Editorial meetings - [Professional Conferences] [6] Information gathering and evaluations [7] Technical development: - Requirements analysis and evaluation - Requirements definitions [10] Documentation of requirements and results [Study and technical documents] [11] Writing of standards: - [Master Draft Standard] - Working draft - Committee draft - Draft international standard - Revision of balloted draft standards [12] Consensus-seeking: - Committee draft reviews - SDO ballots - Ballot resolutions - Reviews of comments - Collation and integration of comments [13] Technical decision-making: - Definition or model and alternative solutions - Harmonisation and integration - Results control - Requirements specifications	[8] Organisation and planning of project [9] Project management [10] Task planning and evaluations [11] Conceptualisation of project [12] Abstraction of products, concepts and inputs [13] Product design and re-design [14] Views of requirements and concepts: - Business, Industry, Organisation and market view - Customer view - Process and products - Engineering principles and practices - Standardisation [18] Information control and management [19] Results control and management [20] Problematisation [21] Project, technical and requirements development [22] R & D activity (concept and product development) [23] Concept building; concept bonding [24] Verification and validation [25] Decision-making [26] Requirements and results specifications [27] Testing and implementation	[12] Participation and memberships [13] Meetings [14] Liaisons and networking [15] Collaborative interchange [16] Liaisons and networking [17] Group-work and interactions [18] Information flow and work flow [19] Administration [20] Co-ordination [21] Communication [22] Committee tasks - Task designs - Assignment of actions and tasks [14] Participative decision-making [15] Environment decision-making	[10] Size of processes, based on subject matters [11] Differences in subject matters [12] Complexity of projects and project matters [13] Project time scales [14] Numbers in Committee of subject matters [15] [SDO policies on sensitive projects] [16] Sensitivity of projects and standardisation approaches [17] Critical and sensitive nature of key processes based on subject matters, need of standard [18] Committee procedures, based on the planned actions [11] [SDO project prioritisation methods]

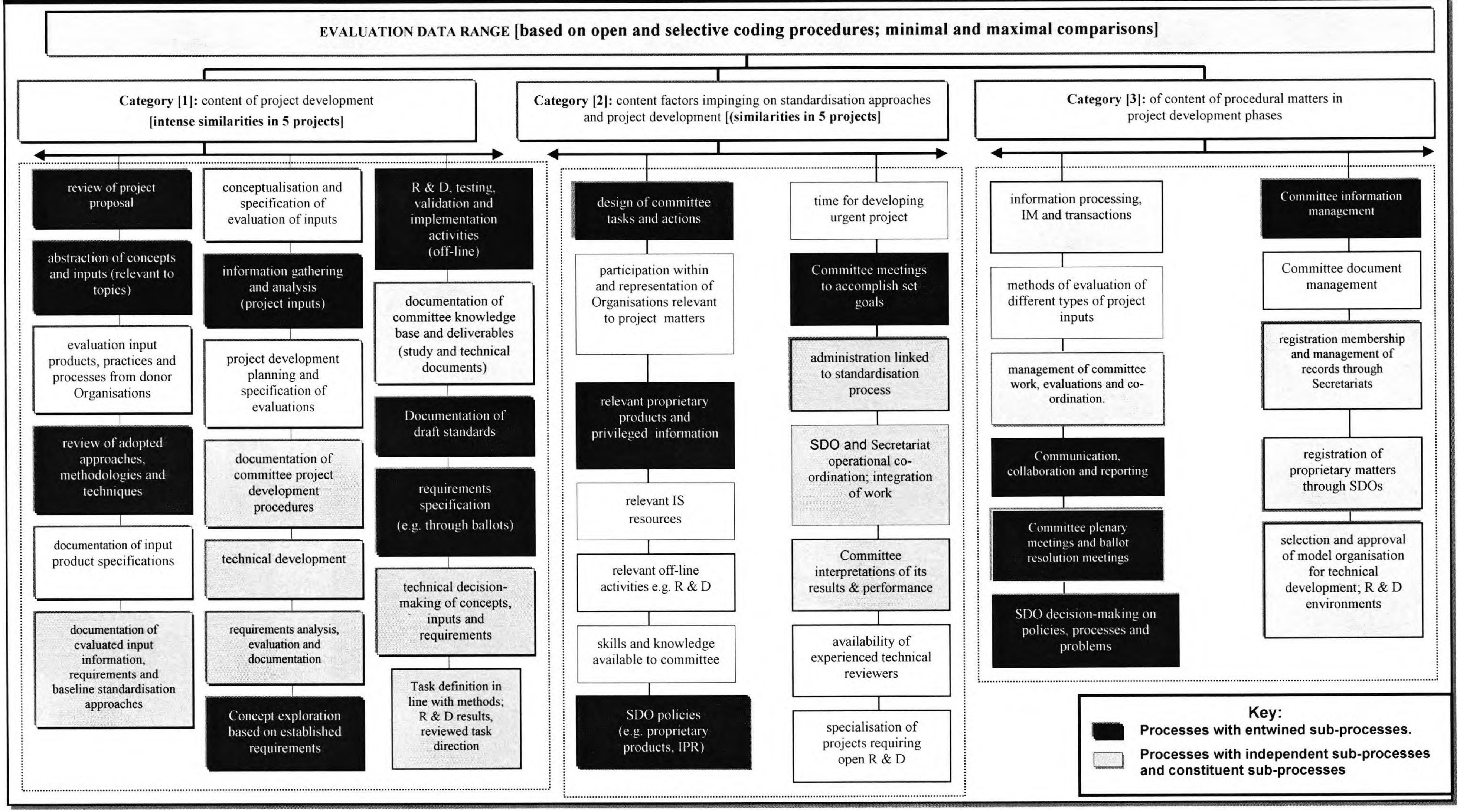
Appendix 7D: Model of base perspectives of the development of standardisation approaches

(Source: compiled by author)



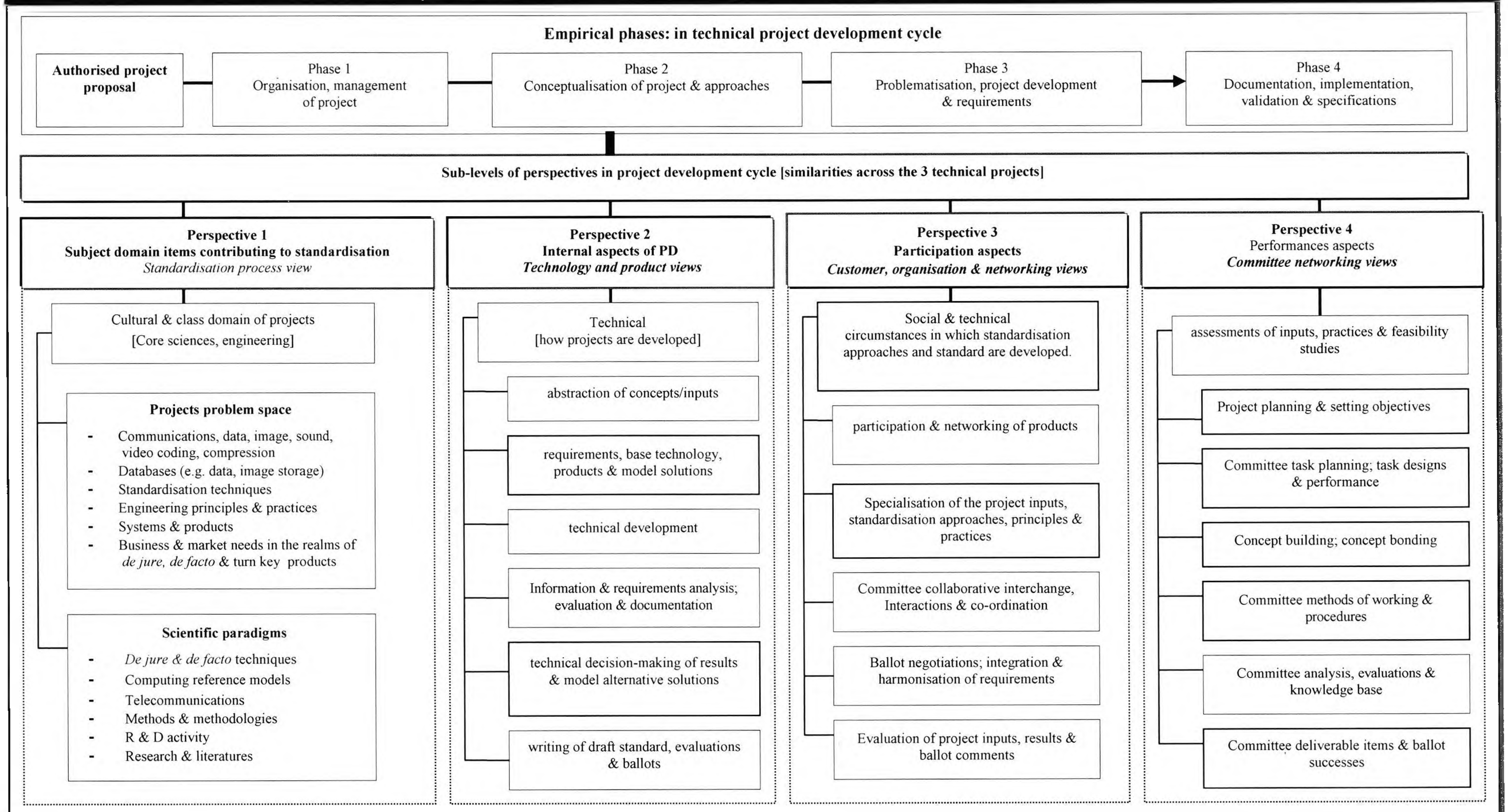
Appendix 7E: **Block Diagram, Categorisation of content of project development and approaches**

(Source: compiled by author)



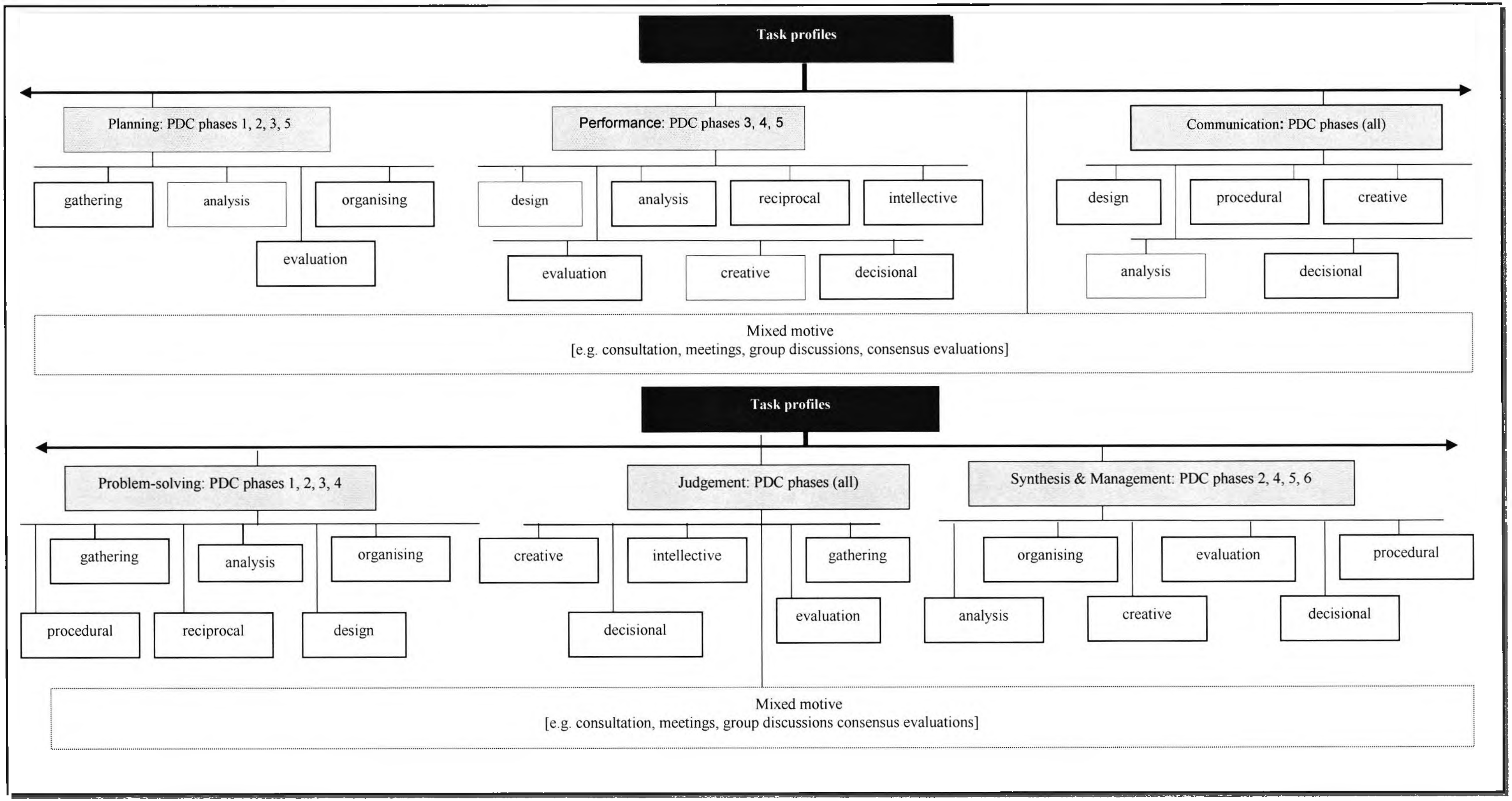
Appendix 7F: Block Diagram, Properties of sub-levels of perspectives of PDC and standardisation approaches

(Source: compiled by author, adaptations from: Madhavji, 1991; SWEP Model, 1993; Social translation framework, 1986)



Appendix 7G: Block diagram of content profiles of committee project tasks

(Source: compiled by author : tasks constructs adapted from Hackman, 1976; Hoffman, 1979 McGrath 1984



Appendix 7H: Categorisations of developers' requirements

(Source: compiled by author)

[Reference Appendix 5, Questionnaire C1]

Case developers' requirements
[Data range of evaluated requirements related to PDC phases]

[1a] **Committee activities and tasks:**

- Committee management support, Secretariats support workers with technical knowledge of committee subject matters
- NSBs with technology resources that fully support committee work e.g. communication, documentation processes, information management
- NBs with facilities that fully support committee work e.g. international meeting provisions
- Accountable work co-ordination

[2a] **Merged performance requirements for project development cycle phases:**

[2a] **Phase 1-Conceptualisation of project**

- NBs with technology resources that fully support committee work e.g. communication, documentation development and review processes
- Co-ordination of information and IM facilities in NBs
- Flexible SDO polices and procedures that permit control of proprietary information
- Proactive advertising in NBs and SDOs for new projects to invite relevant memberships
- Proactive SDO decision-making and policies regarding projects with unique requirements

[2b] **Phase 2-Organisation, management of project and problematisation**

- NBs with technology resources that fully support committee work e.g. communication, documentation development and review processes
- NSB and SDO systems that assist committee in project management
- Committee. management support, Secretariats support workers with technical knowledge of committee subject matters
- Technical responsiveness in NBs to enquiries regarding projects and information
- Co-ordination of information and IM facilities in NBs
- Experienced, committed, skilled developers from diverse nations and core science backgrounds
- Flexible SDO polices for projects requiring R & D activities
- Reduction in duplication of documents from NBs and SDOs

[2c] **Phase 3-Project development and requirements**

- Flexible SDO polices for projects requiring R & D activities
- Flexible NB and SDO technology polices that fully support IM and technical activities
- NBs with technology resources that fully support committee work e.g. communication, documentation development and review processes
- Committed national Organisations and industries to provide R & D environment
- Consistent technical activities within the standardisation process and committee

Requirements (continued)

[2d] **Phase 4: [Documentation, validation and specifications]**

- Committee management support: support workers with technical knowledge of subject matters
- Competent and experienced Project Editors and Chairmen
- Competent and experienced ballot negotiators with support of knowledge workers
- Qualified reviewers of the results derived from the standardisation process
- Flexible NB and SDO technology polices that fully support IM and technical activities
- Flexible SDO polices for projects requiring R & D activities

[3] **Merged core technology requirements for all IT standards projects:**

[3a] Networked information systems

- Video-conferencing for committee meetings in different locations
- Information databases, libraries, indexes allowing developers to source information
- Multimedia document storage systems and applications for committee meetings
- Next generation networked IS (e.g. Internet with search and retrieval capabilities)
- Networked real time knowledge-based systems for analysis, classification and interpretation of vast amounts do data

[3b] **Document development support**

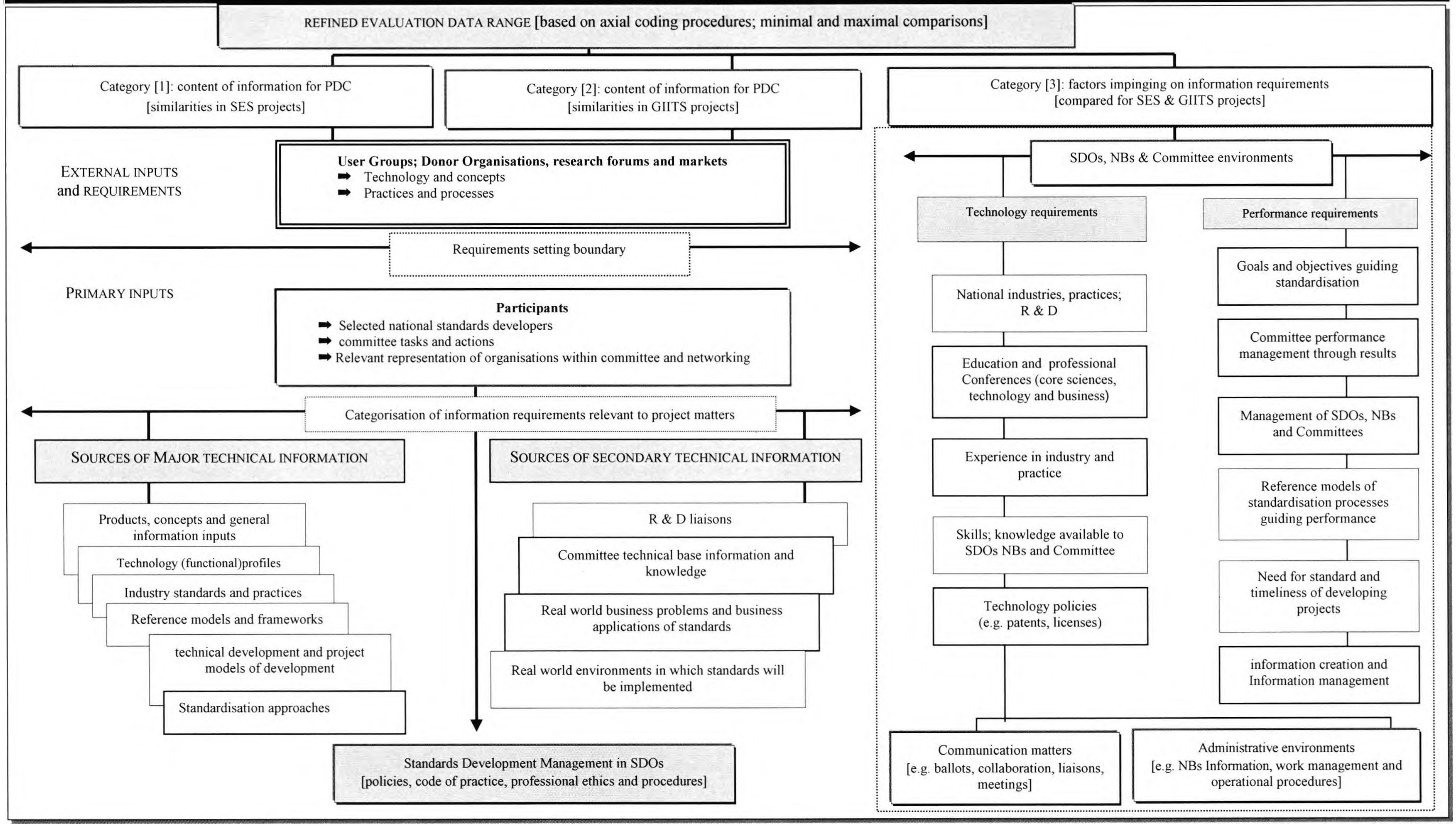
- Information databases allowing developers to source information
- Document databases allowing developers to store, retrieve and search documents
- Project management databases allowing developers to store, retrieve and search for project inputs and results
- Compatible document, text (word) processing formats in the standardisation process
- On-line administration and technical support across NBs and SDOs
- Text validation systems to save tine in pre-publications processes
- Multimedia and hypertext document applications
- Real time knowledge-based systems

[3c] **Ballot and decision support**

- Information databases allowing developers to source information
- Compatible e-mail and fax communications
- Multimedia and hypertext document applications
- Real time knowledge-based systems
- On-line balloting systems and electronic bulletin boards

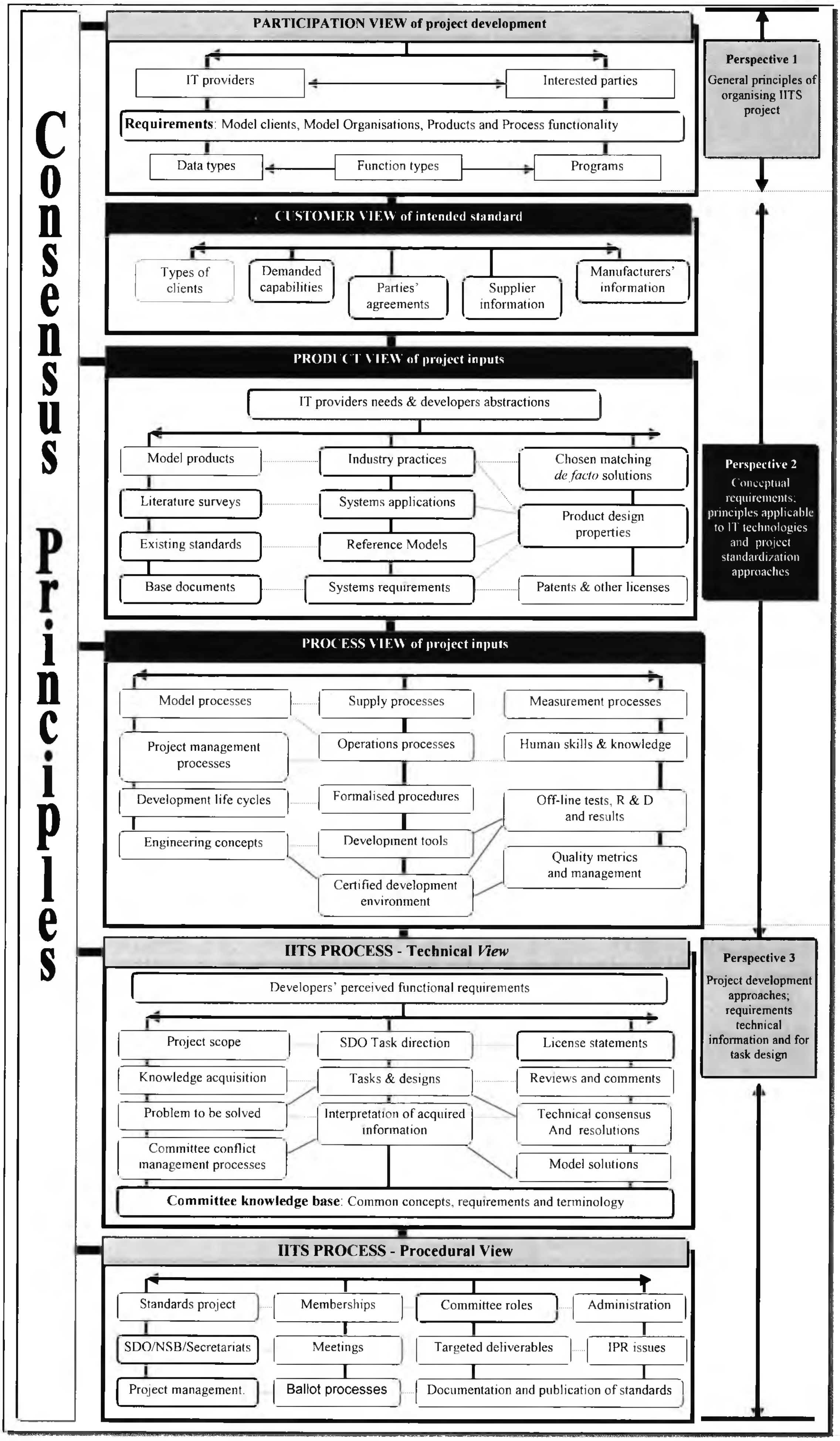
Appendix 7I: Information frameworks of specified PDC requirements

(Source: compiled by author)



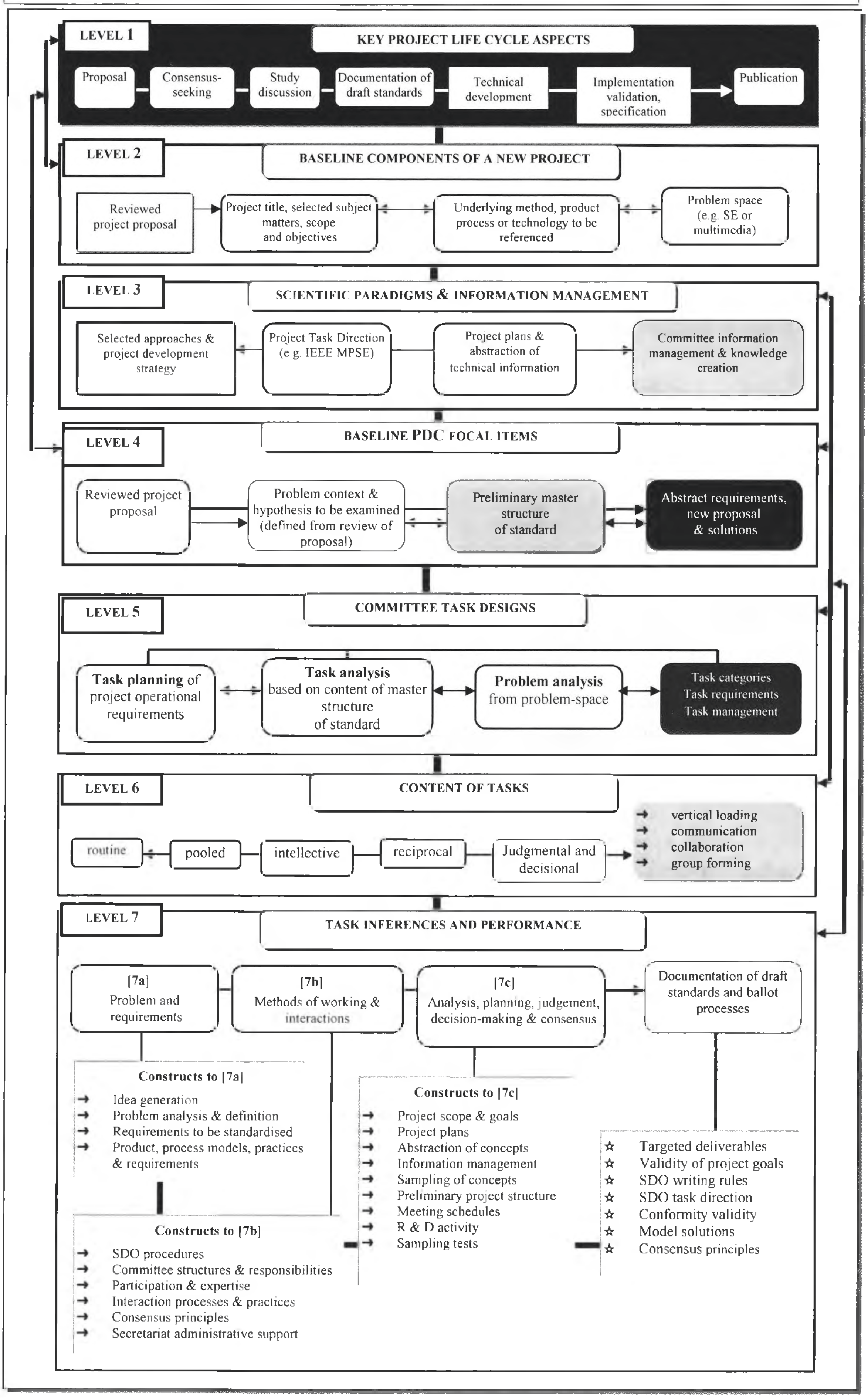
Appendix 8A: (Abstraction processes) Project strategy, approaches, tasks and information

(Source: compiled by author)



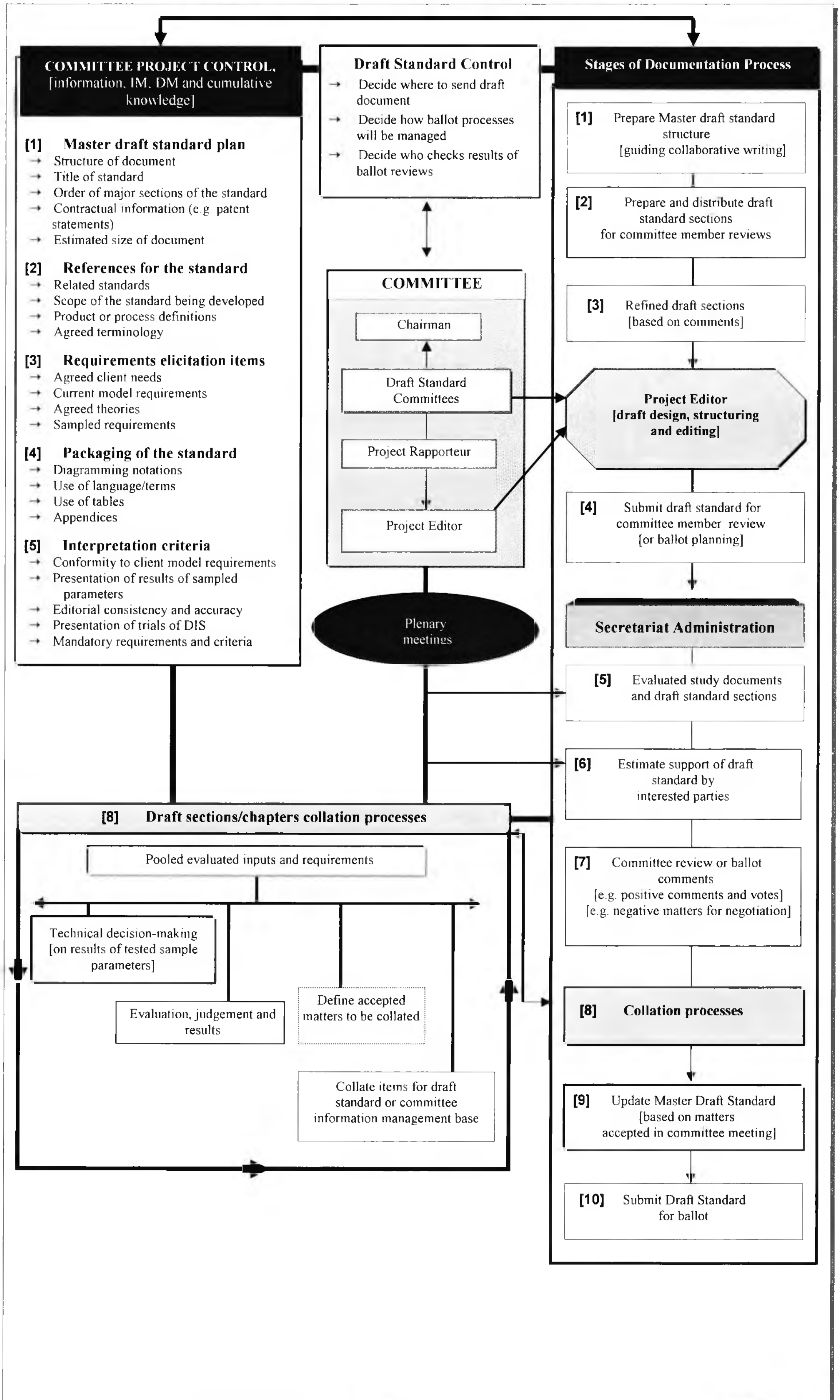
Appendix 8B: Components of design of project tasks and performances

(Source: compiled by author)



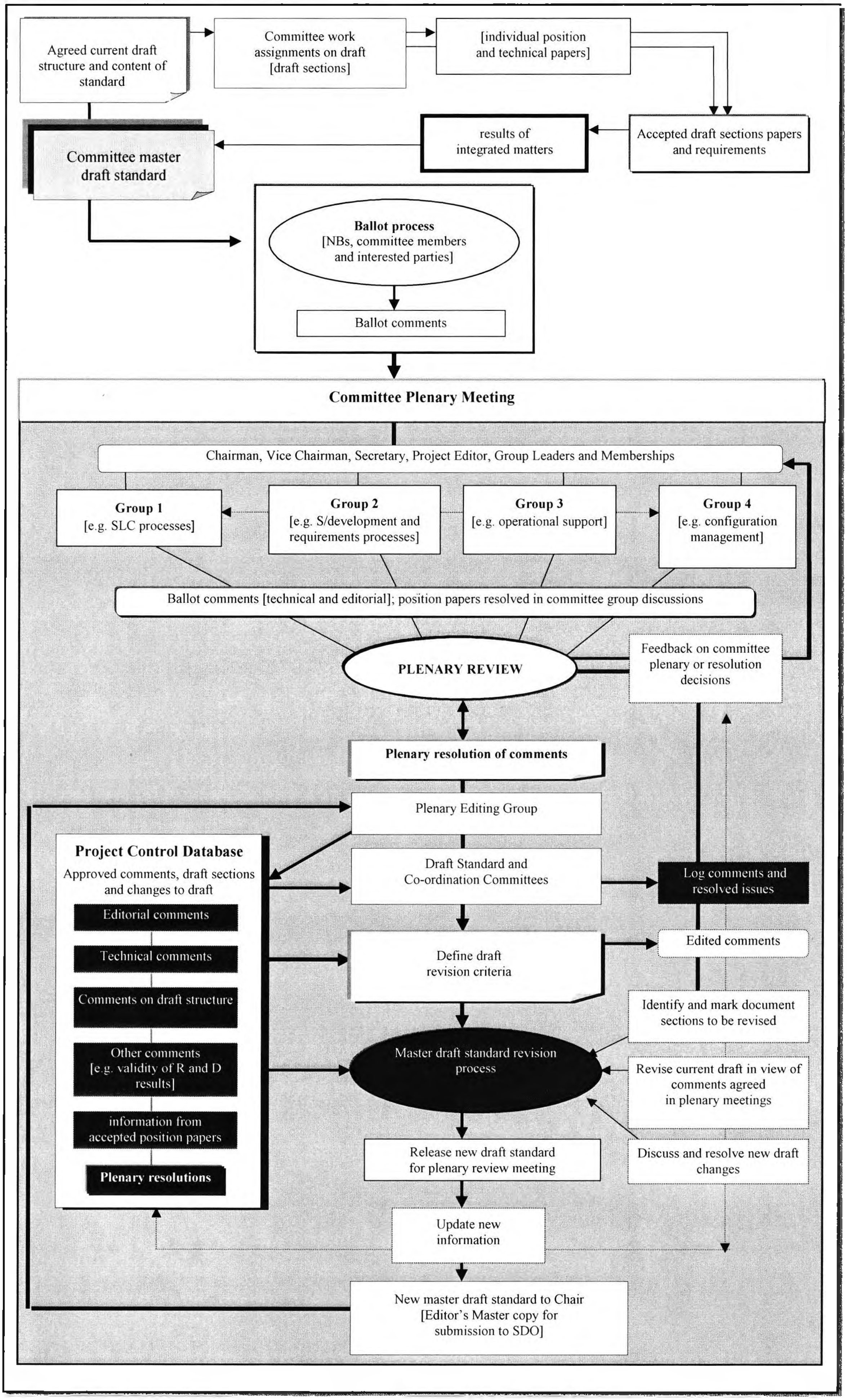
Appendix 8C: Model of documentation of draft standards

(Source: compiled by author)



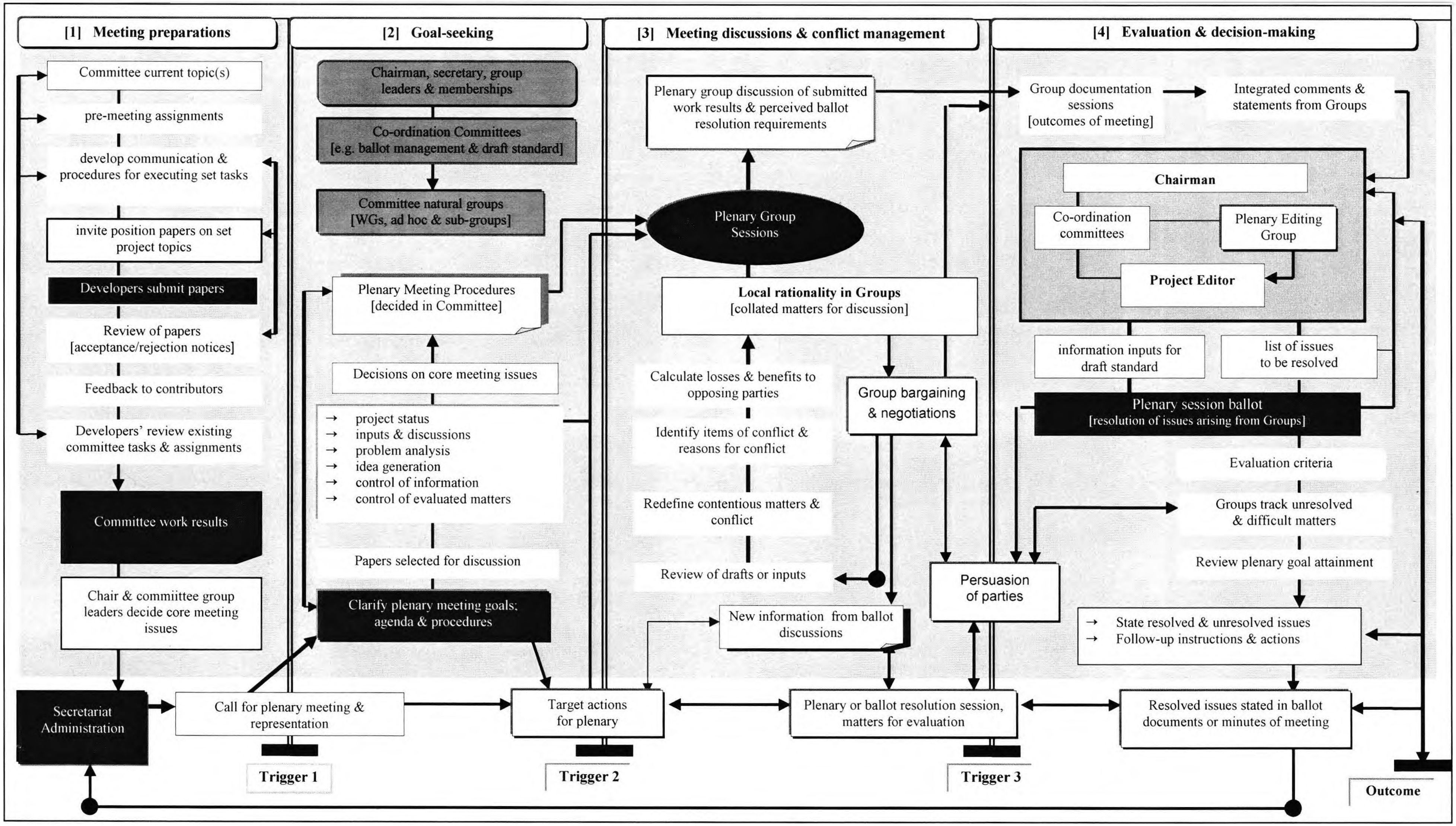
Appendix 8D: Post ballot draft standard revision process

(Source: compiled by author)



Appendix 8E: Integrated ballot resolution process & meeting interactions

(Source: compiled by author)



Appendix 9: Questions and decision criteria

(Source: compiled by author)

Analytic questions	Decision criteria:
[Part A] Composition of process framework	- **Salience** - **Strategic Importance** - **Fundamental Impact** - **Potential Value**
[1] What are the main features should be in this process framework?	
[2] What distinctive scenarios are representative of IITS process performance contexts (e.g. technical, social, operational)?	
[3] Which features of the IITS process fit into these scenarios?	
[4] What are the common elements the scenarios and their relevance to IITS process?	
[5] Which features or items should eliminated from this process framework and why?	
[Part B] Questions for process framework walkthrough	
[1] Which areas are considered high-priority and why?	
[2] Which areas are more complicated than others are and why?	
[3] Which features in these areas are more important than others are and why?	
[Part C] Questions for definition of IITS process core aspects and source model	
[1] Which reviewed areas qualify as core aspects of IITS process?	
[2] Which reviewed features can be eliminated or preserved in the core aspect and why?	
[3] Which features or items should be added to the core aspect and why?	
[4] What reviewed items can be combined or separated in the core aspect?	
[5] What are the functional trade-offs for combined features or items?	

Appendix 9A: Core aspects of IITS process and critical issues
(Source: compiled by author)

Core aspects [from process framework walkthrough]	Critical issues	Reconstruction potential: High	Medium	Low
Project Management:	Unconnected project monitoring, excessive inventory across NSBs - Complications in project co-ordination. - Overlapping projects are not detected early in the life cycle causing costly negotiations during critical project development actions. - Difficulty with innovation and interventionist practices that work for available practices.	✓		
Registration Management:	Intense and rich source for operational information for: - Project, committee and stakeholder registration - Inventory processing and management		✓	
Project proposal:	Intense and rich source for operational information for: - Identification of IITS process strategies, projects and requirements - Identification of stakeholders. - Strategic and operational planning.	✓		
Consensus-seeking (ballots)	Information intense processing infrastructure for building of effective representation of IITS process results: - Complicated impacted scenarios lacking visibility. - Information intense contexts lacking management and resource. - Intense operation supports needs e.g. document processing and transactions - Ambiguous presentations of electronic ballots. - Repetitive complications in technical and social contexts ballot events.	✓		
Committee study and discussion:	Forms the core of representations of how committee can control study constructs e.g. abstraction of inputs, organisation of project, project planning. It is hindered by: - Lack of visibility of the management of information - Complicated and embedded specialised activities e.g. task design - Poor communication. - Intense operation supports needs e.g. document processing and transactions.		✓	
Documentation of draft standards:	- Information-intense events but vague. - Poor presentations of actual documentation cycles. - Complicated diversity in interlocked scenarios with key events e.g. collaborative writing, editing, meetings and decision-making - Highly complex committee practices to aid information gathering and evaluation. - Intense operation supports needs e.g. document processing and transactions. - Lack of support for management of technical information and project plan execution	✓		

Appendix 9A: Core aspects of IITS process and critical issues (continued)

(Source: compiled by author)

		Reconstruction potential		
		High	Medium	Low
Core aspects [from process framework walkthrough]	**Critical issues**			
Implementation (and testing of model requirements)	- Central to evaluations of draft and, linked to information gathering and validations of results. - Currently lacks focus and links to IITS process - Off-line implementations draw away required information from IITS process.	✓		
Publications:	- Information intensive but there are no comprehensive links from IITS process to publication environments except via Web sites for customers - Duplicated publications across SDO and NSB are costly. - Specialised product registration and management not linked to NSBs operational environments for direct publications.	✓		
Revision and maintenance:	Information intensive but is hindered by lack of prominence of a front end to IITS process that can process requests			✓
Results Control:	- Information intensive and requires prominence regarding results that IITS process produces. - Can help requirements management.	✓		
Extant aspects requiring specialised treatment				
Information control and management:	IITS process utilises specialised information with barriers e.g.: - Widespread insufficient and inaccessible sources of technical information. - Valuable information is lost in repeated processing and inadequate control or review	✓		
Administration:	80% of administration is duplication of effort across DSOs and NSBs. Has potential to be customised in specified interfaces that can be linked to any project development setting to reduce excess activities, operational costs and, improve workflow	✓		
Interactions (communication, collaboration)	Consists of diffuse and specialised activities that propel project development activities and linked to creation of information - Existing IITS environment communication and reporting patterns neutralise IITS process interactions through hierarchical processes with non-value adding activities. - Need to create patterns essential for capturing communication and collaboration requirements	✓		
Technical development	Consists of specialised activities linked to the development of draft standards to include e.g.: - Requirements analysis that can be linked to creation of information and knowledge or implementation.	✓		

Appendix 9B: Checklist items of IITS process features, core aspects and survey results

(Source: compiled by author)

Column 1

	List of surveyed core aspects and items
1	Project proposal management
2	Registration management
3	Review of project proposal
4	Abstraction of project concepts and technical information
5	Consensus-seeking
6	Formal ballots
7	IITS environment ballot response evaluation and decision-making
8	Committee ballot resolution
9	Committee study and discussion
10	Committee project planning and organisation
11	Design of project development strategy and tasks
12	Technical development
13	Requirements specification
14	Documentation of draft standards
15	Revision of ballot draft standards
16	Implementation of draft standards
17	Publication of IIT standards
18	Revision and maintenance
19	SDO project management
20	NSB/secretariat project management
21	Committee project management
22	SDO/secretariat membership management
23	Documentation of procedures
24	Information control and management
25	SDO/NSB administration
26	Communication
27	Co-ordination
28	Committee interactions e.g. tasks collaboration, meetings
29	IITS process results control

Column 2

[A1] List of survey results	Response sample ranking 1	2	3
- Abstraction of project concepts and technical information	75	10	15
- Administration	65	5	15
- (Formal) ballots	79	-	-
- Committee ballot resolution	81	-	-
- Communication	73	10	-
- Consensus-seeking	78	10	-

[A2] List of survey results	1	2	3
- Co-ordination	55	2	14
- Committee interactions	65	25	-
- Design of project development strategy and tasks	88	1	-
- Documentation and revision of draft standards	94	-	-
- IITS environment ballot response evaluation and decision-making	69	-	6
- Technical decision-making	90	-	-

[A3] List of survey results	1	2	3
- Committee project planning and organisation	79	-	-
- Information control and management	35	44	-
- Implementation of draft standards	75	-	5
- Membership management	58	5	8
- Project management	89	-	-
- Project proposal management	80	-	-
- Publication of standards	92	-	-
- Review of project proposal	73	20	-
- Registration management	48	12	8
- Requirements specification	75	3	-
- Results control	65	15	-
- Revision and maintenance	64	4	12
- Study and discussion	71	-	-
- Technical development	59	-	27

Column 3

[B1] List of technical core aspects
- Abstraction of project concepts and technical information
- (Formal) ballots
- Committee ballot resolution
- Committee project planning and organisation
- Documentation and revision of draft standards
- Design of project development strategy and tasks
- Implementation of draft standards
- Review of project proposal
- Technical development and requirements specification
- Implementation of draft standards
- Technical decision-making
- Revision and maintenance-

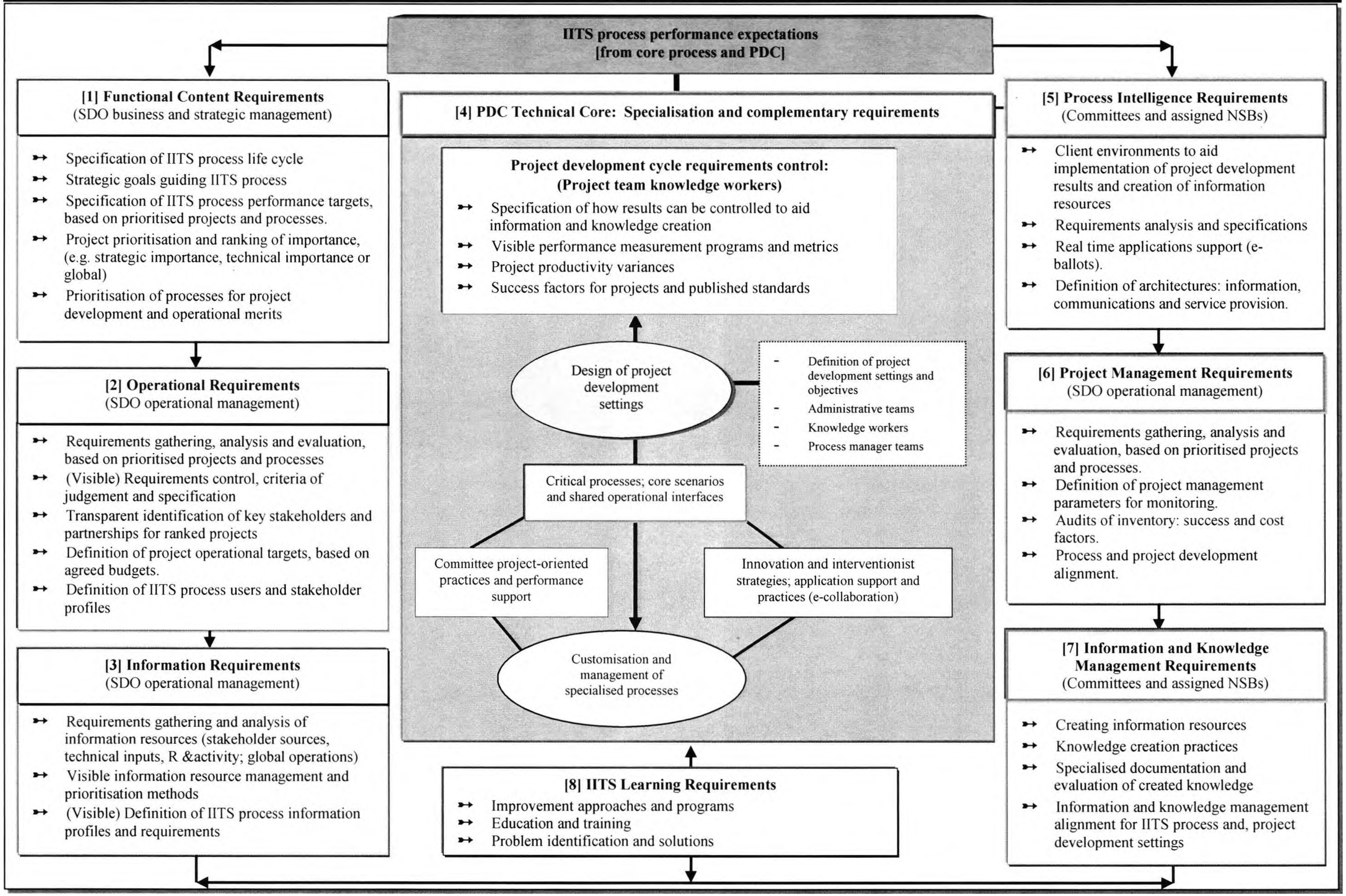
[B2] List of social-technical
- Committee study and discussion
- Committee interactions
- Consensus-seeking principles
- Committee information control and management
- Publication of standards

Column 4

[C1] List of operational attributes
- Administration
- Communication
- Co-ordination
- IITS environment ballot response evaluation and decision-making
- IITS environment information control and management
- Membership management
- Project management
- Project proposal management
- Registration management
- Results control

Appendix 10: Operational Framework-Parameterised IITS Process Performance Requirements

(Source compiled by author, adapted from Ngosi and Braganza, 2006)



Appendix 11: Practices for functional interventionist strategies

(Source: compiled by author)

Practice	Key features	Justifications
[1] Process management	New IITS process embodies specific assets, processes and practices to be managed: - Defining processes and their importance to the IITS environment - Aligning IITS process goals, objectives for defined processes, and needs to be meet - Identifying ownership and responsibility for delivering project objectives - Managing IITS process intelligence needs e.g. information, application of knowledge, skills and techniques - Success criteria for performance of defined processes and for project development	Effective planning and management practices develop operational excellence for cost-effective production of deliverable items and for actualising new practices
[2] Stakeholder identification and management	- Identification through well-structured approaches to develop understanding of who the real stakeholders are; inviting new stakeholders, alliances and their representations - Analyses of what stakeholders bring into IITS process - Continuos search for stakeholders through open consultation processes - Defining how to manage project networking translations based on stakeholder inputs, demands and requests - Determine impacts of stakeholders' inputs and demands on project development - Identifying how to manage conflict with stakeholder demands	IITS process works on the premise that stakeholders have vested interest in project development and IIT standards. Understanding stakeholders and their influential issues leads to discovering processes that can be customised to meet different needs
[3] Project management	- Skills: Effective project management has requirements for team leadership. - Visible prioritisation: assets that eliminate excess inventory; project proposals and networking with sectors - Alignment: project development objectives with IITS process strategy - Integration: Integrated inventory management across IITS process and organisations - Cost management: project expenditure, resource planning, - Methods: standardising project management techniques and methods for determining project success across IITS process - Quality management: providing direction for skill training; consistency; prioritising problems and getting these problems solved - Resource management: providing adequate skills and physical resources	Project development is the core pursuit of IITS process. New IITS process requires contemporary, visible practices and techniques

Appendix 11: Practices for functional interventionist strategies (cont'd)
(Source: compiled by author)

Practice	Key features	Justifications
[4] Requirements management	- Structured analyses, elicitation and definition of requirements across IITS process features - Visible prioritisation of requirements against assets and results - Problem and risk analyses of against procured requirements and results - Requirements control, maintenance, and reporting	Project development depends on recognised requirements, their elaboration in performance and promoting resolution of issues
[5] Capability Management	Embodies operational, processes and practices to be managed: - Map processes to operations to align task orientations, and to make staff accountable for procedures - Defining accountable procedures regarding task orientations - Aligning groups or teams to relevant IS tools to meet their work needs - Defining core competencies for the commitment to IITS strategies - Competence management: education and training to fit requirements for delivering desired results. - Redesign processes and operations to incorporate changes that best fir IITS process strategy; new tools and to improve - Performance results measurement and rewards	New IITS process will embody practices that develop capabilities for operations, human resources, performance, learning and IS. The more integrated these elements are, the greater the capabilities that can enhance performance
[6] Work Results Management	Involves practices for ongoing work results management; quality control; cost and inventory management; publications of products; maintenance; client-liaison operations. - Execution of defined processes is managed to collect documented work results that need to be controlled and that meet the project specific requirements. - Results quality control for defined processes and how quality can be met for interim results and other documents - Information analyses and evaluation of accumulated information, based on results - Information quality control - Product services to clients and management of the services e.g. implementation of IIT standards - Product design for publications and Internet-based content management of results	New IITS process will produce interim results for review and for ballots; committee technical documents; information and cumulative knowledge. Effective results management practices are part of operational excellence.

References to case study items:

Committees in Table 3-5: 'Selected case study items'	
IEEE WG 1074:	Work Group on Software Life Cycle processes.
ISO JTC 1 SC 2:	Subcommittee 2, Character Sets.
ISO JTC 1 SC 7:	Subcommittee 7, Software and system engineering.
ISO JTC 1 SC 29:	Subcommittee 29, Coding of audio, picture, multimedia and hypermedia information.

Secretariats in Table 3-5: 'Selected case study items'	
IEEE WG 1074:	Private organization, USA
ISO JTC 1 SC 2:	France, AFNOR (Association Francaise de Normalisation)
ISO JTC 1 SC 7:	Canada, CSC (Canadian Standards Council).
ISO JTC 1 SC 29:	Japan, IPSJ/JISC, (Information Processing Society of Japan/Information Technology Standards Commission of Japan).
- ISO JTC 1 SC 29 WG 1, JPEG:	Private organization, USA
- ISO JTC 1 SC 29/WG 11, MPEG	Italy, CSELT (Centro stui e Laboratori Telecommunicazioni)

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[Unicode de facto standard version 1.1 (1994) was designed to align the Unicode standard with ISO IEC 10646 Part 1, and included changes & additions that have been made in the process of this alignment. Revisions followed for the Unicode standard: Version 2 (1996), Version 3 (2000) & Version 4 (2003) provide for every character in electronic text].

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- Part 2: Video. (Corrigendum 1-1993; Corrigendum 2-1999, Corrigendum 3-2003).
- Part 3: Audio (and Corrigendum 1-1996).
- Part 4: Compliance Testing.
- Part 5: Technical Report (TR), Software simulation.

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ISO MPEG committee — (http://www.chiariglione.org/mpeg/)

ISO JPEG committee — (http://www.jpeg.org/) (http://www.jpeg.org/jbig/index.html)

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