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INTRODUCING THE GOAL-BASED INFORMATION FRAMEWORK (GbIF)

Documentation and Evaluation of Information Flow in the Low Maturity Organisation

ANDREW JOHN BOYD

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy

at

City University, London
Department of Information Science

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Abstract

Purpose of the Research: To introduce and evaluate a new method, the *Goal-based Information Framework (GbIF),* to model and contextualise information flow in a multi-channel, multi-source, environment. This research presents a derivative of the goal-question-metric (GQM) methodology for use in information retrieval and exchange scenarios, paying particular attention to information needs of low maturity organisations.

Methodology/Approach: Following a review of the GQM literature, this iterative case-based research first presents a reference model based on experiences at an e-commerce business. The reference model is used as a baseline in two further case studies. The primary case study looks at multi-channel, multi-source, information retrieval challenges within the support department of a European software company. The second case study presents the GbIF in an information exchange context within a software integration project. A comparative study of the reference model and case-based iterations is presented in the conclusion.

Findings: The research indicates that the GbIF has value in documenting and evaluating organisational information flow. For information retrieval, the goal-based information framework is a descriptive and evaluative construct, rather than a prescriptive process model. That is, the framework is useful for describing and evaluating an organisation's static information needs, not in guiding it through an information-retrieval process. For information retrieval needs, the value to the organisation is the resulting documented information flow from goal to information source. However, the complexity and expansiveness of the GbIF may make maintenance (adding and documenting new/additional needs) challenging for the low maturity organisation. This factor could make the GbIF more relevant for one-off or static information needs. The research also presents the theoretical application of the GbIF in information exchange scenarios.

Research limitations: The case-based findings could be specific to the observed organisations and could only be valid under similar conditions. Future field and scenario based testing of the framework is required to further understand its strengths and limitations. A complete specification of the framework will need to be authored prior to wide adoption.

Practical implications: Much of the previous work on goal-based methodologies has been confined to software measurement or business strategy contexts in larger organisations with well-established information processes. This research expands on a well-documented heritage to present an entirely new method of modelling and documenting information flow in a much wider context. The research also specifically identifies and investigates the challenges of using goal-based methodologies in a low maturity environment.

1 Introduction

1.1 Background

The information landscape is quietly changing. Historically, information provisioning and exchange dealt with static units of information distributed in a controllable manner – once published, the written page was presented as the author intended. However, the introduction of new information channels such as web, email, wireless and instant messaging changed the rules. Now information is provisioned with rendering instructions through a variety of methods (e.g. HTML and XML). The requirement to provide information through many channels, in differing formats and for different purposes has fragmented organisational information systems, with each channel generally having its own storage and retrieval infrastructure.

Furthermore, emerging technologies such as Services Oriented Architectures (SOA) and web services complicate the situation even further. In the not too distant future, units of information within the organisation will not only include rendering instructions, but will also be malleable at the point of consumption. In this environment, the information 'owner' has no control over the final display, structure or even content of the data. Rather, they will provide information rules to govern the creation and use of these 'information objects'. With the technologies in a nascent state, the ramifications of these developments are not well explored in the information science literature.

In the information environment described above, creating a single organisational view of information assets is very difficult indeed. This research presents a goal-based information framework to contextualise, evaluate and document organisational information flow (retrieval and exchange), paying particular attention to the challenges encountered by low maturity organisations.

1.2 Aim and Objectives

The overall aim of this research is to validate the use of a goal-based information framework (GbIF) to contextualise, evaluate and document information-retrieval and exchange in the low maturity organisation. The research is specifically focused on organisations that do not have the financial or human resources to invest in idealistic or overly-complex information-retrieval and exchange methodologies. Specifically, this research has been conducted with the following objectives:

- Through an exhaustive literature search: 1) examine the strengths and weaknesses of various goal-based methodologies currently in practice, and 2) lay the theoretical foundations to understand multi-source, multi-channel, information retrieval and exchange.
- Review the current *state of practice* for multi-channel information retrieval and exchange through analysis of leading practitioner companies.
- Construct a goal-based information framework *reference model* based on the *state of practice* and literature reviews.
- Evaluate the challenges, strengths and weaknesses of a goal-based approach through case study.
- Synthesise the findings from the literature review and the case studies into a set of recommendations for additional research and further development of goal-based methods.

1.3 Scope of the Research

This research is the convergence of three central themes – goal-based methodologies, multi-channel information retrieval and multi-source information exchange – within the overall context of low maturity organisations. Each of these topics is enormously broad and it is recognised that an entire thesis could be done on sub-elements of each theme. As such, at the offset of this research it is important to declare what this thesis is, and just as importantly, what it is not.

1.3.1 Goal-Based Methodologies

The Goal-Question-Metric (GQM) and the Goals-Question-Indicator-Measure (GQIM) paradigms have a relatively long and illustrious history in the field of software development. Introduced by Basili and Weiss in 1984, the use of GQM and derivatives are well documented in the literature. Broadly speaking, the method involves setting measurement goals based on overall organisational objectives. The goals are then contextualised and focused through question and measurement definition. Once the exercise is completed, high-level organisational goals are linked to low level data definitions providing an organisational information retrieval blueprint.

In the 1990's, the prevalence of goal-based methods grew to the point that they could be studied in a field environment. Numerous examples of successful implementations in larger organisations exist and have been reviewed in the literature review section of the thesis (Chapter 2). The intention of this research is not to measure the effectiveness of a specific goal-based methodology, but rather to illustrate that goal-based methods have value outside their native discipline of software quality and measurement. The research also aims to investigate the value of GbIF methods in low maturity organisations.

In addition to GQM, this research briefly overviews a few other goal-based techniques, most notably Kaplan and Norton's Balanced Scorecard. The Balanced Scorecard is a managerial system that links rounded performance measures to high-level business objectives. In addition to traditional *Financial* measures, such as return on investment and economic value, the Balanced Scorecard incorporates three other perspectives to give executives a complete view of their business. The *Customer* perspective includes elements such as satisfaction, retention, market share measurements. The *Internal* perspective measures quality, cost, new product introductions, etc, and the *Learning and Growth* perspective includes items such as employee satisfaction and information system availability (Kaplan and Norton, 1996,

p. 44) Again in the 1990's, the use of Balanced Scorecard grew significantly in larger organisations.

The discussion of Balanced Scorecard in this research is primarily bibliographic (as such it is included in the Appendices). That is, the flexibility and portability to different disciplines provides excellent background for the discussion of wider applications of GQM-based methods. It is outside the scope to the research to provide an in-depth critique of the Balanced Scorecard.

1.3.2 The Low Maturity Organisation

To develop a working definition of "low maturity" for use in this research, two maturity constructs are reviewed. Borrowed from the software quality discipline, the capability maturity model (CMM) consists of five classifications of organisational maturity. A CMM Level 1 organisation is defined as having ad hoc or few defined processes, and where successful delivery depends on individual effort. The other construct, Information Orientation (IO), links corporate performance to an organisation's ability to use information (Marchand et al, 2001). IO explores the interaction between people, information and technology that result in an organisation's "information orientation".

For the purposes of this research, the low maturity organisation is defined as:

- Ad hoc, chaotic and/or undocumented information processes
- Inability to repeat information searches that produce the same results (systems and data in a state of flux)
- Disparate systems that are not linked, containing duplicate or unsynchronised data
- Multiple systems or data sources with incorrect data (missing, out-dated or incorrect)
- No repeatable process to determine the validity of data

- No tractability from high-level organisational goals to information infrastructure
- No consistently defined and documented organisational nomenclature
- No planned or managed information reporting

The aim of this research is not to provide a definitive definition of the low (information) maturity organisation, but rather to evaluate the use of the goal-based information framework in such an environment.

1.3.3 Multi-channel Information Retrieval

The rise of the internet society with device, channel and internet node proliferation has created a "silo" environment within the organisation. By and large, device and channel specific information systems generally operate independently of each other. That is, due to the complexity and cost of integration, new information systems are generally added piecemeal to the existing information infrastructure. In many cases, each new channel has its own data storage mechanism, and information provisioning and retrieval across these silos creates information flow blockages for both users and provisioners. In Chapter 5, the *state of practice* is reviewed to frame the discussion of the challenges of modelling multi-channel, multi-source information flow. In this context, the nature of information-seeking and retrieval is outlined. It is outside the scope of this research to discuss the various information behaviour models (see Wilson 1999). Additionally, a deep discussion of specific multi-channel technologies is avoided.

1.3.4 Cross-organisation Information Integration & Exchange

Due to the nascent state of the technology, the discussion of information integration and exchange is largely theoretical. The *state of the practice* review overviews the current technology from an information, as opposed to computer, science disciplinary point-of-view. That is, the discussion of emerging technologies in this research is concerned with framing the informatics issues that could arise from the adoption of

these technologies. It is outside the scope to discuss the feasibility of various architectures and technology.

1.4 Outline of the Thesis

The thesis is divided into eight chapters and includes a glossary and appendices. In the next chapter (2), the goal-based literature is thoroughly reviewed with a particular focus on the Goal-Question-Metric (GQM) paradigm and offshoots such as GQIM. The research design chapter (3) overviews the methods and case data used in the research, and in Chapter 4, a goal-based reference model is constructed based on early experiences at an e-commerce company.

Chapters 5 & 6 follow a similar format. First, through literature review and secondary source analysis, the current *state of practice* is outlined. Then, in the context of the *state of practice,* the GbIF is applied in a field setting. Specifically, Chapter 5 discusses the sources of information disparity including multi-channel information seeking and retrieval, multi-channel business operations, mergers and acquisitions and organisational silos. With this background, the GbIF model is applied to the evaluation and documentation of business process reengineering within a software support organisation. The Chapter 6 *state of practice* overviews emerging trends in information integration and exchange. The GbIF reference model is then adapted and applied as part of a software integration project.

The final chapters (7 & 8) conclude the study with a discussion of general findings and specific lessons from each case study. Additionally in the concluding chapter, several other possible applications of the model are discussed. Finally, a references section of cited and bibliographic sources is provided.

1.5 Main Findings of the Research

Based on the aims and objectives declared above, the main findings of this thesis are as follows:

- The research illustrates the use of goal-based techniques outside of the previously researched context of software quality and measurement. Whereas the previous literature shows goal based methods in mature information environments (e.g. Nokia, IBM, NASA, HP), this research indicates that goal-based methodologies have value in low maturity environments.

- In the low maturity organisation case study research indicates that for information retrieval, the goal-based information framework is a descriptive and evaluative construct, rather than a prescriptive process model. That is, the value of the framework is in describing and evaluating an organisation's information retrieval needs, not in guiding it through an information-retrieval process. The practical application of the goal-based information framework in Chapter 5 illustrates its value as a diagnostic tool for the contextualisation and evaluation of information retrieval needs. Since, by design, goal-based methodologies limit knowledge discovery, the primary functional use for the framework is in defining and documenting relatively static information retrieval needs, and providing accurate and timely information to address those needs. As such, the goal-based model is most appropriate for briefing, awareness and some fact finding functions outlined in Nicholas' Information Needs Assessment Framework (see Chapters 5 & 7, also Nicholas 2000).

- With recent changes in the nature of information exchange (illustrated in the introduction to this chapter and further explored in the *state of practice* section of Chapter 6), new methods to contextualise the information environment will become increasingly necessary. As such, this research lays the theoretical groundwork for the use of the goal-based information framework in an information exchange and integration context.

1.6 Terminology

While an attempt has been made to keep the thesis as free of jargon as possible, the nature of the subject does not always make that possible. As such, terms and acronyms are generally defined when first used and a complete glossary has been

provided at the end of the paper. More frequently used terms and acronyms are outlined below (Table 1-1).

Throughout the research, the term "information disparity" is used to describe the challenges inherent to multi-channel/multi-source information provisioning and retrieval and "information-retrieval and exchange" are collectively referred to "information aggregation". Furthermore, the terms information exchange and integration are often used interchangeably. The GQM derivative used in this research is referred to as the "goal-based information framework" (GbIF).

Table 1-1: Key Concepts, Frequently Used Terms and Acronyms

Goal-Question-Metric (GQM)	A method to collect software engineering data, whereby measurement goals are established, questions linked to goals are posed and metrics are derived to satisfy the questions.
Goal-Question-Indicator-Measure (GQIM)	The GQIM method is a way for software evaluators to ensure that the software measurement achieves pre-determined business objectives. An off-shoot of GQM, GQIM adds an "indicator" definition step. Indicators include tables, graphs or other graphical representations of data that link back to questions.
Goal-based Information Framework (GbIF)	A new goal-based method, based on GQM and GQIM, presented in this research. GbIF takes the early GQM/GQIM research beyond the its roots in software engineering to provide a generic evaluation and documentation method to understand information retrieval and exchange.
Information Channel	Method by which an information-seeker receives information or data. Includes: Email, Web, Face-to-Face, Fax, Telephone, Instant Messaging and Text Messages.
Information Flow	The way information moves through a system or organisation.
Information Source	Repository (database or file) where information is stored.
Low Maturity Organisation (LMO)	An organisation without an innate information processing competency.

Additional terms and acronyms are defined in the Glossary section.

1.7 Note on Previous Publication

Sections of this research have been previously published in academic journals, conference proceedings and practitioner publications. Peer-reviewed work that has already resulted from this research includes:

"A Fuzzy Approach to Information Channel Optimisation," Aslib Proceedings: New Information Perspectives, Vol. 57, No. 1, 2005, pp. 11-21.

Editor of Special Issue: "Information Disparity: Research and Measurement Challenges in an Interconnected World," Aslib Proceedings: New Information Perspectives, Vol. 56, No. 5, 2004, pp. 269-272.

"A Goal-Based Approach to the Evaluation and Documentation of Business Process Reengineering," Aslib Proceedings: New Information Perspectives, Vol. 56, No. 5, 2004, pp. 286-301.

"Multi-Channel Information Seeking: A Fuzzy Conceptual Model," Aslib Proceedings: New Information Perspectives, Vol. 56, No. 2, 2004, pp. 81-88.

"The Goals, Questions, Indicators, Measures (GQIM) Approach to the Measurement of Customer Satisfaction with e-Commerce Websites," Aslib Proceedings: New Information Perspectives, Vol. 54, No.3, 2002, pp. 21-24. Awarded Outstanding Paper of 2002

Boyd, Andrew and John Boyd; "Thoughts on the Evaluation of SME Strategic Relationships," Presented at the International Council of Small Business 2002 Conference, San Juan PR, 6 June 2002, Printed in Conference Proceedings.

The above, and additional work appearing in practitioner publications, are clearly referenced in the body of the thesis and a full bibliography of published work appears in the reference section.

2 Review of Goal-Question-Metric (GQM) Literature

This section overviews two of the most promising goal-based methods: Basili and Weiss' Goals-Question-Metric (GQM) paradigm and Park et al's GQIM. Of the two, GQIM seems to be the most complete and useful toward the stated objectives of this research.

Presented in the Appendices are three additional goal-driven techniques including Kaplan and Norton's Balanced Scorecard (BSC), the Objectives, Goals, Strategies and Measures (OGSM) approach and Boyd's own Objective, Entity, Infrastructure (OEI) method.

2.1 The Goal-Question-Metric (GQM) Paradigm

The GQM paradigm was introduced over 20 years ago as a method to collect valid software engineering data (Basili and Weiss, 1984). Since then, some of the world's premiere software development organisations, such as NASA, IBM, HP and Nokia have used or experimented with GQM in several contexts. Although later adapted, the core fundamentals of GQM as they were first presented by Basili and Weiss are as follows (1984, pp 728-732):

1. **Establish Goals of the Data Collection** – First, before any data are collected, goals for the measurement effort must be established. Goals are categorised as either context specific or generic. That is, goals which are of interest within a single project and goals which are relevant outside a specific project context that may be of interest to software engineers, programmers and managers in general. Goals are used to ensure that data are collected are relevant to the problem area. Otherwise, data may be collected that is incomplete or out of context ("incomplete patterns or no patterns are discernable", p. 729).
2. **Develop a List of Questions of Interest** – With goals of the project established, a set of questions that must be answered is derived. Each goal will have several questions associated with it. If goals address the qualitative reasoning of the study, questions frame the future quantitative parameters of

the study. This process not only refines the goals, but also forces the information seeker to consider data collection before any resources are committed. If questions are unclear, do not relate back to a goal or cannot be answered, the information seeker can reconsider the data collection exercise.

3. **Establish Data Categories –** This step essentially assigns a purpose or reason for the data collection. Categorisation ensures that all of the relevant topical areas have at least one question assigned to it, or that all of the questions are not concerned with essentially the same measurement factor.
4. **Design and Test the Data Collection Form –** In environments where the information-seeking exercise is secondary to a deliverable (such as software development), the use of a data collection form ensures that data are collected as a matter of course. Without the form, old versions of documentation or organisational memory must be relied on. Basili and Weiss recommend a short, tick-box form that adhere to the following design principles (1984, p. 730): a) fit on a single sheet of paper, b) could be used in several [contextual] environments and c) permitting the user some degree of flexibility.
5. **Collect and Validate Data –** In this step, data are collected and forms are checked for completeness, consistency and correctness. Interviews may be conducted in cases where there may be ambiguity in the data capture. Basili and Weiss recommend keeping the time between data capture and validation to a minimum to insure accuracy (1984, p. 732). Otherwise it may be difficult to clarify things weeks or months later.
6. **Analyse Data –** Finally, data are analysed and mapped back to each question, thus deriving an answer. With the questions answered, it should be clear that the goals of the study have been satisfied.

In conclusion, Basili and Weiss offer a series of recommendations for data collectors, lessons learned and advice for avoiding data collection pitfalls (Table 2-1).

Table 2-1: Lessons Learned and Avoiding Pitfalls

	Procedural Lessons Learned	Nonprocedural Lessons Learned	Avoid Data Collection Pitfalls by:
1	Clearly understand working environment and specify data collection procedures	Understand environmental factors that may influence or affect data	Select data collectors that are familiar with environment or context
2	Staff should be familiar with circumstances and collection procedures	Do not underestimate resources required to validate and analyse data	Establish data collection goals and methodology prior to beginning analysis
3	Timely data validation is vital	Data may be sensitive – results should not be used against staff involved in collection	For initial efforts, keep data collection goals small
4	Minimise [data collection] overhead on staff	Be mindful of the Hawthorne effect – i.e. monitored behaviour may change	Design data collection instrument so that it is independent of a particular project – i.e. it can be reused and will be understood in later projects
5	If automated data collection is used, validate data immediately	Contractors [or customers] may feel that data are proprietary. Rules for collection need to be agreed in advance	Integrate data collection into project tasks. Automate as much as possible.

Source: Basili & Weiss, 1984, pp. 735-736

Since its introduction, GQM has been used quite extensively for software quality and measurement and has evolved to the following template (Basili et al 1995, Park et al, 1996, Mendonça and Basili, 2000):

> *Analyse 'object of study' in order to 'purpose' with respect to 'focus' from 'point of view'*

And it now incorporates the following six steps (Briand et al, 1997, p.3):

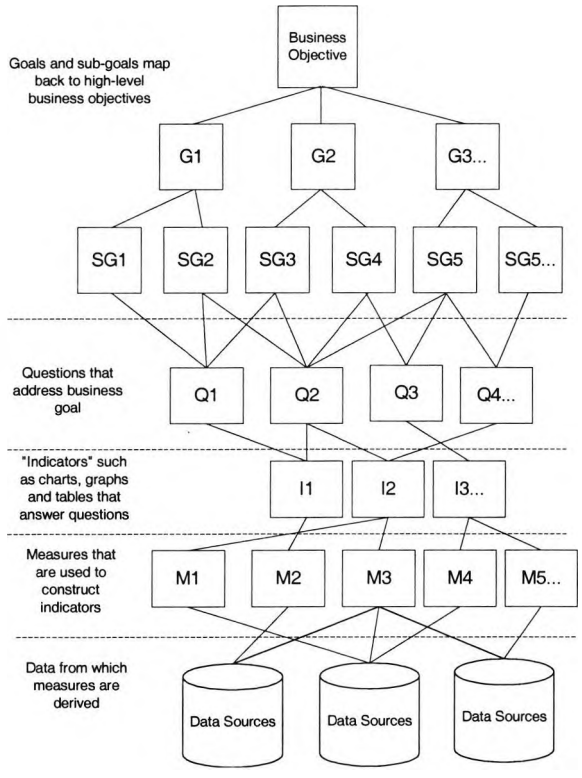
1. **Characterise the environment** – identify the characteristics of the organisation and project or projects to be measured.
2. **Identify measurement goals and develop measurement plans** – define measurement goals based on the information in step 1
3. **Define data collection procedures** – define data collection procedures for all measures defined in step 2
4. **Collect, analyse and interpret data**
5. **Perform post-mortem analysis and interpret data** – compare data collected in step 4 with organisational baseline
6. **Package experience** – structure results into reusable form to be used in the future

2.2 Goals, Questions, Indicators and Measures (GQIM[1])

An off-shoot of GQM, another powerful evaluation method is Park et al's goals, questions, indicators and measures (GQIM) methodology. Developed by researchers at the Software Engineering Institute, GQIM method provides a powerful way for software evaluators to ensure that the software measurement achieves pre-determined business objectives. This method starts by asking, what is it that I want to know?" not by asking, "what measures should I use?" The GQIM process has 10 steps (Park et al, p. 23, 1996):

Figure 2-1: The GQIM Model

1. Identify business requirements
2. Identify what you want to know or learn
3. Identify sub-goals
4. Identify entities and attributes related to sub-goals
5. Formalise measurement goals
6. Identify quantifiable questions and the related indicators that will be used to help achieve measurement goals
7. Identify data elements that will be collected to construct indicators
8. Define the measures to be used, and make these definitions operational
9. Identify the actions that you will take to implement the measures
10. Prepare a plan for implementing the measures



GQIM, like GQM was designed with software measurement goals in mind, but is far more comprehensive. Park et al point out that the method can be used with any organisational goal, but caution that several iterations may be needed at step 2, 3 and

[1] Park et al denote GQIM as "GQ(I)M". The parentheses have been eliminated from this research in the interest of readability.

4 to maintain traceability to overall goals (1996, p. 25). Encompassing much of the construct of traditional GQM, the "I" or indicator step is raised in profile to warrant inclusion in the methodology title. Also, the first four steps (outside the scope of traditional GQM) are used to frame organisational objectives that can be used as the basis for the measurement goals.

The process begins with the identification of business goals (step 1). Although it is possible to start with lower level goals, in doing so the project may lose the support of senior managers (who may consider the project too operational to warrant their attention). One suggestion is to start with the goals of the most senior stakeholder, be it the project champion, project sponsor or if necessary the project manager. To generate business goals, the researchers recommend structured brainstorming or the Nominal Group Technique (1996, p. 26). Before proceeding to the next step, cross-over goals are combined and the list is prioritised.

Step 2: "Identifying what you want to know or learn", begins to map a path from high-level goals to operational measures. It begins by asking what quantitative information is desired. Starting with one of the goals outlined in Step 1, the stakeholders are identified (groups or people whose concerns are being addressed) and mental models are created. This is similar to the step in GQM where the *point-of-view* is specified. Next, entities (thing to be measured and influenced) are identified. The Park research team identifies four types of process entities (1996, p. 29):

1. Inputs and resources
2. Products and by-products
3. Internal Artefacts (e.g. inventory and work in process)
4. Activities and flowpaths

For each entity, questions are asked that seek to elicit information that would useful in managing the goals identified in step 1. Questions generally include descriptors such as: how big?, how much?, how many?, how fast?, how long?, cost?, etc.. With that, additional questions are asked about the processes as a whole to identify additional entities or if anything were missed. These questions revolve around

benchmarks, customer/stakeholder perceptions, constraints, etc. This cycle is repeated for each goal that was identified in step one.

Step 3 is the link-step that connects the high-level business goals to specific measurement goals. Questions (identified in step 2) are grouped into related topical areas according to the issues that they address. With these grouped sub-goals, the next step (4) is to refine entities and attributes. The attributes, or characteristics of entities, are the things that if quantified will help to answer questions (1996, p. 40). A somewhat pedantic, but important, point is the difference between an attribute (characteristic of an entity) and a measure (scales and rules that assign values to attributes). Park et al, warn against spending too much time and energy making distinctions at this point.

This process in step 4 may also lead to refining the sub-goals and related questions. The first four steps (1 to 4) have been added to the GQM paradigm to "get to the point where the goal-question-metric (GQM) paradigm of Basili and Rombach can be applied effectively" (Park et al, 1996, p. 43). Step 5: Formalising the measurement goals, encompasses the GQM paradigm (outlined above) comprised of four elements:

1. Object of interest
2. Purpose
3. Perspective
4. Context (or in Park et al's terms, description of environment and constraints)

The *object of interest* is the "thing" of study that needs to be better understood, evaluated or improved. Examples include: product, process, activity, metric. Park et al, (1996, p. 46) lists *purpose* as understand, predict, plan, compare, assess or improve; whereas, Briand (1997, p. 21) defines six types of models: characterisation, monitoring, evaluation, prediction, control and change. The purpose should be clearly defined without any ambiguity. *Perspective* denotes the point of view from which the measurement activity takes place. As team members will undoubtedly see things differently according to their position, it is important to construct and define measures from the point of view of the user. To avoid out-of-context use of the

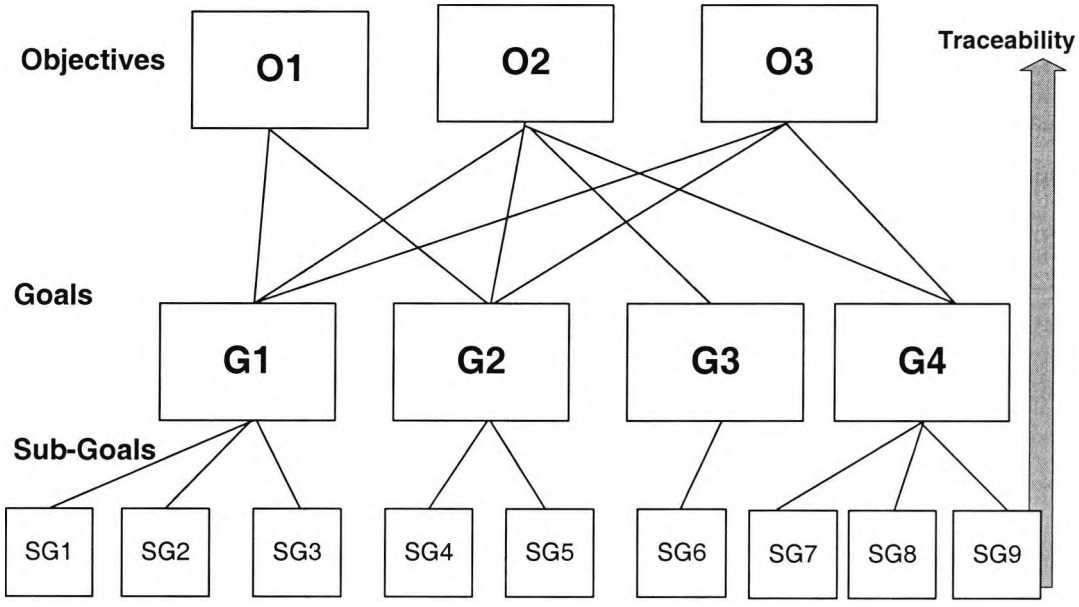
results it is important to define the constraints that may impact the measurement results. This is defined in the GQM model as *environment.*

Now it is time to formalise the above sub-goals, entities, attributes and questions into measurement goals. The tasks associated with this step are to (Park et al, 1996, p. 51):

1. After reviewing the above, identify information needed
2. Identify activities needed to acquire that information
3. "Express measurement goals as structured statements that identify the objective, purpose, perspective, environment and constraints associated with the measurement activity"
4. "Identify and record the business sub-goal that each measurement goal addresses"

Now that measurement goals are defined, it is a good idea to test traceability back to sub-goals, goals and business objectives (Figure 2-2). This exercise will not only ensure that all goals (and objectives) are measured, but also that there are no extraneous measurements (not linked to a specific goal).

Figure 2-2: Maintaining Traceability (Objectives & Goals)



As discussed above, steps 1 through 4 are necessary to frame the measurement goals. With the first steps of GQM completed (measurement goals), quantifiable questions should be identified and indicators can now be constructed. It is also at this point that the "indicator" step (the "I" in GQIM) is added. Indicators include tables, graphs or other graphical representations of data. Park et al strongly recommend that validation processes take place before distribution, as poorly constructed indicators and questions can be misleading to the audience (Park et al, 1996, p. 59)[2]. One specific recommendation is to envisage unexpected results in the context of the proposed indicators. By evaluating how this will be received or interpreted, questions and indicators can be refined in a meaningful way. The process for identifying quantifiable questions and indicators is as follows:

1. Select one of the measurement goals
2. Identify questions that relate to this goal
3. Prepare indicators that will address questions and communicate results
4. Prioritise indicators in order of importance
5. Repeat for other measurement goals

Step 7 involves identifying the actual data elements that have to be colleted to construct indicators. The important thing to remember – particularly in an information-seeking context – is that the data that are to be collected at this point map directly back to measurement goals, which should in turn map back to actual business goals (Figure 2-3). Data elements can serve multiple indicator needs, but no data are collected for collection sake. With data elements, measures are identified.

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[2] At this point, Park et al digress into a slightly pedantic discussion of the use of the word "metric" vis-à-vis "measure". In their minds, GQM stand for "Goal-Question-Measure", not "Goal-Question-Metric" as put forth by the earlier literature. But they feel that discussion of terminology is important in determining what is to be measured; over time a carefully crafted question may be far more useful than "exact percentages" (metrics).

Once the data elements are identified, measures are defined (Step 8). This means a detailed description of how the measure is constructed (including formulas and/or SQL) and how the data are obtained. Two criteria must be satisfied in the definition of measures (Park et al, 1996, p. 67): measures must be 1) clearly communicated, letting others know exactly what was measured and how and 2) repeatable – a neutral party, with the operational definition, should be able to reconstruct the measure. For GQIM to be repeatable and useful beyond a single project, operational definition checklists[3] and documentation forms should be created for the organisational and domain-specific problem set (i.e. information integration). These checklists should not point out what the user should do, but rather give guidance on how the data can be interpreted correctly (Park et al, 1996, p. 84).

Steps for defining measures include:

1. Choose an indicator for definition
2. If a suitable framework (checklists and forms) exists, use it to create definitions. If not, checklists and forms need to be created and special care must be taken to define the measure so that can be communicated and is repeatable.
3. Repeat until all rules are defined for all data elements.

Now is the time to translate measures into an operational plan. Step 9 encompasses the analysis of the current measurement [information retrieval] situation within an organisation as a baseline to launch the action plan. This step involves three activities including analysis, diagnosis and action.

Analysis is the determination of the current baseline and diagnosis is the evaluation of the data elements that that organisation is currently using in the context of the new

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[3] Park et al present a series of operational definitions that can be used in a software quality context (1996, pp 66-82). However, since it is assumed that this research will be applied in other contexts, the section on defining terms is not highly relevant (1996, p. 84).

measurement plan. Questions that could be used in analysis and diagnosis include (Park et al, 1996, p. 88-89):

- *What data elements are required for my goal-driven measures?*
- *Which data elements are collected now?*
- *How are they collected?*
- *What are the processes that provide the data?*
- *How are the data elements stored and reported?*
- *What existing data can be used to satisfy new requirements?*
- *What elements of our measurement definitions or practices must be changed or modified?*
- *What new or additional processes are needed?*

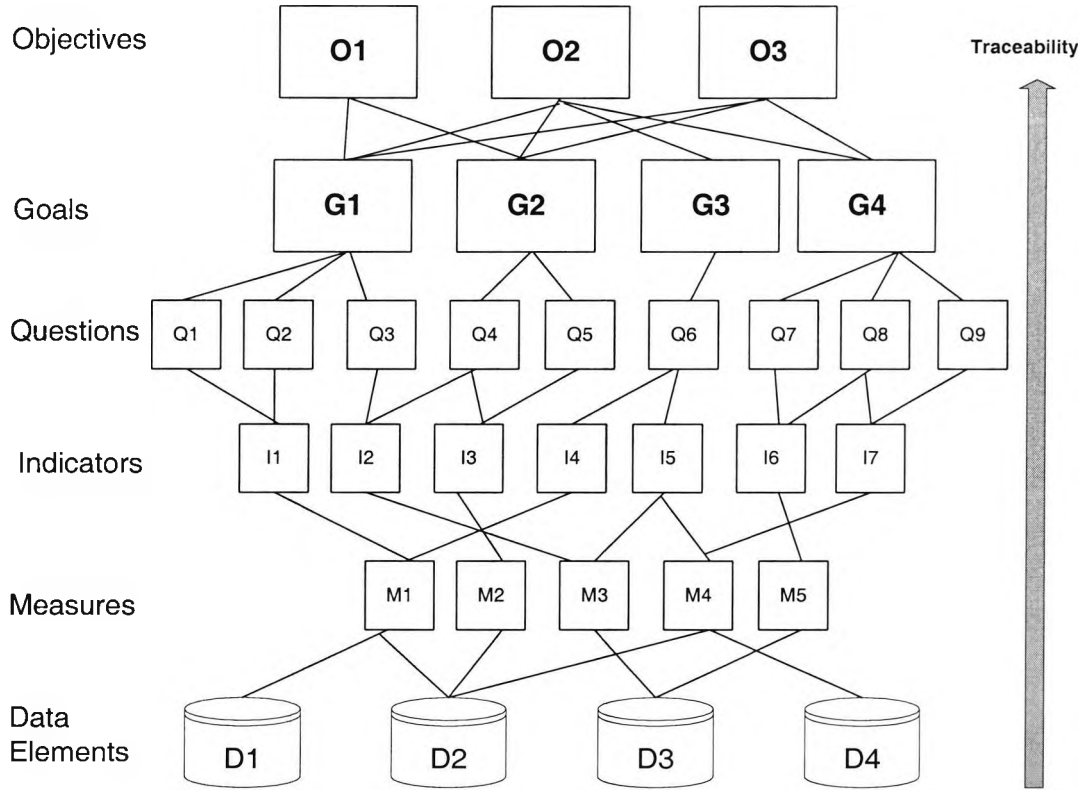
The action sub-step is the distillation of the results of the analysis and diagnosis into an implementable action plan, including task definition, resource allocation and assignment of responsibilities. This could include (Park et al, 1996, p. 90):

- Identification of data sources
- Defining data collection methods and reporting
- Specifying data collection and storage tools
- Defining frequency of data collection and milestones
- Documentation of data collection procedures
- Defining who will use the data
- Defining how the data will be reported and analysed
- Packaging into a data definition and process guide

With the information collected in the proceeding nine steps, a complete and traceable path is created that links data elements back to the over-arching business (or information seeking) objectives of an organisation (Figure 2-3). The last step (10) in the GQIM process is the preparation of a plan[4].

[4] A template is provided by Park et al (1996) on pages 95-98.

Figure 2-3: Maintained Traceability (Goals, Questions, Indicators, Measures)



The next section overviews several industry experiences, mostly in software engineering environments, with implementing GQM and goal-driven measurement.

2.3 Industry Experiences with Goal-Driven Measurement

There are several examples that standout in the literature where GQM was used with success. As winner of the first IEEE Computer Society Software Process Achievement Award, the ground-breaking work at NASA's Software Engineering Laboratory (SEL) incorporates some of the key aspects of GQM paradigm in its process improvement process (McGarry et al, 1994). Again, focused on software measurement, this so-called "bottom-up"[5] approach relies on incorporating past

[5] A note about terminology: here "bottom-up" refers to the incorporation of goals derived on the local level, as opposed a top-down approach whereby goals are part of universal goal framework (e.g. the Capability Maturity Model). Other references in the literature such as Mendonça refer to "bottom-up" as a data-centric approach and "top-down" as an objective-based approach.

experiences into an on-going and iterative measurement programme. The three steps in the SEL approach are (McGarry et al, p. 2, 1994):

1. Understanding
2. Assessing
3. Packaging

First, a thorough understanding of the current environment is gained. Next, goals are used to determine improvements that need to be made (assess) and lastly, process changes are implemented (package). Thus the cycle begins again and iteratively continues. Although the SEL paradigm is focused on delivering software process improvements – in six years, the error rate of completed software dropped 75% (McGarry et al, p. vii, 1994) – the methodology provides an interesting framework for modelling information flow.

Another study (Mendonça, et al, 1998) shows how the approach was used at IBM Software Solutions Division Toronto Laboratory to analyse customer satisfaction data. This study compares GQM, a top-down measurement approach, with the AF (Attribute Focussing) knowledge discovery (bottom-up) technique. In this situation, GQM provided a measurement context and an on-going framework to run a measurement programme. The AF technique gave researchers a tool to analyse legacy data. Many measurement frameworks are prone to (Mendonça et al, 1998, p. 484,): "(1) collecting redundant data, (2) collecting data that nobody uses or (3) collecting data that might be useful to people that do not even know the data exist within the organisation." It is for these reasons that they stress the importance on ongoing measurement and the use of a traceable methodology such as GQM.

At IBM, a bi-directional approach set out to (Mendonça et al, 1998, p. 487): "understand the on-going measurement, structure of the measurement and explore the legacy data". The first ("top-down") phase incorporated GQM to capture user goals and map them to the underpinning data. However, a weakness of the top-down approaches is that it can ignore or overlook certain valuable data that is already collected within the organisation. For exploratory data discovery, bottom-up

approaches are necessary. The second (bottom-up) phase uses AF to discover new and interesting facts. This combination provides a holistic view of the measurement needs of the organisation.

This study shows that GQM can adapt to be used in organisations with existing measurement frameworks and is valuable in identifying extraneous or no longer useful metrics (Mendonça et al, 1998, p. 489). Since GQM maps end-user goals to metrics, if metrics exist that do not map to goals, then the importance of gathering that information must be examined.

Recently, in another study Boyd (2002e) presented an illustration of the adaptability of GQIM. As a model for customer satisfaction measurement with e-commerce websites, this adaptation was outside the context of software measurement, although still measurement focused. Other examples of the adaptability of GQM are put forth by Pai (2002) in the context of Software Quality Function Deployment (SQFD) and Kilpi (2001) at Nokia. As GQM was originally developed as a software measurement framework, the use in requirements engineering seems to make sense. SQFD is a five step process used for eliciting and defining customer requirements. When used with GQM (Table 2-2), the combined process quickly identifies extraneous requirements leading to enhanced usability (Pai, 2002, p. 23). In practice, this combined approach resulted in a 15.2% reduction is system size at the CS Foundation (Pai, 2002, p. 23)

Table 2-2: SQFD and GQM

SQFD Process	SQFD with GQM
Customer requirements are solicited and recorded	Record customer requirements in report form
Requirements are converted to a measurable technical specifications	Identify goals of the project for user, developer and manager perspective
Requirements are mapped to product specifications (with customer feedback) to create a correlation matrix	Ask questions derived from goals and measure against requirements reports.
Requirements are prioritised by customer	Modify and reconfirm the improper requirements, then complete matrix
Priorities are determined by multiplying customer priorities with matrix	Priorities are determined by multiplying customer priorities with matrix

Source: Pai, pp.21-22 2002

Through the adaptation of GQM, much of the overhead normally associated with the GQM methodology was reduced at Nokia (Kilpi, 2001, p. 72). The basic differences in the Nokia method include:

- Uses predefined metrics from a metrics library
- Automates data collection
- Does not utilise a full-time measurement team

Kilpi goes on to argue that management has the responsibility to set the process improvement strategy including goals, and that most goals are common across projects anyway. Nokia also automates data collection as part of the project procedure. Therefore there is a cost saving in data collection as the laborious goal-setting process is avoided and there is no manual data collection requirement. The overheads associated with a sample GQM-based measurement programme (vs. the Nokia way) are (Kilpi, 2001, pp. 72,76):

- Defining the measurement programme equates for roughly 30% of effort, whereas continuing the measurement programme requires 70% of the effort
- An 11 person-year project requires three months of effort to administer
- Using the example above, the total person-hours required to administer traditional GQM is greater than 500, whereas the Nokia way would require less than half that

Rifkin and Cox (1991) studied eleven divisions of eight organisations – including Contel, Hewlett Packard, Hughes Aircraft, IBM, McDonnell Douglas, NASA, NCR and TRW – with reputations for excellence in measurement. Although not explicitly restricted to goal-driven approaches, the primary lessons learned during this study revealed best practices areas. First, they found that organisations that embraced the object of measurement (in a software quality context – "errors") reduced the stigma of negative associations. Thus, employee knew that the delivery of bad news would not be punished and organisation-wide discussion became easier.

In best practice organisations, measurement is not conducted in a vacuum. The measurement programme was conducted as part of a culture of quality, not within the micro-context of software process improvement. This ensured that all level of the organisation bought into the programme – not just management or just engineers. With across-the-board buy-in (and reward structures put in place to encourage participation), people were motivated to participate and expectations were managed across all stakeholder levels. Key to the success of the programmes was getting "the right information to the right people".

Other cross-organisational patterns that emerged revolved around the metrics themselves. Successful organisations generally started small – with one measure – and broadened the programme on the back of success. However, to reduce ambiguity and level of compliance effort, these 'mico-metrics' were vigorously defined and were gathered using automated tools. Programmes often took an evolutionary, iterative, approach, but it was recognised that first efforts might be "throw-away" (as experimental and ever-changing). Some organisational metrics survived scrutiny, others did not. Regardless, an "early win" is deemed necessary for on-going success and survival. For ongoing success, the measurement programme must add-value to development efforts and line-personnel must be empowered to act upon the information. Despite delivering early wins and an iterative approach, successful organisations recognise that measurement programmes sometimes require cultural shifts and changes in attitude. Even when all other success criteria are put in place, this does not happen quickly.

A later study that focused on goal-driven measurement experiences (Goethert and Hayes, 2001) included a series of case studies where GQM had been deployed from three perspectives: 1) in a global software firm, 2) studying the impact of software process improvement and 3) with enterprise performance management from a "local perspective". The lessons learned generally correspond with the Rifkin and Cox study, including the necessity to pilot implementations (start small and build), understand that development of a measurement programme takes time, use automated

tools, define measures and metrics, and motivate the right behaviour. A summary of multi-case experiences is outlined below (Table 2-3).

Table 2-3: Summary of Multi-case Experiences

Goethert & Hayes (2001, p. 25)	Rifkin & Cox (1991)
Maintain Traceability	Decriminalise the object of measure. Make it ok to discuss potentially bad news
Define type and purpose of each indicator	Make measurement part of larger programme – create a culture of measurement
Start small and build on success	Start small (with one measure)
Develop comprehensive list of indicators to detect trends and hidden tradeoffs	Rigorously define measures
Customise the indicator checklists for the organisations	Automate collection and reporting
Use checklists to define measures	Motivate staff to become involved. Put rewards structure in place to encourage measurement efforts
Use specialised tools to disseminate information	Set expectations through articulated goals in a focussed manner (i.e. cost, schedule, quality)
Pay close attention to privacy issues	Involve all stakeholders in goal setting
Plan to address cultural issues	Earn trust of participants by not punishing bad news
When there is no consensus on how to proceed, base decisions on cost	Take an evolutionary approach to programme development
Use pilot implementations	Plan to "throw" the first effort away. Use a pilot study
Recognise time required to develop measurement programme	Get the right information to the right people
Make the tool fit the process	Strive for early success, deliver early win
Don't be afraid to revise initial assumptions	Make sure that the effort "adds-value". I.e. something is delivered from the effort
Beware of the different perspectives of various stakeholders	Empower employees to use information
	Take a whole process point of view – measurement is only one piece of a greater whole
	Understand that measurement and adoption takes time

2.4 Strengths and Weaknesses of GQM

Clearly defined and widely accepted metrics and models are crucial for measurement success (Briand et al, 1997, p. 2). A goal-oriented approach is helpful in three ways: (1) it "ensure[s] the adequacy, consistency and completeness of the measurement plan and therefore of data collection", (2) it "manage[s] the complexity of the measurement programme" and (3) "stimulate[s] a structured discussion and promotes consensus about measurement and improvement goals."

Specifically, this research has found GQM to be:

- **Rigorous** – as seen above, the literature puts forth several examples of the successful use of GQM and goal-driven derivatives. The real-world use of GQM, and subsequent publication of case studies, spans nearly 20 years indicating that the methodology is truly useful and not just a passing "fad".
- **Adaptable** – as illustrated in the industry examples, as well as GQIM, the GQM methodology in practice today differs significantly from the original idea put forth by Basili and Weiss in 1984. As a framework, GQM has proven itself to be adaptable to different organisations and the changing environments of software measurement. The very fact that it is adopted by and used in commercial organisations indicated that there in inherent value in the methodology. In the Darwinian world of software development, rarely do things that do not provide value survive. There seems little reason why GQM could not travel outside the context of that original use to be applied in information integration and retrieval scenarios.
- **Flexible** – Not only is the framework adaptable, but it is flexible as well. As seen in the Nokia, IBM and CS Foundation cases, GQM works well with additional methodologies and can be adapted for a particular organisation. GQM can also be restricted to a subset of goals and grow with success.

Although the literature is conspicuously absent of meaningful criticisms, GQM is not without limitations. One of the major weaknesses is the propensity for the number of metrics to grow to an unmanageable amount **(Expansive).** The production of questions is situation and even organisationally dependant. These two factors lead to questions of repeatability and limiting scope ('non-terminating'). Card argues that GQM can very quickly grow beyond its usefulness; one study he references consisted of four goals that grew to over 100 questions (1993, p. 94). And since multiple teams produce different questions, the results are likely not repeatable. Lastly, he points out that questions that arise from the GQM exercise may not be answerable unless organisational changes are made. Given these limitations, Card feels that GQM should be used as a supplemental methodology. Although in conclusion of his

editorial (1993, p. 95) he concedes that GQIM is better than what is previously available – that is, "largely nothing".

Another weakness, briefly touched upon by Kilpi is the overheads associated with managing GQM **(Expensive)** – from dedicated implementation teams to time consuming goal setting sessions and negotiations, it is could be costly. This could be particularly limiting in low maturity environments.

Additionally, as outlined by Mendonça et al, a "top-down" measurement approach alone does not allow for discovery and can often ignore or overlook legacy data **(Focus)**. McKeehan et al take a more vitriolic tone when discussing the weaknesses of GQM (1998, p. 5,) by surmising that "although this approach [GQM] is better than none at all, it is beset with problems". The researchers assert that GQM "fails to recognise that managers don't always know what their goals should be". They go on to suggest that (1998, p. 5):

> *Top-down methods lack support and enthusiasm from practitioners. It encourages "data-manipulation". With a set goals [sic], the data collection or processing procedures tend to produce results that show improvement because that people developing the measures are focused on the goal and what the numbers are expected to show.*

Although McKeehan et al raise some interesting points, their references are unclear and thus the majority of their arguments remain unsupported by the literature. However, the point about managers failing to properly set goals is also highlighted by Wilson et al in their recognition that business strategies (and consequently goals) may not be fully articulated (2002, p. 198):

> *IT Staff like to ask "the business" (whoever that is) for the "business strategy" (whatever that is) – which they expect to be predetermined, formalised and explicit – so they can "support it" by "solving business problems".*

The double-quotations and parenthesised comments indicate that Wilson et al don't necessarily believe that it always possible for organisation to be fully aware of, or able to articulate, its strategies. If this is true, it is probably safe to assume that it is

also true with organisational goal setting. That is why a structured, goal-elicitation process such as GQIM is desirable, as the process forces both managerial and IT staff participation.

To reduce risks associated with the GQM approach, there are several lessons that can be gleaned from the literature:

1. **Limit metrics** – As pointed out above, a GQM programme can quickly grow out of control as new questions are added. However, at Nokia, it was recognised that many of the project goals and questions could be reused, thus reducing the costs of managing a GQM measurement programme.
2. **Start small and grow / pilot implementations** – The programme is likely to morph and change (much like GQM itself over the past few years). Therefore it is a good idea to start with smaller, achievable, goals and to pilot projects before wide-scale rollout.
3. **Be mindful of human and cultural issues** – For the programme to be successful, people factors must be considered. Several suggestions were put forth recommending that resulting information be masked when presented and that information not be used to "punish" poor performers. Without the risk of the information being used against the participants, cooperation is more likely.
4. **Automate data collection** – Any additional work or overheads that make employees jobs more difficult will be resisted. Some (likely higher maturity) organisations will have the resources to assign dedicated personnel to a project. However, in low maturity organisations, as much of the information gathering as possible should be automated

Clearly, GQM/GQIM is not the right tool for all information-retrieval situations. However, given its history of success, rigor, flexibility and adaptability, it is likely that it will be useful in modelling multi-source information retrieval scenarios. Even the potentially narrow focus could be viewed as a benefit in low maturity

organisations. At this point, due to the potential expense and expansive nature, its practicality in low maturity organisations remains unclear.

3 Research Approach & Design

Over the past decade there has been a long and vociferous discussion about research approaches in information systems (IS) research – often presented as the "rigour vs. relevance" debate in journal articles and conference proceedings (Ciborra, 1998; Davenport and Markus, 1999; Applegate and King, 1999; Benbasat and Zmud, 1999, Lee, 1999, Markus and Lee, 1999, Lyytinen 1999; Banville and Landry, 1989; Khazanchi and Munkvold, 2000 and 2003; Moody 2000). At the crux of the debate, one school of thought believes that there is a universal truth that can be discovered through rigorous scientific endeavour (positivist); the other generally contends that IS research is social science and the "truth" is situational (interprevist). Positivists generally decry a lack of rigour in interprevist methods, whereas the interprevists will retort by questioning the relevance of the positivist approach (Benbasat and Zmud, 1999; Lee 1999; Khazanchi and Munkvold, 2000; Moody 2000; Davenport and Markus, 1999).

The positivist approach would require that the research be set up as a controlled experiment, whereby hypotheses would be verified through rigorous empirical testing. The role of the researcher would be "objective, impartial, passive and value-neutral". In this approach, there is a "tight coupling between explanation, prediction and control" and there is an underlying assumption that "there is a universal set of laws that govern the external world". On the other hand, interprevists believe that "the social world is produced and reinforced by humans through their action and interaction" and that understanding of the social world comes through "interpretation of participant's meanings and actions". The role of the interprevist research is interactive, whereby the researcher interacts with the subjects thus potentially changing the assumptions of both parties (all of the above quotes from Khazanchi and Munkvold, 2003, p. 5). While many positivist researchers would likely still question the lack of academic rigour in interprevist methods, thankfully the debate is beginning to subside with some acknowledging that "neither research paradigm is more suited to producing knowledge-claims that have applicability to practice" (Khazanchi and Munkvold, 2003, p.7; supported by Benbasat and Zmud, 1999).

While it is not the intention of this research to contribute to that debate, it would be remiss not to acknowledge its existence. It would also be remiss not to acknowledge that, with ten years of experience on the front lines of information technology, this researcher has chosen to follow the likes of Ciborra, siding squarely with the relevance camp. This is a qualitative and exploratory field-based study in the interprevist tradition. The multi-method approach outlined below is designed to be rigorous, yet produce relevant results to the low maturity organisation.

3.1 Methodology

Since the purpose of this study is both exploratory and theoretical, a multi-method approach was used by design and necessity. The research methodology is comprised of an iterative case study approach that is underpinned by database and transactional log file analysis. An exploratory case-based approach was chosen due to the suitability to study events that have not yet been clearly defined in previous research.

The case study method involves "intensive investigation of situations which are relevant to the problem situation" and is particularly useful where a "complicated series of variables interact to produce the problem or opportunity" (Kinnear and Taylor, 1991, p.148). According to Kinnear and Taylor, the method is renowned for its flexibility and the ability to react to information discovered during analysis. Case study data can come from analysing records and reports, or from the observation and interviewing of knowledgeable people.

It is important to note that this is not a Grounded Theory based study. First introduced by Glaser and Straus in 1967, Grounded Theory is the systematic and simultaneous collection of data in which theory emerges during analysis (cited in Allen 2003, Pauleen 2004, p. 9). With a 35-year linage, there are literally hundreds of examples of Grounded Theory based research in multiple disciplines, including some recent award-winning work (Pyhrr, 2002; Rerup, 2004). However, certain requirements of the Grounded Theory technique make it unsuitable for this problem domain, namely this research starts with a pre-defined reference model.

In traditional research, a literature review is undertaken, a hypothesis is formed and data are collected to test the theory. In Grounded Theory, the research is entered into without any preconceived notions, and through the collection of data a theory emerges. Over the years, Grounded Theory has evolved to a form of pattern recognition through the use of codes, concepts and categories. Given the specific (often within the field of sociology) and well-defined approach, it is important to note that research should only be considered "grounded" for two reasons. First, it is similar in that it used successive rounds of data collection. Secondly, each round was exploratory and each time the goal-based information framework was refined through the interactions with the case subjects. The methodology deployed in the research differs from the Grounded Theory in three ways. First, the reference model was prescribed in advance of data collection. Second, the Ground Theory methods of coding, concepts and categorisation were eschewed. Lastly, the qualitative research was augmented with quantitative log file analysis.

3.1.1 Iterative Case Study

Due to the peculiarities of conducting research in low maturity environments, the case study approach was chosen for data collection because of its strengths: low cost, usefulness of identifying research issues and general suitability in helping to understand the "how and why" of phenomena (Briand, 1997). This research primarily relies on secondary sources to construct cases.

There has not yet been a widespread adoption of goal-based techniques in low maturity environments and many of the topical threads of this research are still evolving. That is, multi-channel business operations have only become an issue in the last five to seven years and service/standards based information exchange is only now maturing. The primary research objectives is to evaluate the applicability of a new theoretical concept in a particular setting (i.e., the goal-based information framework in low maturity environments), not to measure specific information behaviour. Without a clearly defined domain area and a large, accessible sample population, it was felt that purely quantitative techniques would not satisfy the

research objectives. Two other factors influenced the methodological choice. First, there are significant challenges inherent in researching information channels (Swoboda, 1998) and, secondly, survey data collection is notoriously difficult in low maturity environments.

The primary case method deployed is based on Yin's iterative explanation-building technique. Characteristics of this technique include (Yin, 1994, p. 111):

- *Making an initial theoretical statement or initial proposition...*
- *Comparing the findings of an initial case against each statement or proposition*
- *Revising the statement or proposition*
- *Comparing other details of the case against the revision*
- *Again revising the statement or proposition*
- *Comparing the revision of the facts of a second, third or more cases*
- *Repeating the process as many times as is needed.*

Based on the technique outlined above the following iterative technique was followed:

1. First, a thorough review of the GQM/GQIM literature was undertaken to understand the strengths and weaknesses of the methodologies within their native context (i.e. software measurement). Other top-down methods, particularly Kaplan and Norton's Balanced Scorecard were reviewed as well.
2. Next, a goal-based information framework 'reference model' was developed. To gather peer feedback, this reference model was put out for review to the research community through conference presentation (Boyd and Boyd 2002) and publication in a refereed journal (Boyd 2002e, awarded outstanding paper of 2002). To determine suitability in a field environment and to better understand operational issues, the model was deployed in an e-commerce business and findings were recorded (Case 1). Due to operational circumstances, this research was terminated prior to completion. However, this preliminary work served as good baseline

reference and the implementation enabled learning to be applied in the next iteration. As such, Case 1 discussion is included in the appendices.

3. Next, a thorough background analysis was conducted or to determine the *state of practice* for multi-channel information retrieval and cross-organisational information exchange. With an understanding of the current *state of practice*, the goal-based information framework was again deployed in that contextual situation. In Case 2, the framework was evaluated through an analysis of internal database files of multi-channel software support interactions. Baseline transactional file data were collected prior to implementation of the model and data were recollected a year later after the framework was deployed. Significant changes between baseline data and the follow-up year were analysed to determine the success and short-comings of the model in a field environment. This effort was augmented through informal individual interviews and analysis of internal project communications (email communications).
4. In the third and final case (3), the model undergoes three successive iterations of refinement for deployment in an information exchange context. The case study is based on the development of a best practices development guide to accompany the release of a software integration middleware product (recommending a goal-based implementation process). Again, the case research is preceded by a thorough analysis of *state of practice* of information exchange in the low maturity environment. Data to validate this model were derived from the case subject's software systems (through a form of XML document analysis).

All three cases present the goal-based information framework in a low maturity environment. Each case concludes with specific case findings, but the discussion chapter (7) provides a detailed analysis of the collective learning about the goal-based model in the low maturity environment. It also overviews the successive changes in the model that occurred with each iteration.

Challenges of the traditional case study approach are well documented. Primarily, there is a concern with a lack of rigor in the methodology and the possibility that the researcher could interpret results to suit a pet theory (Yin 1994, 9-10). To safeguard against this possibility, where possible, quantitative methods were deployed to augment the qualitative analysis. Additionally, this research has been presented to the research and practitioner communities at the various stages of conceptual development. In all, six peer-reviewed and eight practitioner articles were generated during the conceptual development phases of this research[6]. Additionally, the author guest edited a special issue of Aslib Proceedings specifically focused on "Information Disparity" (Vol. 56, No. 5, 2004).

3.1.2 Log File Analysis

In recent years, with the growth of the web, the advantages of log file analysis are become more recognised. Advantages of the log file approach include (Nicholas et al, 1999a; Nicholas et al, 1999b, pp.264-5; Nicholas 2000, pp. 134-135):

- Reduction of the risk of sample and non-response bias. That is, under-represented members of the population can be studied without their explicit consent leading to a greater understanding of previously underserved populations.
- Large (almost census) tracks of data can be gathered and studied for a given population. Separate segments of the population can be evenly compared.
- Measurement can influence action – that is future contact can be delivered according to responses. Although, admittedly, this could be more of a practitioner advantage than a research advantage.
- Log file analysis can shorten the lag time between data collection and understanding.

[6] Please see References section for a complete listing.

- The method can provide a very high degree of objectivity. Logs record actual behaviour, not behaviour as it is remembered by survey participants (as in the case with surveys and interviews).

However, there are some drawbacks inherent in log file analysis. Primarily, 1) it can be dangerous to draw conclusion about information need and conclusions about information seeking behaviour from log files alone, or 2) data can be superficial leaving the researcher wanting of information about the subject's motivations, intentions and reasoning (Nicholas, 2000, p.135)

Two forms of file analysis were employed during the course of this research. In Case 2, a database file of over 6000 transactions was analysed. The company provided an Excel spreadsheet of year 1 and year 2 data drawn from its customer relationship management database. The advantage of this approach was the volume of data, allowing the model to be tested under high-volume information conditions.

A second form of file analysis was deployed in Case 3. The firm's integration software stores information about business entities in XML format. Where accessible (through a browser) the XML documents were analysed (please see the Appendix section for sample XML). If the underlying XML was dynamically created during a runtime process (as is sometimes the case with this integration software), the software user interface was used to analyse the definitional structure of business entities.

3.2 Data

3.2.1 Reference Model/Case Study 1

Data for this case were drawn from a combination of internal company documents and discussions with the project manager. Documents were collected between January 1999 and November of 2001, and included publicly presented information by the project manager (in November 2001). Follow-up interviews were conducted in the Spring of 2002. The project manager's contribution has been recognised in the references section of this document.

Although the company fully supported the case research, a change in management resulted in the termination of the management information system development project in the Summer of 2002. Partial results were deemed significant enough to include in this research. At the company's request, all identities have been masked to preserve employee, customer and company confidentiality.

3.2.2 Case Study 2

Research data were collected at the beginning of the project to assess the background situation and serve as a benchmark to determine the success (or failure) of the turnaround efforts at a European software company. Based on the situational assessment, a goal based information framework model was created to document and evaluate business process redesign efforts. After the first year, data were recollected to determine the effectiveness of the process redesign and management efforts. Quantitative information was drawn from the company's customer relationship management (CRM) system, financial databases and personal sources such as Excel spreadsheets. During this research, a total of 6247 support tickets were analysed. Baseline data (from the calendar year 2002) were collected in February and March of 2003. In 2002, 3111 support tickets were created and 2982 tickets were closed by a team of 4-5 support analysts (in May 2002 one analyst transferred to another area of the business). Data for 2003 were collected in January of 2004. In 2003, 3136 tickets were created and 3091 were closed by 3-4 support analysts (in July one analyst resigned and was not replaced). Data were presented in the following format and were manipulated using Microsoft Excel (Table 3-1, 3-2):

Table 3-1: Case 2 Data Base Data Format (Data File 1)

Ticket Number	Source	Year Opened	Opened	Closed	Status	Account	Days Open
Internal Unique Reference Number	Information Channel (phone, Web, email, Fax, Other	Calculated field -- last four digits of opened field	Date support ticket was opened	Date ticket was closed	Resolution status	Customer name	Calculated field -- opened minus closed

Table 3-2: Case 2 Data Base Data Format (Data File 2)

	Opened This Week	Closed This Week	Carried From Last Week	Outstanding
Period	Number of Tickets Opened in Period	Number of Tickets Closed in Period	Number of Previously Opened Tickets	Number of Tickets Not Closed
Analyst	Number of Tickets Opened in Period by Analyst	Number of Tickets Closed in Period by Analyst	Number of Tickets Carried in Period by Analyst	Number of Tickets Not Closed in Period by Analyst

This information was supplemented by discussions with the Support Manager, Financial Director, Managing Director and three other support team members. All identities have been masked to preserve employee, customer and company confidentiality.

3.2.3 Case Study 3

The third and final case study underwent three iterations of (goal-based information framework) model development. The first iteration of the third information framework model was developed in the Summer of 2003, but was not reviewed until the Spring of 2004. Several informal interviews took place with the internal development team in the June/July of 2004 and the model was presented for comment by separate groups of external developers in June and July 2004. Data used to construct the third iteration of the model (C) were collected from internal (to the software applications) documents in June 2004. In all, nine XML documents were analysed and an additional ten entities (derived from integration software interface) were analysed. In this case, XML data were transferred into Microsoft Word format for analysis (samples included in the appendix). Due to the way that the software interface was constructed, information could only be transferred to Word format manually. To ensure accuracy, this process was double verified.

The third iteration of the model was reviewed and finalised in August of 2004. Again, all identities have been masked to preserve employee, customer, product and company confidentiality.

3.3 Discussion of Participatory Methods

The use of GbIF in a low maturity organisation is intended to be invasive and the model construction exercise is both interactive and participatory (between the researcher and the stakeholders). Since the very definition of the low maturity organisation is having ad hoc or a lack of prescribed processes, it is likely that every single one is different. As such, even if a suitable test framework could be designed, a controlled experiment in a laboratory environment is unlikely to produce relevant results for a low maturity organisation.

The exploratory research methodology is designed to capitalise on participant feedback in iterative and interactive learning cycles. Regardless of whether or not there is a universal truth (yet to be discovered) in information systems research or just a collection of situational experience is irrelevant, most would agree that research must be pursued in both a rigorous and relevant manner. However, with that said, there are some inherent risks in this approach – predominantly confirmation/observer bias and the potential for the Hawthorn Effect. Confirmation bias is when a researcher seeks data to validate his or her own theories. The related problem of observer bias occurs when the researcher overemphasises the importance of behaviour they expect to see. The Hawthorn Effect occurs when the participants of the study react differently because they know they are being observed.

Since the researcher was associated with all of the case organisations in a professional capacity, several precautions were taken to guard against observer and confirmation bias. First, although the researcher initiated and moderated the research efforts, projects were not undertaken as part of his professional responsibilities. Secondly, in all three case studies, raw data were not directly accessible to the researcher and were always provided by the organisation. With little stake in the actual results and independently provisioned data, the researcher was free to observe the impact of using the model in a descriptive manner. Lastly, since the use of the method was masked in all three cases, 'Hawthorn Effect' bias is highly unlikely.

3.4 The Disciplinary "Point-of-View"

Given the inter-disciplinary nature of this research, some may question the researcher's point of view, or disciplinary grounding. That is, one may ask if the research is it within the discipline of information systems, information science or information management. While the answer is not particularly relevant to the findings, it is important in understanding the approach and intrinsic viewpoint of the researcher. In the table below (3-3), a working definition of each discipline is provided.

Table 3-3: Definition of Information Disciplines

Discipline	Definition
Information Systems	*The study of the effective use of information and the potential impact of software systems and enabling information technologies on the human, organisational and social world* (based on Cushing 1990 and Lucas 1990 in Khazanchi and Munkvold, 2000, p. 32).
Information Science	*The science devoted to the structure and properties of information and communication, as well as theories and methods for transmitting, storing, retrieving, evaluating and distributing information.* (Johannessen, 1996 in Khazanchi and Munkvold, 2000, p. 32)
Information Management	*The discipline that analyzes information as an organizational resource. It covers the definitions, uses, value and distribution of all data and information within an organization whether processed by computer or not. It evaluates the kinds of data/information an organization requires in order to function and progress effectively.* From http://www.techweb.com/encyclopedia/defineterm.jhtm

The primary objectives of the study are to evaluate the GbIF as a method, not to evaluate the effectiveness of the information provided or the information needs of the low maturity organisation. That is, this study is concerned with the use of goal-based methods for the documentation and evaluation of information flow in the low maturity organisation – not to question the effectiveness or usefulness of specific information delivered by the GbIF. As such, given the definitions above, the research

is primarily categorised as an *Information Systems* study heavily influenced by the reference disciplines of *Information Science* and *Information Management.*

3.5 Rationale for a Structured Approach

Ciborra and other interprevists argue that structured approaches to information systems are not relevant in the real world. As an example, Ciborra questions the underlying assumptions of the Capability Maturity Model ([CMM], reviewed in the Appendices of this research). He states that (1998, p.10):

> *The software process, in order to be improved, has to be rendered "predictable" and proceed "according to plan". Specifically, the process has to be made "stable" and "under control" through techniques of statistical process control, so that this behaviour is predicable within statistical limits.*

In his mind, the problem with this structured approach is that it does not allow for *the multiple "social" aspects of software production* (1998, p.10). He suggests that we have two choices; we can either (1998, p.13): 1) build a model of how the world should be and "operate so that the messy reality in which managers operate moves toward this idealised model" or 2) to "put into buckets what we believe we know about strategy, structure, markets, feedback mechanisms, stage curves, etc., and reflect upon what we observe."

This research does not advocate that there is a "universal truth" to the way that information moves through an organisation, or that there is an "ideal" structured process method for retrieving and integrating such information. Rather, it suggests that a structured method, particularly goals-based approaches that incorporate individual human views, may have use as a descriptive, evaluative, model and as a documentation construct. In essence, this research suggests that instead of helping to model the idealised world, goal-based methods may have another use as a method to evaluate and describe the "messy reality", thus putting information "into buckets" and as a tool to help to "reflect upon what we observe".

4 The GbIF Reference Model[7]

This section presents a reference model that will be used as a baseline in the later sections of the research. Based on Park et al's research, the reference model was researched and completed between 1999-2001 and published in Aslib Proceedings in 2002 (where the article received an Outstanding Paper Award for 2002). This theoretical model is based on the business objective of improving customer satisfaction with an e-commerce website. Included in the Appendix is a case overview of early experiences in implementing the model in a field environment.

4.1 Introduction

In the late 1990's, consumer-focused websites spent much of their time, money and energy devoted to customer acquisition activities. Unfortunately, most of those high-flying pure play e-commerce websites – the ones that spent more time trying to get customers than trying to keep them – are now gone. Pets.com with its ubiquitous sock puppet has been sold to its bricks and mortar competitor Petsmart. Even though the companies and customers are gone, the founders of Boo.com and the globe.com have continued their personal quest for media coverage and attention by publishing their memoirs. Value America is gone and 800.com is a shadow of its former self. Of the early pure-play e-commerce leaders only Amazon.com, who built its reputation on customer service, remains. As e-commerce companies face economic uncertainties, a strong customer satisfaction programme is not going to be a 'nice to have', but a necessity for survival.

The goal of a total customer satisfaction programme should be to keep profitable customers coming back to the organisation. Aside for the intuitively obvious fact that it is easier to sell to existing customers who have familiarity with the company's products and service and presumably have some degree of trust with the organisation,

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[7] Based on Boyd 2002e, winner of 2002 Aslib Proceedings Outstanding Paper Award

Reichheld (1996) points out that a 5% increase in customer retention (keeping 5% more customers than last year) will result in a 35-95% rise of total lifetime profits from a typical customer depending on the industry. Reichheld goes on to point out that there are significant other benefits of customer loyalty, including very low acquisition costs, increased operational efficiency, higher per-customer revenue, price premiums and referrals. According to Kan (1995), a dissatisfied customer will tell 7-20 people about their negative experience. A satisfied customer will only tell 3-5 people about the positive experience. With these factors in mind, it is crucial to measure customer satisfaction and implement management initiatives to guarantee total customer satisfaction.

4.2 Development of a Customer Satisfaction Programme

Although many companies, both online and offline, pay lip service to a commitment to customer service, few actually deliver. This failure can be attributed to a breakdown in mapping high-level (often board-mandated) customer satisfaction goals to operational realities.

For most companies, it is safe to assume that overall customer satisfaction is an objective of the organisation. However, many web-businesses currently operate in an ad hoc development environment and are not in a position to quantify satisfaction goals. In this type of environment, a customer satisfaction measurement programme must be developed from scratch, baseline satisfaction measures must be recorded and areas in need of improvement must be targeted before a meaningful satisfaction programme can be put into place.

For a measurement programme to be effective, specific areas for measurement must be targeted. Boyd and Boyd have identified the following 'five maxims of satisfaction' (1998; 2002e; Boyd, 2001), which provided the company with a high-level framework to develop their customer satisfaction programme:

1. Deliver the product that the customer desires or needs.
2. Deliver quality consistent with the price.
3. Deliver the project in a timeframe the customer desires or needs.

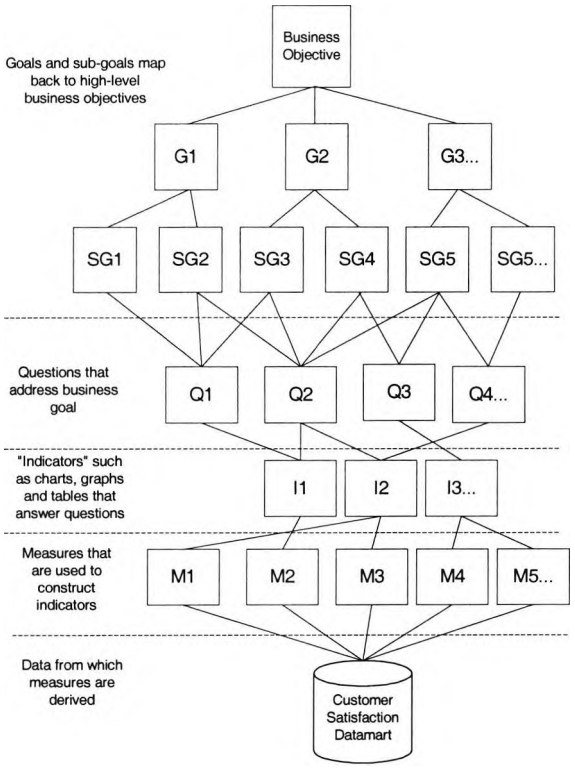
4. Deliver the desired degree of feedback that the customer desires.
5. Have a system of conflict resolution that is fair to both the customer and the business.

Using the GQIM methodology outlined in this paper, an e-commerce business' high-level organisational objectives can be mapped to its information architecture.

4.3 The GQIM Methodology

Park *et al.* (1996) developed their *Goal driven software measurement guidebook* as a way for organisations to map software development measurement to business objectives. The Goals, Questions, Indicators, Measures (GQIM) approach (Figure 4-1) does not start by asking 'what metrics should I use?' but rather 'what do I want to learn?' GQIM starts with high-level business goals and breaks them into measurable sub-goals (Park *et al.*, 1996: 23). It continues to identify measures and indicators that address those goals.

Figure 4-1: The GQIM Model



The GQIM process has 10 steps (Park *et al.*, 1996: 23):

1. Identify business requirements.
2. Identify what you want to know or learn.
3. Identify sub-goals.
4. Identify entities and attributes related to sub-goals.
5. Formalise measurement goals.
6. Identify quantifiable questions and the related indicators that will be used to help achieve measurement goals.
7. Identify data elements that will be collected to construct indicators.
8. Define the measures to be used, and make these definitions operations.
9. Identify the actions that you will take to implement the measures.
10. Prepare a plan for implementing the measures.

4.3.1 Step 1: Identify Business Goals

The first step is to identify the business goals. Of course, what constitutes a business goal often depends on who is doing the measuring. For example, middle management may have a different set of goals than the executive suite. Regardless, from an organisational perspective the overall goals should be the same, such as: *Improve Customer Satisfaction*. However, sub-goals, or objectives, can be different for each functional area.

4.3.2 Step 2: Identify What You Want to Achieve or Know

Next, in question form, the team must identify what it ideally wants from the system (Table 4-1). For each business objective outlined:

- The person(s), team members and relevant parties, should be listed
- A mental model of the process should be outlined
- The model should be presented from the perspective of the project manager
- The important entities of the processes should be listed (inputs and resources, products and by-products, inventory needed and activities and flow paths).

Table 4-1: Questions Relating to Customer Satisfaction

Deliver improved customer satisfaction (CS)	
CS entities managed by the customer service department	**Questions related to customer satisfaction**
Products and by-products ➢ Website ➢ New features	1. Is the site easy to navigate (familiar and standard)? 2. Is the content on the site useful? 3. Are all of the links active? 4. Is system response adequate (i.e. are there too many graphics)? 5. Do all of the features work (i.e. shopping cart)? 6. Are the features stable? 7. Are new features (existence and functionality) communicated clearly to the user?
Internal artefacts ➢ Customer requests/complaints records (e-mail, telephone log)	1. How fast are we responding to customer suggestions/complaints? 2. If there is a bottleneck, where is it? Why is it occurring?
Activities and flowpaths ➢ Site development ➢ Fixing bugs ➢ New feature/functionality development	1. Do customers notice/care about new site features? 2. Are 'buggy' new features negatively impacting customer perceptions? 3. Is it better to release an unstable feature with moderate functionality or a final product with full functionality (with time trade off.)? 4. How quickly do we fix reported bugs? 5. How are new features introduced (software upgrades, marketing, production)? 6. How is the customer educated about new functionality?

Inputs and resources	1. Do we have the staffing to deliver the type of product and service that our customer wants (customer care reps, IT)?
➢ Peopie	2. Are we responding within the promised 24-hour period?
➢ Customer	3. What are customer expectations regarding customer service? Do we need to have phones staffed 24/7?
➢ Fulfilment vendor	4. Is the fulfilment house fulfilling orders within an adequate timeframe?
➢ Product vendor	5. What are customer expectations for fulfilment?
	6. Do customers know or care about our cross-promotions?

4.3.3 Step 3: Identifying Sub-goals

In this step, the previously identified questions are grouped according to an appropriate topic area (Table 4-2). These groupings should be identified through discussion with the cross-functional project team.

Table 4-2: Question Groupings By Organisational Function

Groupings	Questions relating to customer satisfaction
Customer care	• Do we have the personnel capacity to deliver the type of product and service that our customer wants (Customer care reps, IT)? • Are we responding within the promised 24-hour period? • What are customer expectations regarding customer service? Do we need to have phones staffed 24/7? • What are customer expectations for fulfilment? • How fast are we responding to customer suggestions/complaints? • If there is a bottleneck, where is it? Why is it occurring?
Production	• Is the site easy to navigate? • Is the content on the site useful? • Are all of the links active? (What are the testing criteria?) • Is system response adequate (i.e. are there too many graphics)? • Are new features (existence and functionality) communicated clearly to the user?
Information technology	• How quickly do we fix reported bugs? • Are 'buggy' new features negatively impacting customer perceptions? • Is it better to release an unstable feature with moderate functionality or a final product with full functionality (with time trade off)? • Do all of the features work (i.e. shopping cart)? • Are the features stable?
Marketing	• How is the customer educated about new functionality? • How are new features introduced (software upgrades, marketing, production)? • Do customers notice/care about new site features?
Fulfilment	• Is the fulfilment vendor fulfilling orders within and adequate timeframe?

Below (Table 4-3), the central theme of each grouping has been identified and noted. Again, this qualification should be conducted through round-table discussion.

Table 4-3: Derived Sub-Goals

Derived Sub-Goals	
Customer care	Improve/manage customer care process.
Production and design	Improve usability and navigation of site.
Information technology	Improve reliability and stability of software driven product features.
Marketing/strategic development	Manage/improve customer communications.
Fulfilment	Manage customer expectations regarding fulfilment

The five derived sub-goals closely mirror the five-pillars of customer satisfaction outlined previously (Table 4-4).

Table 4-4: Derived Sub-Goals Mapped To The Five Maxims Of Satisfaction

Five Maxims Of Satisfaction	Derived Sub-Goals
Deliver the level of interaction desired by the customer	Improve/manage customer care process
Have a system for conflict resolution that is fair to both the customer and the business	Manage/improve customer communications regarding new features and affiliations
Deliver the product the customer wants	Improve usability and navigation of site
Deliver the quality the customer wants	Improve reliability and stability of software driven product features
Deliver the timeliness that the customer wants	Manage customer expectations regarding fulfilment

4.3.4 Step 4: Identify The Entities And Attributes Of Sub-Goals

For each sub-goal identified in Step 3, entities and attribute of the sub-goal are identified (Table 4-5). According to Park *et al.* (1996, p.58), pertinent attributes, when quantified, 'help answer the question or establish a context for interpreting the answers'. This process is designed to help refine questions.

Table 4-5: Entities And Attributes Of Sub-Goals

Sub-Goal 1: Improve/Manage Customer Care Process		
Questions:	**Entity:**	**Attributes:**
Do we have the personnel capacity to deliver the type of service that our customer wants (Customer care reps)?	Customer, Customer request form	Volume of calls/emails Total hours (effort) Customer expectations
Are we responding within the promised 24-hour period?	Customer complaint	Complaint clearance/volume of complaints
What are customer expectations regarding customer service? Do we need to have phones staffed 24/7?	Customer, Customer Care Group	Call/email traffic Email origination times Customer expectations
How fast are we responding to customer suggestions/complaints?	Customer complaint/request form	Time/date received Data implemented Date communicated to customer
If there is a bottleneck, where is it? Why is it occurring?	Backlog of requests forms	Number of complaints/requests Origination date Completion date Number completed per day Effort to complete
Sub-Goal 2: Improve Usability And Navigation Of Site		
Questions:	**Entity:**	**Attributes:**
Is the site easy to navigate?	Website layout and design	Traffic pattern Levels navigated before completed order Customer expectations
Is the content on the site useful?	Website content (editorial, descriptions, categories etc)	Customer expectations
Are all of the links active (what is the testing criteria)?	Website	Number of 404 errors found internally Number reported

		externally
Is system response adequate (i.e. are there too many graphics)?	Graphics	Number of Aborted loads Average load time Customer systems System requirements Customer expectations
Are new features (existence and functionality) communicated clearly to the user?	New features/functionality	Number of help calls Feature usage Number of pageviews
Sub-Goal 3: Improve Reliability And Stability Of Software Driven Product Features		
Questions:	**Entity:**	**Attributes:**
How quickly do we fix reported bugs?	Bug report (email)	Effort Number of reports Reoccurrence rates
Are 'buggy' new features negatively impacting customer perceptions?	Customer complaints, Customer	Customer expectations, Attribute performance score
Is it better to release an unstable feature with moderate functionality or a final product with full functionality (with time trade off)?	Customer	Customer expectation/perception
Do all of the features work (i.e. shopping cart)?	Maintenance/testing	MTTF, Number of complaints
Are the features stable?	Maintenance	Number errors per pageview
Sub-Goal 4: Manage/Improve Customer Communications		
Questions:	**Entity:**	**Attributes:**
Do customers know or care about our cross-promotions and affiliation?	Customer	Customer expectations
How is customer educated about new functionality? How would they like to be informed?	Customer, Website functionality	Views of help page,
How are new features introduced (software upgrades, marketing, production)? How should it be introduced?	New features, Customer	Customer expectations
Do customers notice/care about new site features?	New features, Customers	Customer expectations
Sub-Goal 5: Manage Customer Expectations Regarding Fulfilment		
Questions:	**Entity:**	**Attributes:**
Is the fulfilment house fulfilling orders within an adequate timeframe?	Fulfilment, Customer	Customer fulfilment expectations, Fulfilment time

4.3.5 Step 5: Formalise Measurement Goals

Below (Table 4-6), the measurement goals are stated and put into context. 'Purpose' states why we are interested in collecting information about the object of interest. The 'perspective' indicates who in the organisation is interested in the measurement of the

sub-goal and 'Environment' provides the context for interpretation of results (Park *et al.*, 1996).

Table 4-6: Context Of Measurement Goals

Object of interest	Purpose	Perspective	Environment
The customer care process	Evaluate the customer care process to identify areas of improving customer satisfaction.	Examine the customer care factors such as response time to inquiries/complaints, telephone hold times and service offerings from the point of view of the customer service manager.	Measure processes during different times of the year and in conjunction with major changes to the website. Customer is defined as a purchaser.
The customer interface (website) design process	Evaluate the interface design process to identify areas of improving site usability and navigation, as well as customer satisfaction.	Examine the interface design factors such as navigation paths, usability and 'creative' positioning from the perspective of the Creative Director.	Examine process before and after major redesigns. Customer is defined as a site user regardless of purchase history.
The software development process	Evaluate the extent to which software development team is utilising standard software development practices. Identify tools and techniques to streamline process.	Determine the effectiveness of formalised software development practices from the point of view of the head of IT.	Examine process before and after major technology changes. Customer is defined as a site user regardless of purchase history.
The product development process	Measure impact of increased functionality and site additions on user's perceptions.	Examine product development from a revenue generation and customer satisfaction perspective.	Customer is defined as a site user regardless of purchase history.
The fulfilment process	Evaluate the extent to which fulfilment delays have an effect on satisfaction, and identify ways to manage customer expectations.	Determine the impact of mismanaged fulfilment expectations on customers from the point of view of operations staff.	Customer is defined as a purchaser.

4.3.6 Step 6: Identify Quantifiable Questions And Indicators

In this step, indicators that will answer measurement questions were developed (Table 4-7). Below, the indicators that answer management questions are outlined.

Table 4-7: Identify Indicators For Each Measurement Goal And Question

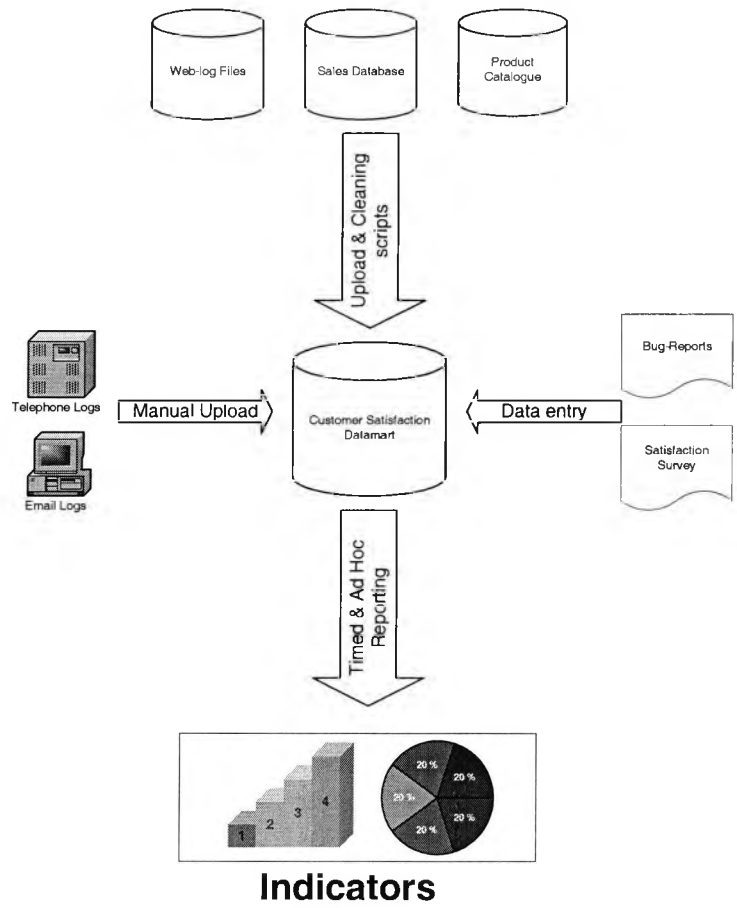
Measurement Goal: Improve Customer Satisfaction		
Questions (Q) that Customer Service (CSR) would like answered:		*Indicators (I):*
Q1.	Are customers satisfied?	I1. Satisfaction top-2 box score (bar chart) I2. Satisfaction by customer (mean) I3. Satisfaction by type of customer (top-2)
Q2.	When do customers expect service representatives to be available?	I4. Service expectations (hours, days)
Q3.	When do customers call in to call centre?	I5. Call/email volume by day I6. Call/email volume by week I7. Call/email volume by month
Q4	What are customer's expectations regarding fulfilment? How long are customers willing to wait before receiving a product?	I29: Response time
Q5.	What is the response time to inquiry?	I9. Response time to incoming call/email (hours)
Q6.	What is the desired response time to inquiry?	I10. Pie chart of expectations
Measurement Goal: Improve Usability And Navigation Of Site		
Questions (Q) that Production would like answered:		*Indicators (I):*
Q7	What are customer's perceptions of usability?	I11. Usability perceptions (buyers vs. non-buyers)
Q8.	What are customers favourite content areas?	112. Favourite content area bar chart
Q9	What are customer modem speeds?	113. Bar chart of modem speeds
Q10.	What type of computers are users using?	114. Pie chart of computer type
Q11	What size monitors are customers using?	I15. Pie chart of monitor type?
Q12.	Do users expand browser windows when using site?	Unknowable without primary research
Measurement Goal: Improve Site Quality		
Questions (Q) that IT would like answered:		*Indicators (I):*
Q13.	Does the site work as intended?	117. Daily bug/error reports by program
Q14.	What areas need improvement?	I18. Monthly bug/error reports by program I19. Number of unique problems (internally reported) – weekly, monthly I20. Number of open problems
Q15.	Have customers had problems in past?	I21. Pie chart
Q15b.	What was done to rectify the situation?	I22. Listed customer responses (coded into bar chart)
Q16.	How may errors from cached pages?	I23. Number of '404' redirects (daily, weekly, monthly)
Measurement Goal: Improve Customer Communications/ Marketing Initiatives		
Questions (Q) that Marketing would like answered:		*Indicators (I):*
Q17.	How does customer want to be educated about new site functionality?	124. Mean score of options 125. Top-2 box of options

Q18.	What new/additional features do customers want in the site?	I26. Ordinal listing of unaided responses I27. Top-2 box of mean score
Q18.	Do customers care about partnerships, cross promotions?	I28. Pie chart of survey score responses
Measurement Goal: Manage Customer Expectations Regarding Fulfilment		
Questions (Q) that Operations would like answered:		*Indicators (I):*
Q19.	What are customer expectations regarding fulfilment?	I29. Response by time category I29b. Fulfilment time by product I29c. Fulfilment type by vendor
Q19a	Are we meeting those expectations?	I30. Fulfilment satisfaction score

4.3.7 Step 7: Identify Data Elements

In this step, the data elements and data collection procedures are identified and documented (Figure 4-2).

Figure 4-2: High-Level View Of Data Elements And Collection Procedures



Next, the indicators are mapped to specific measures and data elements in the customer satisfaction database. Indicators can, and often do use more than one measure derived from multiple data elements. The purpose of this phase is to identify where the needed elements to construct indicators are going to come from.

4.3.8 Step 8: Define Measures

In many organisations, basic definitions are different depending on the department. For example, a customer may be defined by operations as a purchaser, whereas production and design may define a customer as a visitor to the site. In Step 8, all measures and indicators for the organisation are defined (Table 4-8).

Table 4-8: Define Indicators And Measures

Data measures and indicators	Definitions
I1: Attribute level satisfaction chart	Top- 2-box bar chart by type (buyers vs. non-buyers, portal).
I2: Attribute level mean satisfaction scores	Mean bar chart by type (buyers vs. non-buyers, portal).
I3: Overall satisfaction scores	Top- 2-box bar Chart by type (buyers vs. non-buyers, portal).
I10: Desired response time	Pie chart of coded responses .
I11: Attribute level perception score	Top- 2-box bar chart by type (buyers vs. non-buyers, portal).
I12: Favourite content areas	Ordinal table
I13: Modem speeds	Pie chart of coded responses by residential/work use.
I14: Type of computer	Bar chart of coded responses by residential/work use.
I14: Visitor computer and browser type	Pie chart of computer and browser types.
I15: Monitor size and resolution	Pie chart of coded responses by residential/work use.
I17: Number customer reported bugs (daily)	Via email or phone.
I18: Number customer reported bugs (daily)	Via email or phone.
I19: Number of internally reported problems	Internally reported problems daily and monthly.
I20: Number of open problems	Unresolved problems at close of business.
I21: Customer's past problems	Repeat users only – Y/N pie chart.
I22: How problems were solved	Customer's with problems only– bar chart of coded responses.

I23: Number of browser cached pages	Number of '404' redirects daily, monthly.
I24: Desired education (rank)	Bar chart of mean scores by method.
I25: Desired education (overall)	Bar chart of Top-2 scores by method.
I26: Desired new features	Table of responses ranked on frequency of response.
I27: Desired new features	Bar chart of Top-2 box scores.
I28: Customer's perception of site	Pie chart of survey scale scores.
I29: Fulfilment response time	Response time by category, product type and by fulfilment company.
I30: Satisfaction with fulfilment	Bar chart of attribute level fulfilment satisfaction scores.
I4: Customer's service expectations	Pie chart of coded responses.
I5: CSR contact volumes/Call Centre usage	Number of contacts (by type – call or email) by day.
I6: CSR contact volume/Call Centre usage	Average number of contacts (by type – call or email) over a week.
I7: CSR contact volume/Call Centre usage	Average number of contacts (by type – call or email) over a month.
I8: Customer's fulfilment expectations	Pie chart of coded responses.
I9&I10: Expectation verse actual response	Desired time plotted against actual (daily weekly, monthly).
I9: Response time to inquiry	Hours between incoming call and outgoing response – charted daily per call and on average over weeks and months.
M. Email Logs	Inbound emails are captured in CSR's email client. These emails will be coded and used before the indicators below.
M. Error Logs	Internal IT error logs (informal) will be combined with external reports to create a comprehensive error report measure.
M. Fulfilment Time	Fulfilment times have been captured for every Product sold through the site by placing "test" orders with the product vendor.
M. Product Maker Name	Name exists in vendor field in NAME OF table in NAME OF database.
M. Product Type	Offer Type exists in 'period' field in NAME OF table in NAME OF database.
M. Program Name	Errors will be reported by the feature (or program name). The 'offending' URL will also be captured.
M. Sales Data	Survey data will be cross-tabulated with sales data using the view table (NAME) located in the SALES database. Unique ID will be used for the join.
M. Satisfaction Survey	Primary customer data to be collected from both customers and non-customers via a web survey hosted on site. A unique identifier should be attached to the customer's survey responses. Respondents will be given an incentive to participate in the survey (free product or the like.

M. Telephone Call Logs	Inbound call dispositions are recorded by the customer service representatives. These dispositions will be coded and used before the indicators below.
M. Web Log Data	Survey data will be cross-tabulated with sales data using the view table (NAME) located in the SALES database. UniqueID will be used for the join.
M. Web-log Analysis Tool (such as web-trends)	NAME OF TOOL is a log traffic analysis tool that captures information on visitors, as well as aggregated site-traffic patterns.

4.3.9 Step 9: Analyse, Diagnose And Take Action

In Step 9, the current status and use of the measures within the organisation are explored and defined. This includes analysis, diagnosis and action steps. Analysis entails understanding what is being collected currently. During diagnosis, the data elements that are collected currently are evaluated in the context of the needs of this project. Questions such as the following are asked:

- What existing measures and processes can be used to satisfy our data requirements?
- What elements of our measurement definitions or practices must be changed or modified?
- What new or additional processes are needed? (Park *et al.*, 1996: 89)

In a typical e-commerce organisation, the availability and source of data are as follows (Table 4-9):

Table 4-9: Data Sourcing

		Availability	Source
1	Satisfaction survey	(-)	MKT
2	Telephone call logs	O	CSR
3	Email logs	(--)	CSR
4	Web log analysis tool	(+)	IT
5	Fulfilment time	(+)	OPS
6	Internal bug logs	(+)	IT
7	Program name	(+)	IT
8	Sales data	(+)	MKT
9	Log data	(+)	IT

Code	Departmental Responsibility
CSR	Customer Service
OPS	Operations
IT	Information Technology
MKT	Marketing
	Data Availability
(+)	Available
O	Can be derived from other data
OO	Can be derived via minor effort

10	Product catalogue	(+)	OPS
11	Vendor name	(+)	OPS

(-)	Not available now
(--)	Very difficult to obtain

4.3.10 Step 10: implementation plan

Park *et al.* (1996) suggest an implementation plan that should consist of four sections, including:

- **Primary objectives** of the programme should be identified and recorded.
- **Description** of the programme will include goals, scope, relationship to other measurement efforts and relations with other functional area activities.
- **Implementation** actions including activities tasks, schedules, necessary resources, responsibilities, measurement, critical assumptions and risk mitigation.
- **Sustained operation** including a plan for collection, use, retention, evolution and evaluation of measures.

4.3.11 Conclusion

The reference model focuses on mapping high-level customer satisfaction objectives to a company's information architecture. However, as seen in case study 1 (Appendix), the model can be used to map any business objective to the company's information architecture and to develop metrics and indicators to monitor the progress in achieving goals.

The next section discusses the challenges inherent in multi-channel operations and presents the goal-based model in use at a software company.

5 Information Disparity: Cause and Effect

5.1 State of Practice

With the proliferation of new information channels such as the web, email and wireless, it is becoming increasingly important to understand the impact of these technologies within the organisational information infrastructure. In many organisations, especially low-maturity environments, information gathering, retrieval and exchange is an ad hoc activity. Furthermore, supporting information systems are generally not designed to optimise information sharing within the organisation, or to exchange information between organisations. Although, a "quick and dirty" approach to both reporting and cross-system information exchange is often sufficient to support rapid decision making, it can be problematic when the decision later proves to be wrong and results are not re-producible. This problem is exasperated when multiple data sources and numerous information channels must be considered. Fixing these problems can be time consuming and expensive, particularly for the organisation that does not posses an innate information competency. Several macro-level trends are converging to create an information eco-system that is in a state of flux – information channel and device proliferation, coupled with organisational turmoil (social, economic and technological) has created a research problem that is can be described as "information disparity".

This section seeks to broadly outline "information disparity" – from multi-channel information retrieval to cross-organisational information exchange – and aims to present a goal-based information framework for the low maturity organisation. Specifically, areas that will be addressed include:

- **Cross-channel Information Seeking and Retrieval** – information users (and customers) are exposed to several information seeking choices every day. With the proliferation of channel-choice over the past few years, information users expect to be able to interact with organisations seamlessly through the different mediums and methods, such as web, email, telephone, instant

messaging, etc.. And organisations have responded by rapidly expanding their communication channels.

- **Multi-Channel Business Operations –** Over the past few years there has been a radical shift in the way that firms interact with their customers and across the organisation. According to Kalakota and Robinson (2003, p.9), there are three inter-organisational transformations that are taking place. First, new channels and multi-channel processes are emerging from traditional single channel processes. Second, processes are now required to expand across the organisation and beyond a single department. Third organisational processes are currently being digitised (from manual to automated). Firms have embraced these efforts to varying degrees, or in the face of extreme competition rushed to add channels in a rushed, "bolt-on" fashion.

  Organisations operate in departmental silos – marketing, sales, accounting, support, etc. Each of these departments has systems and processes that need to expand beyond silo boundaries. However in the early days of digitisation, systems and processes were developed inter-functionally without consideration for the need to share information with the rest of the organisation. In this section, the notion of data disparity and latency between information silos will be introduced. As a result customer processes are disconnected and have to be rethought.

  Integration, information exchange and reducing this latency in information flow will be further explored in Chapter 6.

- **Mergers & Acquisitions –** the proliferation of mergers and acquisitions over the past few years has created a hodgepodge of systems for the merged companies that are inflexible and increasingly are unable to deliver on the value expected from the merger.

- **Extending the Enterprise** – Although discussed in depth in the next chapter (6), there are fundamental changes happening inter-organisational information exchange. New data formats and technological standards are increasing the interoperability of both data (through XML and HTML to a certain extent) and technology (through services oriented architectures and web services). These changes will have a profound effect on traditional organisational boundaries. The internet retailer Amazon illustrates this phenomenon by displaying 3rd party used products side-by-side with their own new offerings. Although these are 3rd party products, the integrated offering allows Amazon to present these products as their own. The value to the customer is lower cost, the value to the 3rd party partner is the wider customer base and the value to Amazon is the ability to offer customers a greater choice (in selection, quality and price).

Underpinning the relevance of this investigation are several additional emerging trends that should begin to challenge traditional notions of the information science research field. These trends can be described as[8]:

- **Proliferation of communications channels** – Web, wireless, email; none of these communications channels were in wide usage only 15 years ago. The rapid growth of the internet, and now wireless devices and services, underpins the necessity to understand the impact of communication channel expansion on both information consumers and providers. Additional channels continue to emerge – for example, introduced in 1995, instant messaging (IM) is thought to be the fastest growing communications medium of all time with 200% growth in enterprises and 25 million business users in the US (Taylor, November 2003, p.1).

[8] This section was previously included in Boyd 2004c editorial for special issue of Aslib Proceedings.

Companies adopted these technologies quickly, sometimes in an almost ad hoc manner, and as a result customer data are stored in multiple stand-alone information silos – getting at, integrating and deriving useful information from organisational data stores can be an enormous undertaking.

- **Internet "everywhere" –** Channel proliferation has also been complimented with internet enabling of many consumer products. For example, the number of cars with telematic systems is expected to increase from 75,000 in 2001 to a projected 5.4 million in 2009 (Griffiths, August 2003). From telematics in cars for emergency assistance to connecting house hold appliances to the internet for repair diagnostics, the internet is becoming more and more pervasive. Data transfer out of the car (or other appliance) will reduce service and warranty costs and product defect risks, as well as provide marketing opportunities for the manufacturer. However, internet-enabling consumer products comes with a significant data retrieval and storage costs.

- **Increasing information overload –** How many emails, phone calls and other sources of information are people exposed to in a day? With 700 billion documents on the web and employees receiving an average of 30 emails per day (Adams 2003), "information overload" is becoming a serious and potentially expensive issue. Not only do information users have to worry about the amount of data, but also data quality. Some estimates suggest that 60-80% of organisational communications are not understood, resulting in $650m to $1.3b in associated costs (Maitland, 2002). Given the demands placed on the modern information seeker's attention, it is likely that he or she is not even aware of how much of their information is outdated or is of poor quality.

- **Increased need and ability to store information –** In the past few years, the ability to gather, store and retrieve information has progressed significantly. In the same time, data storage costs have dropped rapidly and the understanding of information processing has increased immensely. These

trends are creating markets and products that capitalise on the new capabilities. For example, in the United States the annual sales of digital surveillance products and services are expected to reach $8.5 billion by the end of 2005, up from $5.7 billion in 2002 (Flynn, April 17 2003). One UK company, National Car Parks, has installed 400 digital surveillance cameras in its car parks across Britain. This information gathering creates enormous data stores that need to be classified, catalogued and readily accessible to be useful. Without sound information retrieval taxonomies, much of the data will remain useless or at the very least, under-utilised.

- **Need for faster information processing –** Tracking of international terrorism and the 2003 outbreak of SARS in the far-east (and its rapid spread to the west) underpins the importance of being able to gather and process large amounts of information in a short period of time. In an effort to contain the spread of SARS, Hong Kong police had to keep track of massive amounts of information – including the three "w's" (Who, Where and When) for all patients, family and close contacts of those that fell ill with the disease (Bradsher, 2003, p.2). Assuming that there were 6,000 cases in a 14 day exposure period, and that an average person comes into causal contact with just 20 people in that time, the three "w's" need to be gathered, analysed and acted upon for 120,000 people! This is certainly is not possible using a detective's notebook.

- **Need for auditability and traceability –** In the wake of the Enron, Worldcom and HealthSouth scandals, regulation is being introduced to govern how corporate data are handled and stored. In the US, the Sarbanes-Oxley Act (so-called after the bill sponsors, but officially called the Public Company Reform and Investor Protection Act of 2002) requires that the CEO and Chief Financial Officer sign and publicly attest to the validity of annual reports. This requirement has huge implications for the keepers of corporate information stores. By raising the issue of the validity of corporate information to the corporate board level (and making the penalty for non-

compliance jail), information processing must now be fully auditable, and the information flow from source to printed report must be traceable – including authorisations and sign-offs. According to recent CIO.com article (Worthen, 2003), 47% of companies use standalone spreadsheets (personal information stores) for planning and budgeting. Clearly the use of personal information stores can lead to significant problems – data are not backed up or widely accessible and are prone to human error.

The introduction of instant messaging (IM) into the enterprise illustrates challenges with personal information stores – of the 25 million previously mentioned corporate IM users many of these are "stealth users" (Taylor, 2003, p. 1). That is, the IM software is not supported or approved by the organisation even though the software is used to potentially communicate with customers. Furthermore, the IM client logs are not backed up, or in many cases users may not even know that their conversations are logged creating a security and litigation risks.

- **From "analogue" to "digital"** – In the past 15 years corporations have spent an enormous amount of energy digitising both information as well as business processes. Although touched upon by Nicholas (2000, pp. 6-18), the digitisation of business is continuing to mature, taking the form of the adoption of channels and new technologies such as voice over IP (VoIP). Additionally, consumer products are also becoming digitised. The bookseller Amazon has recently scanned 120,000 books and made them searchable online, digital cameras have for the first time surpassed the sale of film, DVDs outsell video tapes, digital mobile phones have far surpassed their analogue predecessors and the introduction of the Apple iPod MP3 player has changed the fortune of their business. Google's recent announcement that they were embarking on a massive project to digitise Oxford, Harvard, University of Michigan and NY public library further illustrates the broader trend in digitisation (Markoff and Wyatt, 2004). In all forms, digitisation has and will

continue to have a significant effect on company's ability to provide better products, reduce costs, increase service and innovate.

- **Integration of organisational data-stores –** Through company mergers and acquisitions and the rapid channel proliferation described above, the necessity to integrate organisational data-stores is becoming paramount. According to the analyst firm Gartner, Enterprise Business Integration is slated to grow to a 6.7 billion dollar business by 2006 (Everett, 2002). However, integration is not just a technological problem, as employee work habits, organisational culture and organisational processes must also change as part of the effort. Software application and business integration is as much a technology issue as it is an information problem.

- **The emergence of standards and new technologies –** In every technology sector from the systems-centric deployments of the 1960s through the mid-1980s, to the rise of the PC and networks in the past 20 years, the emergence of standards has been a harbinger of a new era in computing. Systems standards led to the divergence of hardware and software, making the personal computer a reality, and PC standards have since enabled the spread of networking computing. And now data standards, such as XML, are fuelling a new age of computing based on information and content (Moschella, 2003). These emerging standards and new technologies such as web services are having a huge impact on the way that firms think about data, integration, retrieval and analysis.

- **Information security & privacy–** Barely a week goes by without a new virus, worm or Trojan horse plaguing the internet. What motivates a h4x0r ("hacker"), to destroy information and restrict others' right of access? Every interaction that occurs on the web is logged and tracked somewhere. What are the ethical considerations in using these digital footprints for research purposes? For commercial purposes? For military and national security? The aforementioned adoption of IM technology is again illustrative of challenges

inherent to the uncontrolled proliferation of new technologies. IM allows employees to by-pass firewalls and monitored communication mediums such as email to communicate and transfer information outside the organisation. This could leave the network vulnerable to viruses, worms and attacks by other malicious code (Taylor, 2003, p.1). Increasingly, developers and providers of new technology are having to consider the needs of law enforcement. For example, recently in the US, Voice over IP (VoIP) providers have been mandated to provide a backdoor for wire tapping by federal agencies (Poulsen, 2004).

- **E-Governance** – Although we live in a multilateral world, particularly on the internet, the governance of the world wide web is country specific. Online gambling is legal in the UK and Europe whereas it is not in the United States, data privacy legislation differs by country and enforcement of copyright protection varies. Even what is patentable varies by country. In an interconnected and global world, the very definition of criminality is defined at the point of access.

Each of the above events creates information disparity – that is, disconnected information silos – throughout the organisation. As a result of this disparity, organisations are scrambling to create processes and adopt integration technology to enable information exchange and to facilitate cross-organisation information sharing.

5.1.1 Cross-channel Information Seeking[9]

Before a discussion about the effects of information disparity can meaningfully be undertaken it is useful to step back and explore for a minute the underlying nature of cross-channel information seeking and retrieval.

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[9] Elements of this section are previously published as part of Boyd 2004a.

Information-seeking is a personal and situation dependent activity that is underpinned by access to information and the strength of the information source. Since multiple factors can influence information-seeking activities, multivariate influences must be considered when modelling and researching information behaviour. As such, it is a mistake to believe that information-seeking is bivalent, or black and white, in nature. In fact, information-seeking as an activity is multivalent, or "fuzzy", relying on "maybe", "sometimes" and "it depends" and other degrees of grey rather than simple black or white, yes or no, answers. As discussed below, it is this situation-dependant nature that leads to difficultly in assessing the impact of channel (i.e. device, media or medium) choice.

The literature has long shown that a person's decision-making behaviour is influenced by several factors including:

- Information that they have access to;
- Information they receive;
- Information source and;
- Seeker's comprehension of that data.

Each of these factors has a varying degree of influence on information seekers. For example, even though a person has access to (and has received) information, they may chose not to act on it because of the lack of trust in the source or because of counter-balancing information. Take for example, teenage smoking – teenagers clearly have information on the risks of smoking, but due to external factors such as peer pressure they are often influenced to act contrary to their best interests. Therefore, it stands to reason that it is both a combination of access to information (information channels) and the weight of the information source that influences outcome behaviour.

Past researchers have long noted the social nature of information-seeking (see Kiel and Layton 1981 for a thorough review and Sproull 1997). More recent research, still recognising the social and interactive nature of information-seeking, even argues that

new terminology is needed to adequately describe the information "player's" (as opposed to "user's") activities as interactive, social and recreational (Nicholas et al, 2000). The very nature of seeking new information sources or, new routes to achieve a goal (information channels), and gathering information as a participant within a social network forces a two-way social interaction. In an information-seeking context, this means that people are both active recipients of information and participants in a social exchange (information sharing is two-way). This dualistic existence causes a lack of clarity in understanding the motivations and actions of information seekers. Additionally, recent research has highlighted some interesting observations on digital information consumption. In that research, the digital consumer is portrayed as demanding, unpredictable, untrusting, novice searchers and, interestingly, promiscuous – that is, willing to bounce between digital sources (Nicholas et al, 2003, pp. 26-27).

Regardless of channel or media choice, all interaction on the part of the digital consumer leaves some sort of "digital fingerprint" in the form of a log file (web, telephony switch or even phone bill) or record in a database (CRM systems, e-commerce records). Non-digital channel interactions also leave traces in the form of credit card receipts, invoices, or library records for example. This research is not concerned with the specifics of how or why channels or sources are chosen by the information seeker, but rather how multiple information channel (or source) data stores (i.e. 'digital fingerprints') can be integrated – either logically or physically – to ensure completeness and auditability of the information-retrieval activities and information presentation.

Techniques for cataloguing, abstracting and understanding information user's seeking and retrieval – staples of information science – are well covered in the past forty years of the literature. While the maxims of information science derived from its basis in the library should not go unheeded, new research and new methods are needed to begin to understand information disparity in an increasingly global information eco-system.

In 2000, Nicholas recognised the following factors in his work on information needs assessment (Nicholas, 2000, pp. 6-18):

- **A systems-driven profession** – First, Nicholas recognises that the information profession is systems driven with emphasis on information processing and storage. Historically there has been very little focus on the information needs of the end-user.
- **Poor communications skills** – Poor communications skills are cited as a reason for not questioning the needs of information users. Although Nicholas focuses on the content professional, the same can be said about technologist within the organisation. Poor communications leads to isolation, which in turn leads to a lower status within the organisation.
- **Expensive to collect data** – The expense of data collection on the information systems users' needs (from the user themselves) takes time and money away from actual information provisioning activities. As such, information professionals are reluctant to spend precious resource on information needs assessments.
- **Lack of commonly understood and agreed framework of analysis** – According to Nicholas, "there are few easily understood and practical frameworks with which to explore people's needs" and methods tend to be theoretical or overly academic (2000, p.10).
- **No single or easy method of collecting data** – The is a wide variety of choice in data collection methods, each with tradeoffs. With deeper clarity comes cost. Techniques such as surveys and interviews are costly and intrusive, whereas log file analysis and citation may not provide a complete picture of user's information needs.
- **Cost of computerisation** – The cost of computerisation has been enormous over the past few years. Added to this cost is the recognition that many information systems are designed by people outside the profession and that technology is constantly changing, increasing the risk of failure to address user's needs.

- **Accountability and auditing –** Increasingly information organisations are being held accountable to business centric metrics such as customer satisfaction and return on investment. In this environment, the ability to measure and quantify value becomes increasingly important. Since Nicholas' work in 2000 and in light of several high-profile accounting scandals, the provisioning of information is actually becoming a board room issue (discussed further above).
- **Competition and deregulation –** The rise of the internet and new information channels is causing competition for the information consumer's attention. Traditional information provisioners – for instance newspapers and libraries – are facing strong competition from web-based information sources.
- **Increase in users –** Device proliferation and [internet] increase of users is both an opportunity and a threat to traditional information provisioners. On one hand, loss of users is a business threat, but increased interest and information competency is an opportunity.
- **The Internet (and the information society) –** Nicholas' last point is largely about using the new connectedness to change the way that information provisioners think about providing information. Currently, there is an opportunity to use new technologies to personalise information to the specific needs of users. However, in providing analogue information digitally (e.g. scanned pages or online card-catalogues), the true potential of the technology remains unrealised.

In response to the above factors, Nicholas proposes a *Framework for the Evaluation of Information Needs* to (2000, p. 37):

- benchmark the needs of the information user;
- "monitor and evaluate the effectiveness and appropriateness of information systems from a user perspective";
- detect gaps in information provision;
- provide personalised information;
- assessment of new/additional information needs;

- bring the information professional and the user closer together.

Nicholas' framework consists of eleven evaluation points, including: subject, function, nature, level of complexity, viewpoint, quantity, quality/authority, date/currency, speed of delivery, place and processing/packaging (2000, pp. 39-85).

Clearly, any information retrieval framework must first account for the *subject* of the information seeking effort. That is, the subject area must be both clearly defined by the system (e.g. keywords, classification, abstracts) and articulated by the user. A definition of *function*, or use of the information, is also necessary to contextualise the information request.

Nature refers to the type of information that is required to satisfy the information request – is the user looking for theoretical, historical, descriptive, prescriptive, statistical or methodological information (Nicholas, 2000, p. 53). With subject, function and nature of the information defined, the l*evel of complexity* must be determined. Level of complexity refers to the capacity of the user to understand received information, taking into consideration presentation and writing styles as well as the user's level of intelligence. *Viewpoint* refers to the philosophical, political or tone (i.e. positive or negative) of the information. Some users are looking for objective information, whereas others are looking for information that supports a predisposed point-of-view. Appetite for the *quantity* of information varies between users and within organisations. In addition to function of the information factors such as motivation, diligence and available time will influence a user's quantity requirement. Although *quality* is subjective, the assurance of quality emerges as a very high information priority and quality 'ratings' can help tremendously in prioritising information. Another factor that can help to prioritise information is *date/currency* – information, like products and technologies, becomes obsolete over time. The shelf life of information varies depending on subject matter and function.

Furthermore, currency and *speed of information* of information can be important to users – for example, stock brokers need real time information, whereas the general

public can largely satisfy their share-trading information needs with information feeds that are delayed by 15 minutes. Information channel and medium plays an important part in currency and speed of information provisioning. For instance, synchronous channels such as the telephone and personal devices such as the mobile phone or the blackberry email pager are more suited to real-time information delivery.

Some users are concerned *place* of origin of information – subject, function and nature of information can influence the importance of place in the user's evaluation. For instance, academic information may be less interesting to practitioners, and vice versa. Furthermore, language can influence the importance of place as an evaluative factor. That is, although all of the other evaluative factors could be satisfied, if the potential user cannot access the information because it is in a different language it will remain of little value.

Lastly, *processing and packaging* of information plays an important role in information evaluation. Some users, such as practitioners, may want only summary information, whereas academic users may be looking for a much greater level of detail. As such, the same information may be of interest, but to be useful it will need to be packaged separately for each individual information constituency.

Although focussed on information needs assessment, Nicholas' framework will provide a useful structure to evaluate the GbIF (see Chapter 7).

5.1.1.1 The Medium is the Message...

Although widely heralded and as madman in 1964 – Marshal McLuhan was later proved right with the rise of the internet in the 1990's – the "medium is the message". In the past few years, information seekers have enjoyed more access to information through more channels, mediums and devices than ever before. These new channels have created new routes of information flow from an organisation to its customers, as well as new information about the customer in and of itself.

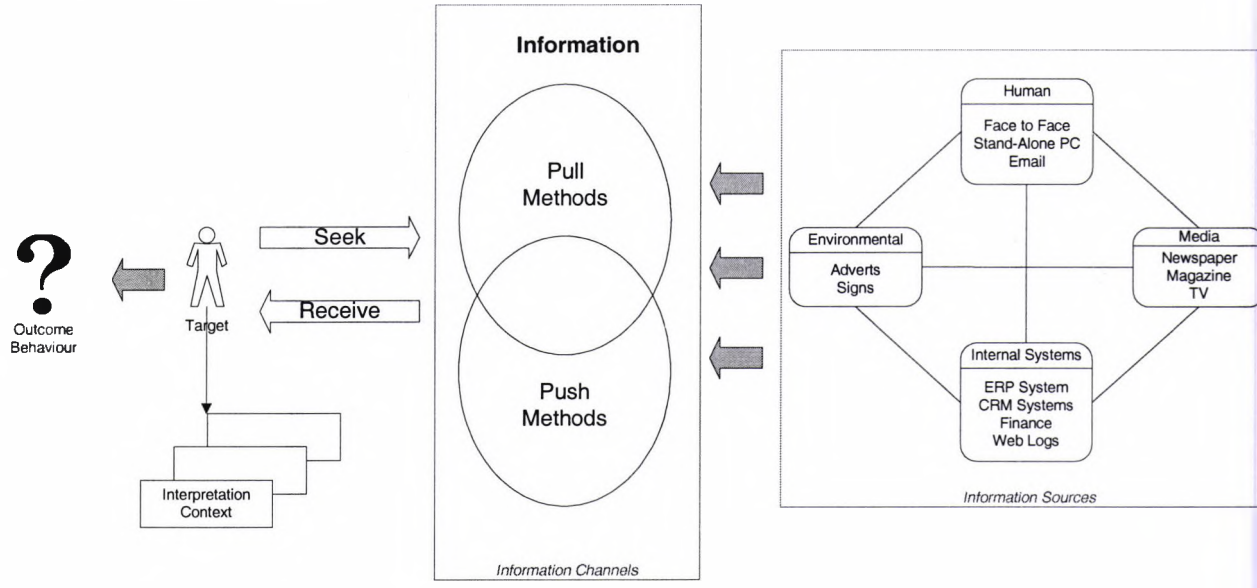
Few are likely to disagree that, over the past few years, the introduction of new information channels such as web, wireless and interactive television have impacted the speed and numbers of ways by which people can access information. Researchers have already begun to explore the ways that channel proliferation has impacted information-seeking behaviour and information consumption (Boyd 2003; Boyd 2002c; Khatri and Robinson, 2002; Kaid 2002). However, the literature is weak in the area of measuring the impact of multi-channel options on information behaviour. The newness of the field of study and the rapidly changing technologies are recognised as reasons for the lack of foundation research (Kellen, 2002, p. 2). Although researchers argue that customers are interacting with far more information channels than 25 years ago and that distinctions between channels are beginning to blur (Kellen, 2002), thus far little evidence has been put forth to support an argument that channel usage is an important factor in understanding information-seeking behaviour. For example, Kaid overviews a few political media studies, and cites Marshal McLuhan's supposition of channel variance through "hot" and "cold" media (1964), but was unable to provide strong evidence for channel differences. One researcher believes that the reasons for this are three-fold (Swoboda, 1998, p. 363):

1. Carrier media [channels] are simply considered to be neutral
2. Media [methods] are seen one impact factor among many
3. Problem is too complex, presenting methodological problems

As discussed in length elsewhere, an information channel is the medium or source by which seekers find and consume information (Boyd 2002c). These channels include both digital (web, email, etc) and non-digital (telephone, face-to-face) methods. Although the terminology "information channel" is not widely used in the literature, it is not unknown. Kellen (2002) uses it to describe "face-to-face", "mail", "phone", "fax", "web" and "email" in his study of CRM (customer relationship management) measurement. From an organisational standpoint, information channels tend to be standalone information carrier mechanisms (each with its own data "silo") and measurement and optimisation is done on a channel-by-channel basis (Kellen, 2002, p. 5).

Figure 5-1 below shows how information is either pushed by or pulled through the channel to drive an information-seeking outcome.

Figure 5-1: Conceptual Model of the Impact of Information Channels and Sources on Information-seeking Behaviour



Information flow can be either classified as "push", whereby unsolicited information primarily flows from the channel, or "pull", where the individual seeks out information from the channel. Methods can be push, pull or both simultaneously. For example, information may be proactively sought or inadvertently received through hybrid methods such as television, or face to face. Examples of each are listed below (Table 5-1).

Table 5-1: Information Channel by Direction of Information Flow

Push Methods	Hybrid Methods	Pull Methods
• Unsolicited Email (Spam) • Direct Mail • Outbound Telephone • Outdoor Advertising	• Television • Sign Display (Location Specific) • Face-to-face • Newspaper • Magazine	• Website • Inbound Telephone • Book • Email request for information

Additionally, methods can either be synchronous or asynchronous. Synchronous methods involve a flow of information that requires and immediate response or acknowledgement. In terms of driving information-seeking behaviour, asynchronous methods do not require a response or immediate acknowledgement (Table 5-2).

Table 5-2: Information Channels by Type

Synchronous Methods	Asynchronous Methods
• Face-to-face • Interactive Website • Telephone • Instant Messaging	• Direct Mail • Television • Radio • Static Website • Sign Display/Product Packaging Email • Book • Magazine • Newspaper • Outdoor Advertising

Bates (2002) presents a model of Modes of Information Seeking, whereby information-seeking activities are classified as either "Active" or "Passive" and "Directed" or "Undirected". Directed and undirected refers to degree that the seeker exposes his/herself to information sources. And active and inactive refers to whether or not the information-seeking activity is actively sought out, or passively received. The methods above fit nicely into Bates' classification scheme (Table 5-3).

Bates identifies four types of information-seeking activities: 1) searching, 2) monitoring, 3) browsing and 4) being aware. Searching refers to activity seeking information to address an identified and known need, whereby browsing is actively collecting information with an unclear, or currently unknown, purpose. In monitoring, an information seeker is "on the lookout" for information of interest, but has not sought out the source to answer a specific query. Lastly, being aware the method by which a seeker passively receives information that they do not know that they need yet.

Table 5-3: Information-seeking Activities by Mode of Information Seeking

	Active	Passive
Directed	Searching: • **Television** • **Outbound telephone** • **Magazine & Newspapers** • **Books, Journals, etc.** • **Websites** • **Face to face** • **Email** • **Mail**	Monitoring: • **Television** • **Radio** • **Fact to face** • **Websites** • **Magazine & Newspapers** • **Books, Journals, etc.** • **Websites**
Undirected	Browsing: • **Inbound telephone** • **Face to face** • **Website** • **Television** • **Radio** • **Unsolicited (e)mail** • **Point of purchase**	Being Aware: • **Inbound telephone** • **Television** • **Radio** • **Advertising & signage** • **Unsolicited (e)mail**

Information-seeking activities can be either single channel or multiple channels, meaning that they are restricted to a single medium (e.g. web only) include multiple mediums (e.g. web and mobile phone). Similarly, information retrieval can be single or multiple sourced. The resulting information channel/source matrix is described below (Table 5-4).

Table 5-4: The Channel/Source Matrix

	Multi-Channel	Single-Channel
Multi-Source	Multiple data sources are used to gather information on multiple channels (e.g. a service organization that offers email, telephone and web based support and the information about each channel encounter is stored in multiple databases and repositories).	Multiple databases or data stores are used to gather information on a single channel encounter (e.g. email server logs, CRM database and email clients on a single machine)
Single-Source	A single source is used to gather information on multiple channels (all information on multiple channels gathered from the same data store, e.g. an integrated CRM system).	A single source is used to gather information on a single channel (e.g. a web log)

Traditional channels provide data "fingerprints" (Nicolas et al 2003) on interactions through sources such as direct mail response rates, loyalty card data, telephone bills, call centre systems and even primary market research. New, or "e" channels, offer new sources of interaction data such as the web-logs and cookie tracking, email server logs, as well as SMS and interactive television application data (Daum, 2003, p.9). Daum further submits that "by analysis those interactions, companies can derive insight, which allows them to improve their ability to satisfy their customers' current and future needs" (2003, p. 9). The next section discusses how multiple channels and sources can be logically and physically integrated to begin to create a single view of organisational information.

5.1.2 The Emergence of Multi-channel Business Operations

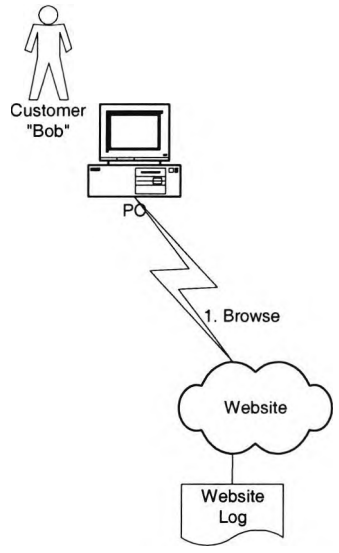
Most organisations'... information capabilities are poor – the result of numerous and fragmented departments, initiatives, databases and systems.

-John Radcliffe, Gartner 2003

The fragmentation described in the opening quotation can result in numerous problems for an organisation including increased costs, inefficient processes and reduced ability to serve the customer (Radcliffe, 2003, p. 1). A 2001 PriceWaterhouseCoopers study found that US, UK and Australian companies' data and systems management practices were in an appalling state. Specifically, 75% (of 600) of the organisations surveyed reported a negative financial impact from defective data, half had incurred data reconciliation costs and a third were forced to delay or abandon a new system development effort. Also, a third missed collection on receivables and fifth failed to meet contractual obligations (Radcliffe, 2003, p. 3).

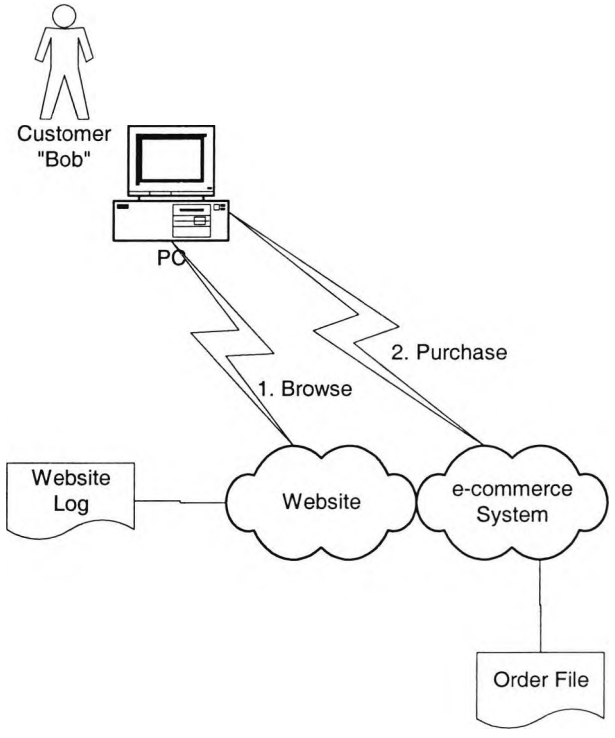
To describe the challenges associated with multi-channel business operations a hypothetical example is put forth below (actual industry experiences and a field study are presented later in the chapter). Using a fairly typical example derived from a hypothetical e-commerce shopping experience, the complexities and challenges of multi-channel, multi-source integration rapidly become painfully clear. Bob, an imaginary consumer is interested in purchasing a new television set. Rather than go down to the local high-street retailer, he decides to browse a few websites before making his purchase. From the retailer point-of-view, this first contact is a single-channel, single-source encounter (Figure 5-2). That is, at this point, Bob has used the web (channel) and the record of that encounter is recorded in the web server logs (source).

Figure 5-2: Single-Channel/Single-Source Encounter



Seeing a model that he likes, Bob makes his purchase – although unknown to him, he is transferred from the browsing site to a secure shopping website. At this point, Bob is still interacting with the organisation through a single channel (web), but there are now records of this encounter in multiple sources (i.e. web logs and the e-commerce order file – Figure 5-3).

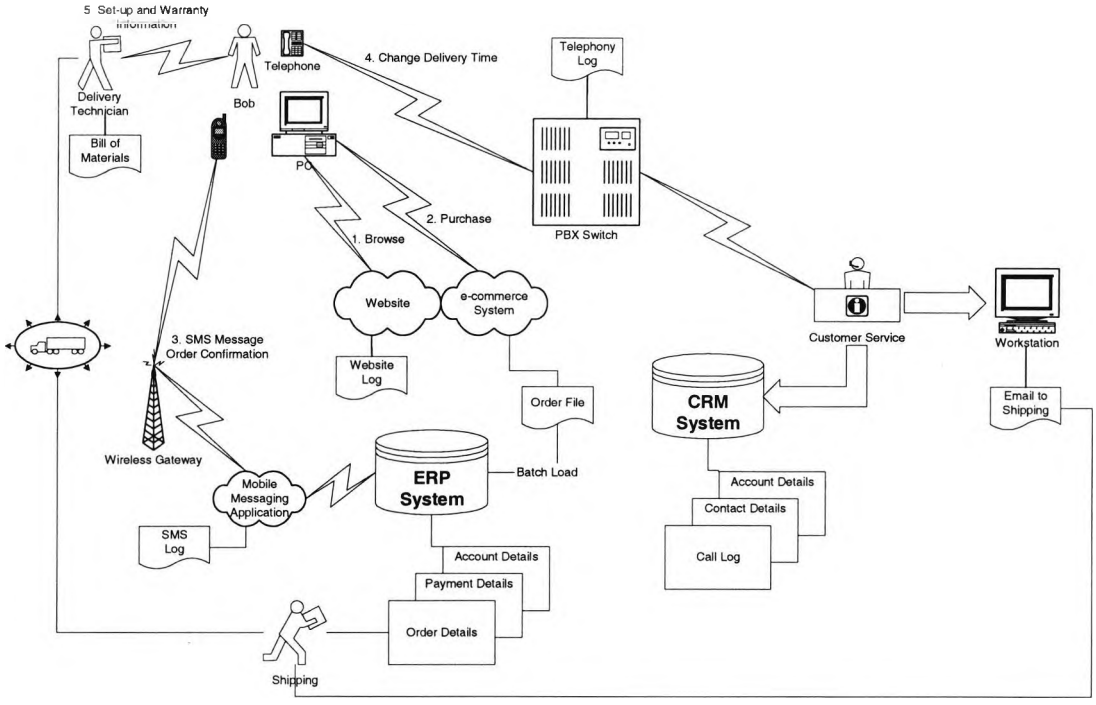
Figure 5-3: Single-Channel/Multi-Source



On an hourly basis, the e-commerce system uploads new orders into the ERP (Enterprise Resource Planning) system for validation and fulfilment. Having opted for a 'cool' new feature of the website, Bob checked the option to have the order confirmation sent via SMS to his mobile phone. At that this point, the interaction between Bob and the organisation becomes multi-channel (web and mobile phone).

However, once he received the SMS message, he realised that he was not going to be home at the scheduled time of delivery. Since it is rather urgent to reschedule a more convenient time, Bob calls the service centre to reschedule the delivery for the following day. At this company, the Customer Relationship Management (CRM) system is not integrated with the ERP system. As such, the call centre representative has to email (i.e. adding a new channel with a new source) to notify the shipping department of the change. At the agreed upon date and time, the order is dispatched. When the television is delivered, the technician (another new information channel, i.e. face-to-face) shows Bob how to set it up and explains the warranty (Figure 5-4).

Figure 5-4: Multi-Channel/Multi-Source Encounter



In the example above, several sources and channels are used (Table 5-5):

Table 5-5: Channels and Sources in Illustrative Encounter

Channels	Sources
• Web • Telephone • Mobile Phone – SMS • Face-to-face • Email (internal)	• Web log • Order Log • Telephony Log • Email 'Sent Items' • CRM Database • ERP Database • SMS Log • Bill of Materials (paper)

In this example, both synchronous and asynchronous methods were used in the two-way communications with Bob (Table 5-6). For some of his interactions (such as web "browsing" and the call to change delivery time), Bob wanted an instant response and chose synchronous methods (telephone, website). For other interactions,

such as "purchasing" and order confirmation, he was willing to use an asynchronous method (SMS).

Table 5-6: Methods Used In Illustrative Example

Synchronous Methods	Asynchronous Methods
• Face-to-face • "Browse" Website • Telephone to Call Centre	• SMS Message • "Purchase" on E-commerce • Email

Imagine the trouble that this organisation has in trying to construct a complete picture of this single customer encounter – this interaction alone utilises five channels and nine sources. Furthermore, each of the underlying information systems is disparate with its own data store. In multi-channel information exchanges, a "hand-off" of information between channels is necessary for success – customers should not have to re-enter information or repeat themselves simply because they are dealing with a new channel, previous transaction data should be available and progress of the complete interaction should be able to be tracked.

Integration could be pursued here on two levels. First, systems and applications could be integrated to achieve the following advantages:

1. Connect the website is to the CRM system. Using a customer profile based on past purchases and web surfing habits, over time, cross-sell and up-sell recommendations can be made. That is, knowing that Bob bought a television, the website may offer a satellite dish the next time he logs on.
2. Connect the CRM and the ERP system facilitating the synchronisation of customer account records and sales order history. This would allow the call centre representative to view and change the delivery time without having to send an email to the shipping department.

3. Link the e-commerce system to the ERP system. The need for catalogue and inventory uploads and order downloads is eliminated, meaning that out-of-stock orders can never be displayed on the website.

In a second integration scenario, data logs and information from the disparate systems are uploaded into a single source analysis database.[10] This source can be used to begin to get a single view of the customer.

Only recently has the emergence of multi-channel operations and related problems begun to be addressed in business literature. Kalakota and Robinson recognise the changing nature of business operations suggesting service platform blueprint for multi-channel operations is necessary (2003, pp. 85-115). With the proliferation of channels, companies may have the tendency to lose sight of their customer's needs and desires. For example, in the rush to develop additional channels and routes to market, companies sometimes didn't really consider how the customer wanted to interact with it. With the complexity of multi-channel operations, customers often are inconvenienced. Using the example above, customers wants to be able to place an order through a website and expect that customer service representatives have all the necessary information if they call for assistance. Many times, this is not the case and the call centre representative must root around in many systems and make enquiries outside the department before answering the query.

Another emerging trend that is fuelling the need for multi-channel business is the push for customer self-service. Notice over the past few years the self-help ticketing kiosks at Heathrow (and other worldwide Airports). A British Airways customer can purchase an e-ticket online. Once at the airport, she retrieves her ticket automatically by putting her credit card or loyalty card in the kiosk. The passenger is asked to

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[10] The benefits of data warehousing are well established elsewhere and further discussion on this topic is considered outside the scope of this research (please see bibliography for further reading on this subject). The purpose of this section is to facilitate the discussion of multi-channel/single source information seeking and retrieval.

confirm security questions and choose a seat. Once completed, the ticket is printed and she proceeds to a quick service desk to check luggage. This is a three-channel encounter (website to purchase the ticket, kiosk to check in and in-person to handle luggage). If the passenger wants to change flights or upgrade the ticket, she can call a call centre (possibly located off-shore) and speak to a representative directly. It is still early days in understanding how much customers are willing to do for themselves.

Consider the fast checkout lanes at Tesco – for the luxury of quicker check out customers are willing to scan and bag their own groceries. However, as people get more comfortable with self-service technology, it stands to reason that the quick-processing advantages will lessen and retailers will have to look for new ways to incentivise these customers. However, two things are clear. First, if properly incentivised customers will engage in multi-channel interactions and secondly customers want seamless integration between channels. Using this logic, it clear why many of the dotcoms of the late 1990's failed. Although at the time considered new markets and new business paradigms – a cursory review of the success stories indicates that the Internet channel was (and still is) simply a new route to market. Dotcoms that were single channel generally had no advantage over single channel traditional retailers. It was those dotcoms as well as traditional retailers that embraced the multi-channel paradigm that are proving to be successful.

However, placed in the historical context of the late 1990's, many firms that rushed to expand their channels and customer bases are suffering from poor planning and disconnected channel operations. As a result, information about customer transactions is not immediately available the rest of the organisation and items purchased through one channel cannot be returned through another – in the long-run if firms cannot deliver on the implicit promises that are afforded through multi-channel offerings, customers will seek out those that can.

5.1.3 The Ever-changing Organisation – Mergers, Acquisitions and Divestitures

Kalakota and Robinson (2004, p. 317) state that the ever-changing nature of business makes the job of execution [on information integration efforts] nearly impossible in a dynamic M&A environment. To illustrate their point, they use the example of AT&T's failed growth strategy. Interestingly, as early as 1964, Marshall McLuhan stated that AT&T was in the business of moving information (1964, p. 9)[11]. However, it was not until 1995, with mounting competitive pressure on its core voice business, that AT&T restructured its business into three separate companies – consisting of telecommunications equipment (Lucent), computers (NCR) and its communications business remaining AT&T. Three years later AT&T needed to respond to the growing threat of local telephone operators and the rise of the consumer internet. From 1998 to 2000, financed through debt, it spent $105 billion to buy a series of companies that collectively could deliver on the "integrated communications" vision (Kalakota and Robinson, 2004, p. 318). By October 2000, the company's stock had dropped to $22 per share from over $66 when the buying spree had started (Kalakota and Robinson, 2004, p. 320). Time Warner/AOL also experienced difficulty in executing on the promise of its merger. In 2000, Time Warner a staid media company was acquired by the new media upstart AOL creating the largest media company in the world. Three years later, Time Warner unceremoniously dropped the "AOL" pulling back from its original plans (BBC, 2003).

In low maturity organisations, similar problems occur. Highlighted by Boyd (2001, 2002g, 2002h), problems in mergers and acquisitions occur on logistical, technological, process and people levels. People need to be relocated and

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[11] Incidentally, McLuhan also states that GE was/is in the information business. When GE woke up to this fact 30 years later it used the internet to reshape itself into one of the most admired companies of in the past 20 years.

management needs to decide on and adopt new technologies, processes and ways of working. New information requirements arise through the measurement of value and creation of new processes. In a highbred environment whereby both organisation's practices are adopted and merged (Boyd 2001), a process for information integration becomes particularly important. In many cases a merger is the harbinger of the necessity to create completely new business processes.

Supported by Kalakota and Robinson's (2004, pp. 321, 329) and Boyd's (2001, 2002g, 2002h) findings, there are several applicable lessons:

1. Mergers create information disparity as companies try to merge people, processes and systems.
2. Post-merger consolidation is expensive and time consuming for management and distracting for employees as old methods are replaced with the new.
3. Volatile corporate strategies are disruptive to on-going integration and digitisation efforts.
4. The prerequisites of a clear and consistent vision and a strong management team are necessary to drive change.
5. Information processes must be flexible, adaptable and scalable. These processes need to be underpinned by agile technology.

5.1.4 Breaking Down Silos and Extending the Enterprise

> *"With the growing demand for consumer-oriented flexibility, there is increasing pressure on companies to improve their responsiveness and achieve better ('more informed') decision-making through effective dissemination and sharing of information and knowledge."*
>
> -Singh and Weston, 1996

Multi-channel business operations are generally supported by a myriad of underlying information systems comprised of multiple, often disparate software applications and databases. This section discusses information disparity associated with departmental functional silos.

It is interesting to note that the vision described in the quote above was outlined by Pheasey more than ten years ago (1992) in the context of a vision for the year 2001. It is more interesting that when Singh and Weston referred to it in 1996 (p. 243), they also recognised the need to reference data and source information from separate application systems. In the past five years, there has been significant progress toward that vision.

Recently, several companies have shown how channels and sources can be integrated and the information used to significantly improve the customer experience or derive other value. Daum discusses how the on-line travel agency Expedia.co.uk tracked customer behaviour across 5000 websites and, with targeted marketing offers, were ultimately able to reduce the cost of sale by 40% (Daum, 2003, p. 12). This is both a benefit to the customer and the company. The company lowers its cost of goods sold, and the customer receives highly relevant information that is generated with their information-seeking needs in mind. Another example of how information (and technology) is being shared with third-parties has been through the introduction of Google's extended search functionality. This application allows external parties to deploy the Google technology remotely to conduct searching and match relevancy of results. The Application Programming Interface (API) used has been tested and works in all operating system environments (Lim and Wen, 2003, p. 54); this environment-independence is crucial for the cross-channel sharing of information.

The internet retailer Amazon is regarded as being on the forefront of information systems/channel integration and the use of information as a competitive advantage. In a May 2003 (Vogelstein) interview, Amazon CEO Jeff Bezos laid out five maxims that embodied "The Amazon Way"; number 2 on the list was "bet on data". As an organisational ethos, Bezos believes that "good information trumps good judgements" and even junior employees are encouraged to collect and act on information independently of senior managers. As Vogelstein puts it, at Amazon, managers are expected to study reams of information generated by the computer systems as if it "were the Talmud" (Vogelstein, 2003, p. 26). This organisational ethos of exploiting information pervades throughout the organisation from its

personalisation engine – where data mining is used to recommend books based on past purchasing history – to driving efficiency in warehouse operations. As a result, Amazon's operating profit margin in the forth quarter of 2002 was 5%, only slightly lower than retail leader Wal-Mart at 6% (Vogelstein, 2003, p.23).

There are numerous discussions about the inherent risks and failures of technology projects (Boyd 2001 and Glass 1998). However, reports of successful systems integration implementations can also be found in the literature and industry press. For example, the notion that information use and systems integration are closely linked is exemplified at both at Dell and Cisco. Through the use of web services technology, Dell was able to streamline its supply chain to reduce inventory buffers from 26-30 days to just three to five hours. This effort is underpinned by the ability to generate a new manufacturing schedule for its plants every two hours. These schedules reflect actual orders received and are published to an internal intranet. It was the de-coupling of the information from the core databases and applications that has enabled this to happen. In another example, Cisco is renowned for being able to close its financial books on a daily basis. As such, all of the company financial information moves about the organisation in 'real-time' and audited results can be released in just three days. This enables the company use its information competitively to react to customer needs and competitive situations at the same time as reducing costs. For example, the order entry error rate at Cisco was reduced from 20% to .2% (Khosla and Pal, 2002, p.3).

In a different context, the configuration of information to the customer can be equally crucial to success. In a move from a product-centric to a customer-focused company, Thompson Financial re-engineered its business to "decouple" customer information from the underlying products and information technology infrastructure. The problem was that the customer information was locked away in separate business unit information systems, effectively limiting the combinations of products that it could offer. Through the use of innovative technology and the objectification (creating information objects) of its data, Thompson reconfigured its product-centric

information assets to customer-focused solutions (Sawhney, 2001, p.96). The result was the creation of a new, more relevant, suite of information products.

All of these companies use information technology as a source of competitive advantage and these cases illustrate the power of integrated information sources. However, as mature organisations, each of these companies has significant resources and the wherewithal to design and implement innovative information strategies. It is also interesting to note that the mass media examples of successful information use usually come from technology (Dell, Cisco) or information (Thompson, Google) companies. It can be argued that even Amazon, which started as an internet retailer, is both a technology and a (consumer) information company with the launch of the A9 search engine.

Business-to-business (B2B) e-commerce has arrived driving the need for sharing and exchanging information outside the organisation's network (generally over the internet). Case study two, presented in the following section, highlights the challenges associated multi-channel, multi-source integration at a post-acquisition software company and presents a goal-based information retrieval model based on the reference model presented in the previous chapter.

5.2 Case Study 2: A Goal-based Approach to the Evaluation and Documentation of Multi-channel Business Process Reengineering[12]

In this section, through a case-based approach, both qualitative and quantitative methods are used to evaluate the applicability of the goals, questions, indicators, measures (GQIM) approach in a field environment, illustrating the practical application of the conceptual work on goal-based methodologies that was previously presented in Aslib Proceedings (2002) and the previous chapter of this research.

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[12] This section was previously published in two parts (Boyd 2004b and forthcoming Boyd 2005).

5.2.1 Background

In 2001, in the shadow of the sagging economy, a US-based software company was sold to a much larger global organisation. Prior to the acquisition, the UK subsidiary operated as the European sales and marketing office of its US parent, but all products were designed and developed in the United States. Its software products were sold through a value added reseller channel in both the UK and continental Europe. Although there were field offices in Spain and Germany, all technical support was done in London. Before the acquisition, the support department could escalate any unresolved issue to the US support team for further investigation and resolution. The process was straightforward and the procedures were well documented. After the acquisition, the subsidiary was spun-off as a stand-alone company reporting directly to the global parent organisation. However, products continued to be developed in the US and the support team used the US-based database – resulting in slow query times and an inability to make any changes to the system. Furthermore, they no longer had access to their US counterparts for issues escalation and resolution.

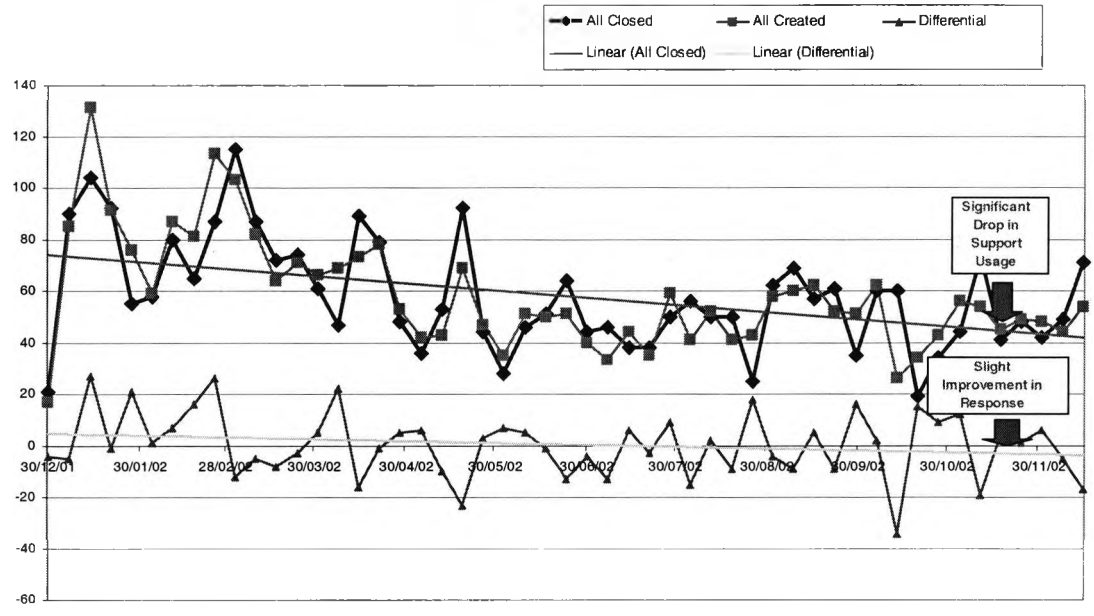
With the creation of this new stand alone business unit, in February of 2002 headcount at the firm was reduced from over 70 to approximately 35 people. Within six months, only nine of the 35 original staff remained (although through hiring overall staff levels remained the same). Four of those nine worked in the support department. Not surprisingly, this group could be considered "weary survivors" – in the past two and a half years they had seen nearly 100 co-workers come and go and the management team had turned over three times. With so much change and staff turnover, processes had become broken and ineffectual.

This background created an intriguing environment to "battle-test" some new research and thinking on the goal based measurement and evaluation. Using the GQIM model presented by Boyd (2002a,b,c), both qualitative and quantitative methods were deployed to evaluate the conceptual model in practice. The research is primarily concerned with the applicability of the goal-driven model and its relevance in contextualising and documenting business process redesign efforts.

5.2.2 Baseline Situation Analysis (2002)

At first glance, overall support usage (Figure 5-5) seemed to be in decline in 2002 due to product maturity and customer experience (as the product is in the market longer, the complexity and frequency of support usage drops as customers become more experienced in using the software and resolving their own issues). The year had been bumpy with several high-profile changes in management and redundancies – each of these changes causing severe morale issues and significant drops in productivity. Despite the morale problems, overall productivity seemed to be improving toward the end of the year.

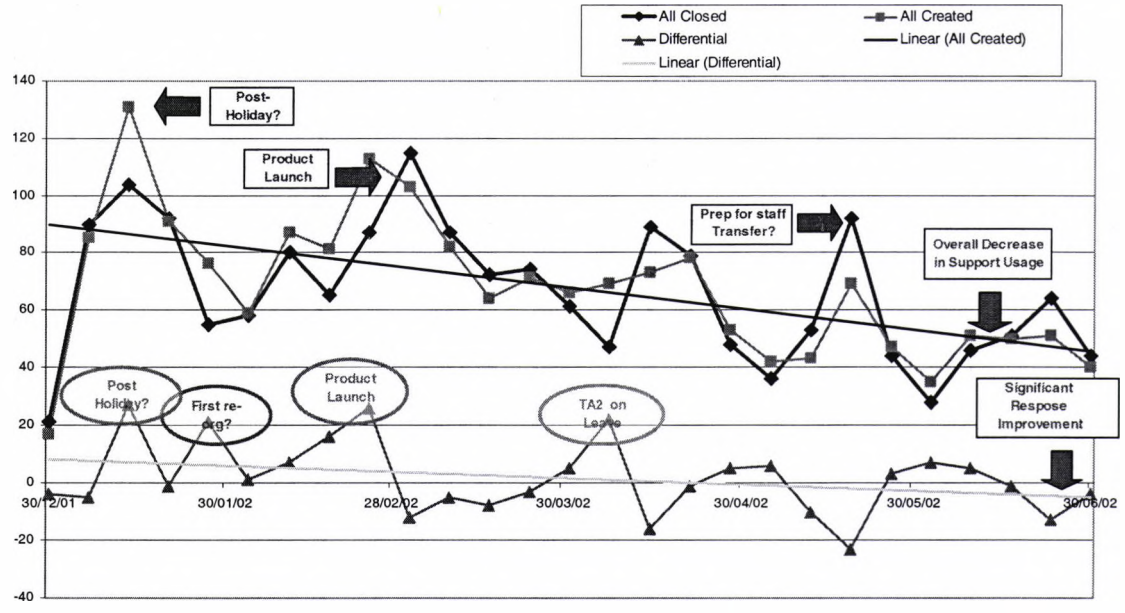
Figure 5-5: 2002 Calendar Year Support Usage



However, a closer look at the half-year usage patterns was revealing. At the beginning of the year, in the wake of the Christmas season, support tickets backed up while staff were on the holiday and productivity dropped significantly (productivity was calculated as the differential between opened and closed tickets and is indicated by the line at the bottom of the graph). Generally an upward spike is negative with more tickets being opened than closed. Inversely, a downward spike is positive with more tickets being closed than opened.

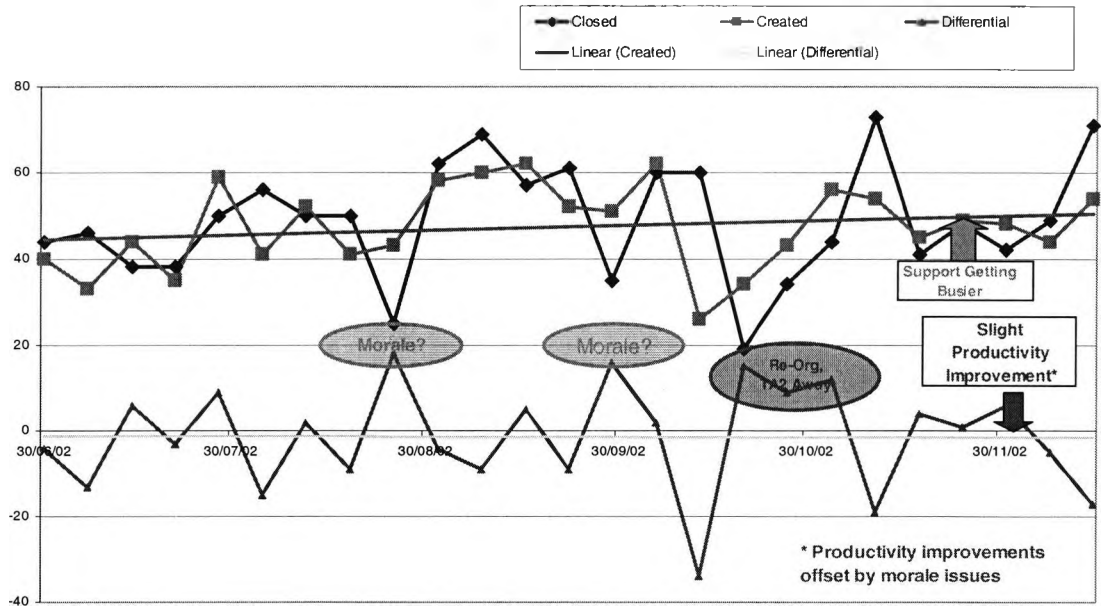
At the end of January, over 40 staff members were made redundant, clearly resulting in a drop in productivity as the support team worried about their own jobs. In February, support productivity again dropped with the launch of a new product version. However, two other events were very surprising (Figure 5-6). First, when Technical Analyst 2 (TA2) had to go on compassionate leave in April, there was an unexpected drop in productivity, indicating that he was a high performing individual contributor. Secondly, in May, there was a significant surge in productivity when an analyst was transferred out of the department. This event was known in advance and significant effort was put in (in advance) to clear the backlog of tickets.

Figure 5-6: 2002 First Half Support Usage



The analysis of the second half (Figure 5-7) of the year also identified some key trends and a few interesting findings.

Figure 5-7: 2002 Second Half Support Usage



In August and September there were two unexplained drops in productivity. Individual interviews revealed that in August there was a rumour that the team was going to be made redundant. The supposed date of the redundancies corresponded with the second drop in productivity in September. There was in fact a reorganisation in October, but it did not directly impact the support team. Although indirectly productivity suffered again. However, this could have been a combination of organisational issues coupled with one analyst (TA2) being away. The significant increase in productivity in the lead up to his absence seems to indicate the latter. Despite these significant morale issues and continued organisational changes, in the second half there seemed to be a slight improvement in productivity. This was good news, considering that the team seemed to be getting busier as well.

5.2.3 2002 Channel Usage Profile

The company communicated with its customers using telephone, email, web and occasionally a few other channels such as fax and face-to-face.

In 2002, 72% of the support tickets were opened over the phone, with a majority of the remainder (26%) logged via email (Table 5-7). Interestingly, the tickets opened by phone were closed on average seven days faster than over the ones opened by email and on average 11 days faster than the ones opened through a web self service portal. Even during this cursory analysis of ticket source, it was clear that there was a difference in either the type issue reported by each medium or in the team's ability to respond to the issues.

Table 5-7: 2002 Number of Support Tickets Opened by Information Channel

	Total	Status		Avg. Days Open
		Closed	Open	
Email	**815** *26%*	807 99%	8 1%	17
Other	**5** *0%*	5		14
Phone	**2226** *72%*	2186 98%	40 2%	10
Web	**65** *2%*	64 98%	1 2%	21
Grand Total	**3111**	3062 98%	49 2%	12

5.2.4 Qualitative Assessment

In December of 2002, the support team was interviewed to get a specific understanding of the group's roles, responsibilities, processes and problems. These interviews consisted of semi-formal one-on-one interviews as well as observation of the team at work. Three interviews were conducted and information was verified by the team's manager (TA1). Summary findings were distributed to the executive management team for comment.

The interviews and discussions with analysts and management were very revealing (see appendices for interview notes). Seven pressing issues were identified as grave areas of concern for the various constituencies:

1. **Poor Morale.** First and foremost, the redundancies, lack of procedures, and general uncertainty had taken its toll on the staff. Furthermore, the booming economy of the previous few years had set an unrealistic expectation when it came to pay raises. In the dot.com heyday it was not uncommon to expect (and receive) 8-10 per cent pay raises every year. When the new management took over, it quickly found that the team was over compensated according to market rates for those positions by 10-15 per cent. Unfortunately, the expectations had not yet been tempered by the economic downturn and they were very disappointed by modest 3-4 per cent raises.

2. **Escalation procedures were poorly defined and processes broken. Counterparts in the US were unequipped and not compensated to handle European support problems.** Since the reorganisations and the reclassification as a stand-alone business unit, escalation processes were fragmented and inefficient. The only official escalation path was directly to US product management and that was only supposed to be used for defects. Occasionally, when calls were passed through to US counterparts, it was to the least experienced analysts and answered as the lowest priority. Any help that was received was due to personal relationships between analysts that circumvented management authority.

3. **Significant "unpaid consulting" and third-party product support.** Due to the natural inclination to be helpful and serve the customer, the support team spent an inordinate amount of time on issues that were outside of its contractual obligations. This was both unprofitable and unproductive, as the ability to resolve other customer's contractual problems were delayed.

4. **Support service was poorly perceived by customers.** Due to the broken and poorly defined escalation procedures, the team's ability to address customer needs quickly and efficiently had been significantly impacted. Because of the bugginess of the product and the frequent escalation of defects to US product

management, some customers viewed the team as a "pass-thru service" that added little value. As seen during the observation day, this assumption proved to be unfounded. Generally, all of the issues that were passed to the US were genuine defects. All other problems were resolved locally.

5. **The team was lacking in both product and basic technical training.** Due to organisational cost cutting and lack of focus on this element of the business by the previous management team, analysts had not received any training for the previous two released versions of the product that they were supposed to support. Additionally, they had never received peripheral training in databases, networking, etc. that is necessary to perform their job functions.

6. **Lack of infrastructure and control over support database.** Since before the reclassification as a standalone business unit, the support team accessed a knowledgebase and support system located in the US. This system was slow and could not be modified to suite the local needs of the business. Furthermore, the team didn't have proper facilities to test the product on international operating systems.

7. **Customers were not following contractual support procedures.** Without systems and watchful management, over the past few years customers had stopped following contractual procedures and had become lax in fulfilling their obligations before placing a support call. For example, they rarely checked the Web-based knowledge base or installed software patches and hot fixes before placing a call.

5.2.5 A Goal-Based Methodology for Evaluation and Documentation

Given the complexity of the situation, the management team agreed to try out an experimental methodology to document the business process redesign and

optimisation efforts. Given the morale situation and history of distrust, it was decided not to reveal to the support team that an experimental methodology was being used.

The ten steps of the goal driven processes outlined in previous research were adapted for this situation to the following nine steps:

1. Identify business objectives or desired outcomes
2. Identify what you want to know or learn
3. Identify sub-goals
4. Identify entities and attributes
5. Formalise measurement goals
6. Identify indicators
7. Define measures
8. Identify and evaluate data sources
9. Implementation of programme

5.2.6 Step 1: Identifying Business Goals

Based on the analysis above, the manager of the department and the rest of the management team were primarily interested in achieving three things:

1. Increase Productivity – essentially "do more with less".
2. Decrease Costs – decrease the cost of servicing support
3. Improve Morale – it was immediately apparent that moral was at a low point and for any change programme to be effective it was important to make sure that addressed the people issues.

5.2.7 Step 2: Identifying Knowledge Points

Next, management and the most senior technical analyst (TA1) set out to identify all of the information that they needed to make business process changes. For management and the support team, the important entities of the improvement process were identified and categorised by outputs (products), inputs, artefacts and activities/processes. For each entity identified, the manager and TA1 identified a series of questions that they would like answered (Tables 5-8 & 5-9)

Table 5-8: Entities Owned By Management

Products & By-Products	
Customer Satisfaction	Are customers getting the service appropriate to their value to the business? What is the strategic value of each customer? How much revenue is produced by each customer?
Budget	What is the cost of service? What revenue (if any) can be attributed to these efforts?
Inputs & Resources	
Salaries	Are salaries competitive? Are salary levels too high?
Staff Levels	Are staff levels appropriate for work loads?
Training Budget	Is there money in the budget available for training? How much money should be spent on training? How will return on investment be measured?
New Product Releases	Are staff levels appropriate in light of future product release plans?
Internal Artefacts	
Demands for unpaid services	How much of the teams time is being used for internal purposes, non-support issues, or unpaid consulting?
Activities & Process	
Escalation Procedures	Are the appropriate escalation procedures in place? How can procedures be improved?

Table 5-9: Entities owned by TA1

Products & By-Products	
Productivity	Is the team performing at the appropriate level? What is the appropriate level (how defined)? How many tickets are opened per day, week, month, quarter, year by each analyst? How many tickets are closed per day, week, month, quarter, year by each analyst? How many tickets are carried per day, week, month, quarter, year by each analyst?
Cost of Services	How much does it cost per ticket? Are customers getting value for the money? Are customers getting too much for the money? How many tickets are opened per day, week, month, quarter, year by each customer? How many tickets are closed per day, week, month, quarter, year by each customer? Are customers getting services that they have no paid for? Are customers qualified to receive support?
Inputs & Resources	
Opened Tickets	How many tickets are opened per day, week, month, quarter, and year?
Experience of level of customer	Does length of time a customer had been working with the software affect support usage? Do more experienced customer find more defects and bugs (thus add value to the business despite increased support usage)?
Support System	Is the system adequate to enforce procedures?
Defects	How much time is spend on defects and not support issues?
Training	What level of training does each staff member need?
Internal Artefacts	

Closed Tickets	How many tickets are closed per day, week, month, quarter, and year?
Carried Tickets (Backlog)	How many tickets are carried per day, week, month, quarter, and year?
Ticket Source	Does the source of the ticket (email, telephone, web, etc) impact the time it takes to close?
Days Open	What is the average days open (ADO) per ticket? Does ADO vary by customer (indicating level of competence)?
Activities & Process	
Time spent on Closing tickets	How much time is being spent on non-support activities?
Time spent on non-support related activities	
Support System Development	What skills are necessary to make the changes to the support system? What environmental changes are necessary? What are the dependencies for making these changes?

5.2.8 Step 3: Identifying Business Sub-Goals

In the next step, the questions were grouped by topical area (Table 5-10). In this step, five topical groupings emerged: People, Process and Measurement, System, Cost and Customer.

Table 5-10: Question Groupings

Groupings (Issues)	Questions Related to Business Goals
People	What level of training does each staff member need? How many tickets are closed per day, week, month, quarter, and year? How many tickets are carried per day, week, month, quarter, and year? Is the team performing at the appropriate level? What is the appropriate level (how defined)? How many tickets are opened per day, week, month, quarter, year by each analyst? How many tickets are closed per day, week, month, quarter, year by each analyst? How many tickets are carried per day, week, month, quarter, year by each analyst? Are salaries competitive? How much money should be spent on training? How will return on training investment be measured?

Process & Measurement	How much of the teams time is being used for internal purposes, non-support issues, or unpaid consulting? How many tickets are opened per day, week, month, quarter, and year? How much time is spend on defects and not support issues? How many tickets are closed per day, week, month, quarter, and year? How many tickets are carried per day, week, month, quarter, and year? Does the source of the ticket (email, telephone, web, etc) impact the time it takes to close? What is the average days open (ADO) per ticket? Does ADO vary by customer (indicating level of competence)? Are staff levels appropriate for work loads? Are the appropriate escalation procedures in place? How can procedures be improved?
Systems	Is the system adequate to enforce procedures? What skills are necessary to make the changes to the support system? What environmental changes are necessary? What are the dependencies for making these changes?
Cost	What is the cost of service? What revenue (if any) can be attributed to support efforts? How much time is spend on defects and not support issues? Are salaries competitive? Are salary levels too high? Is there money in the budget available for training? How much money should be spent on training? How will return on training investment be measured? How much time is being spent on non-support activities? How much does it cost per ticket? Are customers getting value for the money? Are customers getting too much for the money? How many tickets are opened per day, week, month, quarter, year by each customer? How many tickets are closed per day, week, month, quarter, year by each customer? Are customers getting services that they have no paid for? Are customers qualified to receive support? Is there money in the budget available for training? How much money should be spent on training? How will return on training investment be measured?
Customer	Are customers getting the service appropriate to their value to the business? What is the strategic value of each customer? How much revenue is produced by each customer? Are customers getting value for the money? Are customers getting too much for the money? How much of the teams time is being used for internal purposes, non-support issues, or unpaid consulting? How many tickets are opened per day, week, month, quarter, year by each customer? How many tickets are closed per day, week, month, quarter, year by each customer? Are customers getting services that they have not paid for? Are customers qualified to receive support? How many tickets are opened per day, week, month, quarter, and year? Does length of time a customer had been working with the software affect support usage? Do more experienced customer find more defects and bugs (thus add value to the business despite increased support usage)?

When the questions were analysed within the groupings, five derived sub-goals emerged (Table 5-11). Primarily, it became clear that to improve productivity (Goal 1), that changes would need to be made to the processed and systems. Secondly, the customer entity emerged quite strongly as a contributing factor to the three main goals.

Table 5-11: Derived Sub-goals

	Derived Sub-goals
1	Improve People Competency
2	Improve Processes & Procedures
3	Improve Systems
4	Decrease Costs through increasing productivity
5	Better Manage the Customer

5.2.9 Step 4: Identify Entities and Attributes

For each of the sub-goals and related questions raised in the previous steps, entities and attributes are identified (Table 5-12). This step was really used to refine the entities and attributes for measurement and evaluation and to begin to contextualise the problem areas.

Table 5-12: Entities and Attributes

Sub-Goals	Questions	Entities	Attributes
Improve People Competency	What level of training does each staff member need? How many tickets are closed per day, week, month, quarter, and year? How many tickets are carried per day,	Team/Staff/Analyst	Level of training, ability, performance level

		Tickets	Number opened, closed carried in a period
Improve Processes & Procedures	How much of the teams time is being used for internal purposes, non-support issues, or unpaid consulting? How many tickets are opened per day, week, month, quarter, and year? How much time is spend on defects and not support issues? How many tickets are closed per day, week, month, quarter, and year? How many tickets are carried per day, week, month, quarter, and year? Does the source of the ticket (email, telephone, web, etc) impact the time it takes to close? What is the average days open (ADO) per ticket? Does ADO vary by customer (indicating level of competence)? Are the appropriate escalation procedures in place? How can procedures be improved? Are staff levels appropriate for work loads?	Tickets	Number opened, closed carried in a period, ADO, time to close
		Defects	Number
		Source of Ticket	Email, Telephone, Web,
		Customer	Skill level
		Unpaid consulting	Hours, authorisations
		Escalation procedures	Documentation, adherence, internal understanding
		Staff levels	Hours, Optimum levels
Improve Systems	Is the system adequate to enforce documented procedures? What skills are necessary to make the changes to the support system? What environmental changes are necessary? What are the dependencies for making these changes?	System	Changes, Dependencies
		Documented Procedures	
		IT Staff	Availability, Skills
Decrease Costs through increasing productivity	How much of the teams time is being used for internal purposes, non-support issues, or unpaid consulting? What is the cost of service? What revenue (if any) can be attributed to support efforts? Is there money in the budget available for training? How much money should be spent on training? How will return on training investment be measured? How much time is spend on defects and not support issues? How much time is being spent on non-support activities? How much does it cost per ticket? Are customers getting value for the money? Are customers getting too much for the money? How many tickets are opened per day	Tickets	Number opened, closed carried in a period, ADO, time to close
		Defects	Number
		Source of Ticket	Email, Telephone, Web,
		Customer	Skill level, Skill Level, Contract terms
		Unpaid Consulting	Hours, authorisations
		Training budget	Amount (GBP)

		Training	Courses, skills deficiencies
		Return on training investment	Improved morale, increased productivity
Better Manage Customer	Are customers getting the service appropriate to their value to the business? What is the strategic value of each customer? How much revenue is produced by each customer? Are customers getting value for the money? Are customers getting too much for the money? How many tickets are opened per day, week, month, quarter, year by each customer? How many tickets are closed per day, week, month, quarter, year by each customer? Are customers getting services that they have no paid for? Are customers qualified to receive support? How many tickets are opened per day, week, month, quarter, and year? Does length of time a customer had been working with the software affect support usage? Do more experienced customer find more defects and bugs (thus add value to the business despite increased support usage)?	Tickets	Number opened, closed carried in a period, ADO, time to close
		Defects	Number
		Source of Ticket	Email, Telephone, Web,
		Customer	Skill level, Skill Level, Contract terms, Experience Level, Qualification Level
		Strategic value	Qualitative assessment based on revenue and prestige
		Revenue	Amount (GBP)

5.2.10 Step 5: Contextualise Goals

Following the methodology outlined previously by Boyd (2002a) and Park *et al* (1996) this step, "formalising measurement goals", involved putting the sub-goals into context by defining the purpose, perspective and frequency of measurement/evaluation (Table 5-13). Due to the nature of the project, this step

differed slightly from the previous works. Primarily, "environment" was replaced by "frequency".

Table 5-13: Contextualised Objects of Interest

Object of Interest	Purpose	Perspective	Frequency
Customer	Evaluate customer interaction to determine if the customer is getting the level of service that they pay for without being over-served	This evaluation is from the company point of view. The "customer perspective" is out-of-scope of the exercise.	Measurement several times a year and contrasted to a yearly satisfaction survey
People	Evaluate if staff has requisite skills to do their jobs.	Management	Conduct evaluation yearly as part of the annual salary review
Support Process	Determine if processes are adequate to support cost, people and customer initiative. Derive and document measures	Management and employee	Evaluate yearly or as business model changes. Measurement several times a year and contrasted to a yearly satisfaction survey
Internal Systems	Determine if the support system is adequate to support people, process, cost and customer initiatives	Employee	Evaluate yearly or as processes change.
Cost reduction	Determine where cost efficiencies can be gained	Management	Continuously evaluate. Build measurement into financial reporting.

5.2.11 Step 6: Identify Indicators

Again, this step differed slightly than the methodology previously put forth. Since most of the questions raised in the previous steps were already quantifiable or required one-off dichotomous answers, it was felt that indicators could be developed based on the identified entities and attributes (Table 5-14).

Table 5-14: Indicators

Entities	Attributes	Indicators
Customer	Skill level, Qualification Level	Number of certified staff Certified Support Centre Status
	Contract terms	Contract Service Level Agreements (SLAs) Agreed services

Entities	Attributes	Indicators
	Experience Level	Date of certification
	Satisfaction Level	Yearly Satisfaction Survey Results
Defects	Number in period	Number of defects reported by week, month, quarter, year
	ADO	Days to resolution
Documented Procedures	Availability	Have documented procedures been published and read? (Y/N)
	Compliance	Are customers following documented procedures? Is compliance monitored?
IT Staff	Availability	Master project schedule with utilisation
	Skills	Skills audit
Source of Ticket	Email, Telephone, Web,	Source of ticket by period and customer
System	Changes	Requirements Document
	Dependencies	Baseline assessment
Team/Staff/Analyst	Level of training	Skills Audit
	Ability	Skills Audit
	performance level	Utilisation report
Unpaid consulting (UPC)	Hours on UPC	Utilisation report
	Authorisations	Manager approval form
Escalation procedures	Documentation	Procedure document
	Adherence	Procedure Audit
Staff levels	Hours	Utilisation report
	Optimum staff levels	Utilisation report
Training budget	Amount (GBP)	Departmental budget
Training	Courses,	Skills Audit
	Skills deficiencies	Skills Audit
Return on training investment	Increased productivity	Utilisation report, OCCO report
	Improved morale	Analyst feedback
Strategic value	Qualitative assessment based on revenue and prestige	SV Index score report
Revenue	Amount (GBP)	Departmental P&L statement
Tickets	Number opened/ closed carried in a period	Weekly, Monthly usage report (Emailed and available on intranet) including all opened closed and carried tickets by analyst
	ADO/Time to close	Average days open by ticket and ticket type

5.2.12 Step 7: Refine Indicators and Define Measures

Here it was decided to deviate from the methodology put forth previously. Instead of identifying data elements, indicators were further refined and the elements of measure were defined for each indicator (Table 5-15). This could be in the form of a unit of measure or a mathematical action (such as "count of").

Table 5-15: Definition of Measures

Indicators	Description	Measures
Morale Assessment	Quarterly qualitative assessment on morale to be conducted by manager and HR	Morale is Satisfactory, Not Satisfactory, Improving, Not Improving, Worsening
Are customers following documented procedures?	Qualitative assessment of each customer	(Y/N) to be stored in excel spreadsheet
Average days open by ticket and ticket type	Number of days that a ticket remains open	Open date – close date grouped by ticket type
Baseline System assessment	Current system specification	Specification document stored in project folder on the network
Certified Support Centre Status	Has partner undergone support certification?	Two certified, dedicated support staff, documented and audited support procedures
Compliance monitored/enforced	Is compliance monitored/enforced?	Workflow processes to be included in support system
Contract Service Level Agreements (SLAs), Agreed services	Signed contract	Copy of contract in database (Y/N)
Date of certification	Date that partner was first certified and last certified to be used in qualitative assessment of abilities.	Date that customer became certified Date of last certification
Days to resolution	Number of days a ticket has been open for used in qualitative assessment of difficulty of resolution	Ticket open date minus ticket close date (reported in full 24 hour days)
Departmental budget	Money set aside for training in the departmental budget	GBP amount set aside for training
Departmental P&L statement	Revenue generated as indicated on P&L statement	GBP amount of revenue
Have documented procedures been published and read?	Contract amendment	Copy of contact amendment in database
Manager approval form	UPC to be approved in advance by manager with account manager	Signed/dated UPC approval stored in database
Master project schedule with utilization	All projects with description, owners, start/end date and dependencies	MS project Gantt chart
Number of certified staff	Number of staff members that are certified on the product	Count of staff by certification type
Number of defects reported by week, month, quarter, year	Pivot table of defects in time period as certified by product management in	Status = * Defect *
OCCO report	Line chart of Tickets Opened, Closed, Carried, Outstanding	Count of OCCO by week, month, quarter, year
Procedure Audit	Review of procedures by all stakeholders	N/A
Escalation Procedure document	Outlines escalation procedures	N/A
Skills audit	Survey of staff technical skills	Annotated to the HR database

Source of ticket by period and customer	Annotation of the information channel used to communicate the support problem (web, email, telephone, other)	Select from Source field grouped by day, week, month, quarter, year and customer
SV Index score report	1-10 scoring of customer to include revenue, cost of supporting and prestige value of the account	Numeric value 1-10 qualitatively assessed by stakeholders
System Requirements Document	Documented system changes necessary to implement the programme	N/A
Utilisation report	Amount of time staff spend closing tickets, amount of time IT staff spend on approved projects	Number of tickets closed divided by available hours
Weekly, Monthly usage report	(Emailed and available on intranet) including all opened closed and carried tickets by analyst and customer	Count of tickets by status Count of tickets by customer
Yearly Satisfaction Survey Results	Conducted by group headquarters with all customers	Multiple – out of scope of this exercise

N/A indicates that a specific measure is "not applicable"

5.2.13 Step 8: Define and Evaluate Data Sources

In this step, desired measures were evaluated against data sources for availability. None of the requested information would be unobtainable (Table 5-16).

Table 5-16: Measures and Data Sources

Measures	Data Source	Availability
Count of staff by certification type	CRM System	Available
Two certified, dedicated support staff, documented and audited support procedures	CRM System	Available
Copy of contract in database (Y/N)	CRM System	Available
Date that customer became certified Date of last certification	CRM System	Available
Customer Satisfaction (Multiple – out of scope of this exercise)	NA	Difficult to obtain
Status = * Defect *	Support System	Available
Ticket open date minus ticket close date (reported in full 24 hour days)	Support System (data exported to xls for analysis)	Can be derived from other data
Copy of contact amendment in database	CRM System	Available
Signed acceptance form (Y/N) to be stored in excel spreadsheet	Excel spreadsheet	Can be derived with effort
Workflow processes to be included in support system	N/A – customisation of the Support System	Difficult

Project Plan	MS Project Gantt chart	Can be derived with effort
Skills audit Annotated to the HR file	Paper form	Can be derived with effort
Select from Source field grouped by day, week, month, quarter, year and customer	Support System	Can easily be derived from other data
Specification document stored in project folder on the network	NA – document to be created	Can be derived with effort
Number of tickets closed divided by available hours	Support System – exported to xls for analysis	Can easily be derived from other data
Count of tickets by status Count of tickets by customer Count of OCCO by week, month, quarter, year	Support System – exported to xls for analysis	Can easily be derived from other data
Open date – close date grouped by ticket type	Support System – exported to xls for analysis	Can easily be derived from other data
Morale is Satisfactory, Not Satisfactory, Improving, Not Improving, Worsening	Paper form	Can be derived with effort
GBP amount set aside for training	Finance system	Available
GBP amount of revenue	Finance system	Available
Signed/dated UPC approval stored in database	Paper form	Can be derived with effort
Procedure Audit	MS Word document	Can be derived with effort
Escalation Procedure document	MS Word document	Can be derived with effort
SV Scoring	Excel spreadsheet	Can be derived with effort

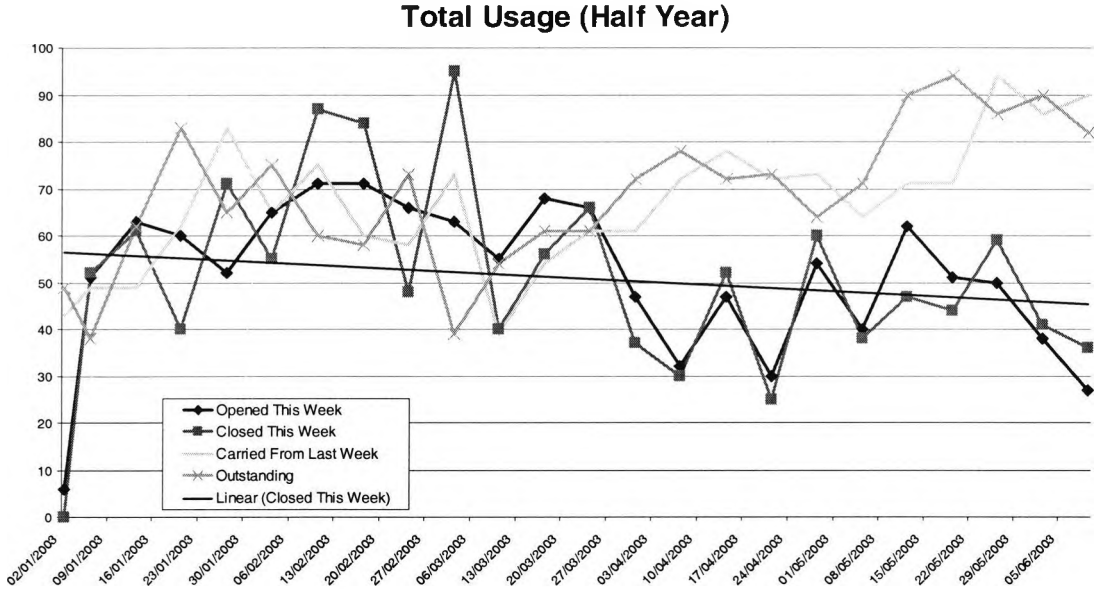
5.2.14 Step 9: Implementation Programme & Results (2003)

Based on this analysis, processes were put into place to eliminate unpaid consulting and unprofitable support work and it was decided by the management team that much of the onus will be put on the customers to follow agreed procedures and published guidelines. The enforcement of these procedures reduced support usage, allowing analysts to work on revenue generating activities and to focus their attention on paying customers. Additionally, systems were put into place to improve management information.

The value of the programme was highlighted two months after implementation. In the first week of June, TA1 had approached management with a request for additional headcount. He felt that the team had been just "too busy over the past few months".

Although the financial quarter had not closed, the O/C/C/O[13] statistics were run in aggregate and for each individual employee. He was right, the team did seem busier. However, as the figure below points out, this was only reflected in the number of tickets that were carried or outstanding. Both the number of opened and closed tickets were in decline indicating that customer usage was actually going down (Figure 5-8).

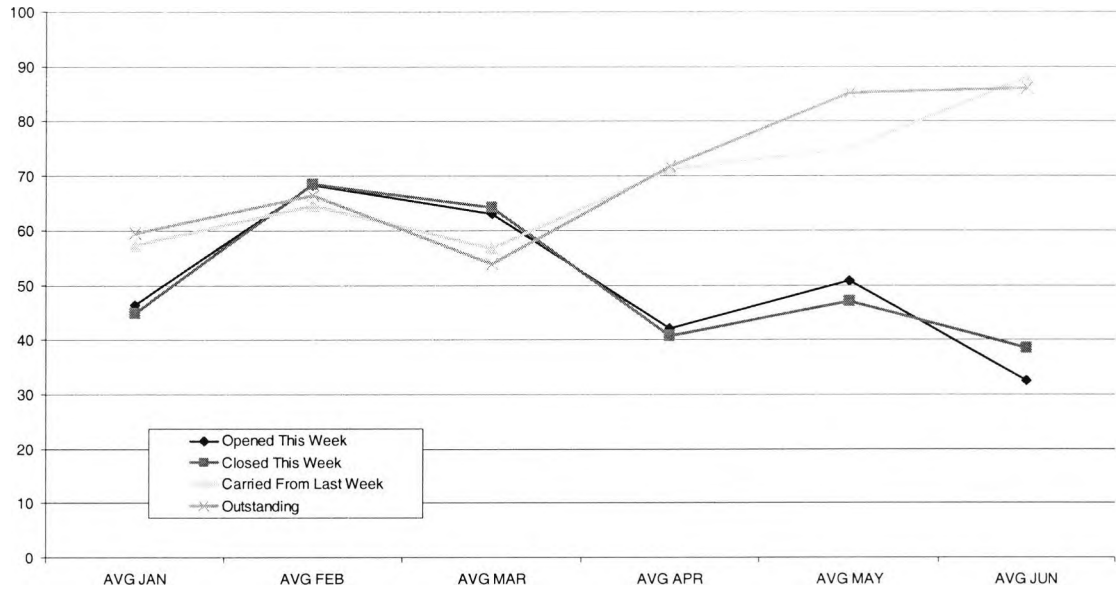
Figure 5-8: Half Year OCCO Statistics



The monthly average report (Figure 5-9) smoothed out some of the peaks and valleys of the Total Usage report, but confirmed that there was a serious problem beginning in March.

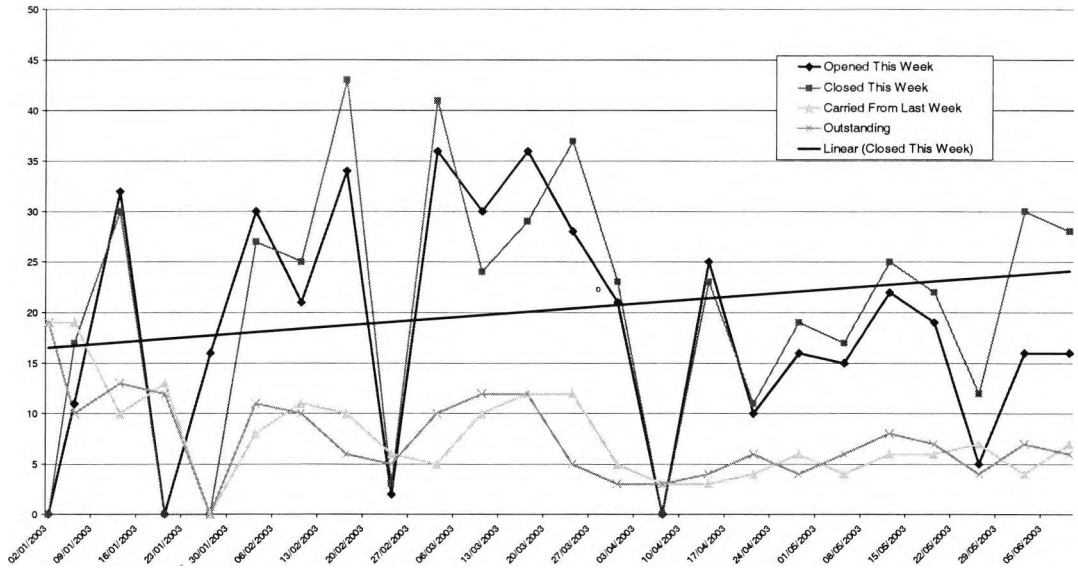
[13] Opened, Closed, Carried, Outstanding

Figure 5-9: Monthly Average OCCO (H1-2002)



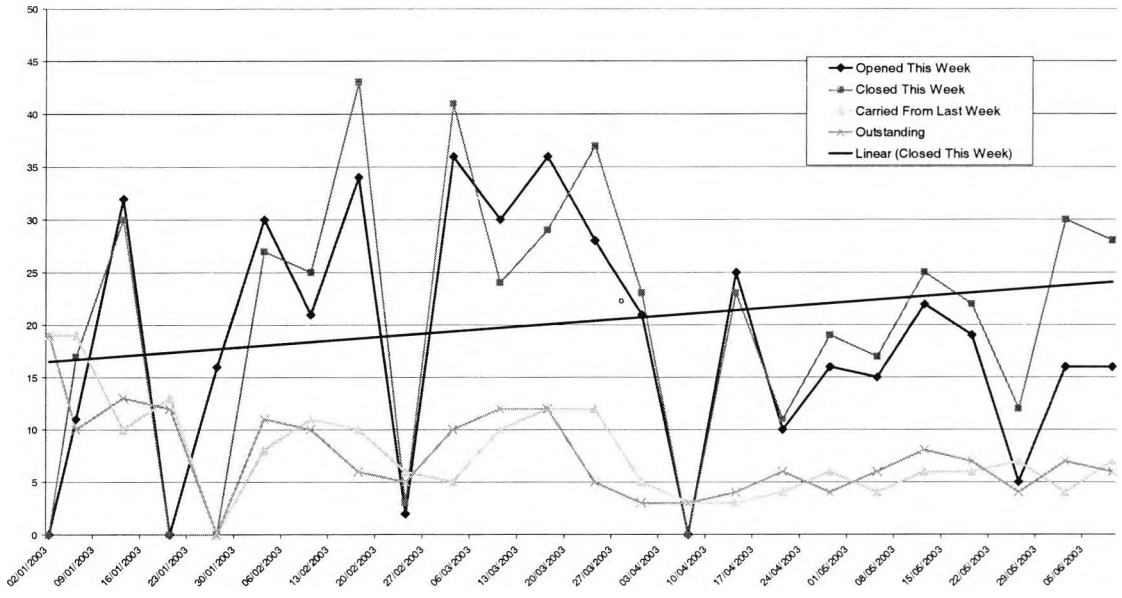
The aggregate OCCO numbers gave no indication as to why things were not operating efficiently. Next, an OCCO report was run for each individual employee (Figures 5-10 through 5-12). The manager of the team (TA1) showed a slight improvement in performance (indicated by the upward trending black line in Figure 5-10). On average, he was closing 1-3 more tickets per week than he had been at the beginning of the year.

Figure 5-10: TA1's Half Year OCCO



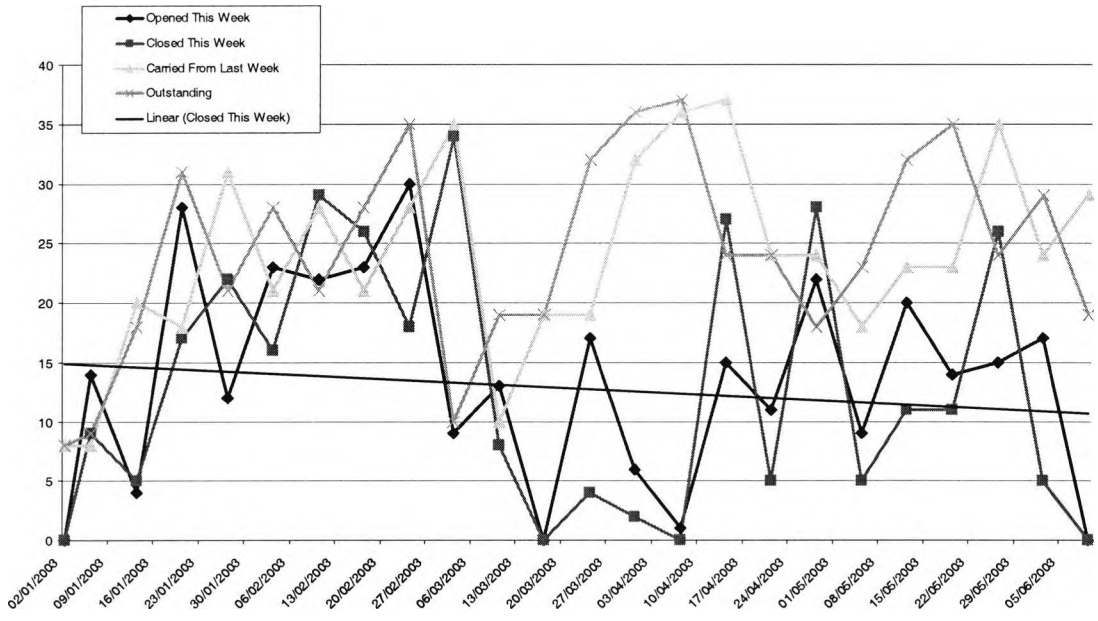
TA2 on the other hand was a real star (Figure 5-11). His outstanding and carry numbers were extremely low (less than 10) and his performance has improved demonstrably (by closing an average of over 10 more tickets per week than at the beginning of the year). The two downward spikes in both opened and closed tickets were attributable to the training and holiday periods.

Figure 5-11: TA2's Half Year OCCO



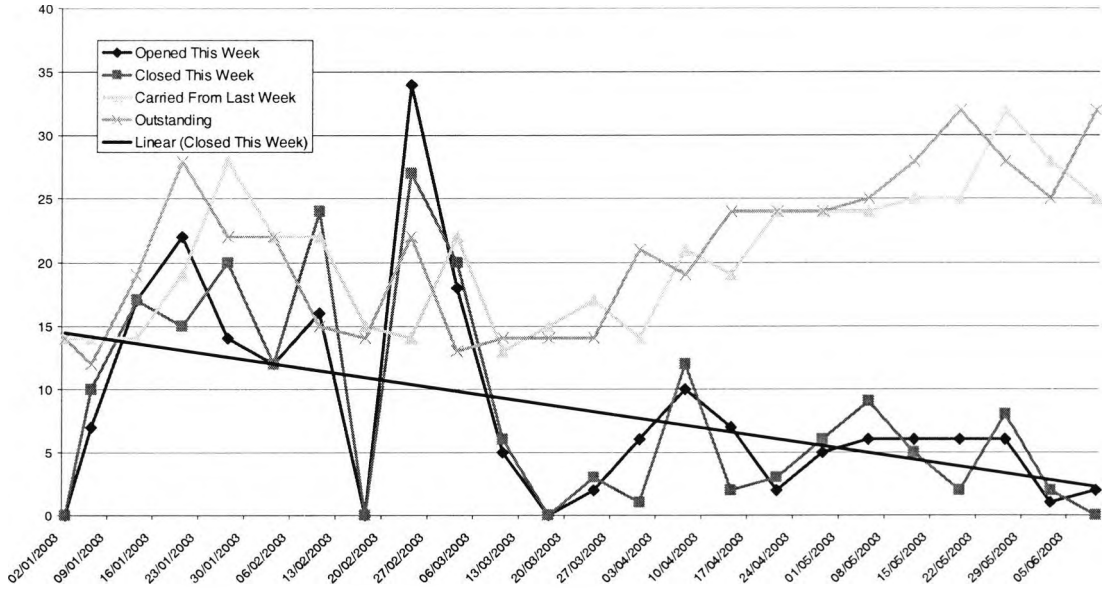
TA3 on the other hand showed a real degradation in performance (Figure 5-12). Since the beginning of the year, he was closing nearly 4 less tickets per week and his overall performance had been erratic. Although it later turned out that he resigned in July, it seems that he had "mentally quit" sometime in early March.

Figure 5-12: TA3's Half Year OCCO



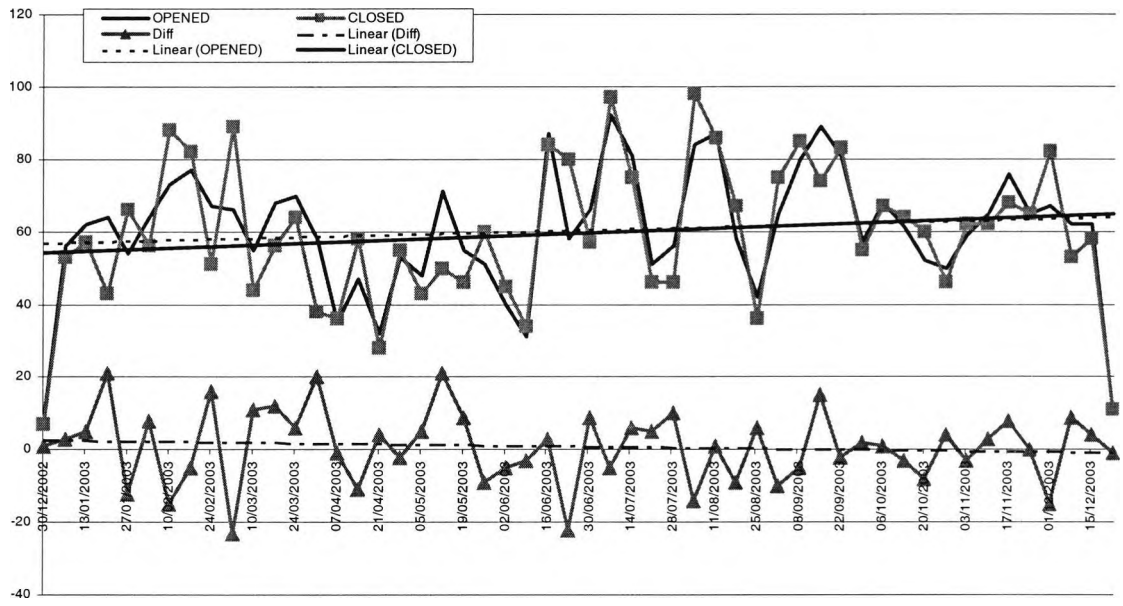
TA4's performance decline was the most shocking (Figure 5-13). In the beginning of the year, he had been a hardworking and conscientious employee, closing nearly 15 tickets per week. By June, he was doing a linear average of less than five per week. Consequently, TA1's request for more staff was denied. He was told that we would have to get his current staff performing, or get them out of the organisation.

Figure 5-13: TA4's Half Year OCCO



By the end of the year, department was getting busier with on average 10 more tickets per week being opened (Figure 5-14). Despite one less staff, they were also closing more tickets per week and throughout the year, productivity had remained the same.

Figure 5-14: 2003 H2 Support Usage



5.2.14.1 A "Fuzzy" Measure of Strategic Value

In addition to being able to use information efficiently in a reactionary manner as shown above, the GQIM exercise was instrumental in identifying information that could be used for the proactive development of strategic plans.

At the offset of the project, there was no organisational way to determine strategic value of a customer. During a GQIM exercise, a qualitative assessment of each account was undertaken by the management team. Based on revenue contribution and prestige of the account, each customer was assigned a 0-10 rating. It should be noted, since this was a qualitative assessment, that the numerical SVI rating can only be considered an ordinal value. Since the management team was after was an approximation or directional indicator of value, it was decided not to define the SVI in interval or absolute terms. Rather a flexible approach based on "fuzzy numbers" would be adopted and a fuzzy control system (FCS) [14] would be used to logically group customers according to how they were to be treated. This approach to developing communications strategies was previously outlined by Boyd (2004a).

Immediately, it was clear that there was a disparity in the level of support received by each constituency. When the average days [that a support ticket remained] open (ADO) was plotted, it was revealed that the less strategic customers seemed to be getting a slower response time to issues (Figure 5-15). In the diagram below, the x-axis has several triangular lines protruding from it. The lines indicate the completeness of belonging to each value grouping for instance, a SVI of 3 could mean a low value or medium value customer. But a 4 or 5 fall squarely in the medium group. Similarly, a seven could belong to medium or high value groups.

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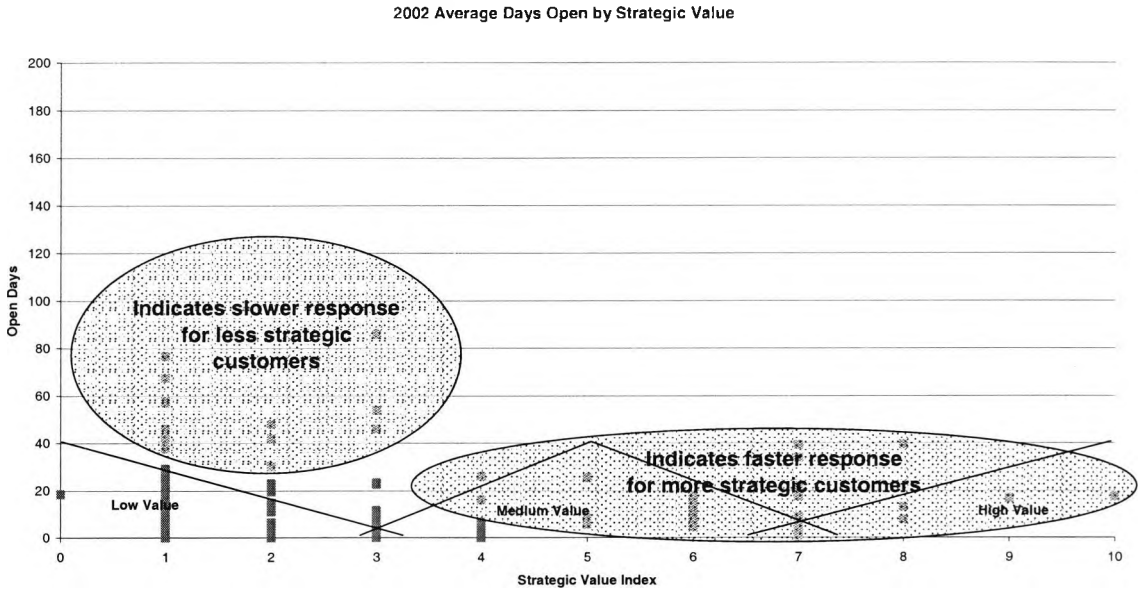
[14] "Fuzzy control systems are control systems are an engineering method whereby response rules are based on approximate input values" (Boyd, 2004a, p. 86).

Figure 5-15: More Strategic Customers Received Better Service



Although management was not unhappy about this finding, no specific policy dictated that more strategic customers should be treated differently than less strategic customers. During a round-table discussion, several hypotheses were put forth as the cause of this phenomenon:

1. More strategic customers were getting better service, either through subtle (management) pressure or familiarity (the team had a more intimate working relationship with high volume users)
2. There was a difference in the types of issues reported via the different mediums – i.e. high priority issues got reported by phone and low priority issues were reported through asynchronous mediums such as web and email.
3. Experience of the customer influenced the medium chosen and amount of support used.
4. A forth-factor such as geographic location/language influenced the medium of choice.

Next, the SVI rating was cross-tabulated by the sum of tickets (Table 5-17). Surprisingly, ticket usage was split between (a non-fuzzy value of) low (SVI = 0-2),

medium (SVI = 3-6) and high (SVI = 7-10) value participants. That is the, 16 high value partners opened as many support tickets as the 152 low value partners.

Table 5-17: Number of Support Tickets and Customers by Strategic Value

Strategic Value	Customers	Tickets	%		
				Low	
0	1	24	1%	value	34%
1	132	804	26%		
2	19	245	8%	*n =*	*152*
3	20	172	6%	Medium	34%
4	9	233	7%	value	
5	4	122	4%		
6	11	529	17%	*n =*	*44*
7	10	261	8%	High	32%
8	3	265	9%	value	
9	1	101	3%		
10	2	355	11%	*n =*	*16*
Grand Total	212	3111	100%		

What was unclear at this point was whether or not the slower response was due to a implicate service policy being granted to more valuable customers, or for some other reason. When a regional analysis was conducted, it was revealed that the vast majority of tickets originated with UK customers (Table 5-18).

Table 5-18: Number Support Tickets by Place of Origin

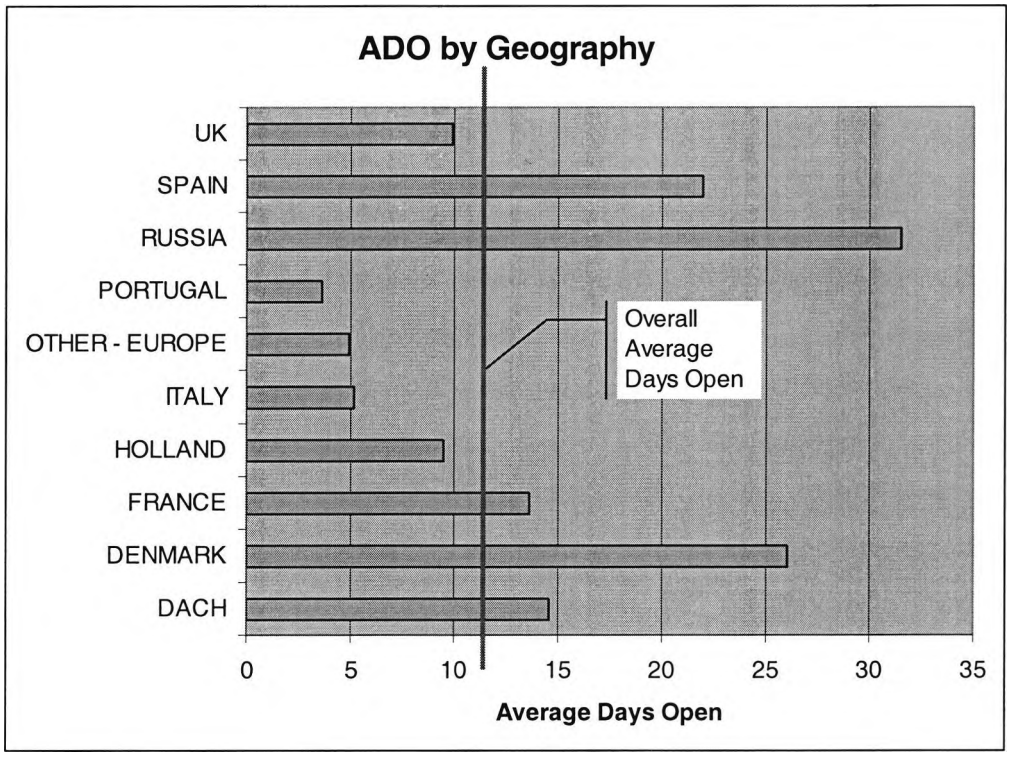
	Tickets	%
UK	2064	66%
FRANCE	254	8%
DACH[15]	220	7%
SPAIN	141	5%
OTHER - EUROPE	93	3%
HOLLAND	66	2%
DENMARK	43	1%
RUSSIA	35	1%
PORTUGAL	23	1%
UNKNOWN	172	6%
	3111	100%

[15] German speaking – Germany (D), Austria (A), Switzerland (CH)

However, when the average days open was analysed by region, it was immediately clear that the non-UK were getting their queries answered more slowly than UK-based customers (Figure 5-16). This could have been a result in 1) language difficulties and/or product problems relating to regional operating systems 2) use of a different communication medium or 3) as a whole, these were less strategic customers.

On the whole, language or regional settings issues seem to be a contributing factor in slower response time. In Holland – where English is known to be spoken very well – had nearly the same ADO score as the UK. Also, the Italian customer who was very good technically and spoke English well also had a significantly lower ADO score than the UK. France, Russia, Germany (DACH), Spain and Denmark on the other hand all had ADO scores significantly higher than the UK.

Figure 5-16: Average Days a Ticket Remained Open by Country of Origin



Clearly, channel choice also seems to influence response time. On average, an email remains open seven days longer than phone and a web ticket stays open 11 days

longer (Table 5-19). However, it should be noted that during round-table discussions, the support team that phone tickets can sometimes be easier to close because they can ask for and get all of the necessary information needed to investigate the problem.

Very interestingly, the country of origin coupled with medium also seems to be an influencing factor (Table 5-19). The UK who by an overwhelming majority (80%) used the phone to communicate with the support team had a significantly lower ADO than the nearest statistically relevant comparison (France at 66% phone usage). Those countries that predominately relied on email and web had a significantly higher ADO averages.

Table 5-19: Number of Support Tickets Opened and Average Days Open by Information Channel & Country of Origin

	Total*	Email		Phone		Web		ADO
UK	2060	389	19%	1653	80%	18	1%	10
ITALY	7	2	29%	5	71%			5
FRANCE	254	80	31%	168	66%	6	2%	14
HOLLAND	66	24	36%	42	64%			9
OTHER - EUROPE	85	31	36%	44	52%	10	12%	5
DACH	220	105	48%	113	51%	2	1%	15
PORTUGAL	23	12	52%	11	48%			4
DENMARK	42	20	48%	16	38%	6	14%	26
SPAIN	141	81	57%	39	28%	21	15%	22
RUSSIA	35	24	69%	9	26%	2	6%	32
AFRICA	1	1	100%					*N/A*
Grand Total	2934	769	26%	2100	72%	65	2%	

** Unknowns removed*

Caution: small sample sizes in some regions.

Of the 16 high value customers, only 7 come from outside the UK (Table 5-20). Therefore it stands to reason that strategic value is linked to geographic location.

Table 5-20: Number of Customers by Strategic Value and Country of Origin

Strategic Value	AFRICA	DACH	DENMARK	FRANCE	HOLLAND	ITALY	OTHER - EUROPE	PORTUGAL	RUSSIA	SPAIN	UK	UNKNOWN	Grand Total
0					1								1
1	1	6		16	3	1	23	2	2	8	40	30	132
2		1	1	7					1		6	3	19
3		1		3						2	14		20
4		2								1	6		9
5		1									3		4
6											11		11
7			1	2	1				1		5		10
8		1								1	1		3
9											1		1
10											2		2
Grand Total	1	12	2	28	5	1	23	2	4	12	89	33	212

With the exception of web ticket usage (with an admittedly low sample size), and accept at the very highest ratings, channel choice does not seem to be significantly influenced by strategic value (Table 5-21).

Table 5-21: Number of Support Tickets Opened by Strategic Value and Information Channel

Strategic Value	Total*	Email		Phone		Web	
0	24	9	38%	15	63%		
1	804	278	35%	496	62%	30	4%
2	244	70	29%	167	68%	7	3%
3	171	50	29%	119	70%	2	1%
4	233	24	10%	207	89%	2	1%
5	122	28	23%	93	76%	1	1%
6	528	115	22%	402	76%	11	2%
7	259	75	29%	177	68%	7	3%
8	265	63	24%	197	74%	5	2%
9	101	33	33%	68	67%		
10	355	70	20%	285	80%		
Grand Total	3106	815	26%	2226	72%	65	2%

** Others removed*

Additionally, there seems to be an inverse relationship between experience and average days open (Table 5-22). For the customers with a SVI score above 4, experience was qualitatively assessed using a "low", "medium" and "high" scale. Not surprisingly, the more experienced customers are finding more difficult cases that on the whole take longer to close.

Table 5-22: Average Days Open (ADO) by Country of Origin and Experience Level

For Customers with SVI >= 4

	LOW	MED	HIGH	Avg ADO
DACH		15	40	21
DENMARK		39		39
FRANCE	21			21
HOLLAND	7			7
RUSSIA			3	3
SPAIN			13	13
UK	8	9	15	10
Grand Total	10	13	16	12

**Customers with unknown experience levels omitted*

In summary, it seems that in 2002 customers got better service for the following, interlinked, reasons:

1. Strategic value to the organisation – Customers that generated more revenue or had a higher "prestige value" to the organisation got better service.
2. Geographic location and language – Regardless of any correlation (although unsubstantiated in this research) between geography and strategic value, customers that were native English speakers using the software received better service than non-English counterparts.
3. Propensity to use the telephone – However, telephone usage (in contrast to email or web) also seemed to influence the level of service. On average, telephone queries were answered significantly faster than other mediums. Three factors could account for better service provided over the telephone. First, support analysts could gather all of the information at once or could answer the query with one contact (thus eliminating delayed responses). Use of the phone is also linked to geographic location and language – Native English speakers (or customers with good English skills where more likely to use the telephone).
4. Experience of the customer – In aggregate, customers with a higher SVI receive better service than lower value customers. It stands to reason that

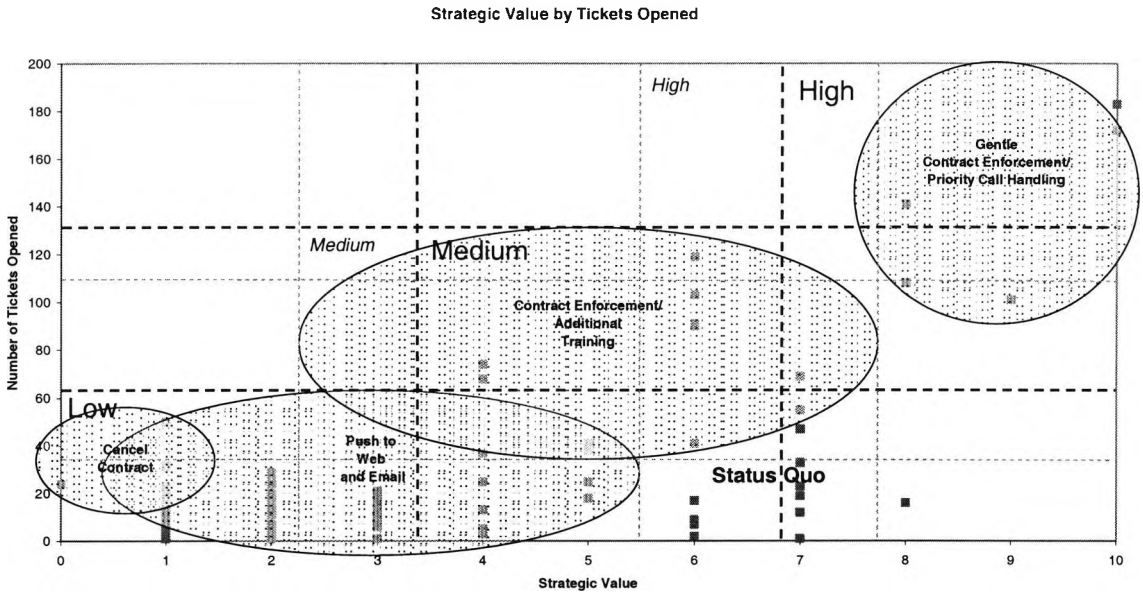
more experienced customers, have more difficult support problems. But higher experience level seems to be linked to longer resolution times.

5.2.14.2 A Value-Based Information Strategy

Given that one of the primary business objectives was to increase productivity of the team (Boyd 2004b), it was clear that procedures needed to be put into place to optimise and control channel usage. Generally speaking the high value users were also volume users, so any strictly volume based controls would likely alienate high value customers. Therefore, it was recognised that controls needed to take into consideration both factors.

As a basis for determining a way forward, a count of the number of support tickets (volume) was plotted by the Strategic Value Index (SVI) score (Figure 5-17). Value was plotted on the x-axis and number of opened tickets on the y-axis of the scatter plot. Since the inputs to this exercise were qualitative, the management team did not want to put too much emphasis on the actual SVI score, but rather wanted to determine response strategies for groups of similar customers. Therefore high volume users were defined as having opened greater than 110-130 tickets, medium volume users were determined as having open 35-130 tickets and low volume users were defined as using 0-65 tickets (notice the overlap between groupings). Similarly, were defined as having SVI score of 7-10, medium value customers as having between 3-7 and low between 0-3 (again, notice the over lapping scores). The plot was then segmented using these fuzzy value scores (noted by the grey and black dotted lines)

Figure 5-17: Fuzzy Control System to Determine Information Channel Strategy



Using the segments as a guide response strategies could then fairly easily be derived for groups of like customers. High volume/ high value customers were given official priority call handling and in some cases, named support analysts were assigned. However, so they could not abuse their status, contracts were reviewed and customers that were not in compliance were "gently" encouraged to follow agreed procedures. High-value, medium to low usage customers were left alone.

Medium-value to medium/high-usage customers were also subject to contract review and many cases encouraged to take additional product training (to reduce future usage). Medium/low value and medium/low usage customers were directed to use email and web self help support, as well as take additional training. Finally, low usage/low value customers were subject to review and contract termination (as they would likely remain forever unprofitable).

This programme was rolled out in late 2002 and early 2003. Follow-up data were collected in January of 2004. In a year the channel usage landscape had changed significantly. Despite one less support team head, the ADO for phone tickets had been cut in half (from 10 days to 5) and the total ADO for all mediums had dropped from 12 to 7 days (Table 5-23).

Table 5-23: 2003 Number of Tickets Opened and Average Days Open by Information Channel

2003 Support Tickets by Source	Total	Status		2003 ADO	2002 ADO
		Closed	Open		
Email	**617** *20%*	596	21	15	17
Other	**8** *0%*	8		1	14
Phone	**2495** *80%*	2433	62	5	10
Web	**16** *1%*	16		27	21
Grand Total	**3136**	3053 97%	83 3%	7	12

Email ADO remained relatively the same (17 in 2002 vs. 15 in 2003), but web usage had also dropped significantly, as this channel option had been discontinued halfway through the year.

The optimisation strategy put into place in 2003 had radically altered the composition of the customer base. The primary difference between 2002 and 2003 was the reduction in the number of low value customers and the consequential number of tickets opened by this group. In 2002, there were 212 supported customers, but through elimination support for low value/low volume users, the number of supported customers was down to 174 in 2003 (Table 5-24).

Table 5-24: Comparison of Number of Support Tickets and Customers by Strategic Value

	2003				2002			
SVI	Tickets		Customers		Tickets		Customers	
0	19	1%	2	1%	24	1%	1	0%
1	518	17%	97	56%	804	26%	132	62%
2	263	8%	12	7%	245	8%	19	9%
3	230	7%	21	12%	172	6%	20	9%
4	277	9%	10	6%	233	7%	9	4%
5	198	6%	5	3%	122	4%	4	2%
6	692	22%	13	7%	529	17%	11	5%
7	227	7%	9	5%	261	8%	10	5%

	2003				2002			
SVI	Tickets		Customers		Tickets		Customers	
8	252	8%	2	1%	265	9%	3	1%
9	146	5%	1	1%	101	3%	1	0%
10	314	10%	2	1%	355	11%	2	1%
Grand Total	**3136**		**174**		**3111**		**212**	

As a result of the training programme for medium value customers, there was actually in increase in the number of tickets opened by this group. Anecdotally, team seems to think that the increased focus on the mid-value group has actually encouraged them to use the software more and begin to do more complex things. As an important strategic group as the potential as high value customers of the future, management was pleased with this increased usage despite additional costs.

5.2.15 Case Conclusion & Implications

The project began with the three business goals of 1) increasing productivity, 2) decreasing costs and 3) improving morale. Overall, each of these objectives was achieved to varying degrees. With the monitoring of four primary statistics (OCCO), management was able decrease headcount (through attrition) without substantially impacting the level of service. Additionally with concrete measures of success and through the openness of this programme, morale began to improve. Other measures and information needs that were identified during the GQIM process were used to reduce the amount of unpaid consulting, make information systems changes and improve the overall customer experience.

At the offset of the project, the organisation had disconnected, disparate information systems, measurement was poor and information retrieval was ad hoc at best. A significant benefit of this programme has been the documentation (and in some cases creation) of standardised and repeatable business processes and measurement. Although the business focus has since moved from turnaround activities to growth, this system is still used to continuously evaluate and further refine the business.

The optimisation strategy based on the fuzzy control system allowed the support team to focus on answering more queries from the medium value customers and reduce the overall ADO. As such productivity was clearly increased and cost reduced as the same number of tickets could now be answered with less staff. With these measurable and demonstrable results, the team could not help but to feel proud of their accomplishments. A fourth benefit, although not quantitatively measured, was improved customer satisfaction associated with improved service, priority handling and focus on mid-level customers.

The literature has long shown that information-seeking is situation dependent and individualised. Several factors such as access to information, trust of source and the quantity and quality of information received can influence information-seeking choices. With a micro-study of a single organisation it is impossible to draw general conclusions about the nature of information channel usage. However, although outside the scope of this study, there were several interesting observations that warrant further investigation:

1. There is evidence that the use synchronous communications such as the telephone resulted in better service than asynchronous methods such as email and web. It would be interesting to compare several multi-channel support operations across industries to see if this is a universal phenomenon.
2. Geographic proximity and a common language may be a driver of channel choice. That is, the non-English speaking and customers outside the UK were more likely to use email and web. Whereas UK customers and those with closer strategic relationships were more apt to using the phone. Again, it would be interesting to determine if foreign customers are inadvertently disadvantaged through the use of asynchronous channels. It would also be interesting to understand if the use of asynchronous channels are due to language difficulties or geographic (time zone related).
3. Familiarity – Many researchers have noted the social nature of information seeking. In this case, familiarity could be an influencing factor in the service received. Further research would be necessary to determine, in general, how

much of an advantage familiarity gives certain information seekers in a commercial environment.

Although out of scope of this specific research, with the recent proliferation and commercialisation of information channels – such as web, email, digital TV and wireless – coupled with increased globalisation, it will be increasingly important to understand aggregate drivers of information channel choice.

The purpose of this study was to validate the use of GbIF model. In this case, the adapted GbIF reference model did prove to be very useful in the documentation and evaluation of the business process redesign efforts. The linking of low-level measures to high-level goals kept the programme focused on results – yielding demonstrable results. However, the management team felt it was lacking in the ability to identify new problem areas and the updating of the model with the addition of new information from discovery proved to be cumbersome. Overall, as a one-off exercise, the model was useful information retrieval taxonomy for documentation and evaluation. However, when pressed management felt that due to other priorities it was unlikely that model would be self-sustaining and would need to be rebuilt each year. In all, although focused, the rigor, adaptability and expansiveness negatively impacted expense (primarily of maintenance) and flexibility.

6 Information Integration and Exchange

6.1 State of Practice

With the introduction and adoption of emerging information technology standards such as XML and web services and the rise of service oriented architectures (SOA), the information landscape is quietly changing. In the past ten years, Information Technology (IT) has been heavily weighted to *technology*. However, if the current trends outlined in chapter 5 continue unabated, in a very short time, the "T" could begin to take a backseat to *information*. The impact of these changes is not yet understood, or likely fully known.

In the past few years there has been a raging debate on the commoditisation of information technology and if information technology can give an organisation a sustainable competitive advantage (Carr, 2003). Carr's argument sparked several high profile responses from both academics and practitioners alike. As this debate raged (largely about semantics and narrow definitions of IT), a few technology-led innovations have continued to quietly emerge. Three distinct trends will be discussed in this chapter:

- **Emergence of Technology and Information Exchange Standards** – Governmental and regulatory pressure has promoted the need for new information sharing standards. In the past few years, new information retrieval and integration standards have emerged in the healthcare (HIPAA), Financial Services (BASEL II) sectors as well as in response to some high profile financial reporting scandals (Sarbanes-Oxley). These specific standards coupled with the maturity of more general technology standards – in particular XML and web services – has created enormous opportunity to streamline information exchange.

- **Application Integration and Information Exchange** – Economic pressures have forced organisations to find new ways to do more with less, by continuing to leveraging older technology investments for longer.

As a result, application integration has become increasingly common in the past few years. Rather than buy a new application suite to address business needs, companies are looking to integrate and leverage older technologies for much longer. The emergence of standards and services-based approaches to application and systems development has created an opportunity for cost reduction, as well as the potential for new business opportunities.

- **Business Process Management –** A third trend sees the move away from application integration to the notion of business process orchestration and management. Rather than simply moving data between systems, companies are seeking to coordinate organisational business processes across many systems and even across many companies. New tools and technologies are emerging to address these needs.

While these advancements are widely known within the technology press and specific industries, there is not a wide appreciation for new business and information research opportunities (as evidenced by scarce mention in both business industry press and information science journals). Information scientists would do well to begin to apply the research tools of their trade to understand the wider social implications of these changes.

This section of the study will briefly review some of the emerging technologies with a particular emphasis on the ramifications to the field of information science and present a goal-based information framework model for information exchange and integration.

6.1.1 Emerging Information Exchange Standards and Technology

There are literally hundreds of emerging technology and information standards addressing many different domain problems. In fact, with many of these technologies in a nascent state, some domain problems are addressed by two or more incompatible

standards. A full review and evaluation of domain areas and the merits of the various standards is outside the scope of this research (and is more likely the preview of the computer sciences discipline). However, in recent years two standards have emerged that are highly relevant for low maturity organisations – the data transfer standard XML (eXtensible Markup Language) and a set of interoperability technologies called web-services.

According the standards organisation W3C, XML is a markup language similar to HTML that is used to describe data (http://www.w3schools.com/xml/xml_whatis.asp). Unlike HTML, markup tags are not predefined, but rather are user defined. XML uses self-descriptive document type definitions (DTDs) or schemas to describe data. It is outside the scope of the research to provide a full tutorial on XML, but the following example of an XML invoice is provided for the reader's edification. The hypothetical invoice is provided for the "sale" of this thesis (Table 6-1).

Table 6-1: Sample XML Invoice

```
<Invoice>
 <InvoiceHeader>
  <Address>23 The Hermitage</Address>
  <CompanyName>Boyd Ltd</CompanyName>
  <City>Richmond</City>
  <PostalCode>TW10 6SH</PostalCode>
  <Country>United Kingdom</Country>
  <OrderID>12345</OrderID>
  <CustomerID>BYDLTD</CustomerID>
  <OrderDate>07/04/2004</OrderDate>
  <ShippedDate>07/16/2004</ShippedDate>
  <Size>12 GB</Size>
 </InvoiceHeader>
 <InvoiceItem>
  <OrderID>12345</OrderID>
  <ProductID>115</ProductID>
  <UnitPrice>20</UnitPrice>
  <Quantity>2</Quantity>
  <Discount>0</Discount>
  <ProductName>Thesis</ProductName>
  <ExtendedPrice>40</ExtendedPrice>
 </InvoiceItem>
</Invoice>
```

Without any knowledge of XML or of the data structure, the reader should have been able to read and place into context the invoice elements (e.g. address, name and product attributes). In a nutshell, this is the power of XML – it is a generic way to describe and share data that is both cross-application and platform independent. With this power and flexibility, XML has enjoyed widespread growth and adoption over the past few years.

Another emerging trend is web services. Without a common, universally agreed definition, web services can mean many things to many people. Definitions range from "enabling a group of related applications to be programmatically involved over the internet, or self-describing services that are HTTP (Hypertext Transfer Protocol) addressable" (Lim and Wen, 2003, p. 49) to software components that employ one or more of the following web services technologies – simple object access protocol (SOAP), web services description language (WSDL) or universal description, discovery and integration (UDDI). However, web services are an emerging technology and that the definition is likely to change. Until recently (2002), web services were primarily used by organisations to create "extended applications" within the firewall. As the technology matures, it will likely begin to extend beyond internal applications to begin to share information (and processes) with external partners (as in the case of the Google example in Chapter 5). Ultimately, the vision of web services is to create a real-time, dynamic integration exchange environment (Lim and Wen, 2003, p. 53).

Generally, there are three groupings of web services technologies. Currently, web services are mostly being used to provide functionality to add third-party functions (or information such as stock quotes or mapping directions) to existing applications. This method of application development (i.e. "plug-in") mirrors how hardware has been produced for years (Lim and Wen, 2003, p. 50). A second application of web services is the provisioning of third-party remote infrastructure services (such as website user authentication or payment processing). Lastly, web services standards can be used in application integration scenarios (Wainewright, 2002, p. 8-9).

As emerging standards, it is important to understand the relevance of these technologies for information retrieval and exchange. Both XML and web services have generally been developed in a bottom-up fashion. That is, they have been technologies looking for applications (admittedly, web services more so than XML). However, in the context of this research, the flexibility and adaptability of these technologies nicely underpins the application of a goal-based information exchange and retrieval methodology. In this context, these technologies become a very powerful method to link the business objectives and the information goals to the underlying information architecture.

Before presenting the application of the goal-based methodology for information retrieval and exchange based on these standards, a discussion of application integration and exchange is presented in the next section. A discussion of the use of web services for application integration is also included.

6.1.2 Application Integration and Information Exchange

There are several integration models that can be deployed in multi-channel/multi-source information integration scenario ranging from traditional data replication to centralised messaging platforms and finally innovative web services based approaches. Among these models, it is generally agreed that there are four common integration types:

- **Information Integration** involving the simple exchange of information between two or more systems.
- **Business Process Integration** – creation of composite enterprise process models to inter-connect and link business processes.
- **Information Portals** – the browser display of information from multiple systems
- **Services-Based Integration** that enables the cross-application (possibly intra-enterprise) sharing of common business logic or methods.

It is important to note that each of these integration types are not mutually exclusive in an integration scenario – that is, business process integration may use services-based integration technologies, or portals may be comprised of a number of services.

This section outlines the various types of integration, placing it in the context of multi-channel, multi-source information retrieval. However, before a meaningful discussion of information integration can begin, it is important to understand a few underlying concepts such as topological layouts and immediacy of information.

In general, integration can be modelled and facilitated utilising a number of topologies. According to the American Heritage Dictionary, the computer science definition of a topology is the "arrangement in which the nodes of a LAN are connected to each other". Although, not in a physical sense such as nodes of a network, the term topology is used to denote the logical arrangement of connected entities within an integration scenario.

- **Point-to-Point vs. Many-to-Many ("Hub & Spoke") –** In point-to-point integration a simple connection is made between two applications for the purpose of sharing information. Generally, a point-to-point connection is most applicable for simple data integration between only two applications (Figure 6-1). Point-to-point links can be created and deployed quickly and generally do not require relatively high-skilled technicians.

  The problem with simple point-to-point integration scenarios is that, in general, they are not scalable when additional integration links are required (See Figure 6-2, the resulting complexity of dedicated point-to-point links is not sustainable for more than two participants). Version updates of the underlying software and new participants in an integration scenario can create data integrity problems and inconsistency. Furthermore, in a tightly-coupled (see below) point-to-point scenario, the resulting fragile architecture can create a single point-of-failure, and the resulting failure of the data link can bring down the entire eco-system of connected applications.

As an alternative, a many-to-many integration scenario uses application middleware[16] to centralise integration between multiple source and target applications (Figure 6-3). However, in contrast to point-to-point integration, the development cost of this middleware can be prohibitive for simple data transfer requirements.

- **Loosely-coupled vs. Tightly-coupled –** Linthicum (2004a, pp. 27-28, 2000, p. 25) defines this argument as "Cohesion" vs. "Coupling", where coupling refers to the extent to which applications are bound together and share common methods, data and interfaces. A loosely-coupled integration refers to a situation whereby applications are minimally dependent on each other. If one of the systems within the integration eco-system goes down, the failure will not affect others. On the other hand, although tighter-coupling (shared components and business logic) gives the efficiency advantages of reuse, it could lead to single-points of failure within the system.

  The impact of coupling is clearly seen in the business process reengineering (BPR) efforts of the early to mid-1990s and the following adoption of enterprise resource planning suites. In the wake of a recession in the early 1990s organisations, businesses began to look at ways to optimise their business processes across-functions. Although BRP became a euphemism for redundancies, there was a knock-on effect. Process designers found that the new business processes required unprecedented integration between underlying information systems. However, developed in a piecemeal fashion using the inflexible technology of the time, the underlying systems were "closed". As a result, organisations purchased all-encompassing ERP suites that tightly regulated various back-office processes (for security and control). Although, this worked for a time, companies today are finding that these tightly coupled systems are again causing problems as additional processes

[16] Software that facilitates communications between two or more applications.

and software applications (such as CRM) need to be added. The choice facing organisations is to enter another round of costly business process redesign for additional short-term gains, or to consider more loosely coupled integration approaches (Hagel and Seely Brown, 2002).

Other useful terminology includes:

- **Synchronous / Asynchronous –** This concept was described above in the section on multi-channel information-seeking is closely linked to the notion of coupling. Synchronicity refers to the mode of communication in a message scenario. Asynchronous processes do not rely on a response or acknowledgement from the receiving application (loosely-coupled) – whereas synchronous communication processes do. The advantages of asynchronous methods are clear – if the network or link is down, then the integration information will be held until it becomes available again. The advantage of a synchronous connection is simplicity and ease of implementation.

In an integration scenario it is also important to understand the requirements for the timing of information delivery – does all information need to be available in all systems immediately (real-time)? Is the organisation willing to trade off higher development costs for "real-time" access, or will "near-time" suffice? The discussion of immediacy is predicated on three information delivery modes:

- **Real-time** – information is available immediately in all connected systems as data are committed to the database. The challenges of delivering information in real-time are high performance overheads and heavy infrastructure requirements.
- **Near-Time or batch** – scheduled or batched availability of information. However, these batch updates could be run every minute, creating a near-real-time delivery environment where latency is hardly noticed by the user. Although many requirements specify real-time access, after a review of the associated costs, near-time access may suffice.

- **Migration or One-time** – in some cases, information integration may only need to occur once. That is, once the information is moved, it is not updated or changed again. This could be in the case of a systems migration project from legacy software to a new system, or in the case of extraction, transfer and load (ETL) of information to a data warehouse.

The immediacy requirements should be thoroughly understood before an integration project is initiated because the decision will have performance and complexity (thus cost and time) implications.

6.1.2.1 Types of Integration Technology

Linthicum (2004a) distils the general approaches outlined above to present several types of integration technologies, each with unique applications and relevance to multi-channel operations and for use in low maturity organisations.

Information-oriented application integration (IOAI) entails creating a mechanism to exchange data between two or more applications (including databases, devices and application APIs). As introduced above, there are several topologies and technologies that can be deployed to accomplish this task. The advantages of IOAI are (2004a, p. 27):

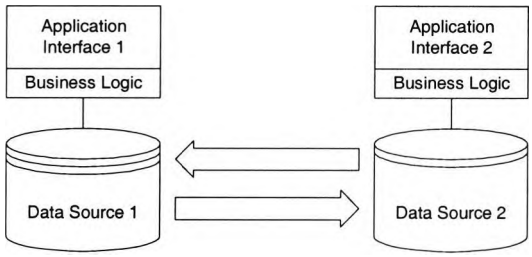
- Source and target systems generally do not need to be modified to create integration links
- Since there is no sequencing of business-logic complex workflow properties do not need to be addressed
- IOAI is relatively easy to develop and administer.

In a low maturity environment, due to its relative low cost and lower complexity than business process and services-oriented integration, IOAI is likely to be the most commonly deployed and most relevant integration type. However, despite the relative lack of complexity compared to business process and services oriented integration,

particularly for a low maturity organisations, there is staggering number of factors – from topology to technology – that need to be considered.

The diagram below (Figure 6-1) depicts an illustrative application integration scenario using a traditional data replication approach. The arrows indicate inputs and outputs of information that often occurs in batch processes. Data replication involves moving information between one or more databases. This relatively inexpensive approach typically uses software code to account for the differences in database structure and data models and to extract and insert data. Commercially available data replication technology may also include a services level that allows the starting, stopping and scheduling of processes.

Figure 6-1 Point-to-Point Integration

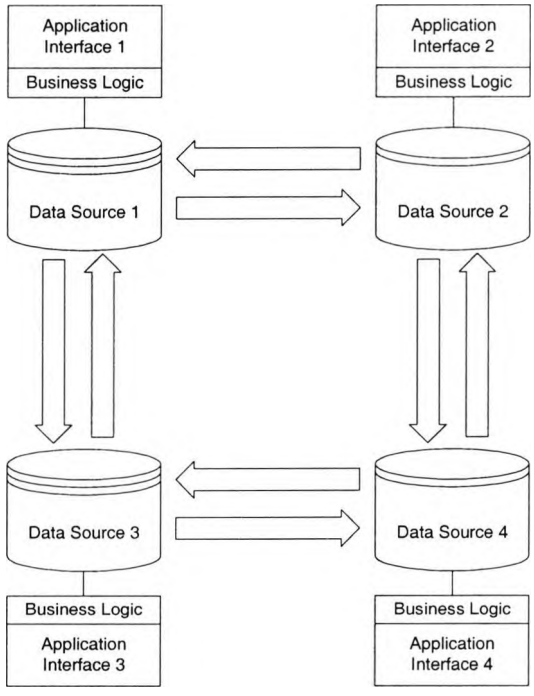


This approach is fine for quick and dirty integrations between two databases – particularly when low cost and simplicity are key project drivers (Linthicum, 2004, p. 7). However, when multiple databases are added, this "point-to-point" approach becomes fragile. The constant movement of data through dedicated links can lead to synchronisation and integrity problems.

The diagram below (Figure 6-2) depicts an illustrative multi-application integration scenario using a traditional data replication approach with more than two applications. The ensuing mess results in what the analyst firm Gartner refers to as "integration spaghetti" referring to nomenclature used to describe jumbled and patched software known as "spaghetti code" (Radcliff and Wood, 2003, p.8). They go on cite that 80% of integration projects use batch transfer processes creating

information bottlenecks and slowed information flow. If one of these batch processes fails, data can get out of sync and users of the various applications suffer.

Figure 6-2: Multi-Application Point-to-Point Integration



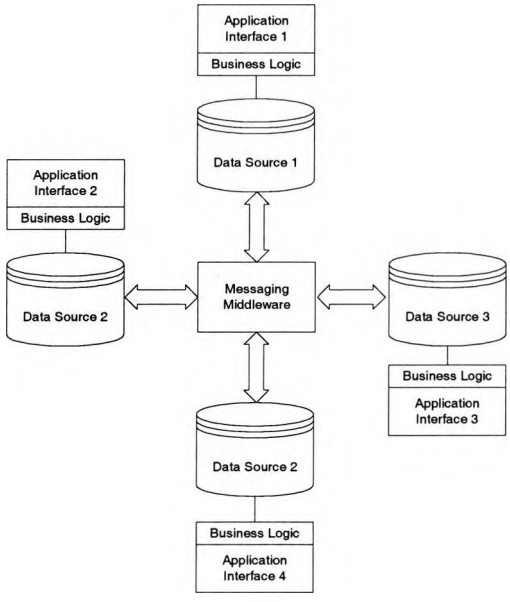
Another approach to database integration is database "federation" – this approach involves the merging of many physical databases into a single virtual database for information exchange (Linthicum, 2004, p. 9).

Learning from shortcomings of point-to-point integration, the technology and integration approach has evolved to a "loosely-coupled", but linked application environment whereby messaging middleware architectures have been deployed. At a high-level, this approach provides a loosely coupled message exchange and transformation service between two or more stand-alone software applications. In a middleware-based approach, there are three components of the system; the middleware (integration server) and two or more connectors (one for each integrated system). The connectors (adapters) interface with the integration server to relay data messages. To send messages, the connector generates messages (using, e.g., XML) that are delivered to the central integration server. The integration server processes

the documents and directs them to the adapter of the receiving application (Figure 6-3).

Unlike point-to-point, this design takes into account the independent nature of the target applications. If the connection between the systems becomes temporarily unavailable, each system keeps running as an independent unit. If the receiving application is not available, the sending application can try again later without impacting performance or becoming out of sync. This design offers maximum benefit for the users of each application, such as sharing of information between currently disparate systems, while minimising the risks associated with many integration projects and products.

Figure 6-3: Centralised Integration Through Messaging Middleware



Yet this approach is not without its problems. Applications in this scenario are still heavily dependant on the application logic embedded in core applications. That is, users are largely dependent on the information and logic that the system was designed or optimised to provide.

Linthicum (2004a) refers to the above collective methods as Information-Oriented Application Integration (IAOI). In IOAI, all of these information approaches occur

at the data-level – more specifically, it generally occurs are the physical data layer (database) through defined interfaces (APIs) into the integrated software applications – there is very little (if any) visibility or access to internal application processes.

6.1.2.2 Service-Oriented Architectures (SOA) and Composite Applications

With the proliferation of integration technology deployed through IOAI, portals and business process integration comes the requirement for common integration services that can be reused to reduce duplication and redundancy throughout the organisation. *Services* are group of software components that perform business processes and organisational transactions (Datz, 2004). Consider the action of inventory check – this process could be used in several applications (e.g. e-commerce web-site, CRM system and ERP system). A service can be created to govern the business logic of performing an inventory check. When an application needs this business logic, it calls the Inventory Check service rather than creating a copied, yet separate, instance of the business logic code. That way if the inventory logic is changed, it is changed at the service level and all of the applications that use that logic do not need to be reprogrammed. A services-oriented architecture (SOA) is a collection of these services and enabled-applications on a network that communicate with each other (Datz, 2004).

In IOAI, business process integration and POAI (portal-oriented application integration described in the next section), the same problems are being solved time and time again. However, without standard technologies, methods and processes, the proverbial wheel is recreated with each integration effort. As a result, over the past few years, services oriented integration models have begun to emerge to create common enterprise (and intra-company) business logic. This business logic can be self-contained and used by any organisational application (both internally and externally). If a change needs to be made in the business logic, it can be made once and it will propagate out the rest of the "clients" that use that service. Services oriented application integration (SOAI, also known as Services Oriented

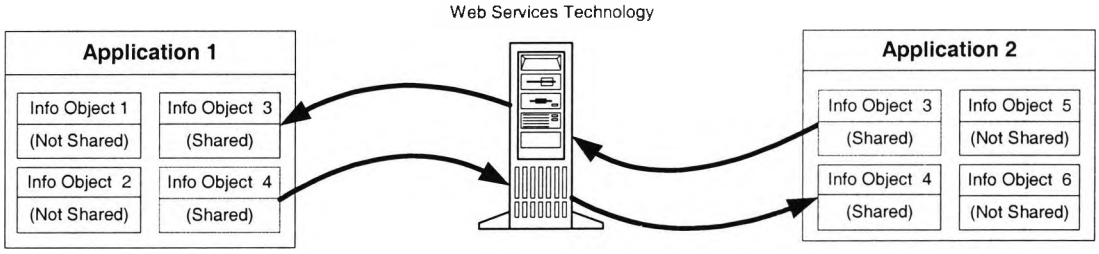
Architectures, [SOA]) allows organisations to share common application services. As a result, information is shared and business processes are integrated as well. Although this ability to achieve business process integration and information exchange through SOAI sounds ideal, there are significant tradeoffs – particularly for the low maturity organisation.

IOAI is a minimally intrusive type of integration (requiring little if any changes to the target and source applications); services oriented application integration will likely require a major overhaul of underlying applications and the adoption of a services platform. These changes will be all encompassing and very expensive. As such, at this point the literature is devoid of examples of SOAIs being deployed on a wide-scale, much less in low maturity organisations.

In many ways, services oriented architectures – particularly the reliance on common component reuse – is not a new concept. Past attempts at this model were plagued with performance problems and lack of technological standards (Sutor, 2003). However, a new breed of interoperability technology – "web services" – has emerged since 1999 that begins to support the "real-time" and "services oriented" vision. At this point, it is important to note that an SOA does not necessarily require the use of web services (Datz, 2004) and web services can and do exist outside of an SOA environment.

For the discussion of information retrieval and integration, web services play an integral part in inter-application sharing of data elements. In the example below, configurations (groupings depicted as 'info objects') of information are shared between applications (Figure 6-4). Even though, in current implementations, this information exchange would likely occur "behind the firewall of an organisation", it uses the same internet technology that could be used to share to share information with third-parties such as partners or suppliers (Wainewright, 2002, p. 18).

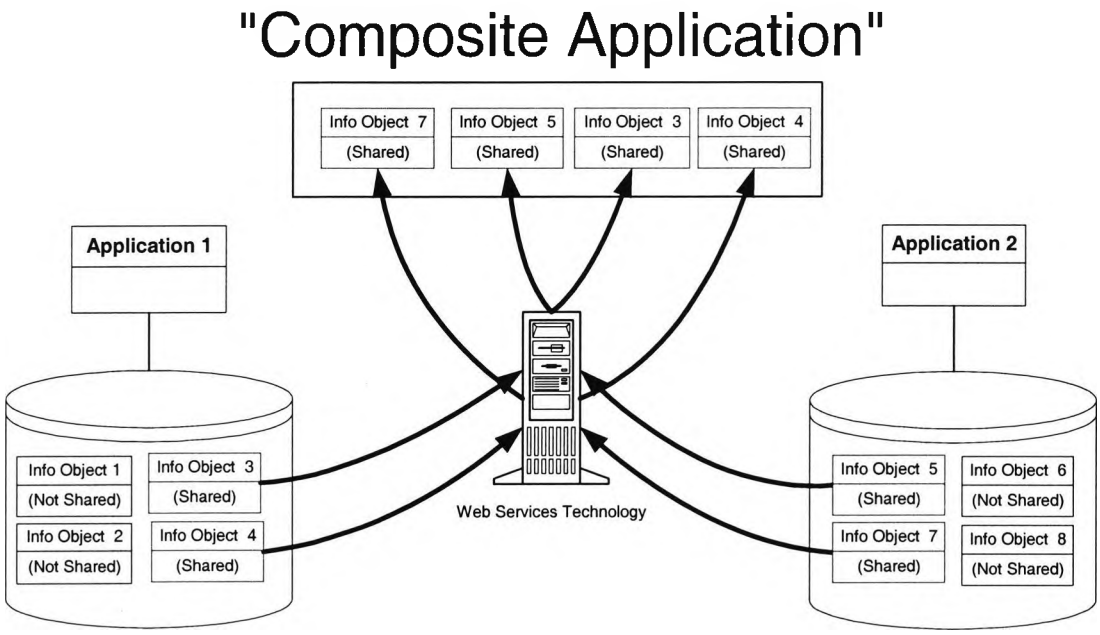
Figure 6-4: Inter-Application Information Sharing Using Web Services Technology



The benefits of this technology that directly relate to the integration scenarios described above include *mobility* and *content* [sharing] (Lim and Wen, 2003, p. 50). Web services are interface-agnostic, thus are well suited to porting to mobile channels such as mobile phones and personal digital assistants (PDA). In respect to content-sharing, web services applications will be streamlined reducing the need for integration technology. However, the future configuration of these "hybrid" (multi-channel combinations) experiences is unknown; therefore it is too early to predict the success of emerging technologies such as web services (Daum, 2003, p. 15).

A third approach – encompassing the creation of "composite applications" (Figure 6-5) is now emerging (Thompson and Bona, 2003; Khosla and Pal, 2002; Downes 2003). Essentially, composite applications use "information objects" from previously disparate applications (such as CRM and ERP) that by-pass native interfaces in favour of a new (possibly user dictated) interface. Composite interfaces can be configured according to organisational role, access rights or business process allowing business analysts, not necessarily programmers, to configure interfaces and business logic around "how things are really done in an organisation" (Khosla, 2002, p. 6). Composite applications require a services-oriented architecture (Hurwitz, 2003) – as such, any discussion of the two are inexplicably linked.

Figure 6-5: Composite Applications



The power of composite applications can be illustrated though a hypothetical (but common) business problem. Imagine the sales order processing system in a typical smaller company. Both CRM packages and ERP systems both have sales order processing functionality. But the CRM system, designed and developed in the United States, does not have VAT or multi-currency functionality. The CRM package has all of the prospect and customer information, and the ERP package has pricing, inventory, catalogues, etc. In this case, an organisation has three choices:

1. Use and install both systems on all of the sales-peoples' laptops. When an order is placed the sales person could exit the CRM system and enter the information into the ERP system. This involves a delay as the application loads and order information is re-entered. Also, since the systems are not connected, the information in the CRM system could be out of date (such as an out-of-stock item). In this scenario, the customer has to wait while the sales-people go through these terribly inefficient processes. This also involves the cost of licensing both applications for a single employee.

2. Option two involves systems integration between the two applications. This would eliminate the necessity to have double licences, but it is not without its problems – business processes and information is still fragmented in separate applications and users would be required to pay for far more features and functionality than they actually use.
3. The third option involves the "composite application" approach whereby the business logic (such as VAT rules) from the independent applications is encapsulated and configured into a third application (possibly "thin client" such as the web browser). In this case, employees get only the information that they need to do their jobs – and the company does not need to buy unnecessary functionality that comes standard in enterprise applications. Khosla and Pal refers to this as a "mass customisation" environment for business processes, workflow and collaboration (2002, p. 6).

This new approach is forcing the previous leaders in business applications to rethink the way they develop and market software applications. No longer is it about offering an "application suite"; a few companies such as SAP and Microsoft are already thinking about "process suites". As of mid-2003, SAP is offering 90 template business scenarios and encompassing over 240 business processes. This is expected to grow to over a thousand business process templates by 2004 (Thompson and Bona, 2003, p.7) and Microsoft has also been working on modelling prototypical small business processes (Aley, 2002). As the technology matures, individualised functionality will be configured for and delivered directly to the user. And as business processes become template-driven as described above, enterprise software will become more about personalised application interfaces (i.e. combinations of composite applications) than the generic functionality offered today.

Clearly, composite applications are the desired end result of SOAs (Hurwitz, 2003). However, many application providers (including those mentioned above) have along way to go before achieving this vision. Aside from the revenue implications of this approach – whereby application vendors must move from providing monolithic suites to hundreds of miniature application services – many have to make significant

changes to the way that their products are architected. For an SOA to become a reality, the underlying application code needs to be modularised and encapsulated into component parts (Hurwitz, 2003). Much legacy code in both applications and within organisations will require near rewrite to achieve the required level of modularity. Secondly, assuming that the code-base is modularised, applications must have well-defined, publicly-available, application interfaces. This in itself is a significant effort. In some cases, such as SAP's BAPI, interfaces exist, but are difficult to work with requiring specialist skills.

That said, the advantages of the service approach are (Longworth 2003, Datz, 2004, Roby 2003):

- Application logic and information from mainframes and legacy systems can be reused
- Ensures cross-functional transactional integrity
- Improves access to existing resources
- Creates a roadmap for innovation whereby legacy technology is used until it can be replaced with a more modern equivalent
- SOAs and composite application encourage IT staff to think in terms of business needs, not from a technological point-of-view.
- Tight control of data access. Since SOAs are inherently componentised to a micro-process level, data access can be more easily restricted at this level. With IOAI or POAI, performance overheads occur or application changes need to be made to lock information down at this level of granularity.
- Create profit centre technology out of organisational core competencies

Specifically, web services can (Roby, 2003):

- Reduce costs of developing SOAs
- Allow the easier connection to external (corporate or government) systems.

One significant drawback, particularly for low maturity organisations, is the complexity of administering a SOA (change control, etc). A general challenge in

loosely-coupled environments is tracking down the source of bad information or bad code (Datz, 2004). This is exasperated when SOAs are deployed in real-time which will result in higher QA and testing costs. Another drawback is newness of the technology and the resulting relative low number of implementations. Lawrence (2003a, p. 40) numbers composite applications systems in the hundreds. As such, it may be difficult for LMOs to find skilled technicians and reference cases to serve as an implementation template. However, analyst firm Gartner predicts that by 2008 more than 60% of enterprises will be using SOA as a "guiding principle" in while developing applications and processes (Datz, 2004). As such, discussion of SOAs and composite applications is included in this research because it is important for LMOs to be considering these emerging trends. As SOAs are designed to leverage legacy systems, they can also be adopted piecemeal. LMOs should consider the four-step process for the adoption of SOAs (broadly outlined by Studor, 2003):

1. Make individual applications available as services to multiple consumers through middleware.
2. Integrate several services to create a composite process.
3. Widely adopt SOA across the organisation.
4. Find new way to exploit the responsiveness and flexibility of the adopted SOA.

When adopting web services specifically, again an incremental approach is recommended (Roby, 2003):

1. Learn about the technology and evaluate its impact on the organisation
2. Develop a roadmap for adoption that will guide the use of web services in the organisation – include business partners in the process
3. Web service-enable an application leveraging existing integration tools.
4. Using a non-core application, look for a way to use web services to create additional value for the organisational technology efforts.

With the road to a services-oriented integration world already mapped out – but the challenges of getting there well documented – another type of integration has emerged as an interim step.

6.1.2.3 Portal-Oriented Information Application Integration (POAI)

Over the past few years, rumours of the death of enterprise portals have been greatly exaggerated. In the late 1990's enterprise portal software was developed and marketed as an employee homepage that contained all relevant information needed for them to do their jobs. However, in the early days, they contained little more than stock quotes and weather (Knorr, 2004, p. 44). However, with tight IT budgets in the early 2000s, the portal moved from this horizontal application to a functionally specific information delivery mechanism (Knorr, 2004, p. 43, Faragher, 2002, p. 31). Another difference between early attempts at creating the enterprise portal and the recent efforts is the involvement in integration efforts. In the early days, a portal was an information-delivery application with its own information repository. Sometimes referred to as "integration at the glass" (i.e. computer monitor), portals are now a means of presenting information from disparate sources within the organisation (Knorr, 2004, p. 46) and Portal oriented application integration (POAI) provides a composite view of information. There are several advantages of this approach, including:

- Non-invasive to source applications
- Provides widely distributed, but controlled access to information
- Relatively easy and quick to implement
- Technology is widely used, thus there are well documented reference cases.

However, Linthicum also highlights some disadvantages of portals (2004a, p. 103):

- Information may not be provided in real-time and requires human intervention to control flow

- Information must be abstracted though an additional logic layer – possibly creating more organisational complexity
- Possibly provides information over less secure web connections

Due to its relative low cost and ease of implementation this type of integration is likely to be of particular interest to low maturity organisations.

6.1.3 Business Process Integration

"Business process integration is a strategy, as much as a technology, which strengthens your organisation's ability to interact with disparate applications by integrating entire business processes, both within and between enterprises."

– Linthicum, 2004, p. 12

Business process integration can be thought of a step beyond traditional application integration. Information-oriented integration involves the exchange of information between databases or applications with little access or interaction with the application defined business logic, whereas business process integration creates a new organisational process model (possibly incorporating many applications and instances of application logic). In other words, information-oriented integration restricts itself to information exchange (the by-product of processes), but process integration involves the end-to-end linking of processes that move information. Information-oriented integration is a means to an end – the cross-application sharing of information. However, increasingly that end includes the development and configuration composite processes. That is application integration is moving beyond the exchange of integration or the end-to-end connection of processes, but to the modelling of interconnected business processes that cross many applications and even multiple organisations. According to Linthicum (2004a, p. 56), Business Process Oriented Application Integration (BPOAI) provides "a single logical model that spans many applications and data stores, providing the notion of a common business process that controls how systems and humans interact to fulfil unique business requirements."

Processes in an organisation are largely automated. However, these processes are generally automated through a variety of systems (Linthicum, 2004a, p.62) and through loosely-coupled means.

At this point it is probably important to take a step back and define processes. According to Ross (2003, p.323), a business process is "a business capability that can take raw materials (as "input") in a certain state and transform it into some value-added form (as "output"). The inputs and outputs may be tangible (for example, physical resources or products) or intangible (for example, information)". As defined by the Business Process Execution Language for Web Services ([BPEL4WS] – Linthicum, 2004b, p. 40), a process "models actual behaviour of a participant in business transactions"

The advantage of creating end-to-end business processes is that the organisation is also the creation of tangible assets that are sharable with business partners and with new entities in a post-M&A environment (see chapter 5 for relevance). Benefits of BPOAI include (Linthicum, 2004a, p. 65, Tonner, 2003, B9):

- Create common organisational business process that transcend applications.
- Ability to monitor processes across information silos, better analytics and transactional reporting.
- Ability to redefine inefficient processes saving time and money while improving quality.
- Abstracts systems complexity from users allowing them to work in non-technical language.
- Improves ability to outsource certain non-core processes.

It is important to point out that the various types of application integration defined by Linthicum (2004a) – IOAI, BPOAI and SOAI are not mutually exclusive. BPOAI crosses many organisational boundaries as such it may include instances of IOAI and SOAI (Linthicum 2004a, p. 59). Where IOAI restricts visibility of internal application processes (generally because of legacy architectures without APIs),

BPOAI starts with a business process model and uses the internal application processes to underpin the information flow.

6.1.4 Implications for the Low Maturity Organisation

With this myriad of types of application integration and integration technologies, it could be difficult for well funded, mature organisations, to discern the most appropriate for their needs. For a low maturity organisation without established processes and evaluation criteria it is likely to be nearly impossible. Ramankutty (2003, p. 20) suggests starting with three questions:

- What applications truly need to connect?
- To what degree must they be linked?
- When is integration not worth the investment?

Starting with a need sets the tone an importance of an integration project. Ramankutty provides tacit support to the need for a repeatable information retrieval and integration framework through his supposition that "needs" should be stated in more than qualitative terms – an integration project should be 1) linked to specific business issues, 2) achieve measurable ROI and 3) be deliverable in a realistic timeframe and be linked to bigger picture goals (2003, p. 20).

A low maturity organisation may be tempted to ask which of the competing myriad of standards is the best for their needs? Is there any advantage to holding of on integration until standards are more defined? Linthicum points out (2002, p. 19) that standards are generally derived by the deep pocketed IT vendors and that waiting could actually put the organisation at a competitive advantage. But more importantly, standards are not designed with the needs of a specific business in mind – a LMO would be better advised to seek integration solutions that do not rely on emerging technology or heavy customisation, but rather configurable, template options.

Efficient application integration relies on the existence of well defined application interfaces (APIs) to expose and control access to an applications underlying database.

These APIs allow a remote application to invoke application logic externally. For example, an application may have an API to allow external an application to run an inventory check on its data. The problem with many packaged applications – particularly in the small business sector is that many low maturity organisations are slow to purchase software upgrades and use out-dated or legacy applications for longer. As a result, it is not uncommon to find at the offset of an integration project that legacy applications do not have an interface that exposes underlying applications. Although application integration can still be done, without an API it can be expensive (requiring customised software code) and risky (said code is unsupported by the vendor and built-in programmatic integrity checks may be unintentionally circumvented).

Additionally, over time point-to-point efforts can become prohibitively expensive, particularly for low maturity organisations. A pure programmatic approach to integration makes the constant rewriting and re-architecture of application integration inevitable (Hurwitz, 2003). A more sensible approach, advocated by Hurwitz, is to integrate business logic rather than applications and to employ a data-linking, rather than [software] code based methodology. As a result, vendors that specially target this segment (e.g. Microsoft and Sage) have responded by launching centralised messaging based platforms for application integration (Ranger, 2003).

Clearly, composite applications are important to both vendors and customers of enterprise software (Lawrence 2003, p. 40). But one couldn't be blamed for asking, what is the relevance of SOAs and composite applications for the typical low maturity organisation? There are three typical advantages that expected to emerge over the next few years. First, SOAs supports migration from legacy systems and older software in the migratory (as opposed to 'rip and replace' fashion). Second, SOAs begin to standardise the application stack thus ultimately reducing costs and improving development efficiency.

6.2 Case Study 3: A Goal-Based Integration & Exchange Model

The final case study presents an application of the goal-based model in an integration and exchange context.

6.2.1 Background

With a long history of growth through acquisition and geographical expansion, and increased pressures from global competitors, a global software company is faced with a difficult challenge. Throughout the 1980's the firm added software products targeted to different sized business and in the 1990's began to expand internationally. Acquired companies where generally left to develop products independently as the firm took the management philosophy of "Think Global, Act Local". By 2004, the company had a market-leading presence in several major geographies; but quite simply, it had run out of acquisition targets that would not arouse significant regulatory attention in both North America and Europe. Furthermore, a significant portion of revenue was being generated though software services (upgrades and support), not through new licenses sales.

With thirteen world-wide operating companies in five geographic regions, the company has at least 100 software products under nearly an equal number of brands. The company's growth strategy has been underpinned by cross-selling additional products and migration (to higher value products) within its customer base. However, most of these products in the company's world-wide portfolio were historically developed using different technologies. These products are built and supported by regionally centred product development groups and each of the product lines were developed at different times. As a result, the underlying technology is in various states of maturity. With different data schema and naming conventions, it is increasingly difficult to integrate the mishmash of products in a cost efficient and high-performing way. For the most part, most of the world-wide product-lines are

built on flat-file databases and do not have a well-defined integration touch points. The cost of rewriting these products to a common platform is prohibitive.

In the summer of 2002, the company kicked off a project to develop integration middleware to begin to provide a consistent and repeatable technology to integrate its software products. When the project was kicked off, the company considered three background factors prior to the specification of any software. The key considerations were identified as follows:

- **Value Added Reseller (VAR) Abilities and Expectations** – the company sells its product through a worldwide channel of value-added resellers ranging from multi-national consultancies with hundreds of employees to one person specialty firms. As such, VAR technical capabilities varied significantly. In the past each individual operating company expected its individual VARs to learn and support its own product developer programmes and integration tools. With a partner community that has developed a broad range of compatible add-ons and modules, the use of proprietary tools and frameworks has created a strong 'silo' culture, If an integration technology were to be accepted and widely used, it needed to be able to be used by the upper echelon as well as the less technologically advanced.

  Historically, the VARs developed point-to-point integration solutions using the application software development kits (SDKs) provided by various product lines. Although these links can be developed relatively quickly with relatively minimal technological skill, this approach is fraught with problems. Primarily, with each new product version, the point-to-point links needed to be updated. With this core technology in the hands of a third-party, it generally was not done in-line with product releases. In the long-run, keeping multiple versions of these links up-to-date is not cost effective, are not easily expandable (i.e. configurable), integration methods are inconsistent and, as a result, customers are reticent to go through the pain of upgrading new versions and adopting new products.

- **Customer Expectations** – The company's roots are in packaged modular software targeted at small and medium businesses. With the introduction new product lines under a single regional brand, customers have an expectation that each new product in the portfolio integrates seamlessly into the portfolio. With a myriad of VAR developed links as the only available mechanism for integration to some product lines, customers also may question the interoperability of products. Also customers expressed concerned about what would happen if the VAR went out of business – who would support their business critical applications?

- **Future Integration Technology Needs** – As mentioned above, the firm is growing considerably both through acquisition and organically taking solutions into ever more markets and segments. As seen in the previous sections of this research, the Internet has moved the necessity for interoperability beyond the organisation boundary, shifting attention from functional applications silos to interconnected businesses. Developing a 'dynamic response environment' that enables organisations to create composite or virtual applications to support business innovation will become important in the future. As such, integration solutions must address legacy integration needs while laying the groundwork for future needs (such as service oriented architectures [SOAs]). When the project was outlined, in addition to providing usable integration technology today, it was clear that the company would need to begin thinking about going beyond applications into application services and an application assembly environment, eventually using them to build composite applications.

With a growing demand for integration from a customer base the company realised that it needed to go beyond simple data replication between two systems to develop a framework that supports many-to-many integration scenarios. The existing VAR-developed point-to-point integration technologies were expensive, hard to maintain

and were not generally configurable – and competitive technologies are either too complex for the target business or too generic to be useful in packaged software environments.

In the summer of 2002, the company felt that it had a good idea of what customers didn't want, and a good understanding of technology options. What was missing was a deep understanding of what exactly the customer was looking for in an integration solution. Through interviews with customers and VARs, it was confirmed that customers were: 1) overwhelmed by the complexity of integration options and technology, 2) were feeling bound to historical technology choices and legacy applications, 3) were reticent to purchase upgrades for fear of breaking fragile integrated solutions and 4) were hesitant to add new products to the integration mix. Desired characteristics of the integration tools were laid out as follows:

- **Oriented toward the customer** – Many of the existing integration tools were technologically oriented requiring a deep understanding of both applications and business processes when many of the customers were simply trying to solve relatively homogenous business process problems (such as account creation in multiple systems). Customers wanted out-of-the-box integration templates that solved relatively generic problems without having to invest in overly complex technologies.
- **Adaptable and flexible –** However, systems are not implemented in the same manner, as many of the underlying applications are highly configurable/customisable. Furthermore, VARs made much of their revenue in customisation services. As such it was imperative that the out-of-the-box tools honour underlying application customisations.
- **Expandable –** Customers and partners also required the ability to add 3rd party applications into the integration mix. The integration toolset needed to include the ability to develop new adapters for third-party products and links to legacy systems.

- **Reliability and performance –** One of the main complaints about the point-to-point links was the relative inability to handle high transactional volumes. The provided solution needed to both reliable and high performing (benchmarked against existing competitive products).
- **Low administrative overhead –** Lastly, customers did not want to hire an additional IT head to administer the integration tools. A reasonably skilled administrator needed to be able to handle basic and intermediate integration needs.

These requirements were distilled into a five guiding principles for the development team:

1. Usability within the customer base. As such the integration toolset needed to be targeted at small and medium sized businesses, must install easily and be intuitive to administer with good documentation and help systems
2. Abstract the complexity of integration while providing sufficient customisation capabilities.
3. Rely on Data Viewing and Linking (as opposed to Data Transfer).[17]
4. Loosely Coupled – Integrated applications are truly decoupled and independent, only tied together by middleware that does not require licenses or clients of the connected applications to function.
5. Unobtrusiveness – Integration needed to run as an unattended background service requiring minimal end-user interaction

With these guiding principles in mind, the company began the development of integration solutions for both small and medium sized business segments.

[17] There are two schools of thought regarding the intra-application use of information – Data Transfer vs. Data View. The most common and easiest to implement is data transfer, whereby information is physically moved from one database into the to another for use in application processes and reporting. This causes a performance overhead and data integrity risks. In a data view method, data are displayed (but not physically transferred) between applications 'on demand', ensuring that it is most up to date.

Considering the topology (hub or point-to-point), coupling (tight or loose) and technologies orientations (data or service-based) discussed above (in the Chapter 6 state of practice section) in conjunction with the user requirements and guiding principles, the company choose to develop a *loosely-coupled, service-based, integration hub* to allow collaboration between two or more applications. The primary functions of the middleware are:

- Abstracting and providing data transfer among collaborating applications
- Providing transformation/translation services for application data
- Data synchronisation
- Scheduling of inter-application tasks and processes
- Providing functionality to allow of generic implementation of adapters

After a year of development, the first integration collaboration between its flagship CRM and ERP products were released[18]. With the version one integration product out in the market for nearly a year, it was determined that a repeatable process was needed to prepare applications for integration and develop and document collaborations between products. For the release of version 2, set of best practices based on the goal-based reference model was to be developed and documented to address these needs.

6.2.2 A Goal-Based Approach to Information Exchange

In response to the background outlined above, the project team determined that they needed a repeatable process to link high-level integration goals to the underlying information infrastructure. At the offset of the project, the researcher devised a derivative of the goal based reference model for review. Working with the head of development, the model was iteratively reviewed and revised taking into

[18] Software used in this case includes: Sage Application Integration Server version 1 and integration adapters for SalesLogix version 6.1 (CRM) and Sage Line 500 version 5 (ERP).

consideration external feedback from development groups. The ultimate objective of the project was to present a goal-based framework as a best practice guide for documenting integration efforts. The primary objective of this research was not to validate the researcher's notions of what a goal-based model should look like or the suitability of the reference model. As such as wide degree of flexibility was granted to modifying and adapting the reference model process steps.

6.2.3 Model A: Goal-based Information Exchange with a CRM System

The development of the goal-based process for this integration project was not a straight forward exercise. As discussed by Park et al (discussed in Section 2.2), goal-based methods can be used with any organisational goal, but may require several iterations at steps 2-4. This is exactly what happened in Case 3 (see the Appendix for a discussion of the iterations).

After several iterations, it was determined that the final process requires a minimum of three models for each integration scenario. An iteration of steps one through six is required for each software application to make it 'integration-ready'. This ensures that the integration-readiness exercise is not context specific to a collaboration (but can be reused for any collaboration). The reason that a minimum of three models is necessary is that a collaboration can of course have more than two participating applications (requiring a model for each), and a full ten step model will need to be developed for the collaboration itself.

Below is the first six step model that has been developed for a CRM system. This model documents an integration-readiness exercise to expose CRM information for external consumption by the company's integration middleware. Steps 1-3 are illustrative, whereas steps 4-6 were documented through analysis of the integration software's documentation and internal application XML documents' structures.

6.2.3.1 Step 1: Identify stakeholders

There are several main stakeholders with an interest in exchanging information with the CRM system, including:

- Users and managers that would like to get a single view of their organisation. This includes viewing accounting information in a single application, creating an order remotely and checking credit limits.
- Integration Architects and IT Managers seeking to design collaborated information systems that require an easy and well documented way to access CRM data through a common interface to corporate integration technologies. This category would include product managers of external applications (e.g. the ERP system) that would like to extend the functionality of their system. It also includes value added resellers (VARs) and independent software vendors (ISVs) that would like create composite applications or aftermarket add-on products
- Product managers of the CRM application that would like to extend the functionality of the CRM system through integration with third-party systems
- Lastly, "non-human" stakeholders should be considered – that is applications that will become consumers of the CRM system's external data. This data needs to be well defined, complete and consistent.

6.2.3.2 Step 2: Identify and define business objectives or desired outcomes

As stakeholders are generally concerned with different things, a list of some illustrative business objectives is provided below (Table 6-2).

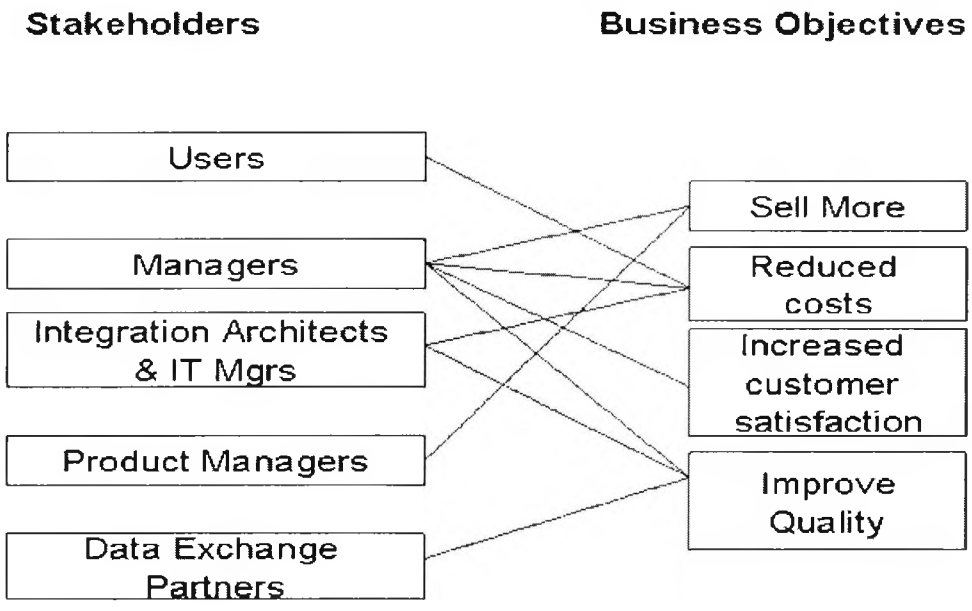
Table 6-2: Primary Business Objectives by Stakeholder

Stakeholders	Primary Business Objects or Desired Outcomes
Users & Managers	Process improvements (make job easier), sell more, reduce costs
Architects and IT Mangers	Reduced cost (development and maintenance) and process improvements
Product Managers	Increased product functionality, revenue opportunities
Collaborated Applications / Data Exchange Partners	Data quality and consistency

However, a straight one-to-one mapping of stakeholders to business objectives is misleading for stakeholders may have a peripheral or secondary interest in additional objectives. Clearly, each of the derived benefits is situational and product dependent. Therefore, these benefits should not be considered universal to all CRM integration-readiness projects. However, the overall business benefits are stated generally. For instance, "sell more" applies to users, managers and product managers. However, the users of the CRM system is concerned about their own personal sales goals, whereas the product manager is interested in selling more of the CRM system itself. Similarly, users and managers are interested in reducing costs; again, the cost of sale and support of their customers. These benefits will be provided through provided from an external system. Architects and IT Managers are also concerned about reducing costs, but these are generally internal costs of developing and maintaining integrated systems.

An illustration of how multiple benefits map back to the stakeholders is provided below (Figure 6-6):

Figure 6-6: Stakeholders Mapped to Business Objectives



6.2.3.3 Step 3: Identify integration goals and sub-goals for each objective

Using the business objectives outlined above as a starting point, the tangible deliverable and benefits of the effort are identified. These high-level integration goals that map back to the business objectives identified above include:

- (G1) Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors
- (G2) Eliminate paper-based processes and duplication of effort in Sales Order Processing by submitting sales orders from the CRM to accounting system
- (G3) Provide visibility of account information to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.
- (G4) Provide a Sales Order history report with order amount, status, etc.
- (G5) Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items.

- (G6) Synchronise activities and alerts with external systems
- (G7) Create CRM opportunities from a master product file that is administered in the back-office.

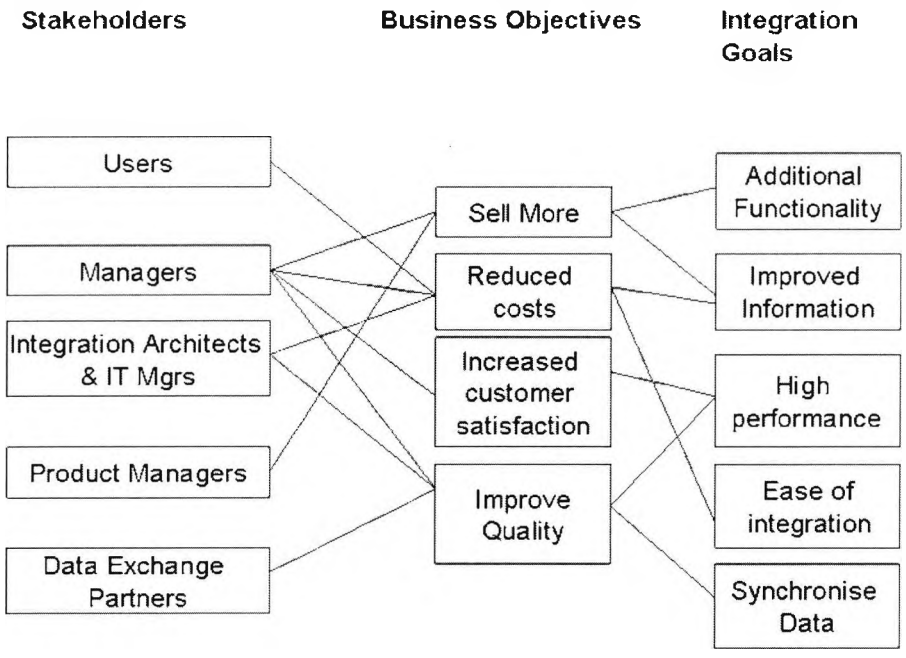
In the table below (6-3), integration goals are mapped to multiple business objectives.

Table 6-3: Goals Mapped to Primary Objectives

Primary Business Objects or Desired Outcomes	Goals
Increased Customer Satisfaction & cost reduction (process improvements)	Process Orders Faster – submit orders to external system Cross-system alerts
Revenue Generation "sell more"	Receive accounting information (credit limit and account history)
Cost Reduction (deployment and maintenance)	Well documented integration touch-points
Quality Improvement	Synchronise account data with external systems Central administration of product-file

All of the above goals address the product manager's integration goal of increasing product functionality. As such, that goal will no longer be tracked through the model. However, again, goals address multiple business objectives (Figure 6-7).

Figure 6-7: Illustration of How Goals and Objectives Map to Stakeholders



Below objects of interest are identified and defined for each integration goal (Table 6-4).

Table 6-4: Objects of Interest Identified

Integration Goals		Object of Interest		
G1	Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors	CRM Account	Entity	Account [name], Main phone, Fax, Address1, Address2, City, Postal Code, County
G2	Eliminate paper-based processes and duplication of effort in Sales Order Processing by submitting sales orders from CRM to accounting system	CRM Sales Order	Entity	AccountID, Ship to Name, Order Name, Sales Order Detail {Product Id, Description, Unit, Quantity Ordered, Price}
G3	Provide visibility of account information to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.	External Data View	User Interface (UI)	***To Be Defined in the collaboration context, XML to be defined generically at a later stage.***
G4	Provide a Sales Order history report with order amount, status, etc	External Data View	User Interface (UI)	***To Be Defined in the collaboration context, XML to be defined generically at a later stage.***

Integration Goals		Object of Interest		
G5	Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items.	CRM Product File	Entity	Actual ID, Name, Family, Product Group, Status, Unit, Stock Item, Vendor, BasePrice
G7	Create CRM opportunities from a master product file that is administered in the back-office.			
G6	Synchronise activities and alerts with external systems	CRM Activity	Entity	Activity ID, description, duration, due,

6.2.3.4 Step 4: Define objects of interest (and required connections)

In this section, the object of interest is placed into context (Table 6-5) including the integration perspective (control of data) and frequency of information exchange.

Table 6-5: Objects of Interest Defined

Object of Interest	Purpose	Perspective	Frequency
CRM Account	This is the CRM account information that is relevant to the third-party system.	**Data are maintained in both systems** – Includes all of the CRM Account information to be integrated to the back-office. CRM information that is relevant to the Finance Director and Accounting System users.	Real or near-real time (less than five minute intervals)
CRM Sales Order	CRM Sales Order screens cannot produce a complete Sales Order (no shipping, VAT) and should therefore be treated like an information capture screen for the back-office system.	**Data are maintained in both systems** – This should be considered a limited order set. Complex business logic is required to validate stock to determine things such as VAT and shipping costs. These calculations need to be done in the ERP system. Therefore a CRM Order can assemble order component pieces for hand off to the accounting system, but the CRM system should not complete any calculations.	Real or near-real time (less than five minute intervals)
CRM Contact	This is the CRM contact information that is relevant to the third-party system.	**Data are maintained in both systems** – Includes all of the CRM contact information that can and should be integrated to the back-office. "All of the CRM information that is relevant to the Finance Director and Accounting	Real or near-real time (less than five minute intervals)

Object of Interest	Purpose	Perspective	Frequency
		System users.	
CRM Activity	This is the CRM activity information that is relevant to the third-party system.	**Data are maintained in both systems** – Creates a single event chain across multiple applications	Real or near-real time (less than five minute intervals)
CRM Product File	This includes all product and pricing information relevant to create a CRM opportunity, quote and sales order	**Read only information provided through data transfer** -- The product file should be created and maintained in a single location. Therefore, the CRM product file should be considered a view of the master product file in the ERP system. No changes or modifications will be allowed on the CRM side.	Daily
External Account Data	Several reports are necessary to provide accounting information to CRM users including credit limits, stock and order history	**Read only information provided through data view** – Accounting information should be provided for viewing only. Data transfer implies some degree of latency (that could be caused by synchronisation problems). Views in the CRM system should be provided to eliminate this risk.	Real-time (zero latency)

6.2.3.5 Step 5: Define implementation patterns and corresponding processes (data flows)

There are basically four integration implementation patterns that are supported by the company's middleware: 1) Synchronisation, 2) Submission, 3) Export and 4) Data viewing.

The first three patterns involve the transfer of data. Synchronisation is the bi-directional transfer and reconciliation of data. That is, data are maintained in each of the connected systems. Submission involves the collection of data in one system for transfer into another. This can be done through either a "push" or "pull" process. Export is the unidirectional transfer of data, again either through a "push" or "pull" process. The difference between an export and submission is that export overwrites the previous transfer each time. Once a submission from source to target is committed, data are maintained in the target system. If there are any changes, the source data were overwritten through a unidirectional submission. The last type of integration pattern is Data View. A data view is a real-time rendering of information

that does not involve transfer (e.g. calling an external web-page or a database view from within an application).

Below, each of the objects of interest are categorised by implementation pattern (Table 6-6).

Table 6-6: Implementation Patterns

Object of Interest	Direction of Data Flow
CRM Account	Bi-directional synch, can be added, updated or deleted by either system
CRM Sales Order	Submit
External Account Data	Data View
CRM Activity	Bi-directional synch, can be added, updated or deleted in either system
CRM Product File	Receive

This categorisation is necessary for programmers to write processes to automate to transfer of data.

6.2.3.6 Step 6: Define data sources and entities

The final step of model involves the specification of entities. Using the reference CRM system, each of the entities were defined as having the following attributes. These attributes correspond to individual database fields (regardless of underlying table structure) or are collections of attributes (denoted by bracketed groupings). Each of the attributes also has a corresponding set of database properties[19] such as type and field length (Table 6-7).

Table 6-7: Data Sources and Entities

Entity	Attributes
CRM Account	Account [name], Main phone, Fax, Address1, Address2, City, Postal Code, County, Account ID, Seccode ID, Account Manager ID, Create User, Create Date, Modify User, Modify Date, Address ID, Shipping ID, Type, Account_UC, Division, Description, Region, Alternate Phone, Tollfree,

[19] Excluded as not relevant in the general discussion of goal based model creation.

Entity	Attributes
	Tollfree2, Otherphone1, Otherphone2, Otherphone3, Email, Emailtype, webaddress, Currency Code, User Field1, Userfield2, Account Reference, Correlation hint, Account Type, Account Types ID, Create New, Notes, Link ref, Account_Summary[20]{Accoutn ID, Type, Account, SECodeID}, AIS_Acc_Ref[21]{AccountID, Account Reference, Create User, Create Date, Modify User, Modify Date, Last Sync, TX Error, TX Status ID, AcctypesID, Linked Date}, Main Address{AddressID, Entity ID, Create User, Create Date, Modify User, Modify Date, Is Primary, Type, Description, Address 1 , Address 2, Address 3, Address 4, City, State, Postal Code, County, Country, Shipping_Address{Address ID, Enitiy ID, Create User, Create Date, Modify User, Modify Date, Is Mailing, Type, Description, Address 1, Address 2, Address 3, Address 4, City, State, Postal Code, Country
CRM Sales Order	AccountID, Ship to Name, Order Name, Sales Order Detail {Product Id, Description, Unit, Quantity Ordered, Price}, sales order ID, Account Reference, customer ID, Bill to name, Ship VIA, Order Type, Status, Sales Commission, Currency Code, Misc Charge, Freight, trade Discount, Order Total, Tax, Invoice Total, Customer Purchase Order Number, FOB, Line Count, Our Purchase Number, Order Date, Period Entered, Period Invoiced, Transmit Date, Comments, Sales Order Detail{External Products ID, Program, Extended Price, Line Number, Price Eff Date, Notes, Price Adjusted, Cal Price}
CRM Activity	ActivityID, Type, AccountID, Accountname, Phonenumber, Startdate, Duration, Description, Alarm ,Timeless, Rollover, Userid, OriginalDate, CreateDate, CreateUser, ModifyDate, ModifyUser, Notes, Longnotes, Priority, Recurring, user_activity {ActivityID UserID confirmed}
CRM Product File	Actual ID, Name, Family, Product Group, Status, Unit, Stock Item, Vendor, BasePrice

6.2.4 Model B: Goal-based Information Exchange with an ERP System

At first glance, much of the ERP systems stakeholders', objectives and goals are similar to those outline in the CRM system. However, there is a subtle, but fundamental difference in perspective. A CRM system is a productivity enhancing system. It is also a system of choice. That is, it can usually be customised to address different ways of doing business with a emphasis on different business goals. Whereas on the other hand, ERP and accounting systems are *systems of record.*

[20] Collections of properties can be created for transformations.
[21] Includes synchronisation information that is required by the integration middleware

Accounting rules, stock allocations and pricing cannot be treated with the same flexibility as sales and marketing processes.

6.2.4.1 Step 1: Identify stakeholders

The stakeholders of the ERP information exchange are similar to the CRM stakeholders addressed above (differences are italicised and bolded below).

1. Users and managers of ***external applications*** that would like to get a single view of their organisation. This includes viewing accounting information in a **CRM** application, creating an order remotely and checking credit limits. ***It could also include checking stock information from an intranet site, or the transfer of stock, pricing and orders to a point-of-sale (POS) system***.
2. Integration Architects and IT Managers seeking to design collaborated information systems that require an easy and well documented way to access ***ERP*** data through an application interface or a common interface to corporate integration technologies. This category would include product managers of external applications (e.g. ***warehouse management, POS or CRM systems***) that would like to extend the functionality of their system. It also includes value added resellers (VARs) and independent software vendors (ISVs) that would like create composite applications or aftermarket add-on products
3. Product managers of the ***ERP*** application that would like to extend the functionality of the ***ERP*** system through integration with third-party systems
4. Lastly, "non-human" stakeholders should be considered – that is applications that will become consumers of the ***ERP*** system's external data. This would include the actual warehouse management systems, CRM or POS systems mentioned above.

6.2.4.2 Step 2: Identify and define business objectives or desired outcomes

Again, the business objectives are similar, however, the integration goals will differ significantly. The only difference is that data control is elevated to a high-level business objective. Since ERP applications are systems of record, external data must

be more stringently validated before being accepted and committed to the database. Furthermore, once committed data should not be able to be deleted from an external source. That is, new accounts or sales orders should be able to be created remotely, but once they have been committed to the ERP, they should not be able to be deleted.

Below, stakeholders and business objectives are outlined (Table 6-8).

Table 6-8: Business Objectives Mapped to Stakeholders

Stakeholders	Primary Business Objects or Desired Outcomes
External System Users & Managers	Process improvements (make job easier), sell more, reduce costs
Architects and IT Mangers	Reduced cost (development and maintenance) and process improvements
Product Managers	Increased product functionality, revenue opportunities
Collaborated Applications / Data Exchange Partners	Data quality and consistency ***Controlled data access and application security***

6.2.4.3 Step 3: Identify integration goals and sub-goals for each objective

In the table below, integration goals are mapped to multiple business objectives (Table 6-9).

Table 6-9: Integration Goals by Business Objectives

Primary Business Objects or Desired Outcomes	Goals
Process improvements	G1) Remote quote generation G2) Remote sales order creation G3) Cross-application alerts G4) Remote Customer Creation G5) Remote Supplier Creation G6) Product and Pricing file transfer G10) Create invoices remotely G11) View supplier information
Revenue Generation "sell more"	G7) Provide read-only account history information: • Account History (Balance, Credit History, DSO, etc) • Sales Order • Invoices • Inventory
Quality Improvement	G8) Synchronise account data with external systems G9) Central administration of product-file

Below entities are identified and defined for each integration goal (Table 6-10). Also, for the ERP system, new terminology is introduced. Artefacts are not entities, but external representations, or views, of data. The UI objects of interest that were defined for the CRM system become consumers of these artefacts.

Table 6-10: Objects of Interest Identified

Business Goals		Object of Interest		
G1 G2	Eliminate paper-based processes and duplication of effort in Sales Order Processing by submitting sales orders **and quotes from external** to accounting system	BO Sales Order	Entity	CustomerID, OrderType, Shipline1, Product, Descript, Unit Code, Unit Price, Quantity
G3	Synchronise activities and alerts with external systems	BO Activity	Entity	Activity ID, description, duration, due,
G4 G5 G8	Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors	BO Customer	Entity	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax
		BO Supplier	Entity	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax

Business Goals		Object of Interest		
G7	Provide visibility of account and supplier information to **external users** so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.	BO Financial Summary Report	Artefact	Customer ID, Company Name, Status, Last Statement, Payment Terms, Currency, Available Credit, Credit Limit, Order Balance, YTD Sales, Cumulative Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay
		BO Supplier Report	Artefact	Supplier ID, Company Name, Last Sale, Payment Terms, Currency, YTD Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay
G7	Provide a Sales Order history report with order amount, status, etc	BO Sales Order Report	Artefact	OrderID, Cust ID, Order Type, Date Required, Ship Line 1, Ship Line 2, Ship Line 3, Ship Line 4, Ship Line 5, Customer Order No., Order Status, Total, VAT Total, Grand Total, Order Details, Invoice No.
G7	Provide a Invoice history report with number, order amount, date, etc	BO Invoice Report	Artefact	***To be determined – not available at time of analysis***
G7	Provide a Inventory history report with number, order amount, date, etc	BO Inventory	Artefact	***To be determined – not available at time of analysis***
G6	Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items.	BO Product File	Entity	Product code, Alpha, description, AnalysisA, Supplier, Physical Qty, Allocated Qty, List Price, Unit Code
G10	Create invoices from a remote system	BO Invoice	Entity	***To be determined – not available at time of analysis***

6.2.4.4 Step 4: Define objects of interest (and required connections)

In this section, the object of interest is placed into context (Table 6-11).

Table 6-11: Objects of Interest Defined

Object of Interest	Purpose	Perspective	Frequency
BO Customer	This is the accounting customer information that is relevant to the ***external*** User.	**Data are maintained in both systems (no external deletion)** – Includes all of the accounting customer information that can and should be integrated to	Real or near-real time (less than five minute intervals)

Object of Interest	Purpose	Perspective	Frequency
		external systems. "All of the accounting information that is relevant to ***external*** system users.	
BO Supplier	This is the accounting supplier information that is relevant to the ***external*** User.	**Data are maintained in both systems (no external deletion) –** Includes all of the accounting supplier information that can and should be integrated to external systems. "All of the accounting information that is relevant to ***external*** system users.	Real or near-real time (less than five minute intervals)
BO Sales Order	Remote creation of sales order	**Data are created in external system –** Includes basic information that is need to create a sales order or a quote – information will be validated and finalised once committed to the ERP system.	Real or near-real time (less than five minute intervals)
BO Financial Summary Report	View accounting information	**Read only information provided through data view –** basic account history information that would be of interest to non-accountants	Real-time
BO Supplier Report	View supplier information	**Read only information provided through data view –** basic account history information that would be of interest to non-accountants	Real-time
BO Invoice Report	Quick look of invoice history	**Read only information provided through data view –** invoice numbers, products and payment details	Real-time
BO Inventory Report	Quick lookup of stock and pricing information	**Read only information provided through data view –** product file and pricing information that is of interest to sales and support staff (product, not component part level)	Real-time
BO Sales Order Report	Quick look of sales order history	**Read only information provided through data view**	Real-time
BO Activity	Cross-application transfer of alerts and activities	**Data are maintained in both systems (no external deletion)** – Creates a single event chain across multiple applications	Real or near-real time (less than five minute intervals)
BO Invoice	Remote creation of invoices	**Data are created in external system –** invoice submission or edit from third-party application (e.g. credit control application)	Real or near-real time (less than five minute intervals)

6.2.4.5 Step 5: Define implementation patterns and corresponding processes (direction of data flow)

Again, the objects of interest are categorised by integration pattern (Table 6-12).

Table 6-12: Implementation Patterns

Object of Interest	Direction of Data Flow
BO Customer	Restricted synch, can be added and updated in either system. Cannot be deleted from front-office.
BO Sales Order	Receive Submission
BO Financial Summary Report	Data View
BO Sales Order Report	Date View
BO Product File	Export only
BO Activity	Receive
BO Invoice	Receive Submission
BO Inventory Report	Date View
BO Supplier report	Date View

6.2.4.6 Step 6: Define data sources and entities/artefacts

Lastly, the entities and artefacts are specified (Table 6-13).

Table 6-13: Back office Entities and Attributes

Entity/Artefact	Attributes
BO Customer	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax, Customer ID, Alpha, Correlation Hint, Credit Category, Export Indicator, Customer Discount Code, Currency, Territory, Class, Region, Invoice Customer, Statement Customer, Group, Customer, Date Last Issue, Analysis Code 1, Analysis Code 2, Analysis Code 3, Analysis Code 4, Analysis Code 5, Reminder Cat, Set Days Code, Price List, Letter Code, Balance Forward, Credit Limit, YTD Sales, YTD, Cost Of Sales, Cumulative Sales, Order Balance, Sales NL Cat, Special Price, VAT Registration, Direct Debit, Invoices Printed, Consolidated Inv, Comment Only Inv, Bank Account No, Bank Sort Code, Bank Name, Bank Address 1, Bank Address 2, Bank Address 3, Bank Address 4, Analysis Code 6, Produce Statement, EDI Customer, VAT Type, Lang, Delivery Method, Carrier, VAT Reg No, VAT Exe No, Pay Days 1, Pay Days 2, Pay Days3, Bank Branch Code, Print CP With Stat, Payment Method, Customer Class, Sales Type, Cp Lower Value, Telex, BTX, CP Change, Control Digit, Pager, Responsibility, Despatch Held, Credit Controller, Reminder Letters, Severity Days 1, Severity Days 2, Severity Days 3, Severity Days 4, Severity Days 5, Severity Days 6, Delivery Reason, Shipping Code 1, Shipping Code 2, Shipping Code 3, Shipping Note Ind, Account Type, Admin Fee, Interest Fee
Bo Supplier	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax, Supplier ID, currency, letter code, pay indicator, pay terms, pay type, bank balance, bank code, bank name, date last sale, analysis code 1, analysis code

Entity/Artefact	Attributes
	2, analysis code 3, , analysis code 22, analysis code 22, analysis code 23, balance Fwd Ind, YTD Sales, Cumulative Sales, Payment Reference, VAT Type, VAT Reg No, Telex, BTX, Price List, Special Price List, Pop Discount Cat, Spare, Supplier Category, EDI Supplier, Account Type, Set Category, CIT Supplier
BO Sales Order	CustomerID, OrderType, Shipline1, Order Detail{Product, Descript, Unit Code, Unit Price, Quantity}, Order ID, Order Date, Date Required, Ship Line 2, Ship line 3, Ship Line 4, Ship Line 5, Cust Order Number, Order Status, Total, VAT Total, grand Total, Order Detail{Line Number, warehouse, long description, unit code, unit price, item VAT amount, item VAT rate, quantity, extended price}
BO Financial Summary Report	Customer ID, Company Name, Status, Last Statement, Payment Terms, Currency, Available Credit, Credit Limit, Order Balance, YTD Sales, Cumulative Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay
BO Sales Order Report	OrderID, Cust ID, Order Type, Date Required, Ship Line 1, Ship Line 2, Ship Line 3, Ship Line 4, Ship Line 5, Customer Order No., Order Status, Total, VAT Total, Grand Total, Order Details
BO Product File	Product code, Alpha, description, AnalysisA, Supplier, Physical Qty, Allocated Qty, List Price, Unit Code
BO Purchase Order	To be determined[22]
BO Invoice	To be determined[23]
BO Activity	To be determined[24]
BO Supplier Summary Report	Supplier ID, Company Name, Last Sale, Payment Terms, Currency, YTD Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay

6.2.5 Model C: Developing a CRM/ERP Collaboration

Now that "integration-readiness" has been defined for each of the applications, a full ten-step goal-model can be developed. In the 10-step process below, steps one through six will need to be repeated for the collaboration and four additional steps will be added.

1. Identify stakeholder

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[22] This entity was not yet available for analysis, objectives and goals will need to be revised to reflect these requirements or this entity will need to be defined.
[23] Ibid
[24] Ibid

2. Identify and define business objectives or desired outcomes
3. Identify integration goals and sub-goals for each objective
4. Define objects of interest (and required connections)
5. Define implementation patterns and corresponding processes
6. Define data sources and entities
7. Define semantic integration (define collaboration)
8. Specify user interface
9. Implement collaboration (mappings and transformations)
10. Package for deployment

For each step of the first six steps, component elements of the first two exercises will be deployed, but stakeholders, objectives and goals will need to be redefined on the collaboration level.

6.2.5.1 Step 1: Identify stakeholder[25]

"Integration" means many things to many people. Depending on a stakeholder's point of view, desired outcomes may differ. There are several main five main stakeholders, including:

- Users and managers that would like to get a single view of their organisation. This includes viewing accounting information in a single application, creating an order remotely and checking credit limits.
- IT manage looking to reduce risk of integrating systems.
- Product managers of the CRM application that would like to extend the functionality of the CRM system through integration with third-party systems
- Lastly, "non-human" stakeholders should be considered – that is applications that will become consumers of the CRM system's external data. This data needs to be well defined, complete and consistent.

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[25] Again steps 1-3 are illustrative.

These stakeholders are roughly the same as the CRM integration readiness with de-emphasis on the Architect as a stakeholder. The reason being is that this collaboration is the output of the architect's efforts. In other words, it is his or her duty to address the needs of the identified stakeholders.

6.2.5.2 Step 2: Identify and define business objectives or desired outcomes

Integration can derive significant business benefits for stakeholders on all levels. However, for a project to be successful, it is important to determine and to identify real and tangible business benefits that can be used as a basis for the determining return on investment (ROI) calculations. In today's economic environment, businesses are generally interested in achieving some if not all of the following objectives (borrowed from iteration 1, see Appendix for further details):

- Revenue growth (O1)
- Cost reduction (O2)
- Process improvement (O3)
- Increased customer service or satisfaction (O4)

Using the above goals as basis of developing the collaboration, the following eight steps show how integrated solutions can make a real and measurable impact on the business.

6.2.5.3 Step 3: Identify integration goals and sub-goals for each objective

Here the scope of the integration collaboration is defined. In this example, the business objectives can be accomplished through the integration of a CRM system with an Accounting system.

Using the business objectives outlined above as a starting point, the tangible deliverable and benefits of the effort are identified. These high-level integration goals that map back to the business objectives identified above include:

- (G1) Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors
- (G2) Eliminate paper-based processes and duplication of effort in Sales Order Processing by submitting sales orders from CRM to accounting system
- (G3) Provide visibility of account information to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.
- (G4) Provide a Sales Order history report with order amount, status, etc
- (G5) Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items.

6.2.5.4 Step 4: Define Objects of Interest

Objects of Interest include Business Entities and Artefacts. Business entities are the "nouns" of integration from the stakeholder point of view. That is, these are the "people, places or things" that are the be integrated between systems. An Artefact is a representation of data that are to be viewed between systems.

For example, to a Sales Director, an Account may mean a business that is either a customer or a prospect and would minimally include properties such as Name, Address, Phone, Number and one or more contact. To the Financial Director, an Account may be a that the organisation has a trading relationship with, having properties such as Name, Address, Phone, Credit Limit, Bank Information and a billing contact. A Services Director may view a Customer that has made a purchase and has a service contract. Immediately, without a common organisational definition, it becomes clear that integration will become problematic.

Business entities and artefacts define and contextualise the object that is to be integrated (Table 6-14).

Table 6-14: Objects of Interest Identified

Business Goals		Object of Interest		
G1	Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors	CRM Account	Entity	Account [name], Main phone, Fax, Address1, Address2, City, Postal Code, County
		BO Customer	Entity	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax
		BO Supplier	Entity	Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax
G2	Eliminate paper-based processes and duplication of effort in Sales Order Processing by submitting sales orders from CRM to accounting system	CRM Sales Order	Entity	AccountID, Ship to Name, Order Name, Sales Order Detail {Product Id, Description, Unit, Quantity Ordered, Price}
		BO Sales Order	Entity	CustomerID, OrderType, Shipline1, Product, Descript, Unit Code, Unit Price, Quantity
G3	Provide visibility of account information to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.	BO Financial Summary Report	Artefact	Customer ID, Company Name, Status, Last Statement, Payment Terms, Currency, Available Credit, Credit Limit, Order Balance, YTD Sales, Cumulative Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay
G4	Provide a Sales Order history report with order amount, status, etc	BO Sales Order Report	Artefact	OrderID, Cust ID, Order Type, Date Required, Ship Line 1, Ship Line 2, Ship Line 3, Ship Line 4, Ship Line 5, Customer Order No., Order Status, Total, VAT Total, Grand Total, Order Details, Invoice No.
G5	Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items.	BO Product File	Entity	Product code, Alpha, description, AnalysisA, Supplier, Physical Qty, Allocated Qty, List Price, Unit Code
		FO Product File	Entity	Actual ID, Name, Family, Product Group, Status, Unit, Stock Item, Vendor, BasePrice

Notice how the collaboration, does not make use of all of the entities that have been identified as available in models A and B.

Below is the combined list of the contextualised objects of interest (as identified and defined in models A and B). Since the business objectives and integration goals do not require all of the exposed information, Step 4 in model C restricts the objects of only those that are necessary to address the current collaboration objectives and goals (superfluous objects of interest are greyed out in Table 6-15 below).

Table 6-15: Defined Objects of Interest

Object of Interest	Purpose	Perspective	Frequency
BO Customer	This is the accounting customer information that is relevant to the ***external*** User.	**Data are maintained in both systems (no external deletion) –** Includes all of the accounting customer information that can and should be integrated to external systems. "All of the accounting information that is relevant to ***external*** system users.	Real or near-real time (less than five minute intervals)
BO Supplier	This is the accounting supplier information that is relevant to the ***external*** User.	**Data are maintained in both systems (no external deletion) –** Includes all of the accounting supplier information that can and should be integrated to external systems. "All of the accounting information that is relevant to ***external*** system users.	Real or near-real time (less than five minute intervals)
BO Sales Order	Remote creation of sales order	**Data are created in external system –** Includes basic information that is need to create a sales order or a quote – information will be validated and finalised once committed to the ERP system.	Real or near-real time (less than five minute intervals)
BO Financial Summary Report	View accounting information	**Read only information provided through data view –** basic account history information that would be of interest to non-accountants	Real-time
BO Supplier Report	View supplier information	**Read only information provided through data view –** basic account history information that would be of interest to non-accountants	Real-time
BO Invoice Report	Quick look of invoice history	**Read only information provided through data view –** invoice numbers, products and payment details	Real-time
BO Inventory Report	Quick lookup of stock and pricing information	**Read only information provided through data view –** product file and pricing information that is of interest to sales and support staff (product, not component part level)	Real-time
BO Sales Order Report	Quick look of sales order history	**Read only information provided through data view**	Real-time

Object of Interest	Purpose	Perspective	Frequency
BO Activity	Cross-application transfer of alerts and activities	**Data are maintained in both systems (no external deletion)** – Creates a single event chain across multiple applications	Real or near-real time (less than five minute intervals)
BO Invoice	Remote creation of invoices	**Data are created in external system** – invoice submission or edit from third-party application (e.g. credit control application)	Real or near-real time (less than five minute intervals)
CRM Account	This is the CRM account information that is relevant to the third-party system to the CRM user.	**Data are maintained in both systems** – Includes all of the CRM Account information that can and should be integrated to the back-office. "All of the CRM information the at is relevant to the Finance Director and Accounting System users."	Real or near-real time (less than five minute intervals)
CRM Sales Order	CRM Sales Order screens cannot produce a complete Sales Order (no shipping, VAT) and should therefore be treated like an information capture screen for the back-office system.	**Data are maintained in both systems** – This should be considered a limited order set. Complex business logic is required to validate stock to determine things such as VAT and shipping costs. These calculations need to be done in the ERP system. Therefore a CRM Order can assemble order component pieces for hand off to the accounting system, but the CRM system should not complete any calculations.	Real or near-real time (less than five minute intervals)
CRM Activity	This is the CRM activity information that is relevant to the third-party system to the CRM user.	**Data are maintained in both systems** – Creates a single event chain across multiple applications	Real or near-real time (less than five minute intervals)
CRM Product File	This includes all product and pricing information relevant to create a CRM opportunity, quote and sales order	**Read only information provided through data transfer** -- The product file should be created and maintained in a single location. Therefore, the CRM product file should be considered a view of the master product file in the ERP system. No changes or modifications will be allowed on the CRM side.	Daily
External Account Data	Several reports are necessary to provide accounting information to CRM users including credit limits, stock and order history	**Read only information provided through data view** – Accounting information should be provided for viewing only. Data transfer implies some degree of latency (that could be caused by synchronisation problems). Views in the CRM system should be provided to eliminate this risk.	Real-time (zero latency)

6.2.5.5 Step 5: Define implementation patterns and corresponding processes

The integration middleware supports four implementation patterns: Synchronisation, Submission, Export and Data Viewing. The following implementation patterns were derived from Models A & B (Table 6-16).

Table 6-16: Model C Implementation Patterns

Object of Interest	Direction of Data Flow
CRM Account	Bi-directional synch, can be added, updated or deleted in either system
BO Customer	Restricted synch, can be added and updated in either system. Cannot be deleted from front-office.
CRM Sales Order	Submit
BO Sales Order	Receive Submission
BO Financial Summary Report	Data View
BO Sales Order Report	Date View
BO Product File	Export only
CRM Product File	Receive

6.2.5.6 Step 6: Define data sources and entities

In this step, the collaboration relevant entities and artefacts are identified. The attributes that are bolded will be used in the collaboration (Table 6-17).

Table 6-17: Model C Entities and Attributes

Entity/Artefact	Attributes
CRM Account	**Account [name], Main phone, Fax, Address1, Address2, City, Postal Code, County,** *Account ID, Seccode ID, Account Manager ID, Create User, Create Date, Modify User, Modify Date, Address ID, Shipping ID, Type, Account_UC, Division, Description, Region, Alternate Phone, Tollfree, Tollfree2, Otherphone1, Otherphone2, Otherphone3, Email, Emailtype, webaddress, Currency Code, User Field1, Userfield2, Account Reference, Correlation hint, Account Type, Account Types ID, Create New, Notes, Link ref, Account_Summary*[26]*{Accoutn ID, Type,* ***Account,*** *SECodeID},*

[26] Collections of properties can be created for transformations.

Entity/Artefact	Attributes
	AIS_Acc_Ref[27] *{AccountID, Account Reference, Create User, Create Date, Modify User, Modify Date, Last Sync, TX Error, TX Status ID, AcctypesID, Linked Date}, Main Address{AddressID, Entity ID, Create User, Create Date, Modify User, Modify Date, Is Primary, Type, Description,* ***Address 1 , Address 2****, Address 3, Address 4, City, State,* ***Postal Code, County****, Country, Shipping_Address{Address ID, Enitiy ID, Create User, Create Date, Modify User, Modify Date, Is Mailing, Type, Description, Address 1, Address 2, Address 3, Address 4, City, State, Postal Code, Country*
CRM Sales Order	**AccountID, Ship to Name, Order Name, Sales Order Detail {Product Id, Description, Unit, Quantity Ordered, Price},** *sales order ID, Account Reference, customer ID, Bill to name, Ship VIA, Order Type, Status, Sales Commission, Currency Code, Misc Charge, Freight, trade Discount, Order Total, Tax, Invoice Total, Customer Purchase Order Number, FOB, Line Count, Our Purchase Number, Order Date, Period Entered, Period Invoiced, Transmit Date, Comments, Sales Order Detail{External Products ID, Program, Extended Price, Line Number, Price Eff Date, Notes, Price Adjusted, Cal Price}*
CRM Product File	**Actual ID, Name, Family, Product Group, Status, Unit, Stock Item, Vendor, BasePrice**
BO Customer	**Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax,** *Customer ID, Alpha, Correlation Hint, Credit Category, Export Indicator, Customer Discount Code, Currency, Territory, Class, Region, Invoice Customer, Statement Customer, Group, Customer, Date Last Issue, Analysis Code 1, Analysis Code 2, Analysis Code 3, Analysis Code 4, Analysis Code 5, Reminder Cat, Set Days Code, Price List, Letter Code, Balance Forward, Credit Limit, YTD Sales, YTD, Cost Of Sales, Cumulative Sales, Order Balance, Sales NL Cat, Special Price, VAT Registration, Direct Debit, Invoices Printed, Consolidated Inv, Comment Only Inv, Bank Account No, Bank Sort Code, Bank Name, Bank Address 1, Bank Address 2, Bank Address 3, Bank Address 4, Analysis Code 6, Produce Statement, EDI Customer, VAT Type, Lang, Delivery Method, Carrier, VAT Reg No, VAT Exe No, Pay Days 1, Pay Days 2, Pay Days3, Bank Branch Code, Print CP With Stat, Payment Method, Customer Class, Sales Type, Cp Lower Value, Telex, BTX, CP Change, Control Digit, Pager, Responsibility, Despatch Held, Credit Controller, Reminder Letters, Severity Days 1, Severity Days 2, Severity Days 3, Severity Days 4, Severity Days 5, Severity Days 6, Delivery Reason, Shipping Code 1, Shipping Code 2, Shipping Code 3, Shipping Note Ind, Account Type, Admin Fee, Interest Fee*
Bo Supplier	**Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax,** *Supplier ID, currency, letter code, pay indicator, pay terms, pay type, bank balance, bank code, bank name, date last sale, analysis code 1, analysis code 2, analysis code 3, , analysis code 22, analysis code 22, analysis code 23, balance Fwd Ind, YTD Sales, Cumulative Sales, Payment Reference, VAT Type, VAT Reg No, Telex, BTX, Price List, Special Price List, Pop Discount Cat, Spare, Supplier Category, EDI Supplier, Account Type, Set Category, CIT Supplier*
BO Sales Order	**CustomerID, OrderType, Shipline1,** ***Order Detail{*****Product, Descript, Unit Code, Unit Price, Quantity},** *Order ID, Order Date, Date Required, Ship*

[27] Also includes synchronisation information

Entity/Artefact	Attributes
	Line 2, Ship line 3, Ship Line 4, Ship Line 5, Cust Order Number, Order Status, Total, VAT Total, grand Total, Order Detail{Line Number, warehouse, long description, unit code, unit price, item VAT amount, item VAT rate, quantity, extended price}
BO Financial Summary Report	**Customer ID, Company Name, Status, Last Statement, Payment Terms, Currency, Available Credit, Credit Limit, Order Balance, YTD Sales, Cumulative Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay**
BO Sales Order Report	**OrderID, Cust ID, Order Type, Date Required, Ship Line 1, Ship Line 2, Ship Line 3, Ship Line 4, Ship Line 5, Customer Order No., Order Status, Total, VAT Total, Grand Total, Order Details, Invoice No**
BO Product File	**Product code, Alpha, description, AnalysisA, Supplier, Physical Qty, Allocated Qty, List Price, Unit Code**
BO Supplier Summary Report	*Supplier ID, Company Name, Last Sale, Payment Terms, Currency, YTD Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay*

6.2.5.7 Step 7: Define semantic integration (define collaboration)

In this step, entities are semantically defined and conceptually matched on the collaboration level (Table 6-18). For example, in Step 7, it becomes clear that a BO Supplier can rendered as a CRM Account (there is no supplier entity in the sample CRM system).

Table 6-18: Model C Collaboration Definition

CRM Entities	Attributes	ERP Entities	Attributes
CRM Account	**Account [name], Main phone, Fax, Address1, Address2, City, Postal Code, County,**	BO Customer	**Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax,**
		Bo Supplier	**Name, Address1,Address2, Address3, Address4, Address5, Address6, Fax**
CRM Product File	**Actual ID, Name, Family, Product Group, Status, Unit, Stock Item, Vendor, BasePrice**	BO Product File	**Product code, Alpha, description, AnalysisA, Supplier, Physical Qty, Allocated Qty, List Price, Unit Code**
External Data View	Defined below as part of UI specification	BO Sales Order Report	**OrderID, Cust ID, Order Type, Date Required, Ship Line 1, Ship Line 2, Ship Line 3, Ship Line 4, Ship Line 5, Customer Order No., Order Status, Total, VAT Total, Grand Total, Order Details, Invoice No**

CRM Entities	Attributes	ERP Entities	Attributes
External Data View	Defined below as part of UI specification	BO Financial Summary Report	**Customer ID, Company Name, Status, Last Statement, Payment Terms, Currency, Available Credit, Credit Limit, Order Balance, YTD Sales, Cumulative Sales, Current Balance, Current Aged, Aged30day, Aged60day, Aged90day, Aged90plusDay**
CRM Sales Order	**AccountID, Ship to Name, Order Name, Sales Order Detail {Product Id, Description, Unit, Quantity Ordered, Price},**	BO Sales Order	**CustomerID, OrderType, Shipline1,** ***Order Detail*****{Product, Descript, Unit Code, Unit Price, Quantity},**

6.2.5.8 Step 8: Specify user interface

Throughout this exercise, there has been several references to the notion of extending the application user interface to accommodate integrated information or to facilitate cross-application business processes. Step three lays out the following goals:

- (G1) **Link accounts** in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors
- (G2) Eliminate paper-based processes and duplication of effort in Sales Order Processing by **submitting sales orders** from CRM to accounting system
- (G3) **Provide visibility of account information** to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated. Provide financial summary report that includes credit status, terms, limit and aged debt.
- (G4) **Provide a Sales Order history** report with order amount, status, etc
- (G5) Provide multi-channel (telesales, web, direct, retail) access to **inventory and catalogue information**, eliminating probability of back-orders and sales of discontinued items.

Using the goals as a starting point, it becomes obvious that the following functionality will be needed to be created in the CRM system user interface. In the

table below (Table 6-19), each of the user actions is linked to its related entity and a description of the user interface is provided.

Table 6-19: User Interface Requirements

Goals	Entities	Description
Link Account	CRM Account BO Customer BO Supplier	Link request button to request account link or creation with the back office
Create Quote/Sales Order	CRM Sales Order BO Sales Order	Sales order/quote creation dialog will be needed to create a Sales Order/Quote for transfer. Will also include database field to be added to the CRM database.
Account History Report	CRM External Data View, BO Financial Summary Report	HTML report that is rendered from within the CRM systems
Sales Order Report	CRM External Data View, BO Sales Order Report	HTML report that is rendered from within the CRM systems
View/Select Product File	CRM Product File, BO Product File	Product and pricing display fields and database additions to store additional requested information.

6.2.5.9 Step 9: Implement collaboration (mappings and transformations)

This step is more technically oriented. As such, in-depth detailed discussion of methods will be omitted as out of scope for this research (as it has no bearing on the creation of a goal-based methodology). In this step attributes from each application are mapped to corresponding value in the external application. However, since each underlying database stores attributes differently (field lengths, types, formats, etc), programming scripts will be needed to write transformation code. For instance, the ACCOUNT attribute in the CRM system has a maximum length of 128 characters,

but the NAME attribute in the ERP system has 32 characters. Therefore, scripting[28] such as:

```
if ((ACCOUNT.IsNull == false)) {
    target = StringFunctions.Cut(ACCOUNT, target.MaxLength);
}
```

will be necessary to trim excess characters before transfer of information from the CRM system to the ERP system. For each of these exposed attributes, the transferred must be programmatically prepared so that it conforms to the format of the external system

6.2.5.10 Step 10: Package for deployment

The final stage is similar to the reference model's step 10 – implementation plan. Since in this context a collaboration is meant to be deployed repeatably, this step includes an installation shield, documentation and release planning. It also includes support procedures and upgrade procedures for customers that have deployed the integration solution.

6.2.6 Case 3 Summary and Implications

Due to the complexity of the problem domain, the development of this goal-based model was the most difficult, requiring a pain-staking iterative approach up front. Although, the model differs from the reference model – most notably in the elimination of the questions step, it stands up to scrutiny for the low maturity organisation. Other changes are outlined in Table 6-20 below.

Table 6-20: Comparison of Case 3 Model to Reference Model

Reference Model	Case 3 Model
Not Included in the reference model	Identify Stakeholder
Identify business requirements.	Identify and define business objectives or

[28] Sourced from reference system ACCOUNT to CUSTOMER transformation template in the Application Integration Server software

Reference Model	Case 3 Model
	desired outcomes
Identify what you want to know or learn.	Identify integration goals and sub-goals for each objective – ***reference model steps combined for expediency***
Identify sub-goals.	
Identify entities and attributes related to sub-goals.	Define Objects of Interest (and required connections) – ***reference model steps combined for expediency***
Formalise measurement goals.	
Not Included in the reference model – context specific to integration exchange	Define Implementation Patterns and corresponding processes
Identify quantifiable questions and the related indicators that will be used to help achieve measurement goals.	***Eliminated in Case 3 – specific to information retrieval***
Identify data elements that will be collected to construct indicators.	Define Data Sources and Entities
Define the measures to be used, and make these definitions operations.	Define Semantic Integration (define collaboration)
	Specify User interface
Identify the actions that you will take to implement the measures.	Implement collaboration (mappings and transformations)
Prepare a plan for implementing the measures.	Package for Deployment

Again, following the conclusion of case two, the goal-based methodology is more descriptive than prescriptive. It is clear from this first pass that the focus of the model makes it unsuitable to anticipate and accommodate all future needs. For instance, model B would need significant changes to accommodate integration to a warehouse management system. As such, model B's steps would need to be repeated before a new collaboration model could be constructed.

On the other hand, the approach has again proved itself to be adaptable and flexible and its expansiveness has proved to be a benefit. If in the future, additional fields need to be exposed in the underlying application – model A or B only needs to be updated and re-documented (thus not impacting the current implementation of model C). In addition, the exercise proved to be fairly low cost method to clear document potentially conflicting needs. The componentisation of each entity made documenting subsequent models far easier than writing collaboration specific documentation from scratch.

Although case three is ultimately concerned with the development of a specific CRM/ERP collaboration, the inclusion of the iterations of the first six steps makes it highly relevant to preceding discussion of web-services and SOAs. These steps were undertaken to make the applications integration ready. These same steps could be used regardless of integration type deployed be it IOIA or a services based approach. The findings from Case 3 show that the model has value in contextualising and specifying IOIA efforts and with demonstrated worth in information retrieval as depicted in case study 2, the model should be highly relevant for use in the specification and documentation of portal integration and composite applications.

7 Discussion

The main objective of this chapter is to evaluate the usefulness of the framework as an information science tool.

Through the case study and the literature review, we have already seen that goal-based methodologies intentionally limit knowledge discovery – that is, information is provisioned according to predefined enquiry criteria. In Chapter 2, the advantages and disadvantages of the goal-based approach were discussed (and next chapter will delve into this further). However, these earlier discussions are focused on goal-based methods themselves and do not address *when* a goal-based approach may or may not be warranted. This chapter will present eleven criteria that should be considered when evaluating information needs on a user level and will discuss the appropriateness of the GbIF in the context of each. Through this evaluation, we will see that the GbIF is most appropriate for briefing, awareness and some fact finding functions. As such, the primary functional use for the framework is likely in defining and documenting relatively static information retrieval needs, and providing accurate and timely information to address those needs.

The chapter concludes by exploring the usefulness in addressing the macro-level trends outlined in Chapter 5 and future applications of the GbIF.

7.1 An Information Needs Assessment of the Goal-Based Framework

In Chapter 5, Nicholas' *Framework for the Evaluation of Information Needs* was briefly touched upon. In that work, he suggested that "there is a requirement to place the concept of information need in a comprehensive, precise and understandable framework" (2000, p. 36). According to Nicholas, to be useful an information framework must achieve the following (2000, p. 37):

- benchmark the needs of the information user;

- "monitor and evaluate the effectiveness and appropriateness of information systems from a user perspective";
- detect gaps in information provision;
- provide personalised information;
- assessment of new/additional information needs and;
- bring the information professional and the user closer together.

Upon review, the GbIF adheres to these six evaluative criteria. By design, it benchmarks specific needs of the user – although somewhat more rigidly and in narrower circumstances than Nicholas's evaluative framework. The GbIF process also detects gaps in information provision and determines the appropriateness of information systems from the user point it view. The information is personalised to the users' requirements and the process of drawing out the information requirements brings the information professional and user closer together. Where it falls over is in the assessment of additional information needs. Although, the GbIF has proved value in determining initial information needs, the model is not self-sustaining. That is, new needs need to be recognised (independent of the model) and manually added in a later iteration.

This section below further assesses the GbIF using Nicholas' 11-point evaluative framework overviewed in Chapter 5. Nicholas' needs assessment framework differs from the goal-based framework in that the former is evaluative, whereas the latter is largely a descriptive construct. As such, Nicholas' 11-points provide a useful outline to evaluate the goal-based framework's potential in addressing information seeker's needs.

7.1.1 Subject

The goal-based framework is not an information classification taxonomy. That is, it does not purport to be useful in providing a structure to categorise information. However, the early phases of the goal-based method (i.e. objectives, goals, questions and entity definitions) serve as a useful mechanism to identify information needs and

begin to group those needs into like categories. In case 1, we've seen the emphasis on creating a common organisational language and in case 2, the determination of sub-goals serves the same purpose. The danger with this approach is that the subject is user defined and will be presented in the nomenclature of the organisation. As such, new employees or information seekers in the organisation may be unfamiliar with the information classification scheme, and may have trouble explaining them in terms that are meaningful. Although, it could be argued, that user-defined keywords in library information systems suffer the same fate (Nicholas, 2000, pp.45-46). Since the goal-based framework is bespoke to the organisation and is applied to a specific problem domain, it is unlikely that universal subject categorisations (i.e. sub-goal and entity definitions) will emerge. However, a by-product of the goal-based framework is a defined and documented method to describe organisational entities that are linked to the information information-seeker's goals and questions as well as the underlying information infrastructure.

7.1.2 Function

Nicholas recognises that "each individual and each information community puts information to work in different ways" (2000, p. 46). He goes on to state that information addresses five functions or purposes (2000, p. 47), including: "1) providing answers to specific questions (fact-finding); 2) to keep-up-to-date (current awareness); 3) investigation of new field in depth (research); 4) to obtain a background understanding of an issue/topic (briefing); 5) to provide ideas or stimulus."

The goal-based information framework is strong in the fact-finding function – that is, in providing answers to pre-defined quantitative questions. In situations where questions can be defined in advance and are answered at prescribed intervals the framework provides focus, repeatability and traceability from query to source. However, it is limited for knowledge discovery work. If new questions are asked, the entire model needs to be updated and a gap analysis needs to be performed. The framework is also limited in situations where questions are ambiguously defined.

That is, specificity is either required up front or is drawn out during the model development process. If the information request cannot be defined in advance, it will likely be left unfulfilled using the goal-based framework.

The goal-based model is also designed to reduce the background 'noise' and deliver targeted information (the current awareness function). Again, for known information needs the model process ensures accuracy and timely delivery of information. However, the goal-based framework purposely excludes information that is not prescribed in advance or does not address the stated information needs. If needs change, or new relevant information becomes available, the model will need to be updated. However, the user and model-keeper may not be aware of the new information needs. Therefore, it is probable that the goal-based information framework has limited use in research and knowledge discovery functions. The only exception may be in ordering and documenting for information-retrieval experiments.

In a commercial environment, much information is of the briefing nature. An organisational goal-based framework incorporates the cross-functional informational needs of organisation into a single information retrieval structure. The framework ensures that each of information stake-holder's needs are identified, information entities are properly defined and put into context, and that retrieval processes are standardised and accurate. Given the strengths of the framework, repeated, but relatively static information needs are well addressed.

Nicholas asserts that in "all other functions people generally know what they are looking for" with varying levels of specificity and definitions (2000, p. 52). In the stimulus function, the user may not know what they are looking for or only have the faintest idea. Through the question elicitation exercise, the GbIF is valuable for initial stimulus functions. However once the model is complete, its stimulus function likely diminishes.

The top functional uses for the goal-based information model is in defining and documenting relatively static information retrieval needs and providing accurate and timely information to address those needs. As such, in summary the goal-based model

is most appropriate for briefing, some instances of awareness and some fact finding functions.

7.1.3 Nature

In Nicholas' model the "nature" of information need refers to whether the information is conceptual, theoretical, historical descriptive, statistical or methodological. The goal-based information framework is largely designed to deliver quantitative information that requires little interpretation prior to consumption. That is, the "indicator" should be self explanatory to the user without having to be further interpreted. Therefore, descriptive, statistical or historical (that require a minimum of processing or interpretation) information needs are the most appropriate for the GbIF.

7.1.4 Intellectual Level/Level of Complexity

According to Nicholas, this characteristic is relates to the "intelligibility" of information; "information is made complex not just by how much knowledge and education it assumes but also how abstract or compressed it is" (2000, p. 54). The determination, abstraction and presentation of information delivered through the GbIF is user determined. That is, the user sets the goals and questions, and will have significant influence over the indicators. Thus, the user-determined topical areas and indicative responses enable the packaging of complex information into usable and accessible packets, making the GbIF a highly useful tool to calibrate the level of complexity to the appropriate level to the user.

In the past few years there has been a debate about information overload or "information malnutrition, whereby people are unable to digest information" (Nicholas, 2000, p. 56). The danger, pointed out by Nicholas (2000, p. 55), is that presentation can become too simplistic or that complex concepts can be diluted to the point of irrelevance. If indicators are not properly constructed or do not exist, the GbIF will be of little use in addressing this issue.

7.1.5 Viewpoint

Information,..., is sometimes written up from a particular point of view, approach or angle and consumers may require information sympathetic to the views that they subscribe to (Nicholas, 2000, p. 56). There are several ways of presenting information, including: schools of thought, political orientation, positive or negative approaches and discipline. For example, in information science there are user-driven and system-driven schools of thought (Nicholas, 2000, p. 57). These "schools" are classifications of collective viewpoints. Other classifications exist such as the political orientations such as 'conservative' and 'liberal', positive or negative 'spin' and the viewpoint from which users approach a problem (subject orientation). Within a commercial organisation, these viewpoints abound. Boardroom politics or the stock price will have an impact on the way the information is sought and received. The user's role within an organisation will determine their orientation. For instance, a Financial Director may be more numbers oriented than the Marketing Director, or an operations person may be interested in information internal to the business whereas a strategist may be interested in external information. The GbIF process addresses this issue by providing indicators to satisfy each stakeholder viewpoint.

7.1.6 Quantity

The quantity characteristic is a double edged sword. Elsewhere in this thesis and the literature the issue of information overload has been thoroughly discussed. However, the mere existence of information does not necessarily mean that informational needs will be addressed. Sometimes, this over abundance will lead to a problem in "digesting" the useful bits. "Most people do not have the time, inclination or need to wade through large volumes of information – they would in the main be content to have sufficient, but small quantities" (Nicholas, 2000, pp. 63-64). Nicholas goes on to analogise that information consumption is like food, too much can be harmful and that "on the whole, people are quite aware of their information appetite so it makes a good deal of sense to ask them [how much] they would ideally like in response to their query" (Nicholas, 2000, p. 65).

Since both the information request and the response is user determine, the GbIF is a modulator for information flow. The user can increase the flow of information by asking new questions, or decrease the flow by eliminating goals, questions and indicators. In case 1 (as in the Nokia example), the organisation restricted information flow to a certain number of indicators per person. This was in tacit recognition that measuring and monitoring too many things can lead to a defocusing of efforts. However, like in the level of complexity discussion, there is a danger of eliminating too much information, thus leaving some needs unsatisfied.

7.1.7 Quality/Authority

Quality ranks highly among user's lists of information priorities; however the determination of quality is fairly subjective (Nicholas, 2000, p.66). As such, determinates of quality are very important in helping users filter through the aforementioned overload of information. Information science literature has long shown that source, or "authority" or information is a key filtering mechanism for users. That is, more weight is given to information provided by respected people or organisations.

The GbIF is a neutral construct. The process by which a GbIF framework is built assures that, particularly statistical or historical, information is delivered in a consistent, repeatable and accurate manner. The entity definition phases also ensure that the entire organisation is looking at data that is defined in the same manner. Although that it should be noted that viewpoint can influence indicators and how the processed data (information) are used within the organisation. That said the GbIF ensures that information are delivered accurately, but the interpretation is up to the user. Although, not specifically covered in this research, it stands to reason that more senior users within the organisation will have more "authority" when interpreting and using GbIF information. In fact, more senior contributor's goals and questions will probably take precedence when building a GbIF model.

7.1.8 Date/Currency

The date/currency characteristic refers to two facets of the 'timeliness' need; how far back in time is the information required and how up-to-date the information is needed. The first facet refers to the obsolescence of information, or how long the information is relevant. Nicholas uses the example of scientific information having a "shelf-life" of five years (or less in some fields), after which new discoveries, political/economic/technological factors render the information obsolete (2000, p. 73). Conversely, in the academic discipline of History, original sources that could be hundreds of years old are valued more highly than later secondary or tertiary research. In a commercial environment, particularly publicly traded companies, information obsolescence can sometimes be measured in months or quarters. In a stock trading environment, minutes could be shelf-life of information.

The second timeliness factor that needs to be considered is the amount of time that a user has to search for and digest information. It is commonly thought that users are more interested in the most current information first. As such, date becomes a useful filter as well as determinate value of information. The GbIF addresses this characteristic is by providing the ability to filter and present relevant information based on user defined date ranges (see Appendices for examples of weekly and monthly case 2 indicators).

7.1.9 Speed of Delivery

This characteristic refers to getting information to users as fast as they need it (Nicholas, 2000. p. 77). Speed of delivery is highly correlated to currency; the faster people can get information, the more current it is, thus influencing the users expectations for currency (see Chapter 6 for a discussion of real-time vs. near-time processing of information). Information channels influence the speed of delivery. The discussion of synchronous and asynchronous channels and digital vs. hard copy channels in Chapter 5, greatly influence the speed of delivery and both the perceived and actual currency of information.

GbIF contextualises information; in Case 3, delivery instructions (real-time, near-time or daily batch) were included to address this user need. By the very nature of the GbIF exercise, information comes pre-filtered for the user based on their predetermined timeliness criteria. One drawback is that the timeliness needs are circumstantial. That is, the immediacy of the information need can change under certain irregular circumstances. If the GbIF predetermines delivery times, there could be certain situations that the information need is left unmet between delivery cycles.

7.1.10 Place

Place refers to the origin of information. According to Nicholas, the importance of place is dependent on three things: subject, language and whether the user is an academic or a practitioner. Some subjects are international in nature. That is, Nicholas points out that Cancer researchers are likely to be interested in any relevant information regardless of place of origin, although some countries have greater influence than others based on reputation (2000, p. 80). In a commercial environment, for certain subjects the relevance of place will likely be based on whether the information was produced inside or outside the organisation. For instance, independent market research of future predictions of stock performance may hold more weight if it comes from outside the organisation. Nicholas points out that linguistic ability will also determine the value of information from outside the organisation (2000, p. 82). In a multinational environment, organisations are more likely to heed information produced within their own region. The impact of place was seen in Case 2 with the differing levels of support depending on language proficiency. Lastly, Nicholas also points out that academics are more likely to gather information internationally than practitioners (2000, p. 81). Although slightly different in a commercial environment, the relevance of "place" may differ depending on the role within the organisation. For example, strategist (akin to academics) may be more interested in international information (markets, opportunities, etc), whereas operations people (practitioners) are more likely concerned with local information needs.

The ability for GbIF to address the place information need is likely to be minimal. However, the importance of the place factor may be uncovered during the GbIF exercise. For example, in Case 2, difference in service levels received by native English speakers was highlighted through the analysis of strategic value and ADO statistics.

7.1.11 Processing & Packaging

According to Nicholas, the "processing characteristic refers to the different ways that the same ideas can be presented" (2000, p. 84). The GbIF exercise requires that information entities are defined in a common manner, and data are extracted in a documented and repeatable way, but the presentation (indicators) is customised to specific information needs (goals and questions). As seen in all of the cases, the underlying entities are recombined to address the needs of different constituencies and highly processed information (indicators) were presented to support various viewpoints and address individual information needs. However, unprocessed data are available to answer new questions or to construct new indicators. The level of processing within the organisation is going to be dependent on role. Executives or senior management may generally require more highly processed information, whereas line managers may wish to investigate the data in a more raw form. Packaging, on the other hand, refers to the external presentation or the physical form of the information (Nicholas 2000, p. 87). The preferred packaging is largely dependent on the individual. As such the GbIF addresses this information need; for example, in Case 1 information was delivered in a variety of formats – via hardcopy to some executives and via the web or mobile phone to others.

7.2 Discussion of Macro-trends

In Nicholas' work discussed above, he suggests that an information framework must be useful at both the strategic (i.e. macro) and at the "enquiry" (i.e. micro) level (2000, p. 36).

In Chapter 5, several broad organisational trends were outlined. These included: 1) cross-channel information seeking and retrieval, 2) multi-channel business operations, 3) mergers and acquisitions and 4) the expanding of the enterprise. On a micro-level, the usefulness of GbIF was illustrated through each of the case studies, with each of the case studies falling into one or more of the trend categories outlined above. In the reference model and the first two cases (1 & 2), multi-channel information had to be collected from disparate information systems and databases (trends 1 and 2) The organisational upheaval described in the background to case 2 was due to an acquisition (and ironically case 1 was not completed due to an acquisition). The application integration challenges and the analysing of XML data in case 3 are illustrative of the fourth trend.

In consideration of the broad trends outlined in Chapter 5, the GbIF may have potential to address some of the inherent problems of "information disparity":

- **Proliferation of communications channels –** Using the GbIF method, the organisational objectives and the information-seeking goals are considered, not the information sources or channels as the basis for information retrieval and exchange. In the literature review and the case studies, the have been shown to be flexible within organisations and adaptable on the whole. Therefore, as new channels are added, or new organisational objectives arise, the model can be adapted to incorporate this new information.
- **Increasing information overload –** The use of goal-based methodologies, by its nature, limits the amount of extraneous information that is provided within that particular information method (i.e. if it does not link to a goal, the information are not collected). Since the method is user-driven there is a

danger of users requesting too much information (contributing to their own information overload). However, as demonstrated in case 1 and 2 studies and at Nokia, objectives goals and metrics can be limited. In the first case, George Miller's chunking theory (1956) was used to limit the number of measures (see appendix), where as in the second case and at Nokia (see literature review), goals were predetermined limiting the amount of information that was subsequently collected.

- **Integration of corporate data-stores –** GQIM (as it is designed for software measurement) and the GbIF framework outlined in this research logically link data stores by drilling down form high-level objectives to the under-lying data stores. As seen in the third case study, this can be extended in an information-retrieval scenario as a process for understanding physical link requirements.
- **Need for faster information processing –** With predetermined objectives and questions (as may be expected in the illustrative SARS case outlined in Chapter 5), indicators can be constructed that only require the updating of underlying data stores. Rather than a bespoke query every time a new piece of information is sought, the indicators can merely be updated. If additional sources are added, or new questions are asked, the model can be adapted to incorporate the new requirement.
- **Need for auditability and traceability –** Using the GbIF, every step of the retrieval process is documented and traceability is enforced from high-level down to the database. Therefore, the highest level executive's information needs are linked to the data sources and extraction definitions. If there later proves to be a mistake, by tracing the audit path, it can be identified and fixed quickly. The additional benefit is that all other affected areas are identified as well.
- **The emergence of standards –** Technology standards such as XML and web services make it easier to physically integrate systems. The goal-driven methodology put forth in this research provides a framework to understand the integration context and the organisational information retrieval objectives before the technology is deployed. It also documents the information retrieval

and integration efforts so that efforts are repeatable, or can be expanded upon later. In effect, GbIF becomes an information flow documentation method that can be used in conjunction with the aforementioned technology standards.

- **Information security privacy** – Admittedly, GbIF's contribution to security is limited. However, as a method to document information flow within the organisation, properly used it can model the information touch-points exposed to the user, uncovering personal data-stores that need to be secured and backed up and unauthorised information channels such as Instant Messenger.

7.3 Future Applications of the GbIF

The introduction of this research asserts that the information landscape has been quietly changing. Traditionally, information has been presented in a static format whereby the user can read the information, but can do little else with it. With the advent of the XML, and HTML to a certain extent, information rendering (or presentation) instructions have been delivered with the raw data. With these new mechanisms the user has a greater degree of flexibility in how they interact with the data. With the introduction of web-services and services oriented architectures, this interoperability is taken to a new level. Using these technologies, the user (or consuming system) not only receives information but also methods and instructions for manipulation of data. Right now, these technologies are firmly ensconced in the realm of computer science and IT. However, to harness the power of this architectural shift, organisational users will need to begin to understand the capabilities of new technology. Based on the findings of this research, the GbIF may be useful in information modelling to help bridge the gap between the underlying technology and information users in a standard, traceable and repeatable way.

Service Oriented systems are very complex and although they are flexible, but, compared to user driven information retrieval, are relatively static. That is, it is unlikely that changes are going to be made in an underlying SOA without determining the impact on the entire system. Since, by its very nature, the GbIF

documents linkages between business objectives and the underlying information architecture, it may provide a suitable evaluative and explanatory framework for services based information provisioning.

The method outlined in case 3 could also prove to be valuable in the development of composite applications. Discussed in-depth in Chapter 6, composite applications utilise services-oriented architectures to deliver specific functionality to specific users. For instance, today a credit manager who collects on invoices may use two systems to do her job – for instance both the finance system and the CRM system. She will check the invoice status using the finance system, but will need to record notes and history of the contact in the CRM system so that salespeople do not waste time trying to sell to overdue accounts. With today's technology the two systems can be integrated to share this information through methods discussed in Chapter 6 and in case 3. Although this will make the credit controller's job somewhat easier, there are still drawbacks to this approach. For example, the data may not always be in sync causing customer services problems (if services are denied to an up-to-date customer between synchronisation cycles). Additionally, the organisation may have to licence two sets of software so that the credit controller has access to the functionality she needs from each. A better approach would be to build a composite application that utilises underlying services from each system (See Figure 6-5). Based on the findings from case 3, the GbIF could be a useful method to model information retrieval and exchange needs for developing composite systems.

8 Conclusion

The overall objective of this research was to validate the use of the goal-based methodologies to contextualise, evaluate and document information-retrieval and exchange in the low maturity organisation. Secondary aims of the research were to: 1) lay the theoretical foundations to understand multi-source, multi-channel, information retrieval and exchange, 2) review the current *state of practice* for multi-channel information retrieval and exchange, 3) evaluate the challenges, strengths and weaknesses of a goal-based approach through case study and 4) synthesise the findings from the literature review and the case studies into a set of recommendations for additional research and further development of goal-based methods. Overall, both the primary objective and secondary aims of the research were achieved.

As a contribution to the field, this research presents goal-based methods outside their roots in software quality and measurement and in the context of low maturity organisations. Specifically, the research found that:

- For information retrieval in the low maturity environment, the goal-based information framework is a descriptive and evaluative construct, rather than a prescriptive process model. That is, the value of the framework is in describing and evaluating organisational information flow. However it should be noted that at this point, there is no indication that the GbIF has value as a process methodology.

- The goal-based information framework is a diagnostic tool for the contextualisation and evaluation of multi-channel, multi-source information retrieval needs. Since, by design, goal-based methodologies limit knowledge discovery, the primary functional use for the framework is in defining and documenting relatively static information retrieval needs, and providing accurate and timely information to address those needs. As such, the goal-based model is most appropriate for briefing, awareness and some fact finding

functions outlined in Nicholas' Information Needs Assessment Framework (see Chapters 5 and 7, also Nicholas 2000).

- With recent changes in the nature of information exchange (illustrated in the *state of practice* section of Chapter 6), new methods to contextualise the information environment will become increasingly necessary. As such, this research lays the theoretical groundwork for the use of the goal-based information framework in an information exchange and integration context.

This rest of this chapter presents detailed conclusions based on the review of the literature as well as the case studies.

8.1 The Emerging GbIF Model

In this research, two types of problems were presented. For the reference case and the first two case studies (1 & 2), the GbIF models were constructed to address *information retrieval* problems. In the third case, the model was constructed to document an *information integration* effort. In constructing the reference model, the baseline business issue was collecting customer satisfaction information that would address the needs of different stakeholders. The case 1 experience (although, not specifically discussed in the body of this research, but the included in the appendices) highlights the challenges of 'semantic integration' – in this case goal-based methods were used to define a common language across the business. In case study 2, the GbIF model was used to document and evaluate information needs during a business process re-engineering effort. In the third case study, the integration objectives and goals are largely illustrative; instead it documents the information integration flow requirements of integrating two software applications.

In the information retrieval cases (1 & 2), the semantics of the model varied slightly. It was not until the information exchange problem (in case 3) that the model was altered drastically. In case 3, the question development exercise was ultimately deemed superfluous to the goals and entity development sections. Furthermore, the nomenclature of each of the model steps was significantly changed to adequately

describe the process steps. Table 8-1 overviews the specific steps of each implementation.

Table 8-1: Comparison of GbIF Implementations

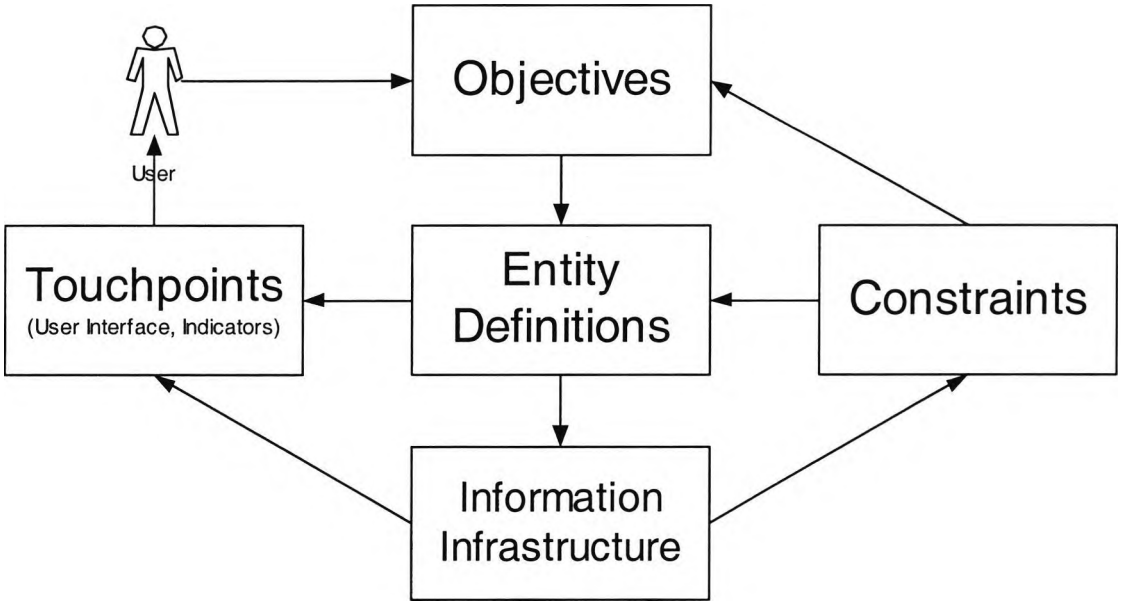
Reference Model	Case 1	Case 2	Case 3
1 Identify business requirements. 2 Identify what you want to know or learn. 3 Identify sub-goals. 4 Identify entities and attributes related to sub-goals. 5 Formalise measurement goals. 6 Identify quantifiable questions and the related indicators that will be used to help achieve measurement goals. 7 Identify data elements that will be collected to construct indicators. 8 Define the measures to be used, and make these definitions operations. 9 Identify the actions that you will take to implement the measures. 10 Prepare a plan for implementing the measures.	1 Identify business objectives or desired outcomes 2 Identify goals and sub-goals for each objective 3 Identify questions that address business goals 4 Identify business entities and attributes 5 Define measures that will be used to construct indicators 6 Identify and construct indicators that will answer questions 7 Identify data sources that house the elements of measures 8 Implementation of programme	1. Identify business objectives or desired outcomes 2. Identify what you want to know or learn 3. Identify sub-goals 4. Identify entities and attributes 5. Formalise measurement goals 6. Identify indicators 7. Define measures 8. Identify and evaluate data sources 9. Implementation of programme	1. Identify stakeholder 2. Identify and define business objectives or desired outcomes 3. Identify integration goals and sub-goals for each objective 4. Define objects of interest (and required connections) 5. Define implementation patterns and corresponding processes 6. Define data sources and entities 7. Define semantic integration (define collaboration) 8. Specify user interface 9. Implement collaboration (mappings and transformations) 10. Package for deployment

Viewing this side-by side comparison, it is clear that these process steps should not be considered universal. Instead, these 8-10 process steps can be roughly grouped into four categories. At the offset of the exercise, the organisational and objectives and project goals need to be determined. Next, business entities need to be identified and defined. To aid in transitioning between these two steps, the question step may be deployed. It seems that this step is particularly relevant for information retrieval exercises. After that, the entities need to be grafted to the underlying information infrastructure. This is done through the contextualisation and data source

determination steps. Lastly, the information needs to be packaged for users. In the information retrieval context this is done in the indicators step. In the information exchange project this was done in the specification of the user interface stage.

The resulting GbIF model could be described at the very high-level as follows (Figure 8-1). The user defines their objectives and goals; these goals are translated into entity definitions (perhaps through the aid of questions); the entity definitions are then mapped to the underlying information architecture; and lastly, the results are feedback though a touch-point layer to the end-user. In case 2, this touch-point layer was in the form of indicators; whereas in case 3, the touch-points were in the format of user interface screens.

Figure 8-1: The GbIF Model



Lastly, the *data source* step acts as a constraint identifier. If information is not available in the under-lying information infrastructure, it will either need to be modified to accommodate the new information requirements, or objectives and entity definitions will need to be rethought.

8.2 Summary of Findings

This research indicates that the goal-driven model works in a variety of multi-source information retrieval and integration situations and can be successful in low maturity environments. Specifically, for the low maturity organisation, the goal-based information framework was found to be adaptable, flexible, expansive, focused and descriptive.

The literature puts forth several cases of successful use of GQM and goal-driven derivatives. The real-world use of GQM, and subsequent publication of case studies, spans nearly 20 years indicating that the methodology is truly useful and not just a passing 'fad'. As a framework, GQM has proven itself to be adaptable and flexible to different organisations and the changing needs of the software measurement field. The industry examples outlined in the literature review show that the GQM methodology in practice today differs significantly from the original idea put forth by Basili and Weiss in 1984. Not only is the framework adaptable, but it is flexible as well. As discussed in the literature review of the Nokia, IBM and CS Foundation cases, GQM works well with additional methodologies and can be adapted for a particular organisation. Several examples in the literature and the different process steps outlined in cases 2 and 3 also illustrate the adaptability of goal-based methods – not only did it address the original purpose of software measurement, this research illustrates its potential for information retrieval and exchange problems. The method's flexibility was also illustrated in case 3. In this case, a single hierarchical model did not prove to be appropriate. Rather two sub-models were necessary to outline integration-readiness and third complete model was used to represent the information exchange environment.

This research also shows that goal-based methods are both focused, yet could be expansive as well. The case studies (particularly 1) as well as some of the reviewed literature show that goal driven methodologies have a tendency to grow in scope to quickly become unmanageable. If too many questions are asked, information efforts could become too expensive to manage. If this risk is not mitigated (by limiting

metrics as in the Nokia example put forth in the literature or in case 1), this could be a significant risk for a low maturity organisation. However, somewhat paradoxically, by focusing solely on the predetermined objectives and goals, goal-based methods also limit the data collection exercise. Some critics argue that this is limiting in that it does not allow for 'discovery' of new information, but in some situations this perceived weakness may be considered a virtue as time and money are not wasted seeking extraneous information.

This research differs from the literature in that it contends that goal-based models are useful in a descriptive, rather than prescriptive manner. Due to the complexity and lack of discovery, prescriptive models are difficult to determine in advance. This was evidenced in all three cases, but particularly true in case study three (which required several iterations). Since, by design, goal-based methodologies limit knowledge discovery, this research suggests that the primary functional use for the GbIF is in defining and documenting relatively static information retrieval needs, and providing accurate and timely information to address those needs. Whereas the previous literature had only considered goal-based methods for use in measurement problems, this research suggests the goal-based model is most appropriate for more general briefing, awareness and fact finding functions.

Additionally, there are several success factors that were not identified or explicate in the literature. A theme that repeatedly emerged in the research is the notion of limiting metrics or questions. Case 1 presented an innovative approach to the problem of limiting metrics. Unlike the Kilpi example at Nokia (2001), metrics were not limited by management or predetermined, but were constrained in number. Basically line managers could ask what ever they liked, but could ask no more than nine things (see appendices and Miller 1956). This forced them to consider the information that would be most useful to their particular piece of the business and encouraged them not to add too many requirements.

A second success factor that arose, predominately in the case studies, was the proper and thorough identification of stakeholders. Given the cultural change necessary to

make any information systems project a success, it is unlikely that a goal-based project initiative can be successful without a strong and on-going commitment from the management team. This was particularly evident in cases 1 and 2. However, in a goal-based initiative it is important not to get enamoured with the methodology itself. Early on in the planning stages of case 1, the methodology was shared with the stakeholders in an attempt to get buy-in. Unfortunately, it opened up extensive discussion on the choice of methodology, competing options and general confusion. After that early false start, it was decided that the business owners did not need to know that they were following a specific process to elicit objectives and goals and the process (especially use of acronyms) was masked (Shuman 2002). The use of the model was masked in cases 2 & 3 as well. The GbIF is a useful tool to determine and evaluate information needs; as such it is dangerous to be a stickler to process if it's counter-productive to producing desired results. Additionally, with goal-based methods, success does not occur in isolation – all of the cases relied on participation from the various segments of the business, be it management or IT or cross-functional teams (users of the information). One of the most startling conclusions in cases 1 and 2 was the overwhelming predominance of personal information sources (mostly spreadsheets, email files and Word documents). These proved to be enormously useful in determining what people used information for, how it was gathered and what information is important. Also in case 2, personal knowledge was evident in discussion of how people did their jobs (inherent knowledge). This sometimes differed drastically from the organisational process documentation and official procedures.

In a low maturity environment, systems are likely to be ad hoc, poorly designed or already over taxed. In all three cases, the information retrieval plan was developed independently of pre-existing reporting and information provisioning platforms (the third success factor). After the analysis is complete, sections of the pre-existing platform were used, but only after the determination that it was right for the purpose (and not to save time, money or effort). In cases 1 and 2, there was a significant amount of legacy reporting that was no longer used. The goal-driven methodology quickly identified redundant metrics that were outdated and the measure definitions

that were no longer correct. These finding confirm the importance of maintaining tractability from high-level objective to data elements.

The fourth success factor was the definition of a common language. Since most of the examples outlined in the literature focused on a singular problem area (software measurement) within a fairly narrow field (software engineering), this issue was only really highlighted in terms of defining metrics. When applied in a wider context (cross-function organisational information retrieval and integration), it quickly became clear that organisations do not speak the same language and that a common definition for even the simplest terms (e.g. customer) are necessary. The entity definition phases are particularly suited to helping to define a single organisation nomenclature. Take for example the metric of Average Days Outstanding (ADO) in case 2; prior to the implementation of the GbIF, there was no consistent method to determine service level response rates.

8.3 Further Research & Implications for the Field

There is a long history of the use of GQM/GQIM in the software quality discipline and this research indicates that GbIF is useful in different contexts. However, additional work needs to be conducted to benchmark the GbIF as an information flow documentation and evaluation tool. The logical next step in the development of the GbIF will be the specification and publication of a generic reference model, similar to Park et al's handbook (1996). The specification will include seven sections (encompassing much of this research):

1. **Introduction** outlining the current state of practice and rationale behind the method.
2. **Objective Setting** including identification of stakeholders and objectives, goal elicitation and the use of questions.
3. **Entity Definition –** guidelines on the identification of primary information entities and attributes. This section will also include instructions on contextualisation of the information needs.

4. **Touch-point Specification** – the next section will be outline how to identify and specify both the user touch points (indicators) but also the data/application interfaces necessary to facilitate the information flow (from source to user)
5. **Infrastructure** – In section five, guidelines for evaluating available data sources and conducting information gap analysis will be presented.
6. **Constraints and Refinement** – in this section, the specification will outline how to identify and document constraints and refine the model accordingly.
7. **Packaging and Maintenance** – the final section will discuss presentation, automated data collection and expanding the model to incorporate new information needs.

With a well specified process, software could be developed to aid in the construction and maintenance of GbIF models.

What are the implications of this research for the field? First, it is apparent that as the information ecosystem becomes increasingly more complex (discussed in the *state of practice* sections of Chapters 5 and 6), new methods will be necessary to document and evaluate information flow. Goal-based methods are one such avenue to begin to address this need. However, to be truly effective GQM/GQIM (as well as the newly presented GbIF derivative) will need to be further adapted and improved upon to address these new challenges. Additionally, it is unlikely that goal-based methods alone are the only answer. The research has shown that goal-based methods are poor at information "sensing" and discovery functions. Undoubtedly, a complete information model will include techniques to address this deficiency. A starting point for researchers and practitioners may be in the field of data mining.

The second implication for the field is the recognition that the needs of the low maturity organisation are different than those with greater resources. Through this research, we have seen that less mature organisations may not have the resources to embrace complicated or idealistic methodologies. However, not only does further

work need to be done in the specification and documentation of the GbIF, the notion of "low maturity" itself needs to be explored and defined through further research.

Lastly, Ciborra points out that most systems analysis methodologies were designed to represent the flow of information in machines and were later adapted to describe organisational information flow (1998, p. 38). Since the method begins with the human information need as a starting point, further research should be conducted to investigate the suitability of using the GbIF (or a derivative) as a human-centric flow charting method.

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9.2 Recent Publications (2001 – Present)

Below is a list of academic and practitioner publications that were generated during the early concept and definition phases of the research project.

Academic Journals

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Unpublished Whitepapers

Boyd, Andrew (2002a); "Developing a Unified Information Infrastructure Through Goal-Driven Systems Development", Unpublished Whitepaper, January 2002

10 Glossary

Acronym	Short Definition	Definition
ADO	**Average Days Outstanding**	Metric used in case 2 to measure responsiveness of the support team.
API	**Application Programming Interface**	*Application Programming Interface) A language and message format used by an application program to communicate with the operating system or some other control program such as a database management system (DBMS) or communications protocol. APIs are implemented by writing function calls in the program, which provide the linkage to the required subroutine for execution. Thus, an API implies that some program module is available in the computer to perform the operation or that it must be linked into the existing program to perform the tasks.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
B2B	**Business to Business**	*Refers to one business communicating with or selling to another.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
	BASEL II	Basel II is an effort by international banking supervisors to update the original international bank capital accord. From: http://www.federalreserve.gov/generalinfo/basel2/default.htm
BPOAI	**Business Process Oriented Application Integration**	According to Linthicum (2004a, p. 56), Business Process Oriented Application Integration (BPOAI) provides "a single logical model that spans many applications and data stores, providing the notion of a common business process that controls how systems and humans interact to fulfil unique business requirements."
BSC	**Balanced Scorecard**	Managerial system that links rounded performance measures to high-level business objectives. Developed by Kaplan and Norton, BSC presents the four views of the organisation: financial, customer, internal, and learning and growth.
CMM	**Capability Maturity Model**	*A process developed by SEI in 1986 to help improve, over time, the application of an organization's supporting software technologies. The process is broken down into five well-defined levels of sequential development: Initial, Repeatable, Defined, Managed and Optimizing.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
CMS	**Content Management System**	*Software that manages documents for Web sites. It provides for the storage, maintenance and retrieval of HTML and XML documents and all related elements.* From :

		http://www.techweb.com/encyclopedia/defineterm.jhtm
	Composite Application	*An application built by combining multiple services. A composite application consists of functionality drawn from several different sources within a service oriented architecture (SOA). The components may be individual web services, selected functions from within other applications, or entire systems whose outputs have been packaged as web services (often legacy systems).* From: http://looselycoupled.com/glossary/composite%20application
CRM	**Customer Relationship Management**	*An integrated information system that is used to plan, schedule and control the presales and post-sales activities in an organization. CRM embraces all aspects of dealing with prospects and customers, including the call centre, sales force, marketing, technical support and field service.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
DTD	**Document Type Definitions**	A template that defines the contents of an XML document.
EAI	**Enterprise Application Integration**	*Refers to integrating applications internally within the organization.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
ERP	**Enterprise Resource Planning**	*An integrated information system that serves all departments within an enterprise. Evolving out of the manufacturing industry, ERP implies the use of packaged software rather than proprietary software written by or for one customer. ERP modules may be able to interface with an organization's own software with varying degrees of effort, and, depending on the software, ERP modules may be alterable via the vendor's proprietary tools as well as proprietary or standard programming languages.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
GbIF	**Goal-based Information Framework**	A new goal-based method, based on GQM and GQIM, presented in this research. GbIF takes the early GQM/GQIM research beyond the its roots in software engineering to provide a generic evaluation and documentation method to understand information retrieval and exchange.
GQIM	**Goal-Question-Indicator-Measure**	The GQIM method is a way for software evaluators to ensure that the software measurement achieves pre-determined business objectives. An off-shoot of GQM, GQIM adds an "indicator" definition step. Indicators include tables, graphs or other graphical representations of data that link back to questions.
GQM	**Goal-Question-**	A method to collect software engineering data, whereby the goals

	Metric	are established, questions linked to the goals are posed and metrics are derived to satisfy the questions.
HIPAA	**Health Insurance Portability & Accountability Act of 1996, Public Law 104-191**	Title II provides standards for patient health, administrative and financial data interchange.
HTTP	**Hyper-Text Mark-up Language**	*The communications protocol used to connect to servers on the Web. Its primary function is to establish a connection with a Web server and transmit HTML pages to the client browser or any other files required by an HTTP application.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
	Information Channel	Method by which an information-seeker receives information or data. Includes: Email, Web, Face-to-Face, Fax, Telephone, Instant Messaging and Text Messages.
	Information Flow	The way information moves through a system or organisation.
	Information Source	Repository (database or file) where information is stored.
IOAI	**Information-Oriented Application Integration**	Creating a mechanism to exchange data between two or more applications (including databases, devices and application APIs).
LMO	**Low Maturity Organisation**	An organisation without an innate information processing competency.
OEI	**Objective - Entity - Infrastructure**	An earlier conceptual model similar to the GbIF.
OGSM	**Objective, Goal, Strategy, Measure**	A consulting method whereby objectives are specified, goals are linked to high-level objectives, strategies are defined and measures are outlined.
POAI	**Portal-Oriented Application Integration**	Portals are a means of presenting information from disparate sources within the organisation (Knorr, 2004, p. 46) and Portal oriented application integration provides a composite view of information.
POS	**Point of Sale**	*Capturing data at the time and place of sale. Point of sale systems use computers or specialized terminals that are combined with*

		cash registers, bar code readers, optical scanners and magnetic stripe readers for accurately and instantly capturing the transaction. From : http://www.techweb.com/encyclopedia/defineterm.jhtm
SMS	**Simple Message System**	Text messaging technology in mobile phones
SOA	**Services Oriented Architecture**	*A system for linking resources on demand. In an SOA, resources are made available to other participants in the network as independent services that are accessed in a standardized way. This provides for more flexible loose coupling of resources than in traditional systems architectures.* From: http://looselycoupled.com/glossary/SOA
SOAI	**Services Oriented Application Integration**	Allows applications to share common business logic or methods.
SOAP	**Simple Object Access Protocol,**	A web service message-based protocol based on XML for accessing services on the Web.
SOX	**Sarbanes - Oxley**	Enacted after the Enron and WorldCom scandals of the early 2000s, defines the type of records that must be recorded and for how long.
UDDI	**Universal Description Discovery and Integration**	*A web service technology. An industry initiative for a universal business registry (catalogue) of Web services turned over to the stewardship of OASIS in 2002 as the version 3 specification of UDDI was released.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
UI	**User Interface**	*The combination of menus, screen design, keyboard commands, command language and online help, which creates the way a user interacts with a computer.* From : http://www.techweb.com/encyclopedia/defineterm.jhtm
VAR	**Value Added Reseller**	An organization that adds value to a system and resells it.
W3C	**World-Wide Web Consortium**	*An international industry consortium founded in 1994 by Tim Berners-Lee to develop standards for the Web. It is hosted in the U.S. by the Computer Science and Artificial Intelligence Laboratory at MIT (www.lcs.mit.edu).* From : http://www.techweb.com/encyclopedia/defineterm.jhtm

	Web Services	A group of related applications that can be programmatically invoked over the internet. Often using one or more of the following technologies: SOAP. UDDI, WSDL *Automated resources accessed via the Internet. Web services are software-powered resources or functional components whose capabilities can be accessed at an internet URI. Standards-based web services use XML to interact with each other, which allows them to link up on demand using loose coupling.* From: http://looselycoupled.com/glossary/web%20services
WSDL	**Web Services Description Language**	A web services technology.
XML	**Extensible Mark-up Language,**	*A data description technology. open standard for describing data from the W3C. It is used for defining data elements on a Web page and business-to-business documents. XML uses a similar tag structure as HTML; however, whereas HTML defines how elements are displayed, XML defines what those elements contain. While HTML uses predefined tags, XML allows tags to be defined by the developer of the page. Thus, virtually any data items, such as "product," "sales rep" and "amount due," can be identified, allowing Web pages to function like database records. By providing a common method for identifying data, XML supports business-to-business transactions and has become "the" format for electronic data interchange and Web services."* From : http://www.techweb.com/encyclopedia/defineterm.jhtm

11 Appendices

11.1 Other Goal-Driven (Top-Down) Approaches[29]

GQM and GQIM are not the only goal-driven methodologies. Although, this may not be an exhaustive list, three additional methods are reviewed in this section, including: Kaplan and Norton's Balanced Scorecard (BSC), the author's own Objective, Entity, Infrastructure (OEI) Framework and Proctor & Gamble's Objective, Goal, Strategy and Measure (OGSM) method.

11.1.1 Balanced Scorecard (BSC)

Organizational evaluation techniques such as Kaplan and Norton's balanced scorecard (BSC) provide an interesting starting point when seeking to evaluate the business-focussed information-retrieval requirements. Instead of focusing on a historical financial perspective (like many analytical systems), BSC presents three additional operational considerations for measurement: customer satisfaction, internal processes and organizational learning (Kaplan and Norton, 1992).

Kaplan and Norton analogise that the BSC provides managers with an "airplane cockpit [-like]" view of the organization by answering four basic questions (1992, p. 126):

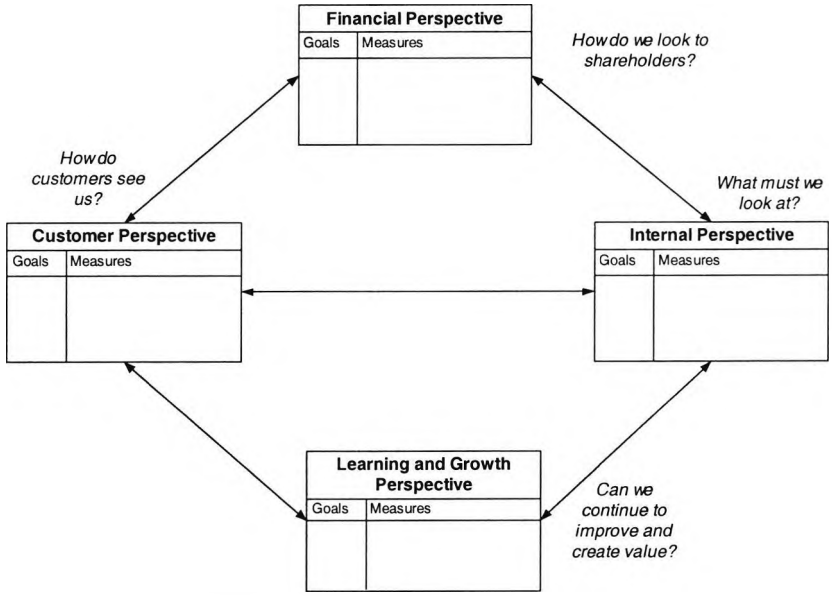
- How do our customers see us (customer perspective)?
- What must we excel at (internal perspective)?
- Can we continue to improve and create value (innovation and learning perspective)?
- How do we look to shareholders (financial perspective)?

---

[29] Much of this section previously appeared in Boyd and Boyd, 2002.

All of these questions are crucial for managers to consider when evaluating information needs. The four disparate views are linked and connected into a single management report for cross-functional managers, creating a single view of the business (Figure 11-1). The advantage of this approach is that it "minimises information overload by limiting the number of measures used" (Kaplan and Norton, 1992). According to Kaplan and Norton, "companies rarely suffer from too few measures" implying that the proliferation of measures can cause managers to defocus from the most critical (HBR, 1992).

Figure 11-1: Balanced Scorecard Links Performance Measures



Source: Kaplan and Norton, HBR, 1992

Below, each of the four scorecard perspectives is fully explored.

11.1.1.1 Financial Perspective

While it is good management practice to link financial objectives to overall strategy, all too often corporations use the same blanket measures for all divisions (Kaplan and Norton, 1996, p. 47). Instead they recommend crafting financial measures that are based on the strategies of the company. For example, growth businesses may wish to measure percentage of revenue or sales growth in new markets or to new customers;

"sustain-stage" business would naturally be more interested in profitability measures. Conversely, "harvest" stage business would be interested in operating cash flow measures and reductions in working capital (Kaplan and Norton, 1996, pp. 48-49). Ultimately, these strategic themes drive the types of measures that are used to construct the scorecard.

11.1.1.2 Customer Perspective

In this perspective, companies determine the customer or market segments that they compete in and develop metrics accordingly; "these segments represent the sources that will deliver the revenue component of the company's financial objectives" (Kaplan and Norton, 1996, p. 63).

With the segments identified the company must create a value proposition that addresses the target customer's needs. Customer metrics would include satisfaction, loyalty, retention, acquisition and customer profitability. In practice, Kaplan and Norton found that companies often produce two sets of customer measurements – generic metrics that apply to nearly all companies and metrics based on potential differentiators. Metrics in the core group would include market share, customer retention, customer acquisition, customer satisfaction and customer profitability (Kaplan and Norton, 1996, p. 67). Value proposition customer metrics might include product/service attributes (what makes the product or service different and is that sustainable?), customer relationship (delivery of the product or service) or image and reputation.

11.1.1.3 Internal Perspective

In this perspective the organisation identifies the processes that it must excel at to address the financial and customer objectives (Kaplan and Norton, 1996, p. 115). Specifically mentioned are the innovation, operations and post-sale processes. To innovate, the company must sense the needs of its customers and translate those needs into new products and services. Operations ensure that the products are services

are delivered. Finally, the third process revolves around how well the company delivers post-sale service and support.

Innovation measures could include: percentage of sales from new products, rate of new product introduction (vis-à-vis competition) and time to market (Kaplan and Norton, 1996, p. 100-101). Product development will have its own set of metrics (for instance errors per thousand lines of code or bug counts are common in the software business). Post-sale service metrics include items such issues closed in a single call, and cross-sell, up-sell and repeat purchase ratios. Operations metrics measuring quality, costs and time are relatively common in most businesses. However, Kaplan and Norton urge companies to use this perspective to identify performance measures based on the expectations of customers segments outlined in the company perspective (Kaplan and Norton, 1996, p. 115).

11.1.1.4 Learning and Growth Perspective

According to Kaplan and Norton, the purpose of this perspective is to provide information and the infrastructure to enable the organisation to achieve the objectives set out in the other three perspectives (Kaplan and Norton, 1996, p. 126). When managers are rewarded and motivated on achieving short-term goals, it is difficult to invest (either in training, systems or process that have longer payoff periods) in longer term initiatives. The inclusion of this perspective ensures that those investments are being made and are measured. Through Kaplan and Norton's research three categories of internal perspectives emerged: 1) employee capabilities, 2) information systems and 3) motivation, empowerment and alignment (1996, p. 127).

Metrics in the employee group include employee satisfaction, retention and productivity. An expanded group of metrics might include: strategic job coverage or availability of strategic information.

In the literature, this seems to be the most esoteric perspective. As such, it is interesting to note that the Kaplan and Norton research also found that organisations most often lacked formal measurements on this perspective (1996, p. 144).

11.1.1.5 Building a Balance Scorecard

To begin using the BSC method Kaplan and Norton suggest that the organization must determine goals and measures for each area of concern including financial, internal processes and innovation and learning and customer satisfaction.

Kaplan and Norton believe that each organisation is unique and methods for building a scorecard will differ (HBR, 1992, [2000, p. 172]). At some organisations, such as AMD and Apple, the senior financial manager develops the initial scorecard, as this person is likely familiar with the strategic goals of the organisation. At other organisations that have not yet determined a strategic the approach is more iterative. Kaplan and Norton outline an eight-step process for scorecard development (HBR, 1992 [2000, p. 176-7]):

1. **Preparation** – the first step is to identify a business unit for the first implementation. This unit should be self-sufficient, with its own P&L, customers, product and distribution.

2. **Interviews: First Round –** next, a background pack is prepared for a core group of 6-12 senior managers. This pack contains background information on the balanced scorecard, as well as the company's vision, mission and strategy. A BSC facilitator conducts interviews with this group of executives to obtain their view the company's objectives and their initial views on possible scorecard measures. This interview round may also include external stakeholders such as customers and significant shareholders.

3. **Executive Workshop: First Round –** the management team is then gathered in a workshop setting to discuss the proposed strategy. With consensus on the strategy, the groups is then asked to answer this question: "If I succeed with

my vision and strategy, how will my performance differ for shareholders; for customers; for internal business processes; and for may ability to innovate, grow and improve?" With this information, the group is asked to put forth proposals for operational measures.

4. **Interviews: Second Round** – in this stage, the facilitator collects all of the information from the rounds of interviewing and workshops and interviews each of the senior executives about the proposed scorecard measures. In these interviews, the facilitator tries to suss out expected operational issues in implementing the scorecard.

5. **Executive Workshop: Second Round** – in the next round of interviewing the group is expanded to include direct reports of the first group, some middle management.

6. **Executive Workshop: Third Round** – in this round the senior executives review the previous work and try to come to a consensus on the vision, objectives and measurements. Additionally an implementation plan is outlined, including the communications plan to employees and information systems development.

7. **Implementation** – a dedicated team is formed to implement the programme including linking the objectives to the database and communicate to programme to the organisation. Here feedback from the line staff could be incorporated to expand the scorecard.

8. **Period Review** – quarterly or monthly metrics are prepared for executives. Annually, the programme is reviewed to assess the need for additional information.

Steps 1-4 of the GbIF model may be useful for the objective setting parts of the implementation programme outlined above. The remaining steps of GbIF would be useful in steps 7 & 8 depicted above.

11.1.1.6 An Evolving Method

In later work, Kaplan and Norton outline how the BSC can be used as a strategic management system (1996). This process involves four steps:

- Translating the vision
- Communicating and linking [strategy to unit and organizational goals]
- Business planning
- Feedback and learning [through testing and gathering feedback]

Clearly, BSC provides an interesting starting point in beginning to provide a framework for the evaluation of organizational information needs, particularly with the focus on customer satisfaction measures as criteria for success. However, the method is limited in that it traditionally is a business-focused evaluation method that predetermines evaluation areas. Although, for the right application, this could have its strengths. McKeehan et al (1998, p. 5) point out that the limited number of metrics that managers have at their disposal for quick reference is a major benefit of the balanced scorecard.

11.1.1.7 Comparison of BSC and GQM

There are a few fundamental differences between GQM and BSC. Some argue that GQM is a *technique* for deriving measures, whereas BSC is a *performance measurement framework* (Buglione and Abran, 2000). However, given the discussion in the main body of this research, this assertion could prove debatable. Regardless, the literature presents evidence that the two techniques are not mutually exclusive. Becker and Bostelman advocate a combined BSC and GQM approach to "bridge the gap between business and technical management" (1999, p. 49). The benefits of this combination are three-fold:

1. **Common vision** – Goals are agreed (or at least understood) throughout the organisation from senior management down to project participants

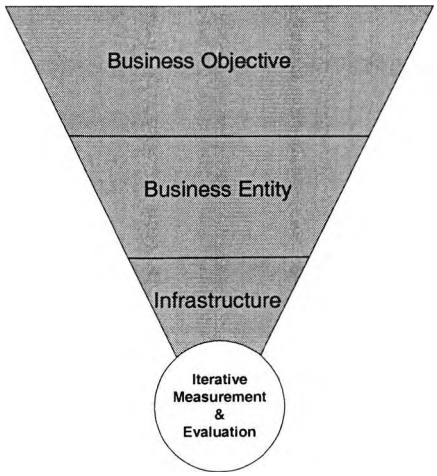
2. **Information infrastructure** – Dictates and promotes common data collection and dissemination
3. **Balanced perspective** – Takes into consideration both internal and external considerations (i.e. customer, financial, process and learning)

With the well-defined perspective outlined in BSC, and the wealth of metrics put forth in BSC literature, GbIF could be a good tool to help organisation identify and extract BSC information from underlying information systems.

11.1.2 Objective, Entity, Infrastructure Framework (OEI)

Another technique is the (OEI) framework (Boyd 2002a, 2002b, 2002c). Based on GQM this method was developed for use in the analysis and design of information systems. The OEI framework (Figure 11-2 and 10-3) presents both practitioners and researchers with an evaluation method whereby, like BSC, high-level organizational objectives are linked to specific measures of success. However, it goes one-step further than BSC by linking the measures with the underlying organizational information architecture.

Figure 11-2: The Objective, Entity, Infrastructure Evaluation Model

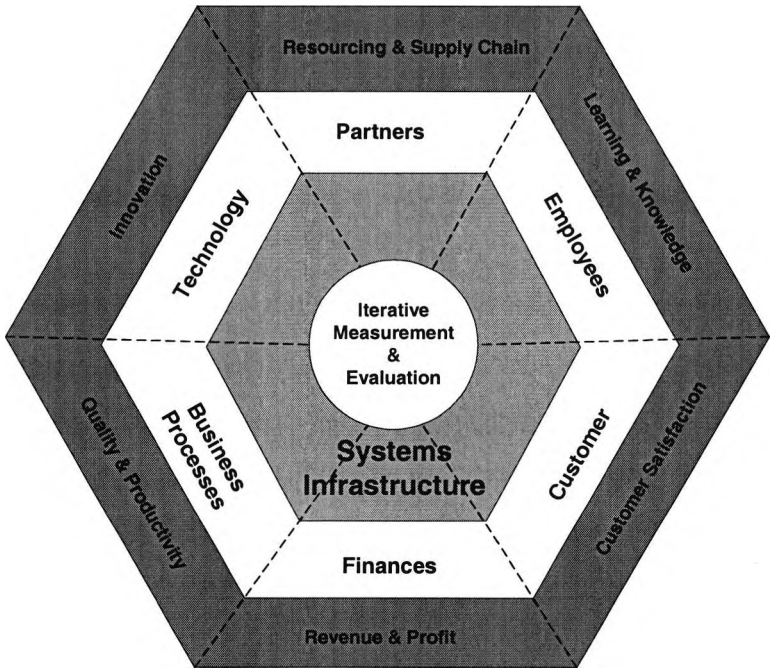


The OEI framework starts with the information-retrieval objectives. Next, users must determine each business entity that will need to be influenced or affected to achieve

the business objective. Entities can generally be considered the nouns of OEI. That is, entities are the "person, place or thing" that will be directly impacted when achieving objectives. Lastly, entities are mapped to the information architecture and a gap analysis is conducted to determine what information exists and what will need to be developed to support the evaluation program.

Once the OEI exercise is completed for each of the business goals, a new paradigm emerges that encompasses all of the BSC considerations such as Customer, Finances, Business Processes and Innovation and Learning, as well as non-BSC factors such as partners, employees and technology (Figures 10-3 and 10-4). This figure is illustrative in nature, as each firm's OEI framework model will differ depending on the stated objectives and influenced entities of the organization. Using this paradigm, the project goals are put into the context of larger organizational considerations.

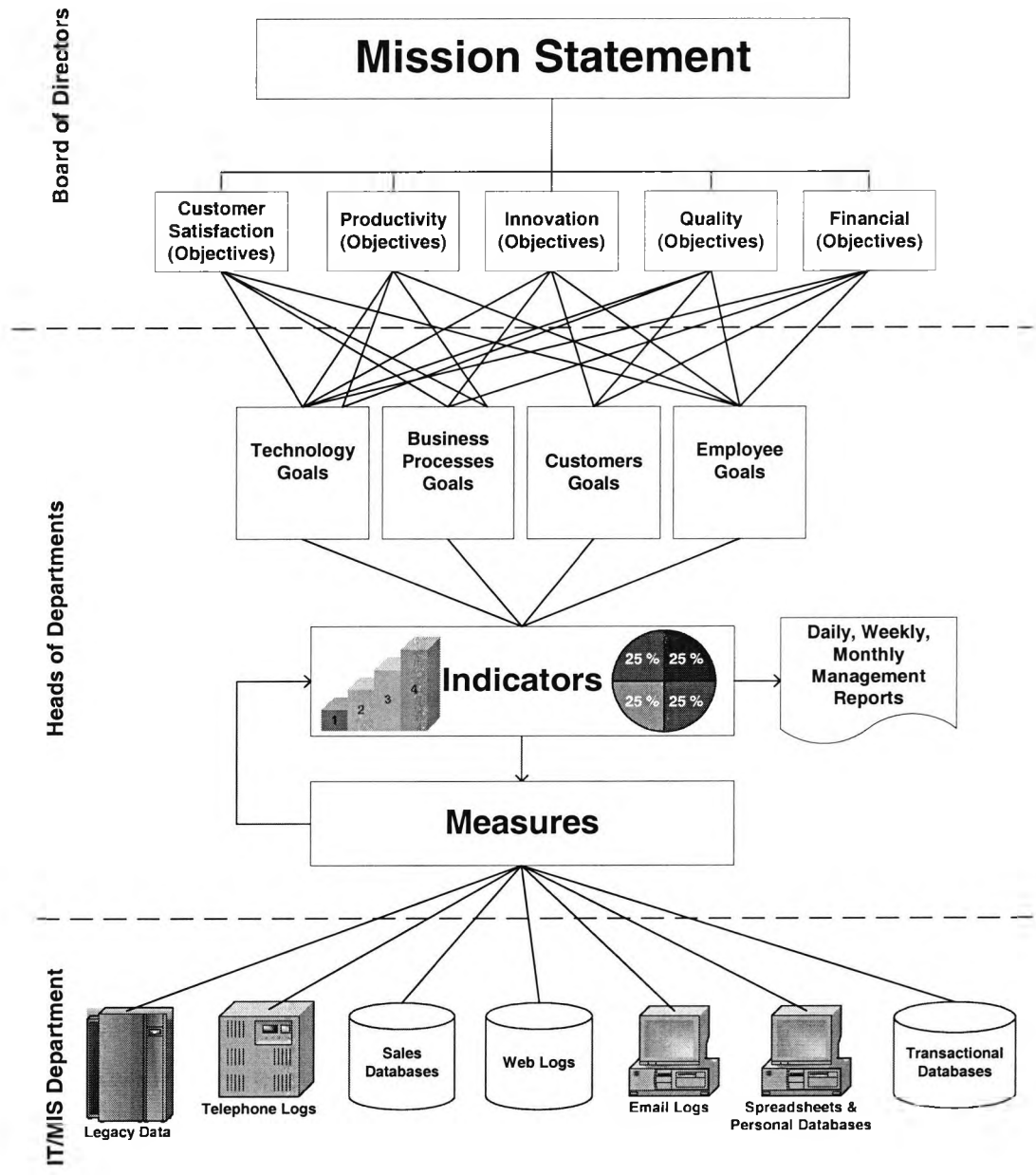
Figure 11-3: The OEI Framework for a Typical Business



Sources: Adapted from Boyd 2002b, p. 22, and Boyd and Boyd, 2002

As seen below, the linking of the high level objectives to entities and finally the underlying infrastructure follows a GQM like process (Figure 2-6).

Figure 11-4: Linking Mission Statement to Information Infrastructure



Source: Boyd 2002b, p. 24

Again, like GQM, this technique is highly flexible and can be adapted to a number of situations. Figure 11-5 below shows how OEI is limited to specific project objective – understanding a multi-channel content management and delivery.

A classic illustration of why a technique such as OEI is useful can be found at most organisations that engage in e-commerce[30]. In many organisations, website content generation is often "stove-piped" away from the backend fulfilment and inventory systems. Not only does this cause problems in presenting outdated information on the website (leading to increased customer service contact and potential legal problems), but analysis of the entire business becomes problematic. For example, a typical process for an e-commerce site may be as follows:

1. Import or enter new products into product database
2. Edit or delete old offerings
3. Import new catalogue onto website
4. Generate marketing text and images for new catalogue offerings
5. Publish to website

This can be a daily, weekly or monthly process. Regardless of frequency, inventory levels must be monitored. Oftentimes, manual intervention is required to remove out-of-stock items from the site. This problem is compounded when multiple routes to market are being utilised – if a company runs out of an item, but has to manually remove the item for two or more separate systems, there is a risk that a customer may be disappointed when their order cannot be fulfilled.

These stovepipe or "silos" are caused when each functional area runs as its own fiefdom regarding content and decisions can be made autonomously as long as they fall within a certain budget. When developing a multi-channel information management strategy, the firm must first inventory and document all of its content sources, determining what already exists, where it is stored and how it gets processed. Next, a determination needs to be made as to what other content is likely going to be needed in the future. Once this gap analysis has been performed, the technology requirements can be specified. This process should be completed for each channel. Once completed, commonalities between the systems will be very apparent and the firm can begin to look at technology integration tools and methods.

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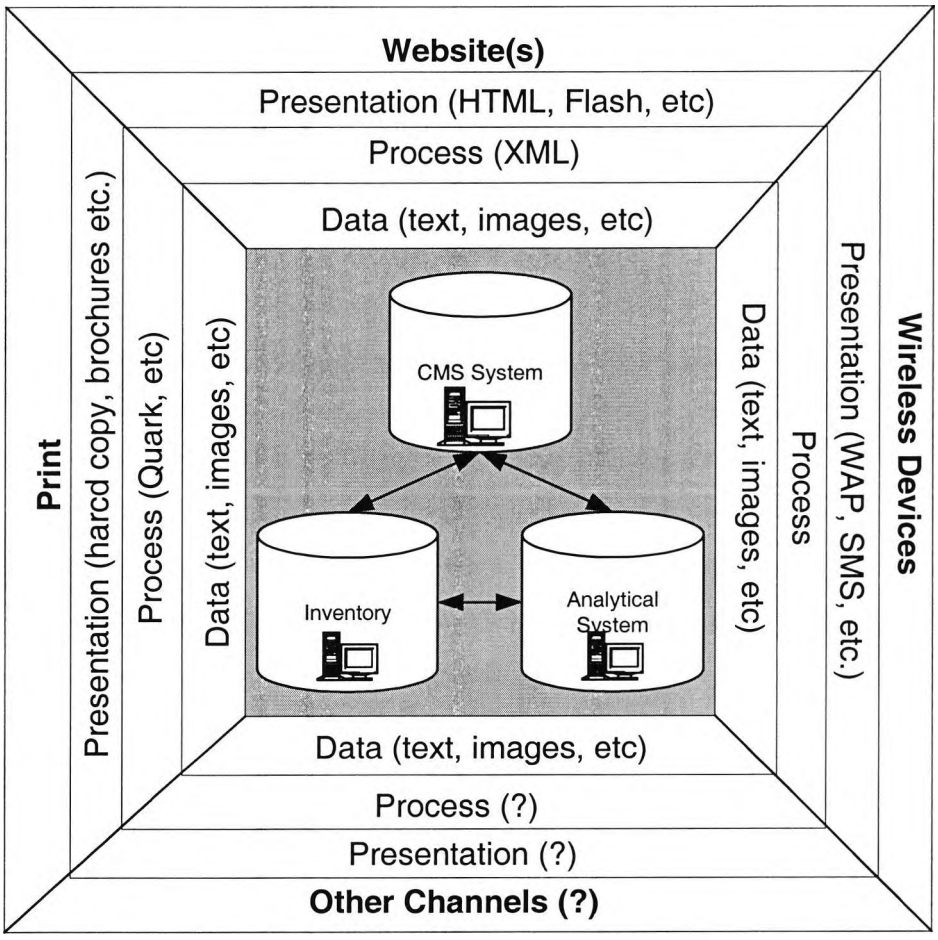
[30] This discussion was originally presented in Boyd 2002c.

Figure 11-5: Multi-Channel Content Management & Delivery



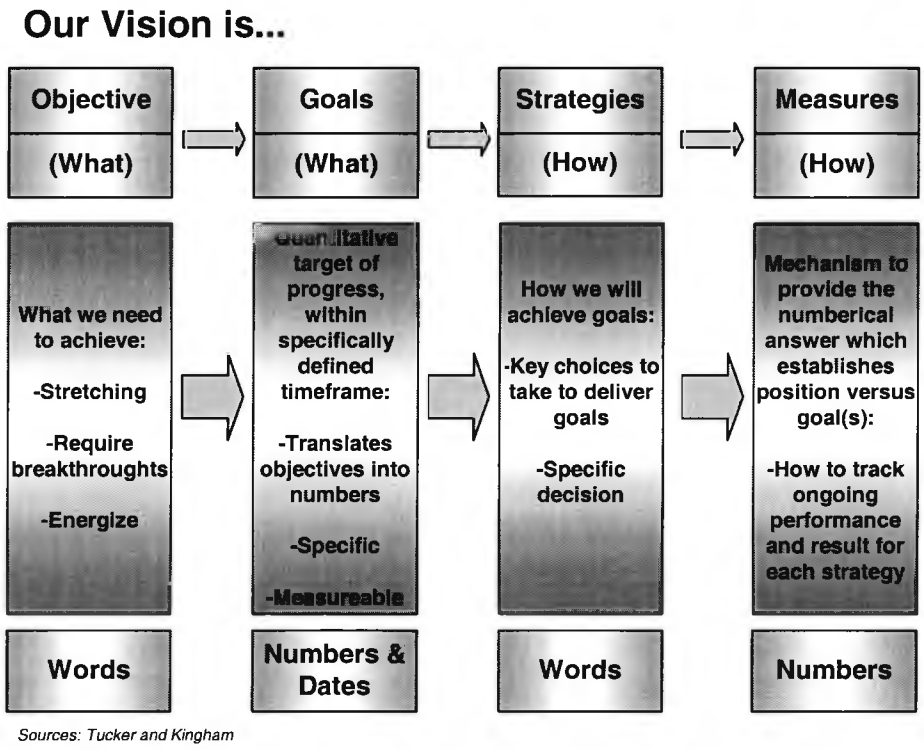
Source: Boyd 2002c, p. 10

The advantages of this technique are its flexibility and adaptability, and it specifically takes into consideration the underlying information architecture. Given its simplicity compared to other methods, expense should be minimal. However, it lacks the rigor of GQM and it could also be expansive. Clearly more work needs to be done before the OEI construct can be considered a truly useful tool for researchers and practitioners.

11.1.3 Objective, Goal, Strategy, Measure (OGSM)

Lastly, the objective, goal, strategy, measures (OGSM) method (Figure 11-6) also provides an interesting starting point for researchers and academics when evaluating information-seeking requirements. Although research indicates that this method was developed by Proctor & Gamble (Kingham and Tucker) and is commonly used by many consultancies, the verifiable origins of OGSM are unclear. OGSM starts with business objectives that are linked to the overall organizational vision, and then links goals to those objectives. Objectives are what the users want to accomplish, whereas goals are achievable targets that address those objectives. Strategies outline how the user will accomplish goals, and measures determine the effectiveness of strategies. Once the exercise is completed, the organisation has articulated its high-level objectives and has produced a documented and measurable strategic plan.

Figure 11-6: The OGSM Model



Sources: Tucker and Kingham

The adaptability of OGSM is demonstrated in an example (Table 11-1, which included an 'assumptions' step) for use in evaluating multi-channel developmental objectives Boyd (2002f, p. 15).

Table 11-1: OGSAM for a Multi-channel Strategy

Objectives	Goals	Strategies	Assumptions	Measures
Generate new revenue through content reuse	100,000 of incremental revenue	Launch a mobile channel, reusing web content	20% of customer base (100,000) will use new channel Customer will pay £5 for new content	20,000 x £5 = £100,000

Source: Adapted from Boyd 2002f, p. 15

Although the literature on OGSM is sparse, the method seems to be fairly flexible, adaptable and rigorous. Nor does it seem that it would be all that expensive to deploy and administer. Weaknesses are similar to GQM in that it may be expansive and may focus too much on pre-determined measures, not necessarily allowing for discovery. Again, more work needs to be done to determine the usefulness of OGSM and derivatives.

11.1.4 Comparison of Evaluation Methods[31]

A common theme in all the evaluation techniques is the starting with business objectives and building an evaluation program around that core. Undoubtedly, without a clear and demonstrable objective, any goal-based method is likely to fail to meet expectations. Each of the discussed methods has advantages and disadvantages

[31] Elements of this section are adapted from Boyd and Boyd, 2002

(Table 11-2) in how it guides the organization in translating high-level objectives into operational reality. However, without modification none of the methods are perfect for the evaluation of information flow.

Table 11-2: Comparison of Evaluation Methods

	Strengths	Weaknesses
Balanced Scorecard	Well documented, deployed in major corporations and supported by consultancies.	Still heavily focused on financial and business measures. Limited in scope (predetermines evaluation areas).
GQM	Well documented and widely deployed. Flexible, Adaptable	Propensity to create too many metrics. Questions about "green-field" repeatability. Top-down approach limits the discovery of new information. Documentation written in the context of software measurement and evaluation with limited use in wider context.
GQIM	Strengths of GQM, but incorporates high-level business (organisational) objectives.	
OGSM	Very flexible and easily grasped at all levels of the organisation.	Minimal documentation, no rigorous method.
OEI	Ties high-level business objectives to the organisation's information architecture. Flexible in handling customised business objectives/situations.	Methodology untested in evaluating business relationships. Processes are undocumented.

11.2 The Low Maturity Organisation: A Working Definition

This section will begin to explore the notion of information maturity and define the concept of a "low maturity organisation" (LMO) for the purposes of this research. A baseline understanding of maturity is important to understand an organisation's innate abilities to begin to address information disparity.

In the immature organisation, processes are improvised (or, if specified, are not rigorously adhered to), reactionary and short-term focused (Paulk et al, 1993, p.2). As a result planning is ad hoc, budgets and schedules are often wrong and overall

quality suffers in efforts to meet arbitrarily set budgetary and timing constraints. In low maturity environments, it is recognised that information systems decisions are driven by technological and cost issues (Jiang et al, 2001, p. 3). As planning matures, goals begin to guide and direct organisational behaviour (Abdel-Hamid et al 1999). As organisations grow, the focus shifts from technical and cost-based to an organisational desire to incorporate pervious lessons-learned into an improvement cycle (Paulk et al, 1993).

Planning maturity has long been known to be a factor of success in information systems projects (Jiang et al, 2001) and several constructs exist to classify organisational maturity (OM) in a quality context (i.e. ISO, CMM, TickIT). Only one of the reviewed OM frameworks (Information Orientation) links an organisation's ability to use information to its performance. However, the reviewed literature is devoid of any explicit linkage that between organisational maturity and goal-setting methodologies. Again pulling from software and engineering disciplines, a good maturity model exists (e.g. CMM) that more than adequately lays the framework for understanding organisational maturity as it relates to information behaviour.

11.2.1 Capability Maturity Model

The capability maturity model (CMM) is based on the principles of process improvement and was developed as a way for organisations to "gain control" of software development processes (Paulk et al, 1993, p. 5). Based on an earlier quality management construct and later adapted to a software process context, CMM consists of a five step process (Paulk et al, 1993):

1. **Initial** – Characterised as ad hoc (and possibly chaotic). Few defined processes and success deliver depends on individual (often heroic) effort.
2. **Repeatable** – Repeatable processes to track costs, schedule and functionality. Discipline is in place to repeat previous success.
3. **Defined** – Managerial and engineering processes are documented, standardised and integrated into organisational processes.

4. **Managed** – Quantitative measures are in place to understand and control projects
5. **Optimising** – Continuous quantitative feedback loop exists

This study primarily concerns itself with information disparity in low maturity information retrieval and integration environments. As such, the lower levels of CMM are likely the most relevant. In CMM, level 1 (initial) is a baseline used to measure later improvements and progress. For level 2 and beyond, there are a set of Key Process Areas that must be addressed. For instance, to be classified as a CMM Level 2 organisation, the following activities[32] must be undertaken (Paulk et al, 1993, p. 31):

- Configuration management
- Quality assurance
- Subcontract management
- Project tracking and oversight
- Project planning
- Requirements management

For a level 3 organisation, activities include:

- Peer reviews
- Inter-group coordination
- Software product engineering
- Integrated software management
- Training programme
- Organisation process definition
- Organisation process focus.

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[32] The idea that levels consist of certain "key" activities is being conveyed. In an organisational information behaviour context, the key activities will obviously be different than in CMM. For a complete definition of each activity, see Paulk et al, 1993.

It is important to note that lower maturity organisations can and do use key activities from higher levels. However, attainment is only achieved when practices are followed in every situation, even when a crisis threatens to impact the project. The advantages of this tiered-maturity framework is that as higher levels of maturity are achieved, costs drop, development time becomes more predictable and shorter (as much of the rework common in level 1 organisations is eliminated), and quality and productivity increases. The obvious learning for an organisational information behaviour context is the necessity for low maturity organisations to move beyond ad hoc and chaotic information behaviour and deploy:

- Documented and repeatable information gathering processes
- Consistent definitions and metrics
- Maintain traceability from source to output
- Planned and managed information-seeking efforts

As the organisation matures further, it can begin to address:

- Cross-function information gathering
- Training
- Organisational information-seeking processes

11.2.2 Information Orientation[33]

The second reviewed maturity construct, Information Orientation (IO), reveals the results from two years of research that seeks to link corporate performance to an organisation's ability to use information (Marchand et al, 2001). However, the authors break with tradition to broaden the focus beyond the company's information technology practices to explore the interaction between people, information and technology that result in an organisation's "information orientation".

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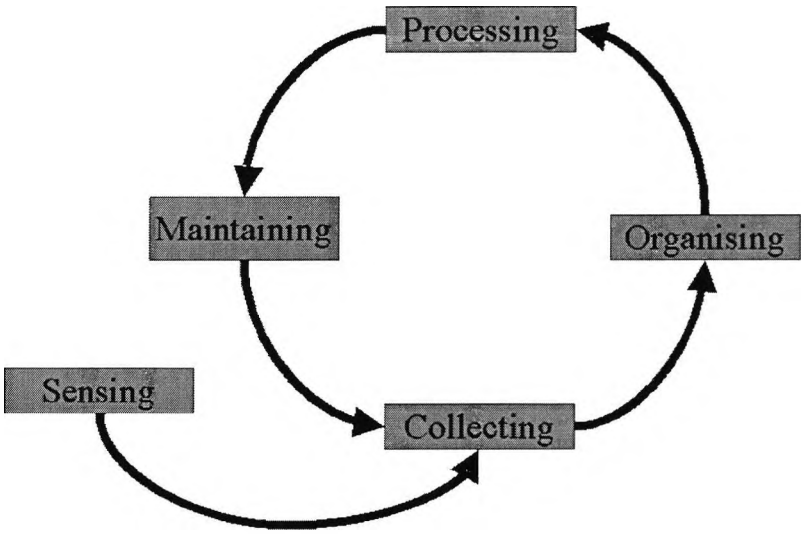
[33] This section was originally published in Boyd 2002d.

IO presents itself as a new paradigm that determines the degree by which a company gains competence across three information capabilities (Marchand et al, 2001, p. 1): information technology practices (ITP), information management practices (IMP) and information values and behaviour (IVB). While none of these focus areas are new to scholars or practitioners, historically each was considered in its own right as a mutually exclusive school of thought. For the purposes of this research, the relative score in each IO area may prove to be a basis for determining organisational maturity.

First, the authors examine senior managers' attitudes toward the applications and infrastructure that supports **operations, business processes, innovation,** and **management decision-making**. These four functions are considered separate and distinct, but interrelate to complete a picture of an organisation's IT competency. The authors argue that an organisational focus on just IT support for operations or business process will not likely significantly improve business performance. To perform well, an organisation must embrace all four competencies, including the more intangible and difficult to achieve – IT support for management decision-making and innovation. Furthermore, the authors contend that good IT support is only the beginning; organisations must also excel at information management and "people-based behavioural competencies".

Next, the Marchand et al discuss the life cycle of information management (Figure 11-7), whereby an organisation *senses, collects, organises, processes* and *maintains* information. The last four phases are interrelated creating an iterative information management cycle. Sensing, – which means to 'perceive, become aware of, or detect' information needs – feeds the collection phase, but falls outside the cycle.

Figure 11-7: The Life-cycle of Information Management



Source: Marchand et al, 2001, p. 76

Of the five phases, an organisation's ability to sense information is the most critical information valuation point. That is, it is at this point when the value of the organisation's information can be determined. Interestingly, the authors point out that an organisation's information management practices score low in managers' perceptions of relevance in the relationship to performance. However, their research suggests the exact opposite.

Having explored IT and Information Management practices, the authors turn their attention to people-centred information values and behaviours. The IVB competency consists of six core behaviours and values, including integrity, formality, control, transparency, sharing and proactiveness. The interrelationship between these six values and behaviours is what gives an organisation the ability to create and maintain a strong information management competency, particularly sensing. But again, the authors contend that IVB alone has little impact on overall business performance. It is the combination of information technology and management practices, with people-centred information values and behaviours that create a new framework to measure

business performance called "information orientation", or IO. However, excellence in one of the competencies is only a starting point. To achieve superior business performance, company must do well at all three competencies.

In conclusion (Chapter 9), the authors discuss developing IO maturity within the organisation and competing for the future. For most organisations, IO maturity is likely a premature concern; in that few companies have reached maturity in a single competency much less in all three. However, in the final chapter on competing for the future, the authors identify three information practices by which a company can establish leadership: use of competitive information, use of customer information and use of operational information. They conclude by presenting evidence that IO not only predicts business performance, but also managers' expectations about the ability to compete with information. This link suggests that if the company's IO is high, their ability to compete with information will be high as well.

Although Information Orientation raises some interesting points, it fails to present a usable model for organisational information maturity. The theory is sound, but IO seems to be in its embryonic state, much work needs to be done on IO before it offers a viable method to categorise the maturity of an information organisation. Additionally, it still seems geared toward organisations with significant resources.

11.2.3 Implications for this Research

The literature abounds with models and measurement frameworks that are applicable to specific contexts (e.g. software measurement) and are proven in organisations with established procedures. NASA, IBM, HP and Motorola have all developed goal-based measurement programmes of some sort – but what about the thousands of small firms that lack the resources of those multi-nationals? Drawing on the constructs above, regardless of size or turnover, in an information-behaviour context low maturity firms are characterised as:

- Ad hoc, chaotic and/or undocumented information processes

- Inability to repeat information searches that produce the same results (systems and data in a state of flux)
- Disparate systems that are not linked, containing duplicate or unsynchronised data
- Multiple systems or data sources with incorrect data (missing, out-dated or simply wrong)
- No repeatable process to determine the validity of data
- No tractability from high-level organisational goals to information infrastructure
- No consistently defined and documented organisational nomenclature
- No planned or managed information reporting

Instituting an information-gathering effort requires expertise, non-bias, access to data, cost, availability and motivation (Briand, 1997, p. 24). Low maturity organisations may have the access to data and motivation to implement a structured programme, but availability, non-bias, expertise and financial resources are likely to cause a problem.

In a commercial organisation, it is assumed that much of the sought-after (target) information will be measures and metrics of some sort. Rarely do companies, particularly less mature firms, expend resources or money on information gathering that is not directly relevant to the running of the business. That is, managers will be looking to get some sort of commercial information that is contained within the company databases, data-stores, log-files and even personal computers in the form of documents, spreadsheets and web-pages (multiple sources). This information will arrive in those sources from multiple communications channels (telephone, web, face-to-face, email, etc). The context of information-seeking will likely be for characterisation, monitoring, evaluation, prediction or control purposes. However, until a stable and repeatable process is in place (that is, the organisation has reached a modicum of maturity) evaluation, prediction or control models will likely be beyond the capabilities and resources of the low maturity firm. Lower maturity organisations will have undoubtedly will have a greater degree of difficulty in assuring the reliably

of data – much less have the financial or human resources to invest in developing repeatable and sustainable processes.

11.3 Case Study 1: Implementation of the Reference Model – GQIM at an E-Commerce Website

Founded in 1993, the company was a GOPHER based news service where magazines could post articles online. With the rise in popularity of the world-wide-web in 1995, it adapted its business model to provide website hosting, development and directory services for the publishing industry. By 1997, with the decline in advertising revenue the business adapted itself again to an e-commerce model. With this rapid growth and frequent changing of business models, the supporting information systems were generally one step behind. In the summer of 2000, the board commissioned a project to build an information system that would produce clean analytical data to support the organisation's information needs. A goal driven integration method was pioneered and further developed over the course of the project as a high-level taxonomy to guide the architects through the planning process.

Like many integration projects, this project was not considered by the organisation to be in the domain of the technology, marketing or finance departments. Since many of the problems lay in the inherent organisational structure, and many of the informational requirements would be conflicting, an entirely separate division reporting to the CEO was set-up to plan, execute and manage the project. A long-standing and respected member of the executive team headed the project. By following a goal-driven process, the team was able to deliver a system that met and exceeded stakeholder expectations. The project team completed the eight following steps over the course of an 18-month period:

1. Identify business objectives or desired outcomes
2. Identify goals and sub-goals for each objective
3. Identify questions that address business goals
4. Identify business entities and attributes
5. Define measures that will be used to construct indicators

6. Identify and construct indicators that will answer questions
7. Identify data sources that house the elements of measures
8. Implementation of Programme

11.3.1 Step 1: Identify Business Objectives and Desired Outcomes

According to David Shuman, Executive Vice President of MIS (Shuman 2002), before a single query was written or executed, the high-level organisational objectives needed to be determined by the management committee. To do this, each department head contributed his or her information requirements. Once that process was complete, the executive sponsor of the project synthesised the requirements into four high-level business objectives. Primarily, senior management wanted information that provided information that would enable managers to:

- Increase profitability by identifying the most profitable and least profitable campaigns, products and customers;
- Increase revenue opportunities;
- Reduce the number of dissatisfied customers, and;
- Decrease operational and transactional costs.

These became the business objectives of the project.

11.3.2 Step 2: Identify Goals

Once the high-level business objectives were determined, tangible and measurable targets (goals) were set. Goals are numbers, dates or other measurable and achievable targets that functional areas can strive to meet. George Miller's theory was discussed a basis to set a limit on the number of goals that an organisation should strive to achieve (Boyd, 2002b). Miller surmised that the human mind had a limit on the number of items it could store in short-term memory and subsequently process (Miller, 1956). He suggested the maximum number of items that a human can handle

in the mind's equivalent of RAM is seven plus or minus two – or 5 to 9 items. At the company, the project team decided to use this as a basis for goal setting. Each functional area was coached to determine it's 7+/-2 goals that would be tracked by the system. Some examples of goals were:

- Reduce charge backs (fraudulent credit card transactions) by 10%
- Increase customer retention by 15%
- Decrease cancellations by 10%
- Decrease customer contact rates by one-third

Across the four main functional areas on the business (finance, marketing, customer care and technology) the organisation came up with more than forty goals that mapped directly back to the high-level business objectives. Next, each area of the business that would be affected by these goals was identified and documented.

11.3.3 Step 3: Identify What You Want to Know

This main focus of this step was to identify all of this information that was being produced by various desperate systems and who was using that information. This involved conducting interviews with various senior and line managers and a comprehensive review of all of the auto-reporting scripts. Interestingly, the project team was shocked to find how much information was being provided by the legacy systems that were never used. These included emailed reports that were being diverted into network folders that were never read, reports that emailed to mobile phones and pagers that no longer existed and reporting web pages that were never accessed. But more interesting, the team was shocked to find out how much information was being compiled and stored in private data sources. This included managers begging or bribing database access from the database managers to write and run their own queries. Reporting had been such a low priority by the IT group that line managers had found alternate methods to get needed information. This becomes problematic in being able to verify and audit report results. Much of these

reporting practices were not authorised and in many cases, the data were pulled from production servers, impacting overall website performance.

The team considered this step on one of the most crucial to the success of the entire project. Historically, numerous attempts had been made to provide data. Yet, despite these efforts, executives felt that they had poor visibility into the workings of the organisation. The team decided to generate and deliver early proof of concept results as a way to get organisational buy-in into the larger effort. Although this took a bit of on-going managerial effort, the executive sponsor felt it was politically necessary for the long-term health of the project.

This step concluded when all of the information required by each functional area was captured and catalogued. However, during this process, something very disturbing was discovered – the organisation was not speaking the same language! Much of what was being reported cross-functionally was being interpreted, understood and used in different ways resulting in miscommunication and inter-departmental arguments.

11.3.4 Step 4: Identify Business Entities and Attributes

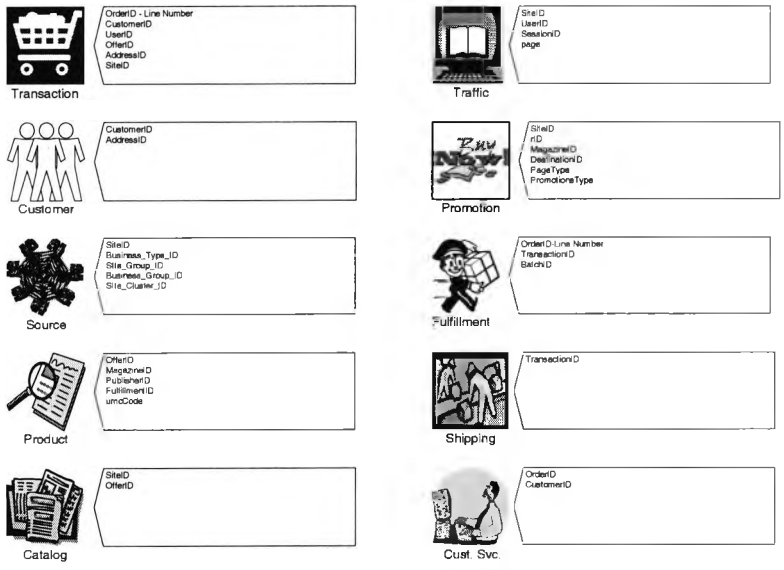
This step involves understanding what people, places or things will be investigated or queried by the system. At the company, ten items of interest were identified and defined. These entities included:

- Customer Details
- Customer Service Records
- Fulfilment Details
- Product Details
- Product Grouping or "Catalogue"
- Promotional Details (details of marketing campaigns)
- Shipping Logs
- Source of Sale (referral site)

- Transactional Information (order details)
- Website Traffic

For each of the defined entities, (in this case, database) attributes were assigned to each (Figure 11-8). If entities can be defined as the "nouns" of the system, "attributes" are the adjectives that describe them.

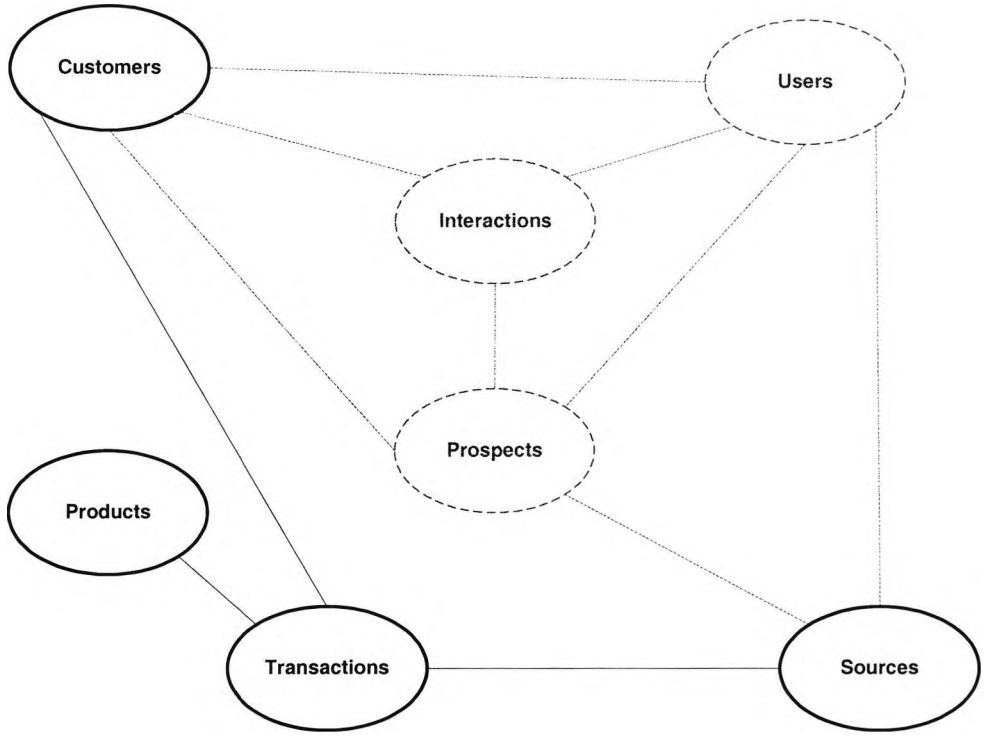
Figure 11-8: Company Entities and Attributes



Source: Shuman, 2001

The project team next looked at information across several of their entities and mapped their inter-relationships (Figure 11-9). The data were viewed as being either explicitly available or implicitly available. Explicit data are "user-reported" and stored in one of the many transactional, catalogue or customer databases that existed within the organisation (or in private data stores), whereas implicit behavioural data generally came from the website traffic logs (and were surmised by analysing user behaviour).

Figure 11-9: Entities and Relationships (with Explicit and Implicit Data Sources)



Source: Shuman, 2001 (Entities and relationships with implicit data are indicated by dotted lines).

11.3.5 Step 5: Define Facts and Measures

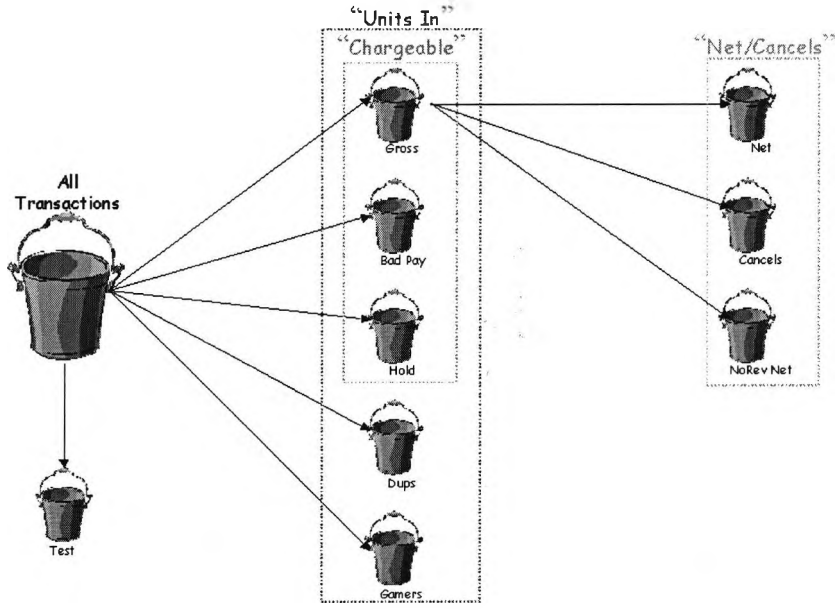
The team quickly found out that different parts of the organisation were using different words to describe the same event. For instance, a "cancel" meant different things to the finance, customer services and the marketing departments. Even a "sale" was being counted differently depending on which report or department was doing the counting. To finance, a sale was a single net unit within an order, to marketing a sale was a gross unit and to customer care, it was attempt for an order or unit that may or may not have been fulfilled.

The team's first order of business was to define a single common language to describe the organization's transactional events and entities. This common language would be used at the programming level, as well as at the boardroom reporting level. This was not easy chore and the team had to make sure that it didn't make enemies at

this stage (as historical sales figures would have to be restated). This required many cross-functional meetings and much compromise.

This step started with the mapping of the transactional process, following an all orders as they entered the system through their termination states. To explain the process internally, a metaphor likening the process of passing water (orders) between buckets (order states) was used (see Figure 11-10).

Figure 11-10: Company's Transactional Process – The "Bucket" Metaphor



Source: Shuman, 2001

Once all of the possible states were mapped, each state was defined in user-friendly terms (Table 11-3).

Table 11-3: Sample Definition of Measures

Class	Metric	Definition
	Test	A transaction whose sole function is to test shopping cart or back end functionality. Test orders are excluded from all reports.

Units In	Gamer	Any transaction with a syntactically and algorithmically correct credit card number that is known not to be valid. Passes the LUHN Formula (Mod 10) for validation of primary account number and exists in a list of known invalid numbers. Example: Master Card 588888888888888
	Dup	Any transaction where in the previous seven days another transaction exists for the same product to the same ship to name and address
	Hold	Any transaction that is in flux and has not been identified as belonging to Gamer, Dup, Bad Pay or Gross. Examples: An over limit "soft-decline" or a transaction that is waiting for payment processing.
	Bad Pay	A transaction with a credit card that has failed payment processing. Either declined outright or with two over limit declines over a period of 10 days.
	Gross	Any transaction that has been successfully charged and sent to fulfilment.
Net / Cancel	Net	Any transaction that has been successfully charged and sent to fulfilment and not cancelled.
	Cancel	Any transaction that has been cancelled.
	No Revenue Net	Any transaction that has been fulfilled with no revenue collected or has had revenue collected and refunded without cancelling the order.

(Shaded area indicates chargeable states).

Source: Shuman, 2001

11.3.6 Step 6: Identify and Construct Indicators

Now, with catalogue of information needs and a common language to describe to the organisation's transactional events and entities, the team began to identify and construct indicators. Indicators are tables, graphs and charts that are used to convey information. Recognising that certain managers only wanted high-level graphical representations of the events, and others want to see the minute details, a variety of delivery mechanisms was used to transmit information. The team also recognised that some managers preferred having access to information at all times and other preferred to get a daily, weekly or monthly summary. Both "pull" and "push" mechanisms were developed to address these requirements. Given budget constraints, two common products – MS Excel and Seagate Crystal Reports – were chosen to

address the user needs. Excel provided the ability to imbed a query that extracts data directly from a database. Combined with the pivot table and charting functions, this tool was more than adequate for executives wishing to do their own analysis. Crystal Reports provided the functionality to push out timed email reports.

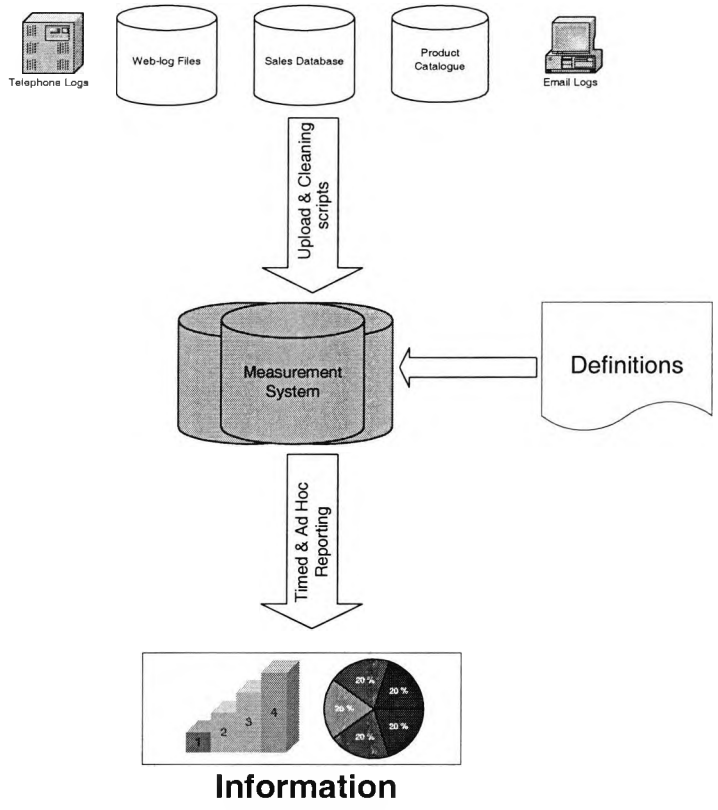
For reasons discussed earlier, indicators were limited to 7+/-2 for each entity. It was felt that if more than nine indicators were studied, there would be a tendency to get lost in the minutia. And if there were less than five, there would be a real danger of manager's not getting enough information.

11.3.7 Step 7: Identify Data Sources

Next, the team set out to map its information requirements to the information technology architecture. In this case, most of the data sources already existed. However, must of the information was not in a usable format. It needed to be moved from the transactional systems to analytical databases. The extraction process ensured that the data were updated and cleaned in a consistent and repeatable manner.

The indicators and reports outlined in step 6 were then written to a new data-warehouse environment (Figure 11-11).

Figure 11-11: Data Sources



11.3.8 Step 8: Implement Measurement Programme

Developing a useful and sustainable measurement programme that links corporate goals to the information architecture is an ongoing process. Corporate objectives, the information infrastructure and manager's information needs change. A successful measurement programme will change with the organisation. Mr. Shuman provides these tips for success in developing any information management programme (Shuman, 2001, 2002):

- **Get board level commitment** – Although it need not be expensive, a good measurement programme will command both financial and human resources. Having a very senior executive sponsor will help in negotiating budgets and resources from other departments.

- **"Start with a clean pot"** – There is a tendency to start with an old, likely inadequate, system and build the new system on top of it. But a good chef will always start with a clean pot. Certainly ingredients from older systems can be used in building the new one, but only where appropriate. In a rapid-growth environment, the transactional code base will have changed frequently. This can cause a significant increase in project scope to interpret historical results in the lingua of the current transaction system. A word of warning, "starting with a clean pot" can create political battles with the designers, managers and users of the older systems.
- **Identify and deliver short wins** – Without tangible benefits or a high degree of visibility into the development process, organisational support for the measurement programme will wane. To mitigate this risk, the programme manager should identify and frequently deliver small but noticeable benefits to end-users.
- **Eliminate the waste** – At the company there was a significant amount of legacy reporting that was no longer used. The goal-driven methodology quickly identified redundant metrics that were outdated, and measures definitions that we no longer correct.
- **Limit, but don't constrain metrics** – By using Miller's chunking theory to limit metrics managers got access to the information that they needed, but the programme did not grow unmanageable.

11.3.9 Case 1 Summary & Conclusion

The organisation was sold in the Spring of 2001 to a major on-line retailer creating one of the few dot com success stories of the time (somewhat ironically, the impact of mergers and acquisitions in creating information disparity is discussed earlier in this research). Unfortunately the change of management meant that the implementation measures were never collected. However, there are several key findings from this case study that are relevant and warrant inclusion in the research.

The lessons learned here can be applied to any integration or measurement project. When all business functions are considered and business objectives drive the project, success is more likely than when it is managed by a single business function with insular goals. Also, it is interesting to note that much of this project had very little to do with technology. Much of the actual technology and expertise existed within the organisation, and a big spend was not necessary to drive spectacular results. In the first phases, the programme has yielded great success, including (Shuman, 2001):

- Increase of sales by 400% in 120 days through the systematic identification of most profitable positions and programmes;
- Increase of customer retention more than 20% through better reporting of customer defection "danger signs";
- Decrease in customer care costs 30% through better channel alignment (pushed customers from the phone to email and self-help);
- Identified and fixed systems inadequacies with strategic partners that were resulting in lost sales;
- Decreased charge-backs by approximately 25% by identifying suspect behaviour.

11.4 Case 2: Additional Information

11.4.1 Qualitative Interviews

This section provides insight into the motivations of and challenges faced by the support organisation described in Case 2.

11.4.1.1 Team Lead (TA2)

As the tech support lead, TA2 generally checks the support email in-box and assigns tickets to either himself or the rest of the team. If he is unavailable (holiday or offsite) this is done by either TA1 (Manager) or TA4. At the time of the research, he had 21 unresolved (OPEN) issues.

Interestingly, contrary to the executive team's assumptions, TA2 asserted that no issues get escalated to the US division (former parent organisation) for resolution. This is primarily because the tech support team in the US is generally less experienced and is not incentivised to resolve issues beyond the capabilities of the European (EMEA) team. If an issue cannot be resolved in the UK it goes directly to US product management. Therefore, the tendency for customers and management to believe that the EMEA support team is a "pass-thru" service is unfounded. Additionally, given the relative experience of the US team, if customers are not getting the level of support that they feel that the need or desire in EMEA, it is unlikely that will fare any better with a US contact. TA2 suggested that this needs to be clearly communicated to the customers and the (official) introduction of advanced support services in the UK should help to enhance the perception of EMEA support with customers.

He also noted that it would also be interesting to compare the composition of the supported base in the US vis-à-vis in Europe. Anecdotally, the US seems to support more end-users, whereas EMEA largely supported resellers. The level of staff required to support end users is significantly lower than to support resellers. Therefore it stands to reason that the average tech support analyst in the US does not require, or have, the same skills and experience as an EMEA tech support analyst. This would cause more problems than solve if customer escalate issues to US technical support.

TA2 provided illustrative email example of the particular unhelpfulness of his US counterparts. In one example, the team wrongly advised the customer based on some advice from US tech support. When seeking a correction, the person that gave the incorrect advice was unavailable to help further. This was particularly frustrating because the analyst did do not have access to the technology (source code) needed to resolve the issue. TA2 can produce several examples of this type of response. When they do need accurate advice quickly and generally depend on "back door" channels and each other to get things done. TA2 suggested that management needed to build

ties and develop personal relationships with the US management team to try and reinstate escalation processes and procedures.

Specific issues raised by TA2:

- TA2 needs access to reports that can be generated off the US support system. This has been repeatedly requested, but to no avail.
- Customers have become used to a single point of contact that they inevitably begin to always contact directly (either by phone or email). If that person is out (on holiday or offsite), the issue will sit unattended until their return. This could lead the customer falsely believing that EMEA support team is unresponsive.
- There is no easy way to verify that a caller is certified (able to receive support). Many of the premiere resellers are not certified on the products that they call in for support on (this practice is unfair to the support team and unprofitable for the services department). Conversely, the US requires that all callers be certified and recite a PIN before support is granted.
- Customers heavily rely on email support requests. Transferring these requests to the support system takes time away from actually resolving the issue. There is no reason why a partner cannot use the web based system to report an issue themselves (except laziness).

Business Opportunities:

TA2 identified three opportunities to increase revenue:

1. Require training and certifications for all BP support contacts (may cause issues with customers)
2. The team could offer a data repair and clean up service
3. The organisation could develop a process for referring work to PSG

Support Analyst (TA3)

TA3 is a dedicated resource for a single larger partner and seems to handle many of the continental partners. He is also involved with some product beta test and setting up support processes.

Specific issues raised:

- TA3 mentioned that issues with international versions (or with international operating systems) sometimes cause a problem in that it is very difficult to recreate the problem (and later in the US). As the team doesn't have test environments for all support products and configurations, the resolution of international issues tends to take longer. As a result they have offered access to the EMEA test machines to the US to speed up resolution. This has only been utilised once.
- Support of new products also poses a problem from the aforementioned test environment reasons. Each time they need to recreate a issue in an un-configured environment, the tech analyst has to spend a lot of time to installing software before working on the issue (sometimes up to half a day)
- Performance of the support system is painfully slow.
- Customers are not using publicly available resources (i.e. Knowledgebase and newsgroups) to try to solve issues before raising a ticket.

Business Opportunities:

TA3 felt that some customers were "time wasters". For example, the team recently spent two weeks investigating an issue that was solved in a previously released service pack. When asked, the customer assured the team that the service pack had been installed. After two weeks of investigation, and once we got a copy of the database, the team found that this was not in fact true. TA3 suggest that could introduce a penalty charge for "time wasters".

Additional Comments:

- "It would be useful to get a list of current/imminent implementations so test environments can be set up in advance."
- "The upgrade path for "international" versions of product is complicated and the documentation is confusing. This, added with the language issues, results in many installations being done incorrectly."
- "We need further information/clarification from the US to explain "localisation" – perhaps a direct contact in R&D"
- "Further educational and documentation needed for foreign customers".
- "Many [customers] are actually using the English version of the product on foreign operating systems, this needs to be properly tested."

Support Analyst (TA4)

TA4 largely supports the French customers and the organisation's French office in their internal implementation. However, he also supports many of the newer and long-standing customers. Actually, a majority of his calls are from the organisation's French sister company. Many of the issues raised with him have to do with the French resellers' inexperience with the product, or even relational databases, as they are largely specialists in other domain areas. This comment also holds true for the newer customers in the UK (e.g. "they call us when they receive SQL Server errors"[unrelated to the supported application]). He also receives quite a few advanced support issues that should be billable [but there is no process in place to raise, approve or process invoices for this service].

Specific issues raised:

TA4 mentioned that the support of older version of the product tends to be difficult for the same reasons as supporting international versions. That is, it could take half a day to build a test environment to replicate an error. Also, if it is a defect, a later version has likely resolved the problem. He suggested that the firm should actively

encourage customers in this situation to upgrade rather than wasting a lot of time trying to sort it out.

Business Opportunities:

- TA4 spends a bit of his time chasing third party product (e.g. Microsoft, Oracle, Crystal reports) issues. If customers require this service, they should be charged for it.
- Again, highlighted the issues of customers not being certified and using the service.

Management Comments

Being largely new and preoccupied with the restructuring of the wider business, most of the management team were unaware of the challenges that the group faced on a daily basis. On a whole, they were supportive of the need to make rapid and drastic changes in the group. The strongest support came from an unexpected ally – the Sales Director.

Sales Director

> *A couple of comments which I am happy to take to the customer and re-enforce:*
>
> *I) We should insist that anyone placing a support call should at least be[basic-level] certified. We could give a amnesty of a couple of months or until the next two training sessions have been run but after that we should refuse to take calls. If I remember correctly this was always a requirement in the early days.*
>
> *2) We should INSIST That all calls are logged electronically and that the knowledge base has been checked before we provide telephone support. This means that a BP should quote the ticket number on instigating the telephone conversation. FYI [Main Competitor] have NEVER offered telephone support, they use their web based systems for ALL communications and they have some of the highest customer satisfaction stats for support of any IT organization, this was borne out when you spoke to the customers as they genuinely were impressed with the service they provided. Its more a culture issue and we need to educate the resellers to do this.*

Note can we use telephony software on the support call group number to firstly prompt "if you are logging a new call please use the web site, if you require an update on an existing call please enter the ticket number using your telephone key pad." This will minimise the number of calls and will speed up the management of existing tickets.

3) We should enforce a policy of not supporting the peripheral products , e.g. SQL, Crystal etc. getting them to log calls electronically and categorize the calls properly we could automatically respond to these calls with a FAQ type response and an "ask someone else message as we don't support these products."

Finance Director Comments

The Finance Director's comments were more in keeping with character:

"I liked the recurrence of "we should be charging for this" message. If you need any assistance from Finance in these areas - we will be very pleased to help..."

"I read the US email and "the too busy to help" attitude would drive me mad!!"

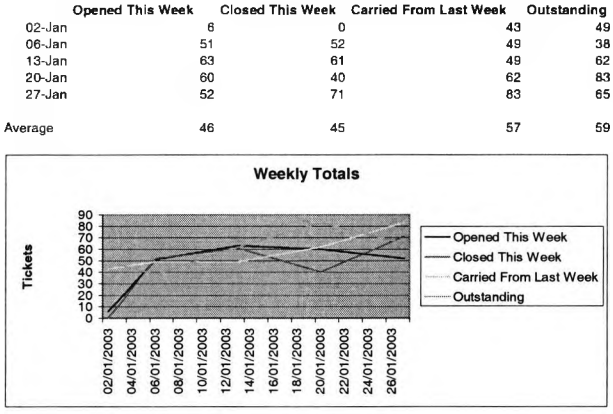
11.4.2 Case 2 Indicators

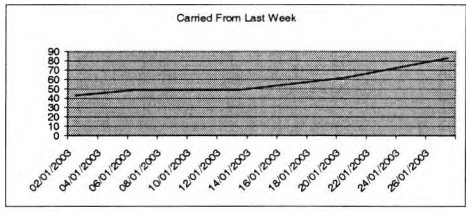
Included below are examples of the weekly and monthly indicator reports that were delivered as a result of the goal-based framework exercise (Figure 11-12).

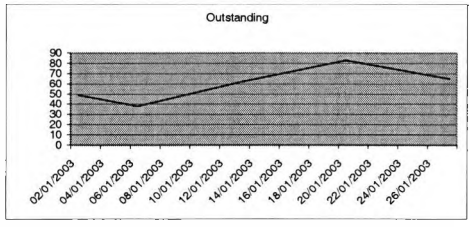
11.4.2.1 Sample Monthly Usage Report

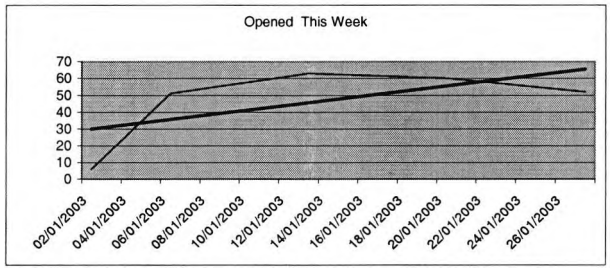
Figure 11-12: Sample Monthly Usage Report Distributed to Management

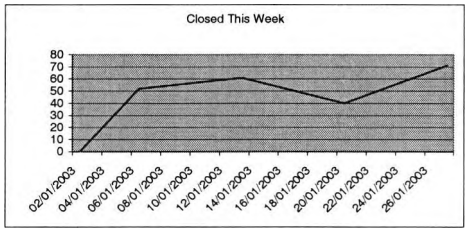
	Opened This Week	Closed This Week	Carried From Last Week	Outstanding
02-Jan	6	0	43	49
06-Jan	51	52	49	38
13-Jan	63	61	49	62
20-Jan	60	40	62	83
27-Jan	52	71	83	65
Average	46	45	57	59











11.5 Case 3 Additional Information

11.5.1 Case 3: Iterative Goal-Based Process Development

Before the final model in Chapter 6 was agreed upon it underwent several iterations and rounds of refinement. The first model was collaboration based. That is, the eight step GQIM based approach took into consideration all of the applications that participated in the information exchange scenario. Based on feedback from development teams, a second iteration was undertaken to revise the collaborative model. Primarily in this iteration, the model was adapted for the specific integration technology resulting in a few additional steps being added. Although this version of the model was more appropriate to the problem at hand, through additional feedback, concerns arose about repeatability and the context-specific depth of knowledge that would be required about all of the integrated applications in the collaboration. As such, the model underwent a third iteration with the objective of making the process

less context and technology specific. This time, the need arose to actually conduct three (or more) goal-determination exercises – one for each integrated application and one for the collaboration itself. The resulting model is the one presented in the body of this research.

11.5.1.1 Iteration 1: A Collaboration Based Approach

This section outlines the first iteration based on the reference model. A hypothetical integration scenario, based on a typical integration scenario, was used to construct the model. With a rudimentary understanding of the way that the integration middleware worked, the researcher put forth the following goal-based process for review:

1. Identify business objectives or desired outcomes
2. Identify goals and sub-goals for each objective
3. Identify questions that address business goals
4. Identify business entities and attributes
5. Identify integration patterns
6. Identify and construct interface touch-points
7. Identify data sources
8. Implement Programme

Several context specific elements were modified or adapted from the reference model – including the addition of a integration pattern step, exchange formats and user interface definitions.

Step 1: Identify Business Objectives and Desired Outcomes

It is important to understand and agree on the business objectives before undertaking any information aggregation exercise. Depending on the functional point-of-view, organisational objectives many differ. To measure and benchmark the success of the project, the objectives of each of the major stakeholders should be agreed up front. Information aggregation projects are generally undertaken to address one or more of the following business objectives:

- (O1) Revenue growth
- (O2) Cost reduction
- (O3) Process improvement (i.e. better decision making)
- (O4) Increased customer service or satisfaction

Of course, if this methodology is used in a wider context, than business objectives will be organisationally specific and should be agreed in advance of project commencement by the business owners. For the avoidance of confusion, the OGSM definition of an objective (vis-à-vis a goal) was adopted. That is an objective is a high-level word-based description of what is desired, whereas goals are achievable (answerable with "yes" or "no" answers at the completion of the integration exercise).

Step 2: Identify Project Goals

Using the business objectives as a starting point, the tangible deliverable and benefits of the information aggregation effort are identified (goals). Some sample integration goals that map back to the business objectives identified above include:

- (G1) Link accounts in multiple systems so that there is no duplication of data entry and records are kept in sync, reducing clerical costs and errors
- (G2) Provide visibility of account information to the sales people so that account status and credit limits can be checked before an order is accepted and negotiated
- (G3) Eliminate paper-based processes and duplication of effort in Sales Order Processing
- (G4) Provide multi-channel (telesales, web, direct, retail) access to inventory and catalogue information, eliminating probability of back-orders and sales of discontinued items

Step 3: Identify What You Want to Know

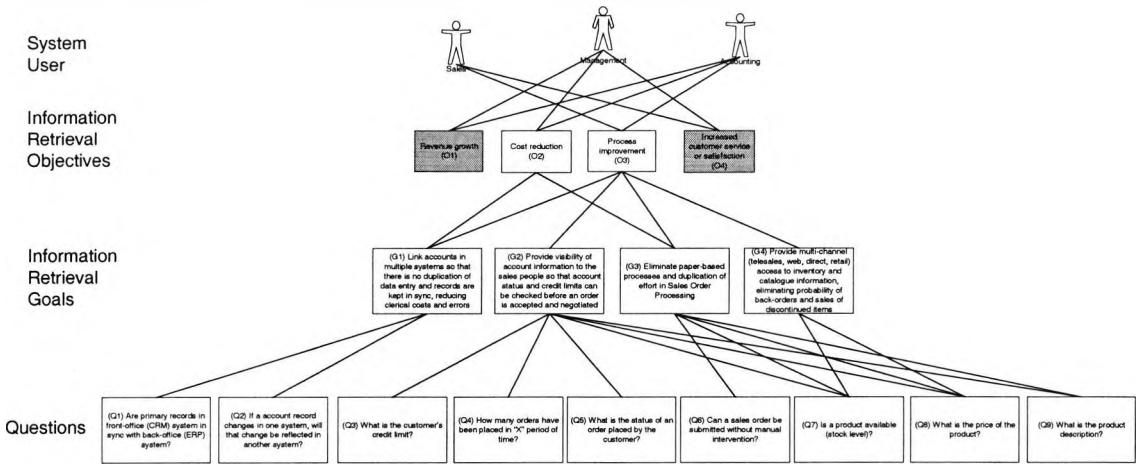
Next, a list of questions is produced by the stakeholders. These questions qualitatively define the information that will be sought from the aggregated system

and should map back to the business goals identified in the previous step. If questions that do not map back to the goals arise, goals should be updated to reflect the new information need. If the question does not warrant an update, than serious considerations should be given to the importance of the question. Sample questions are provided below:

- *(Q1) Are primary records in front-office (CRM) system in sync with back-office (ERP) system?*
- *(Q2) If account record changes in one system, will that change be reflected in another system?*
- *(Q3) What is the customer's credit limit?*
- *(Q4) How many orders have been placed in "X" period of time?*
- *(Q5) What is the status of an order placed by the customer?*
- *(Q6) Can a sales order be submitted without manual intervention?*
- *(Q7) Is a product available (stock level)?*
- *(Q8) What is the price of the product?*
- *(Q9) What is the product description?*

At this point, a traceable methodology that links high-level business objectives to the information infrastructure begins to emerge – that is, goals link to objectives, and questions link to goals (Figure 11-13).

Figure 11-13: Traceability Links (Objectives, Goals, Questions)



In this case, Objectives 2-3 are satisfied, whereas Objectives 1 and 4 are not. There are two choices; either develop some goals and questions that address these objectives, or declare them out of scope and move on.

Step 4: Identify and Define Business Entities and Attributes

For the sample business goals proposed above, several questions were derived. From the goals and questions, the "entities" of interest are identified. "Entities of interest" are the nouns of the information process – that is the 'person place or thing.' The entities in this case are identified in the table (11-4) below.

Table 11-4: Identified Entities

Business Goals		Entities of Interest	Questions	
G1	Link **accounts** in multiple systems so that there is no duplication of data entry and **records** are kept in **sync**, reducing clerical costs and errors	Account (E1) Primary record (E2) Sync process (E3)	Q1	*Are **primary records** in front-office **(CRM) system** in sync with back-office **(ERP) system**?*
			Q2	*If account record changes in one system, will that change be reflected in another system?*
G2	Provide visibility of account information to the **sales people** so that **account status** and **credit limits** can be checked before an **order** is accepted and negotiated	Sale (E4) Sales person (E5) Account Status (E6) Credit Limit (E7) Order (E8) Customer (E9) Order Status (E10)	Q3	*What is the **customer's** credit limit?*
			Q4	*How many **orders** have been placed in "X" period of time?*
			Q5	*What is the **status of an order** placed by the **customer**?*
G3	Eliminate paper-based processes and	Sales Order (E11) Sales Quote (E12)	Q6	*Can a **sales order** be submitted without **manual intervention**?*

Business Goals		Entities of Interest	Questions	
	duplication of effort in **Sales Order** Processing	Manual Intervention (E13)		
G4	Provide access to **inventory, catalogue** and **Price** information, eliminating probability of **back-orders** and **sales** of **discontinued items**	Product (E14) Catalogue (E15) Inventory (E16) Stock level (E17) Price (E18) Product description (E19) Back-order (E20) Sale (E4) Discontinued Item (E21)	Q7	*Is a **product** available (**stock level**)?*
			Q8	*What is the **price** of the **product**?*
			Q9	*What is the **product description**?*

Step 5: Identify Integration Patterns

Next, it is necessary to identify the integration pattern. Information aggregation generally adheres to three or four integration patterns – synchronisation, viewing, export and submission. Synchronisation is the bidirectional exchange of data between two systems whereby the data are maintained in both systems. Viewing is the unidirectional reading of data, whereby data are pulled from one system and rendered into another. Export is the unidirectional transfer of information from one system to another. Lastly, Submission is a type of export, whereby after the first transfer, data are maintained and updated in the external system and exported back to the originating system.

Below, the questions raised in the previous steps are grouped according to the type of integration pattern (Table 11-5).

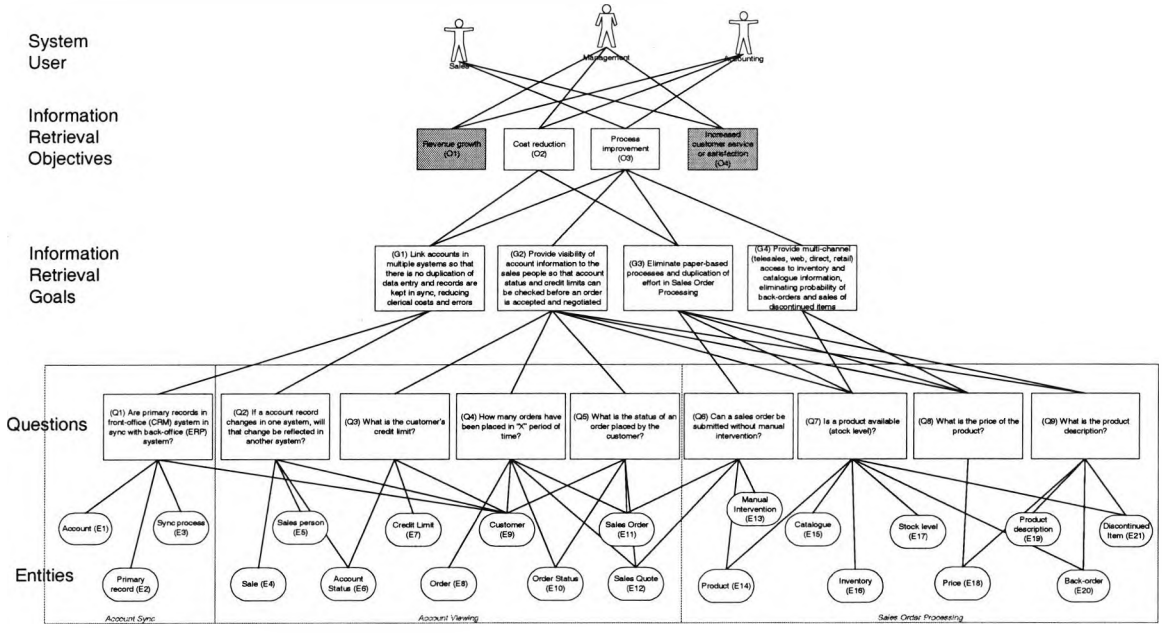
Table 11-5: Integration Patterns

Integration Pattern	Related Questions
(P1) Account Synchronisation	*Are account records in front-office **(CRM) system** in sync with back-office **(ERP) system**?*
	If account record changes in one system, will that change be reflected in another system?
(P2) Data Viewing	*What is the **customer's** credit limit?*
	*How many **orders** have been placed in "X" period of time?*
	*What is the **status of an order** placed by the **customer**?*

Integration Pattern	Related Questions
(P3) Submission	*Can a **sales order** be submitted without **manual intervention**?*
	*Is a **product** available **(stock level)**?*
	*What is the **price** of the **product**?*
	*What is the **product description**?*

In this step, the model is adapted from earlier goal-driven approaches; although, it is similar to the step in GQIM where sub-goals are derived. In the tractability model (Figure 11-14), the entities map back to questions, but the processes are depicted as loose groupings of entities and questions. To improve readability, entities and questions are associated with processes that rely on the most (i.e. the highest number of) links.

Figure 11-14: Linked Entities and Grouped Processes



Step 6: Identify and Construct Interface Touch-points

Next, the interface touch-points are identified through analysing the entities and impacted business processes. The resulting touch-points are identified below (Table 11-6).

Table 11-6: Interface Touch-points

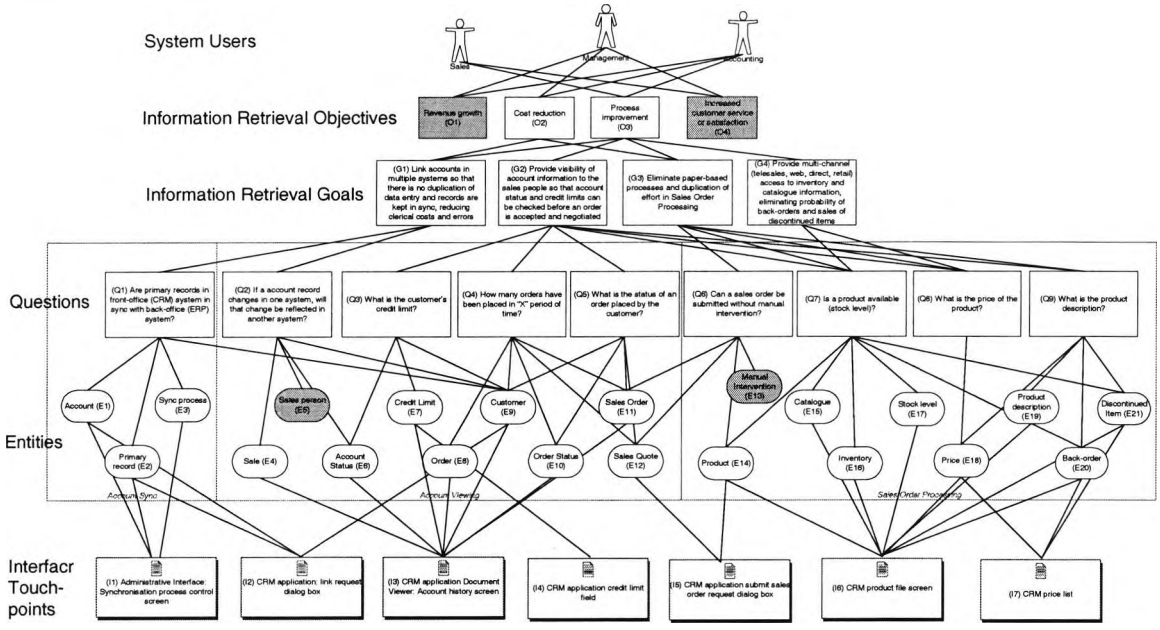
Business Processes	Entities of Interest	Touch-points
Account Synchronisation	Account Primary record Sync process	I1: Administrative Interface: Synchronisation process control screen
		I2: CRM application: link request dialog box
Document Viewing	Sale Sales person Account Status Credit Limit Order Customer Order Status	I3: CRM application Document Viewer: Account history screen
		I4: CRM application credit limit field
Sales Order Processing	Sales Order Sales Order Process Sales Quote Manual Intervention Product Product Catalogue Inventory Stock level Price Product description Back-order Sale Discontinued Item	I5: CRM application submit sales order request dialog box
		I6: CRM product file screen
		I7: CRM price list

To identify interface touch-points, business planners (i.e. management) should ask the following questions:

- *What information needs to be visible?*
- *Who needs to see this information?*
- *Who cannot see this information?*
- *What are the benefits of sharing this information?*
- *What competitive advantage will be derived from the sharing of this information?*
- *What are the risks of sharing this information?*

Next each of the entities is mapped to the interface touch-points. Again, extraneous elements, in this case 'manual intervention' and 'sales person' are identified and can be eliminated from the model (Figure 11-15).

Figure 11-15: Traceability Map with Interface Touch-points



Step 7: Identify Data Sources

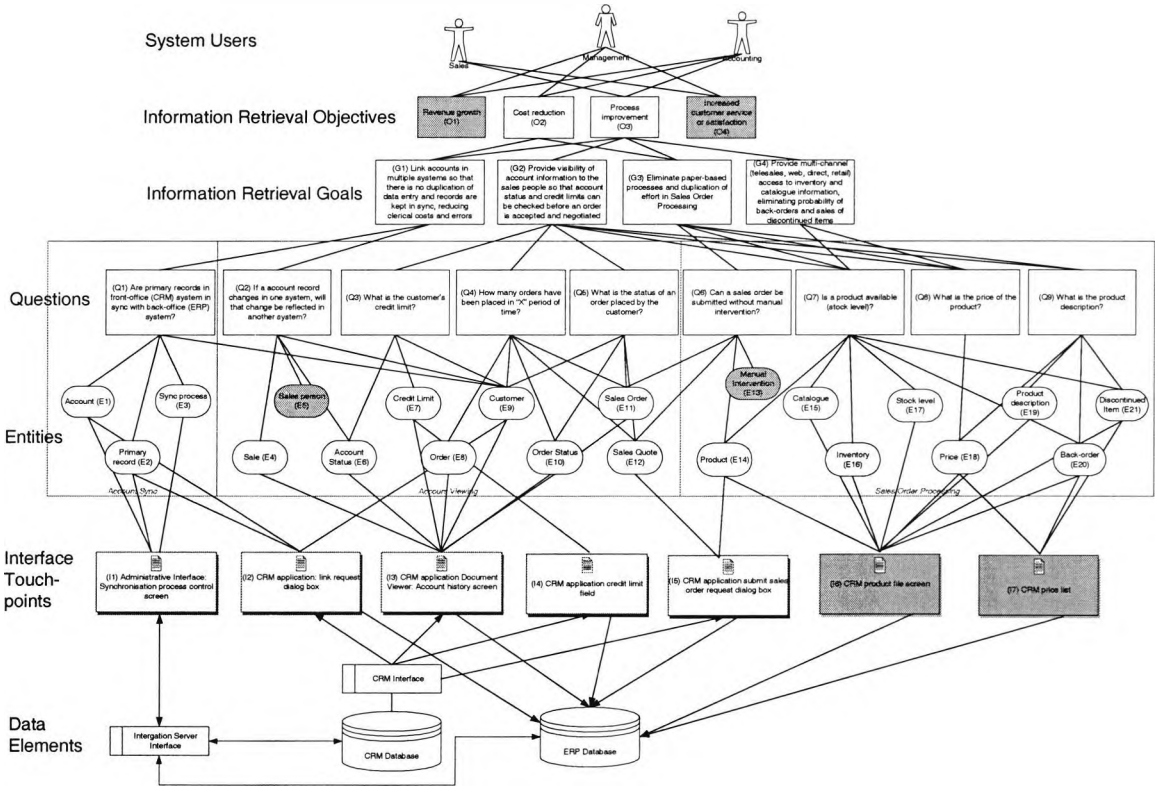
Much discussion has been had as to where this step should be modelled. Arguments can be made that it belongs before the interface touch-point identification (as entities map directly to data sources). However, since the interface touch-point is more important to answering the question, it should be identified first. In this case, the data elements are mapped to both the core application interfaces (as the 'target') and the core application database (as the 'source'). Upward arrows indicate that the interface touch-point is an extension of the linked application interface. In this case all upward arrows are connected to the CRM system indicating the there are no interface touch-points into the ERP system. Downward arrows indicate the data source that the linked information is being drawn from.

This is useful in identifying touch-point functionality and new interfaces that need to be created. In this case (as highlighted by lack of arrows linking the CRM interface with I6 and I7 and the resulting grey highlighting), there is no mechanism to display ERP pricing and product file in the CRM system (Figure 11-15). This functionality will need to be created, or the original questions, goals and objectives will need to be revisited.

Step 8: Implement Programme

With a fully constructed map that links high-level business objectives to the underlying information architecture (Figure 11-16), it is time to implement the integration programme. This is a illustrative model, but the actual linked system would be constructed using these guidelines. In reality, additionally identified requirements (goals), questions and entities would be added to the model.

Figure 11-16: Traceability Map with Data Elements



11.5.1.2 Iteration 2: A Revised Collaboration Based Approach

Upon review, it was felt that explicit stakeholder identification is a useful and necessary first step. Second, it was felt that the explicit question step was superfluous in an information exchange scenario, and that the integration goals step is sufficient to link the entities to the business objectives. Lastly, a process specific step was

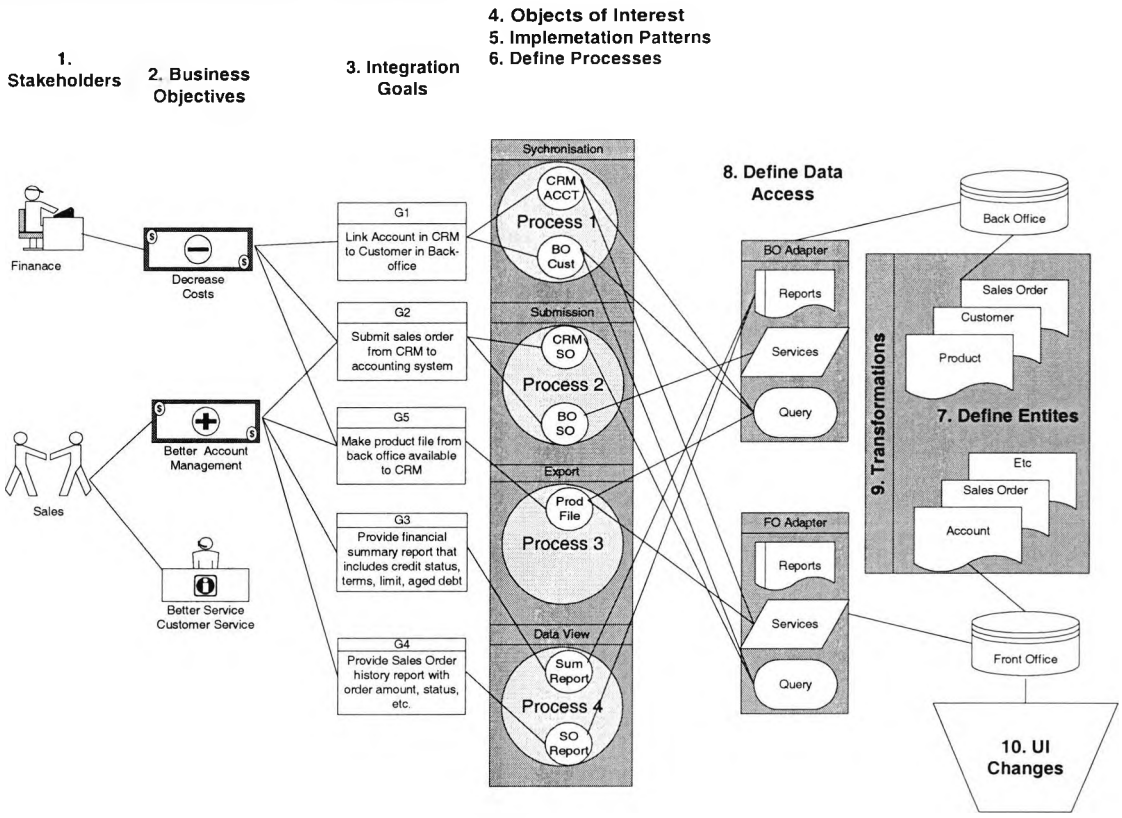
added. Based on this feedback, the model was again refined to include the following steps:

1. Identify stakeholders
2. Identify business objectives or desired outcomes
3. Identify integration goals and sub-goals for each objective
4. Define objects of interest (Business Entities and Artefacts)
5. Define implementation patterns
6. Processes
7. Define entities and data sources
8. Specify data access (Adapters)
9. Specify transformation of entities
10. Specify user interface and documentation

Notice how it differs slightly from the reference model. Primarily there are several context-specific steps and includes a formal identification of stakeholders as the first step. But most significantly it eliminates the question step and the contextualisation of goals is collapsed into one step. It was felt that formulated questions are more appropriate in an information retrieval context.

The ten-step process has several advantages a few primary disadvantages. First, it ensures buy-in and harmonisation of all project participants and two, it links high-level business objectives to data access (Figure 11-17).

Figure 11-17: Iteration 2 Process Steps



However, there are significant issues with repeatability. In it's current incarnation, the process is tied to specific application integration technology and is dependent on a predefined collaboration scenario (the integrator would need to know the specifics of each integrated system). Another drawback of this approach is the is that it could become confusing since process steps are non-sequential. That is, if the underlying applications are not 'integration-ready' you would like start the process at seven and eight without the benefit of a clearly defined set of 'integration-readiness' objectives and goals.

11.5.1.3 Iteration 3: A 'Nested' Approach

As a result of this second iteration, the model was revised again almost immediately. With the addition of the process step, it became apparent that a purely collaboration based approach would be limiting. Rather, it was decided that multiple models should be deployed and each should be granular and encapsulated. That way the

development of collaborations and composite application could employee nested models, but the underlying application's integration readiness goals could be accounted for. In this third iteration, the goal-based integration model was refined to the following steps:

1. Identify stakeholder
2. Identify and define business objectives or desired outcomes
3. Identify integration goals and sub-goals for each objective
4. Define objects of interest (and required connections)
5. Define implementation patterns and corresponding processes
6. Define data sources and entities
7. Define semantic integration (define collaboration)
8. Specify user interface
9. Implement collaboration (mappings and transformations)
10. Package for deployment

In this scenario, steps one through six are application dependent. That is, they must be repeated for each application that is going to be integrated. However, these steps can be undertaken independently to prepare an application for integration. The advantage of this approach is that the process is now independent of technology choices and intended collaboration partners. As such, the process may have relevance exposing monolithic applications to services oriented architectures or as web-services.

Step 7 is the first collaboration-specific step. In this step, business entities of each underlying application are linked and the semantic definitions of each are transformed so that information can be exchanged in a format that can be consumed by the receiving application. Step 7 occurs at a programmatic level. User interaction with the collaborated systems is defined and enabled during step eight. Step 9, implements the definitions stated in step 7. Lastly, in Step 10, the integration is packaged (including documentation, install shields, etc) for deployment. This is roughly akin the reference model implementation step.

Below, both iterations are compared to the agreed process (Table 11-7):

Table 11-7: Comparison of Process Development Iterations

Iteration 1	Iteration 2	Iteration 3
	Identify stakeholders	Identify Stakeholder
Identify business objectives or desired outcomes	Identify and define business objectives or desired outcomes	Identify and Define business objectives or desired outcomes
Identify goals and sub-goals for each objective	Identify integration goals and sub-goals for each objective	Identify integration goals and sub-goals for each objective
Identify questions that address business goals		
Identify business entities and attributes	Define Objects of Interest (Business Entities and Artefacts)	Define Objects of Interest (and required connections)
Define implementation patterns	Define Implementation Patterns	Define Implementation Patterns and corresponding processes
	Processes	
Identify and construct indicators or interface touch-points	Define Entities and Data Sources	Define Data Sources and Entities
Identify data sources	Specify Data Access (Adapters)	
	Specify Transformation of Entities	Define Semantic Integration (define collaboration)
	Specify User Interface and Documentation	Specify User interface
Implement programme		Implement collaboration (mappings and transformations)
		Package for Deployment

11.5.2 Case 3 Entity Definitions[34]

The underlying entity structures were investigated in two ways. First, where XML was dynamically generated at run-time, there is no physical documents to analyse. In that event, the integration middleware software GUI was used to determine exposed entity attributes.

Figure 11-18 below shows the structure of the CRM account entity (on the left titled "Source Document" and the structure of the BO customer entity (on the right, titles "Target Entity". The lines in the middle show the linking of each of the entity attributes (discussed further in the transformation" section.

[34] Screenshots from Sage Application Integration Server, version 1 with integration adapters for SalesLogix version 6.1 and Sage Line 500 version 5.

Figure 11-18: CRM Account (Source) and BO Customer (Target) Entity Attributes

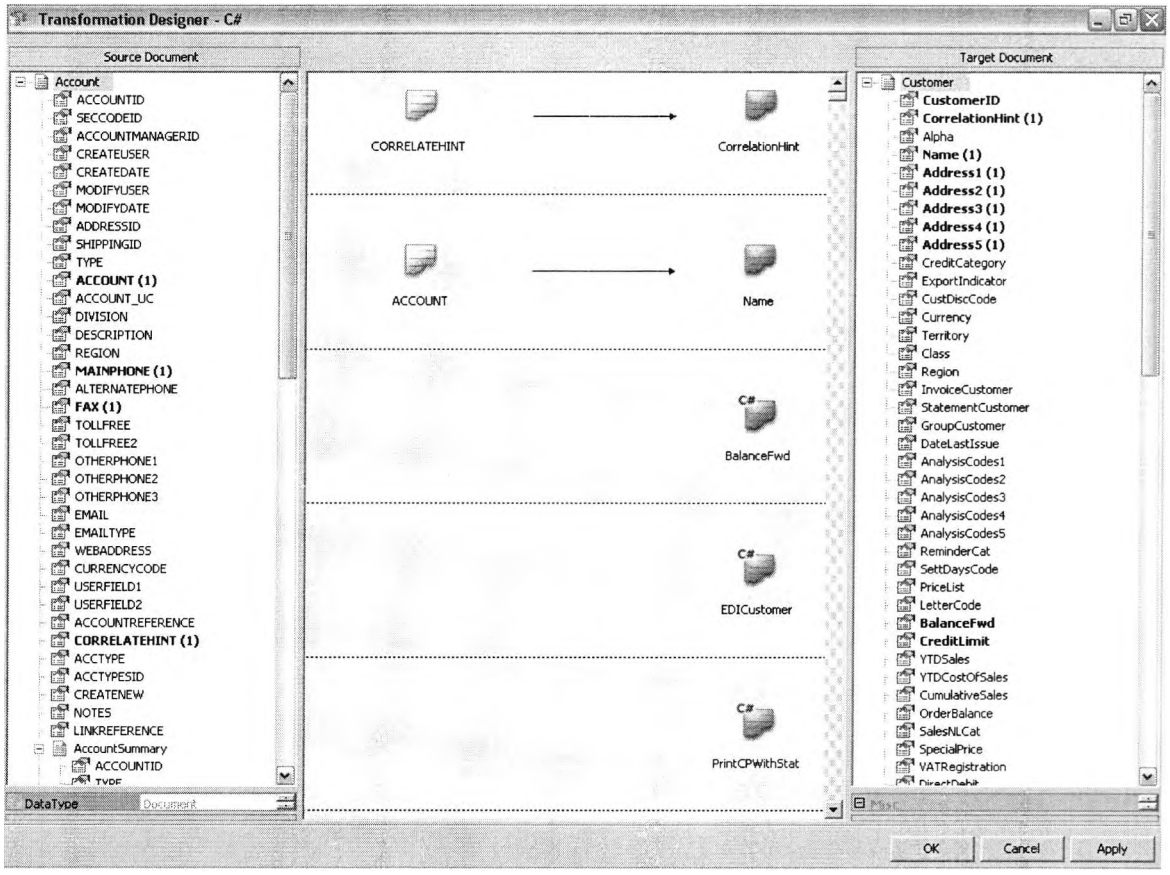
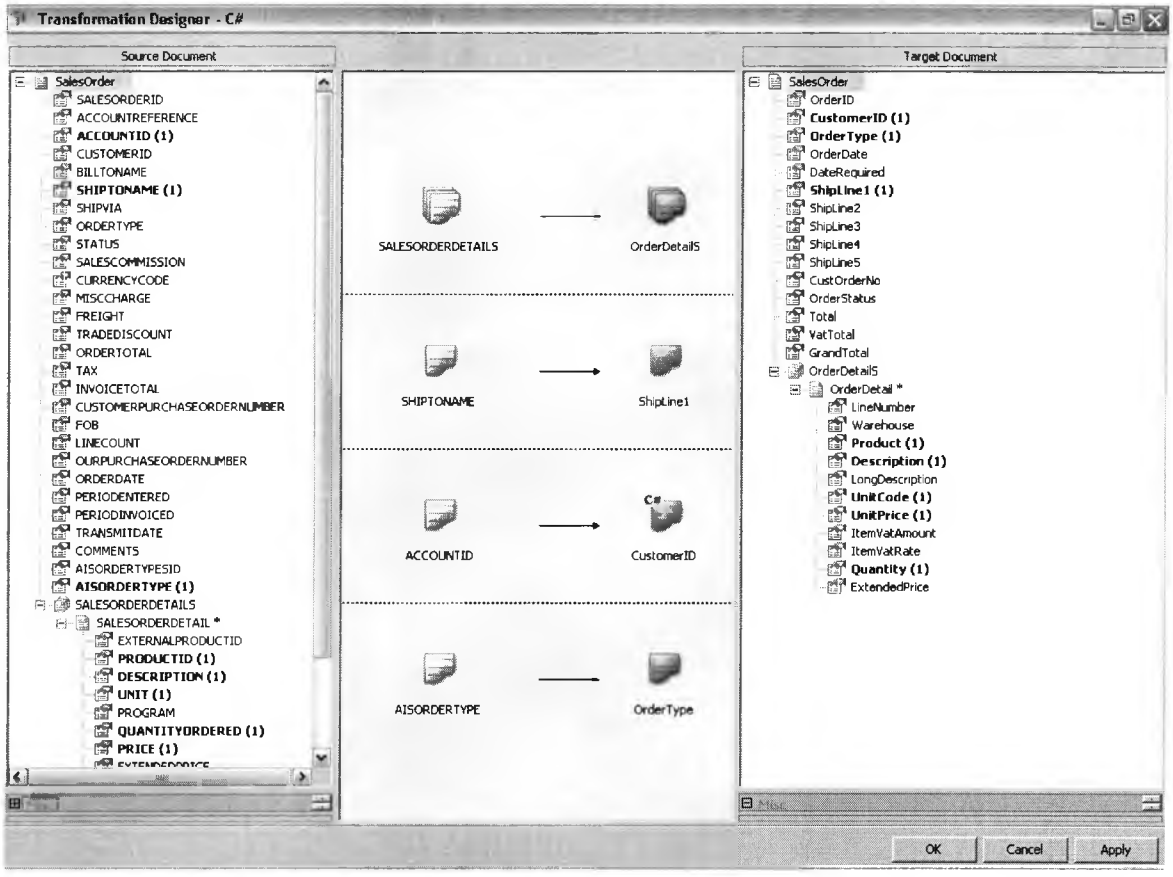


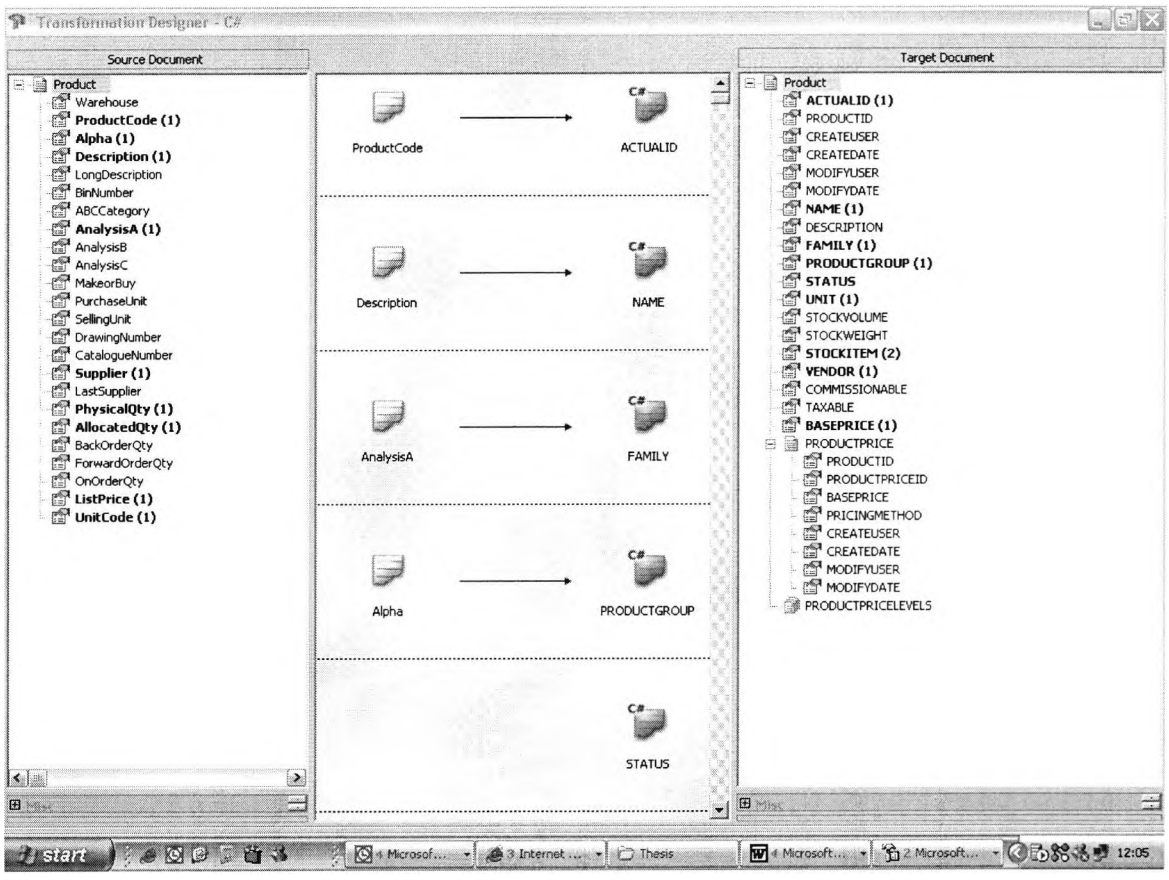
Figure 11-19 below depicts both the CRM (source) and BO sales order (target) entities. Note the indented nodes on the tree structure indicate that entities can be logically regrouped for transformation.

Figure 11-19: CRM Sales Order (Source) and BO Sales Order (Target) Entities



Both the CRM (target) and the BO product entities are depicted below in Figure 11-20. Note that because the product information originates in the ERP system, that the CRM entity is now the target (on the right) and the ERP entity is the source (on the right).

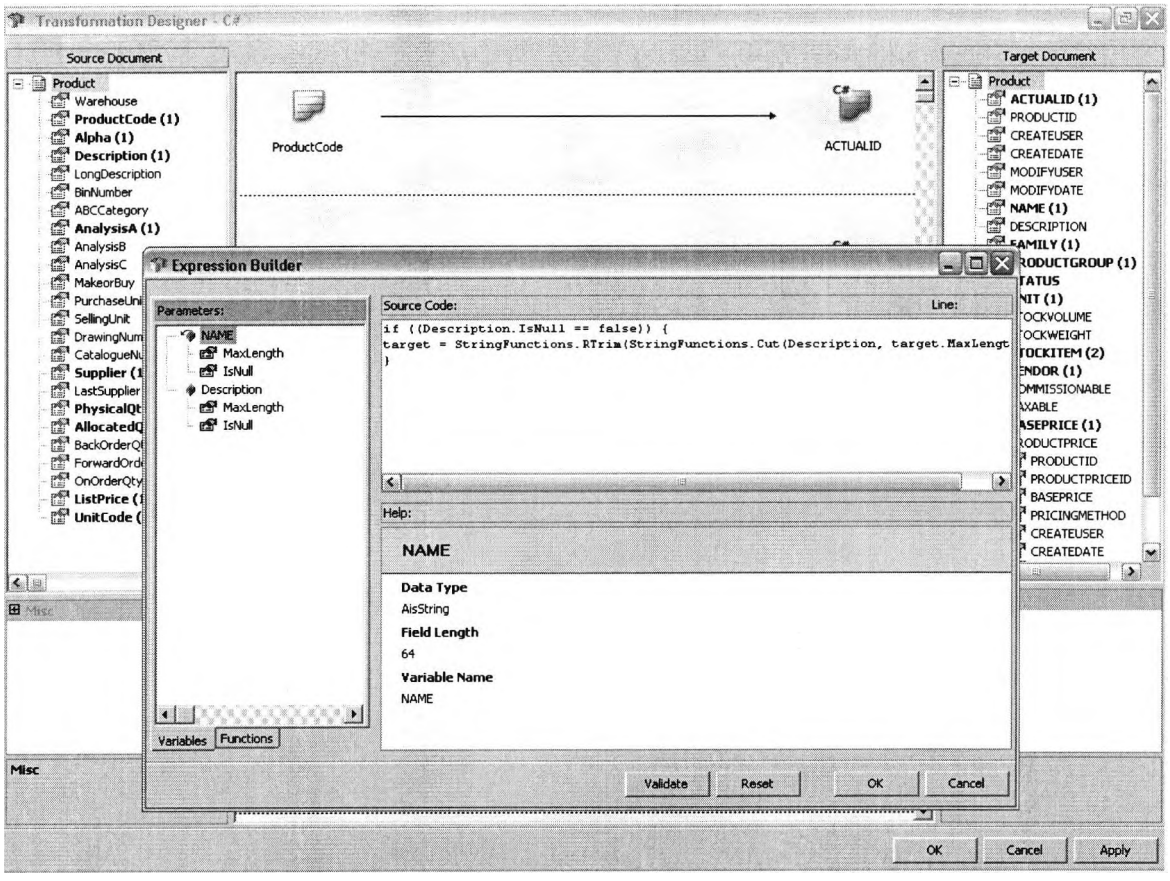
Figure 11-20: BO Product (Source) and CRM Product (Target) Entities



11.5.3 Case 3 XML Transformations

Using the company's integration software, transformations are programmed using a graphical interface. This window is opened by clicking on one of the attribute links, revealing a script editor. Here the activities of step nine are completed. Below is a sample screen shot of a single transformation (Figure 11-21). This activity needs to be completed for every linked attribute (of which there are hundreds making it unrealistic to include a screenshot of each). The actual transformation scripting and resulting XML in the screenshot below were created by the development team.

Figure 11-21: Sample of Graphical Transformation Editing



The transformations that are created using the GUI produce XML files that are stored in the application system files. These files can be accessed using a web browser.