The Design of Accessible, Usable and Meaningful Content

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January 2008

Volume 1: Explanatory Essay

VOLUME 2 HAS BEEN RESTRICTED UNDER INSTRUCTION FROM THE UNIVERSITY

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List of publications in support of PhD

This list of 31 mostly multi-authored[1] publications submitted in support of the PhD is divided into three parts corresponding to the sections of the Essay (Discourse Studies; Uses of Metadata; Accessibility of Content) in which the publications are discussed. The publications are in a numbered sequence for reference purposes.

A set of commentaries on a selection of 8 papers from the 31 can be found at the end of the volume, before the References. Those 8 papers are marked here with background shading.

Publications referred to in Section 1: (Discourse Studies)

1. Sutcliffe, A.G. & Darzentas, J.S. (1994): The Use of Visual Media in Explanation. In *Cognitive aspects of Visual Languages and Interfaces. Human Factors in Information Technology*. Eds. Tauber, M.J., Mahling, D., and Arefi, F. Elsevier, Amsterdam. pp. 105-132.

2. Darzentas, J. Darzentas, J.S. Spyrou, T. (1993): Explanation Provision for Decision Aiding in Intelligent Systems: *Proceedings of The Fourth National Conference Of The Greek Computer Society*, Vol. 1, pp. 169-186

3. Darzentas, J., Loukopoulos, N, Darzentas, J.S., Spyrou, T. (1991): Models of Task Knowledge Structures in Designing Intelligent Tutoring Systems Architecture (in Greek). *Proceedings of the Third National Conference of the Greek Computer Society,* Vol.1, pp. 435 - 448.

4. Darzentas, J. Darzentas, J.S. Spyrou, T. (1995a): Designing a Designers' Decision Aiding System (DDAS). *Journal of Decision Systems*, Vol. 4, No 1, pp. 9 - 22

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6. Darzentas, J. Darzentas, J.S. Spyrou T. (1995b): An Architecture for Designer Decision Aiding - DDAS. In: *DSS - Galore*, M. Brannback, T. Leino (Eds), Abo Akademi, Turku, pp. 115 - 132

7. Darzentas, J. Darzentas, J.S. Spyrou T. (1997a): Choosing Appropriate Tools by Means of Intelligent Decision Support. *Journal of Decision Systems*, Vol. 6, pp. 45 - 62

8. Darzentas, J. Darzentas, J.S. Spyrou T. (1997b): Helping the User to Make Use of the Tools: Transferring Research Results from the Laboratory to the Market by means of Intelligent Decision Support. In *Human Comfort and Security-Advanced Interfaces for the Information Society*. Springer Verlag, pp. 193 -213

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[1] The author's name (J.S. Darzentas) is underlined in this list and marked in bold when referred to in the text of the essay, to distinguish from John Darzentas (spouse and colleague).

Publications referred to in Section 2: (The Uses of Metadata)

9. Skourlas, C. Maroulis, D., Darzentas, J.S., Assimakis, N. Murray R. (1995): Connectivity and Protocols: The Library and Information Services Environment, in *Proceedings of The Fifth National Conference of The Greek Computer Society*, Vol.2, pp. 659-667,

10. Clissman, C., M urray, R., Davidson, E., Hands, J., Sijtsma, O., Noordzij, A., Moulton, R., Shanawa, S., Darzentas, J.S., Pettman, I. (1997): The UNIverse Project: state of the art of the standards, softwares and systems Part 1: z39.50;WWW integration with Z39.50 and Unicode *New Library World* Vol. 98, no1138, pp. 267-274

11. Clissman, C., M urray, R., Davidson, E., Hands, J., Sijtsma, O., Noordzij, A., Moulton, R., Shanawa, S., Darzentas, J.S., Pettman, I. (1998a): The UNIverse Project: state of the art of the standards, softwares and systems Part 2: Record Syntax Conversion, Result Set De-Duplication and Multilingual Thesauri *New Library World* Vol. 99, no1139, pp. 10-20

12. Clissman, C., M urray, R., Davidson, E., Hands, J., Sijtsma, O., Noordzij, A., Moulton, R., Shanawa, S., Darzentas, J.S., Pettman, I. (1998b): The UNIverse Project: state of the art of the standards, softwares and systems Part 3: Inter-Library Loan Protocols, Multimedia Document Delivery and Authentication and Directory Services *New Library World* Vol. 99, no1140, pp. 60-69

13. Darzentas, J.S. (1999): Sharing Metadata: Enabling On Line Information Provision, *OCLC Systems and Services*, Vol. 15, no.4, Available online at: http://educate.lib.chalmers.se/iatul/proceedcontents/chanpap/darzenta.html (This paper originally appeared in the IATUL Conference Proceedings, Crete, May, 1999, and was subsequently selected by the OCLC for journal publication).

14. Konstantopoulos, M., Darzentas, J.S., Koutsabasis, P., Spyrou, T., Darzentas, J. (2001): Towards Integration of Learning Objects Metadata and Learner Profiles Design: Lessons from GESTALT in *Journal of Interactive Learning Environments.* Vol. 1, pp.1-24.

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Publications referred to in Section 3: (The Accessibility of Content)

17. Koutsabasis, P., Darzentas, J.S., Abascal, J., Spyrou, T., Darzentas, J. (2001): Designing Internet-based Systems and Services for All: Problems and Solutions, in *Proceedings of HCI International, New Orleans*, Vol. 3, pp. 31-35.

18. Koutsabasis, P., Darzentas, J. S., Spyrou, T., Velasco, C.A., Mohamad, Y., Darzentas, J. (2001): Towards an Environment that supports Internet Design for All, in *Proceedings of 1st Panhellenic Conference on Human-Computer Interaction, 2001,* pp. 281-286

19. Darzentas, J., Arnellos, A., Darzentas, J.S., Koutsabasis, P. Spyrou, T. Viorres, N., Vlachogiannis, E., Velasco, C. A., Mohamad, Y., Abascal, J., Tomαs, J., Arrue, M., Tsopelas, N., Floratos, N. (2003): IRIS: Implementing an Open Environment supporting Inclusive Design of Internet Applications, in *Proceedings of INTERACT 2003, (Ninth IFIP TC13 International Conference on Human-Computer Interaction)* pp. 749-752.

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23. Theodoropoulos, V., Koutsabasis, P., Darzentas, J.S., Spyrou T., Darzentas, J. (2001): Designing a Postgraduate Curriculum in Information Systems: A Greek case. In *Ninth Annual European Conference on Information Systems (ECIS 2001),* pp.1070-1080

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Educational Design Conference, ICSID (International Council of Societies of Industrial Design), pp. 69-73

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Acknowledgements

I am deeply indebted to Professor Helen Petrie who so generously supported me in undertaking a PhD, and has acted as supervisor, colleague and friend, taking time out of her extremely heavy schedule to help and advise me.

My husband, Professor John (Yannis) Darzentas, who has always encouraged my academic undertakings - often at the expense of family life, and domestic orderliness - deserves much praise for his forbearance and fortitude, and also my children, Alice and Dimitri, who manage to take in their stride a mother seemingly permanently engaged in (life-long) learning. There cannot be words enough to express my love and gratitude to them.

I also owe a great debt to my mother, Margaret Mary Lennox née O'Donovan, whose love of books I inherited, and who set me on the path to discovering the world around me. She continues to enjoy finding out and seeking to understand, setting an example to her children and grandchildren.

Finally, there have been many collaborations with colleagues over the years from whom I have learnt and with whom I have shared much. I thank them all, and look forward to continuing to work with them, and to continuing to share the excitement of exploring and enquiring.

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Abstract

This Explanatory Essay discusses the 31 papers which I have authored, or made a substantial contribution to, and submitted for a PhD by Prior Publication. The Essay presents these publications in the light of their original contribution to an emerging theme of concern, Content Design, which I will argue is the deliberate design of content so that it is accessible, usable and meaningful.

Content is any type of information carrying material that is produced in any medium or mixture of media, for human, as opposed to machine, consumption. As such, content has always played an important role in our lives. In the Information Age, however, the importance of this role is becoming critical. This may be attributed to many factors, including: the inexorable proliferation of digitally produced content of all types; the increased possibilities, even expectations, to interact with content; and our growing reliance upon information. Thus, there should be a renewed attention to design of content, particularly its accessibility, usability and meaningfulness.

There are many research areas that deal with aspects of content. I believe that deliberate attention to the composition and structuring of content can benefit from all of these. Content Design represents a multifaceted 'problem space' that draws on a wide variety of disciplines, from the humanities to the sciences. It also has lessons to learn from traditional ways of meaning-making, particularly literary studies and rhetoric. This problem space is a place to pull together knowledge and expertise that is needed in the digital age to help to design content so that it is consumable by humans. In this Essay, my publications are situated within three strands of research that offer such knowledge and expertise: Discourse Studies; the Uses of Metadata; and the Accessibility of Content. Broadly speaking, my work contributes, within these strands, to the design of content in terms of composing, packaging and making content apprehendable.

Explanatory Essay: Rationale and Overview

The purpose of this essay is to offer a reasoned argument in support of the publications that I have authored, or substantially contributed to, over the last 14 years. I claim that these publications have made an original contribution to what I argue is an emerging theme of concern, that I term 'Content Design'.

In my definition, Content Design, briefly described, is the deliberate composition and structuring of content of all types that is intended for human, as opposed to machine, consumption. In this view, content is a general term that refers to any type of information-carrying material that is produced in any media or mixture of media: i.e. audio or visual, paper based or electronic or any combination of these. This definition of content encompasses traditionally produced content as well as electronically produced content. It applies to content encountered in every aspect of everyday life: at work, at leisure and in our lives as citizens and social human beings. The purpose of content may be to inform or to entertain, or both.

Thus Content Design is a wider term than that of "Information Architecture"[2] that is mostly interested in the structure and organisation of web based materials, or that of "Information Design" that has emerged from a mixed background of research into information visualisation[3] and technical writing. In my view, Content Design represents a multifaceted 'problem space' that draws on a wide variety of disciplines, ranging from the humanities to the sciences, and encompasses both aspects of Information Architecture and Information Design (Horn, 1999) as they are presently defining themselves. I see the theme or research area of Content Design as a place to pull together knowledge and expertise that is needed in the digital age to help to design content so that it is consumable by humans, in terms of being accessible, usable and meaningful.

The need for content to be designed is even more urgent as boundaries between previously vertical content industries are being broken down; new roles are being created; and alignments change almost daily as industries try to determine new business models and modes of working. In this swiftly changing environment, that is built upon technologies for rapid and ubiquitous transmission of content, "information overload" was one of the first problems to occur. The problem of inaccessible, unusable and

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[2] This can be seen in for instance the subject matter of the acknowledged 'bible' on the subject, "Information Architecture for the World Wide Web: Designing Large Scale Web sites" Rosenfeld and Morville, (2nd Edition) O'Reilly Media, 2003 (also known as "the Polar Bear book")

[3] For example, the International Institute on Information Design (IIID)recommended by UNESCO as a partner organisation for world wide co-operation on matters of information design (Resolution 4.9 of the 28th General Conference of UNESCO, 1995, Paris) is primarily concerned with "visual communication" http://www.iiid.net/FrameSet.htm

meaningless content is already here. Yet, there are many people working to solve aspects of these problems. This means that there is an opportunity to share and amalgamate knowledge and experiences, across domains and disciplines, if it is recognised that all are engaged in a similar goal, that of designing content.

The Essay begins with my conceptualisation of Content Design, using as supporting evidence the centrality of content in the 'Information Society', (Introduction: Content and Content Design). I first outline some background issues to the theme of Content Design, beginning with a definition of content, and tracing the Information Age view that content of all types is an important commodity. I show how this development is linked to the technology convergences and the rise of a range of 'content industries' that leverage new ways of manipulating content. Some of these, such as ways of producing, re-purposing, delivering and regulating content, are discussed in order to show the extent of the range of work carried out in content related industries, and to note as well that traditional ways of dealing with content can still be relevant.

Given the breadth of the perspective of content, I next posit the increased need for attention to the design of content, particularly in regard to the accessibility, usability and meaningfulness of content. I qualify that this is not new: content has always needed to possess these attributes, and indeed content of various types has always had its design rules and guidelines. These traditional ways of information communication and meaning making are still important, and can offer useful lessons, especially if they are viewed alongside the evolving Information Age knowledge and expertise.

That expertise and knowledge is not confined to producers and manipulators of content, content consumers also need to understand how to best use and exploit the interactive possibilities now often offered by content. This means learning new types of literacies to be able to access, make use of, and make meaning of content. The renewed attention to design of content is more pressing because of the centrality of content in our lives, that is, we have expectations of it, and others of us, regarding our interaction with it; we increasingly rely upon it; and all the while, it is proliferating inexorably.

Having posited the theme of Content Design in the Introduction to the Essay, the next three sections discuss three research areas from among the many that can and continue to offer approaches and methods useful for Content Design. Within these three research areas I have situated the publications that I have submitted in support of this PhD by Prior Publication and the contributions I have made to them. These three areas are Discourse Studies; the Uses of Metadata; and the Accessibility of Content, (sections 1, 2 & 3 respectively). Within each section, the research area is introduced, the background to my contributions is given alongside an explanation of the contributions themselves, and the current situation pertinent to the overall theme of Content Design is briefly noted. Finally, in the conclusions to each section the contributions and their impact are summarised

Briefly, these research areas and my contributions are the following:

1. Discourse Studies:

Discourse Studies is a general term for a number of approaches analysing language, both in speech and in text. It looks at the principles governing the production and interpretation of language and contextual features such as participants and setting.

My contributions took approaches and methods from this area to analyse explanatory content, including the use of visual material to illustrate or augment textual explanations. This work was evaluated for use in Intelligent Tutoring Systems. I subsequently built upon this work to provide appropriate detailed explanations to support the input and output of Decision Support Systems in domains such as HCI. This was achieved at the 'dialogue level' by restricting the descriptions presented to the users to those that were representative of their concerns rather than of domain knowledge. This made the system more amenable to users who were able to explore choices through problem descriptions that were relevant to them. The work also helped to make the output from such systems more acceptable to users by explaining some of the rationale underlying the recommendations (i.e. the output) these systems make.

2. The Uses of Metadata:

Metadata can be understood to mean structured data about digital (and non-digital) content that can be used to help support a wide range of uses. These might include, for example: content description; searching for content; managing content (i.e. especially in terms of rights management).There are many different types of metadata schemas

In a singly authored paper, I laid out my claim that different views on the uses of metadata from two separate research communities (that of digital libraries and learning technology researchers) could be made to complement each another and provide some solutions to aspects of content management problems that were becoming more urgent in the face of increasing amounts of digital content to catalogue and to search through. In the other publications which I draw on in this section, I show how the use of content metadata integrated with user centred metadata (e.g. user profiles) could address a number of content management related issues to do with search and retrieval of content and with providing content appropriate to users' needs. It is in this sense that previously separate metadata uses were combined to ensure greater accessibility and usability of the content for the user.

3. The Accessibility of Content:

By accessibility of content, I interpret more widely the notion of accessibility, from meaning the ability to access web based content, possibly with the aid of assistive technologies, to a more general meaning that the content is "accessible" in the sense of being able to be apprehended. The introduction to this section attempts to justify this interpretation.

This section contains three types of contribution. The first was the creating of a support environment to help designer author accessible content, and to learn about accessible content. The second can be considered in a general way as a continuation of the work on metadata, in 'customising'

content to the needs of users, but now including the devices (i.e. PC, mobile phone, assistive technology, etc.) that they are using to access content. The third type of contribution relates to a concern for more widespread education on accessibility and Design for All. This involved a classification of a wide range of material relating to accessibility and Design for All so that it can be more easily accessed and used by educators and learners.

In the next section, entitled: "Towards a theory of Content Design", a vision of Content Design is articulated; the relationship of the three preceding sections to this vision is elaborated to explain how these contribute to the design of content that is accessible, usable and meaningful. The scientific import of the work presented in this essay and the publications is then claimed. This is followed by a discussion of the validation of the work: how it was validated; the limitations of this validation; and how validation on Content Design related work should be carried out in the future. Finally, this section concludes with the setting out of an agenda for Content Design.

In the penultimate section to the essay (Summary and Conclusions: Content Design Revisited), my contributions to the areas outlined in the three sections are reviewed and then discussed in the context of the overall theme of Content Design, ending with some reasoned speculation about possible future needs regarding content and the emergence of a profession of 'content designers'.

The final part of the essay consists of a set of commentaries on eight publications (from the total of thirty-one) submitted. The aim of the commentary is each time is fourfold:

1. to make clear my particular contribution to the paper, including the part I played in the research that led to the production of the publication.
2. to briefly describe the background to each publication, given that the papers are set in a variety of research areas, such as Intelligent Tutoring Systems, Decision Support Systems, Digital Libraries, Online Learning, etc.,
3. to assess, where possible, the impact of the publication, in the light of the information given about the background,
4. to show the relevance of the work to the theme of Content Design

Introduction: Content and Content Design

Overview of Introduction

In this Introduction to the Explanatory Essay, my conceptualisation of the emerging Content Design 'problem space' is sketched out. It sets the scene for the discussions of the published work that follow in the body of the essay. The section starts by giving a definition of content. Content is defined according to dictionary and consensual use, and contrasted with the term 'information'. The increased use of the term 'content' is accounted for, especially with regard to 'e-content' or 'digital content'. The argument that content is increasingly central to our lives is supported by briefly describing industries that are content dependent or based upon content creation, management, manipulation and delivery. Having put this evidence forward, in the second part of this Introduction, I go on to make the claim for Content Design. I recognise that bodies of knowledge about how to design content so that it is effective has always existed. However, I maintain that now that content industries are so extensive and pervasive, it is important to gather together independently developing expertise and knowledge, in recognition of the need to consciously design content.

Introduction

As stated in the Rationale and Overview, the purpose of this essay is to offer a reasoned argument in support of the publications that I have authored, or substantially contributed to, over the last 14 years. I claim that these publications have made an original contribution to what I argue is an emerging theme of concern, that I term 'Content Design'.

Content Design reflects a need for attention to the design of content, particularly in regard to its accessibility, usability and meaningfulness. This is actually renewed attention. Content of various types has always had its design rules and guidelines. These traditional ways of information communication and meaning making are still important.

However, there are now many innovative aspects to content that are a result of the new ways of producing and distributing content, and the new ways of interacting with it. In addition, many of the traditional boundaries between producers and consumers of content are being broken down, leading to different expectations from content. Finally, content itself is assuming a richer character, often being composed of elements which leverage traditional and new technologies.

I believe that Content Design can be a unifying theme within which to gather together much of this traditional and newly developing knowledge and expertise. In particular, I believe it is important to pull together strands of work that are taking place independently when in fact there are valuable lessons to be learned from one domain to another. Attention to the design of content is now especially important in the Information Age with its inexorable proliferation of (digital) content of all types; growing

expectations (both from ourselves and others) regarding our interaction with content; coupled with our increasing reliance upon information.

In the body of the essay, I discuss three strands of work, -discourse studies, uses of metadata and accessibility of content and show my contributions to them, in the form of my publications. I believe these strands also contribute to the wider theme of Content Design, and this is explicated in the section "Towards a theory of Content Design".

In the next subsections, I lay out the background to this theme, by firstly discussing content, what it is (Defining Content); how it is viewed by the various communities (professional, technical, business, governmental academic) that engage with it; and the various perspectives one can take of it Content in Context). I note that accessibility and usability are among the reasons that could be quoted for the slowness in the trade of professionally produced content.

Finally, I explain my conceptualisation of Content Design. In spite of diversity in types of content, I believe that some activities, such as producing and re-purposing content are common to all content. There are now new ways of doing this, but also the traditional ways are important. Borrowings should be made across former boundaries. Important new factors are the new literacies of the content audiences, and the centrality of "dis-intermediated" information in our lives (information not mediated by another person), and the changing nature of content due to new forms of content enabled by new delivery and devices.

Defining content

In this essay, content is defined as any information carrying material that is intended for human, as opposed to machine, consumption. Content may be conveyed by any kind of document; image; audio or visual media. It may be in traditional form: e.g. paper based print, film or tape, or it could be electronic content. Its purpose could be entertainment (films, books, music, artworks); education (textbooks and journals, online learning materials); work related (reports, memos, brochures, slide presentations, videos); or just part of daily living. Daily living as citizens means interacting with content from private and public service industries: for example, banking; insurance; travel; gove rnment services, etc. In addition 'daily living' includes interacting with content that is part of personal communication activities, such as emails, online fora and even SMS from friends and family. The point to be made here is not about the form or even the purpose of content, as much as about the fact that it plays a central role in our life, particularly in the Information Age, now that there is much more of it and now that there are new ways to interact with it. I will posit that this means that we need to pay more attention to the design of content so that it is accessible, usable and meaningful.

I use the term 'content' because it is presently in wide use, and there is generally a consensus about its meaning. A contemporary view from

Wikipedia[4] defines content as "information as distinct from its mode or channel of communication". In literary, music and art terminology, content is distinguished from form, content being the substance and significance and form being the shape or structure it takes, (Eagleton, 1976; Middleton, 1999; Gombrich,1951)[5].

This definition of content also seems to hold in different specific communities. For instance:

- In educational contexts, particularly in discussions of curricula, 'content' is the subject matter to be taught, as distinguished from the way it should be taught (Jones et al, 2001; King-Sears, 2001; Saracevic and Dalbello, 2001)
- In the library community, 'content' is the physical holdings of the library, or the digital information resources to which it can give access. The use of the term 'content' is perhaps more commonly encountered as 'digital content' and 'collection' is used for items with a physical presence[6] (Oppenheim, 1999)
- In journalism and mass media, "newscontent" is the 'story' that is to be delivered via a variety of media, and using various technologies, (Pavlic, 2001; Bierhof, 2003)

The "medium/message dichotomy" prevalent in the Middle Ages (Rummel, 1995)[7] has come around again in the Information Age. Rather than 'data' and 'information', 'content' seems now the favoured term. In choosing this term, I believe that people are not just using it because of its currency in broadcast and mass media (for instance, censors "rating the content of a film"). Instead, I believe that people use the term 'content' because they are implicitly acknowledging two attributes of content, especially content that is digital.

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[4] Content is described at http://en.wikipedia.org/w/index.php?title=Content&oldid=59240768 note that this is the permanent link to a disambiguation page

[5] This being said, from an artistic and literary point of view, as well as a philosophical one, the separation of content from form is often contentious, and rather artificial: "Real works of art are those where content and form exhibit a thorough identity", see Hegel: *Encyclopaedia of the Philosophical Sciences, §133 Content and Form* available in translation online at http://www.kern-ep.de/Internet/Hegels_Logik/appearan.htm

[6] See for instance the document relating to the British Library's Collection Development Policy http://www.bl.uk/about/policies/collections.html and their use of the term 'content' as used in the British Library's Content Strategy document at http://www.bl.uk/about/strategic/pdf/contentstrategy.pdf

[7] Rummel describes the transformation of the classic conflict between philosophy and rhetoric into quarrels between humanists trained as philologists (e.g. Erasmus) and scholastic theologians trained as dialecticians over interpretations of scripture, in the time of the Renaissance and the Reformation. That is, the "essence" that the philosophers of classical times tried to describe as clearly as possible, as opposed to the concern of the rhetoricians to "convey" the essence, was also part of the problems between the humanists and the theologians later on. In our times, we have the flexibility to separate content and structure to the benefit of the end audience, but not always the understanding of the design implications of this.

- Firstly, there is increasing awareness of new ways of distributing content, so that the same message can be delivered in various forms using different media. This is part of the cross-media or technology-convergence research that tries to solve, technically at least, the problem of content delivery to different platforms, e.g. desktop computer and mobile handheld device (Boumanns, 2004; Spinellis, 2003). As well, in less technically challenging ways, hybrid information delivery draws the distinction between "the message" i.e. the content, and the form that message takes, for instance, content about tax returns contained in a paper based leaflet or available on the website of the U.K.'s Inland Revenue.
- Secondly, 'content' is once again an apt term for the information on web sites. This is because web content (if it has also markup that describes its structure) can be separated from that structure by browser technologies. This means that the informational content can remain the same, but the information rendering or presentation layer (that is, margins, font, graphics, etc.) can be changed to suit the receiver of the content (where the receiver is the device and/or the human). Web developers themselves distinguish clearly between 'content' i.e. the information of the site, and how it is organised and structured, (Robbins and Stylianou, 2003).

The relationship of content to the more usual terms encountered within information systems and computer science literature, that is, 'data-information-knowledge' is next examined. There have been many words written about this hierarchy (Ackoff, 1989[8], King and Ko, 2001). Summarising, these terms have been defined in a linear sequence as follows:

- Data may be human, as well as, machine readable. It has no meaning of and by itself (as in the expression "raw data" which needs some form of analysis or processing for it to become meaningful). It is context free.
- Information is richer than data, it is processed data, and provides some relationships between data.
- Knowledge is the combining of data and information to produce understanding.

Content, as I have defined it, does not fit into this linear sequence, except as being information carrying material. Furthermore, it cannot be apprehended by information systems unless it is 'wrapped' in metadata that is comprehensible to the computer. Content has the sense of being an entity although it is tied to context. Content requires interpretation. That interpretation may produce knowledge, another term whose epistemology can be debated for pages. The closest term to content then, is information. However, they are not quite interchangeable. A useful illustration of this

[8] In Ackoff's full description the progression is from data and information to knowledge, understanding and wisdom, but it is the first three that are most used.

can be seen in the suggested ICE (Information and Content exchange)[9]protocol, where 'content' refers to the 'goods' (books, magazines, films, music) that publishers will exchange whereas 'information' is the 'non content', like subscription information, etc. In a similar way, video, film and virtual environments (Odlyzko, 2000, Bearman et al., 1999) tend to talk about content, and information is the descriptive data that accompanies it, like instructions for use, etc. Having made this point, in this essay, I will use the term 'information' interchangeably with 'content' for stylistic purposes.

Content in context

From a historical perspective, it is possible to see the term 'content' *per se* gaining in usage from around about the time of the often quoted 1996 prediction of Bill Gates that "Content is King" (Gates, 1996). That is, Gates claimed that content would be the most profitable part of the Internet. He was echoing the French philosopher, Lyotard, who, a decade prior, was perhaps the first to posit that 'knowledge' (*le savoir*) would be the commodity of the postindustrial epoch (Lyotard, 1979), well before even it had become commonplace to talk of the 'Information Age' and the 'Knowledge Society'[10]. Gates defined content very widely. His focus was on all material that could be transmitted digitally, using the Internet. It included software[11], but also high quality professionally produced content that was traditionally broadcast, or sold as discrete items (e.g. music CDs, and movies). He included as well all sorts of information rich sources, like directories and online communities. His 'essay' closed with the statement asserting that the Internet would be:

> *"a marketplace of ideas, experiences, and products - a marketplace of content."*

In the ten years since 1996, the understanding of the potential of content as an economic asset has become more widespread. Public funds are being put into its development by national and international organisations. Some countries are implementing national content strategies, based mostly upon preserving cultural heritage, for example New Zealand[12]. The EU implemented a research programme called eContent for 2001-2004 which focused upon "digitising" content and renewed it last year with the

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[9] Information and Content Exchange Protocol http://www.w3.org/TR/NOTE-ice This protocol was designed to facilitate the controlled exchange and management of electronic assets between networked partners and affiliates. A note to the W3C in October 1998 explaining ICE claimed that *"Applications based on ICE will enable companies to easily construct syndicated publishing networks, Web superstores, and online reseller channels by establishing Web-site-to-Web-site information networks"*

[10] These terms date respectively from the decades of the 1980s and 1990s while "Knowledge based economy" is the term used in 2000 eEurope policy: http://ec.europa.eu/employment_social/knowledge_society/index_en.htm

[11] This, of course, is the business of Microsoft, and in particular, Gates was interested in developing software for payment and charging mechanisms for content, as well as transmission of content

[12] New Zealand Digital Strategy National Content Strategy http://www.digitalstrategy.govt.nz/templates/Page____116.aspx

eContentplus (2005-2008) programme, with a focus on the development of interactive content[13]. Meanwhile, the Organisation for Economic Co-operation and Development (OECD) set up a working party on Digital Content in 2005. In their view, digital content is widened to include:

> *sectors not previously considered to be content producers or users (for example, business services) and in the public sector (public sector information such as weather and geographical information with direct commercial potential, and public sector content such as archives and cultural content), education and health"*[14].

Specifically the OECD are currently (2006) producing reports on five content sector studies: (scientific publishing, music, computer games, mobile content, public sector information and content) (OECD, 2006)[15]; while the influential IDATE forum, a long standing alliance between telecommunications, media and internet based industries, considers the dominant content to be video, games, music, news, auctions, meetings, etc[16]

Thus by 2001 it is accepted to talk of "knowledge industries", (Zook, 2001), and the EU to refer to "eContent industries"[17]. The OECD produced an indicative list of content "products" by sector, which is reproduced below.

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[13] *"While creating new content delivery systems and channels for traditional content, allowing access to any content, anywhere and at anytime, convergence is also opening the path for the development of ground-breaking content services, such as online gaming or interactive TV. By creating a new interactive element and changing the viewing, listening, reading or playing experience, convergence and digital development allow users to have a growing control on the content they are accessing. Together with the widespread availability of fixed and mobile broadband networks, this creates a promising range of opportunities for the development of interactive content".*
http://europa.eu.int/information_society/eeurope/i2010/docs/studies/interactive_content_tor.doc and http://cordis.europa.eu/econtent/

[14] This text is drawn from the conference announcement of the OECD's Working Party on the Information Economy (WPIE) January 2006, Conference on the Future Digital Economy: Digital Content Creation, Distribution and Access, and available at http://www.oecd.org/topic/0,2686,en_2649_37441_1_1_1_1_37441,00.html

[15] OECD Conference Summary of January 2006 Conference on the Future Digital Economy: Digital Content Creation, Distribution and Access
http://www.oecd.org/sti/digital-content and
http://www.oecd.org/dataoecd/54/35/36854745.pdf

[16] See IDATE,
http://www.idate.org/pages/index.php?rubrique=cmpt&idr=12&idp=17&idl=7 This organisation, established in 1977, is a consultancy and research forum for Telecommunications, Internet and Media sectors. Its members are telecom carriers, TV channels, manufacturers, software houses, banks and financial organisations, large businesses such equipment manufacturers. The European Commission is also a member.

[17] eContent Programme http://cordis.europa.eu/econtent/

Media and entertainment applications	Non-entertainment applications	Government	Network users
Publishing (books, magazines, comics, etc.)	Industrial and visual design	Public sector information for commercial re-use	Web sites
Film / Motion pictures	Software design and development	Research & Science	Blogs and podcasting
Animation (animation characters and avatars)	Business and professional related content	Education	Virtual communities
Music	Advertising	Culture (e.g. digital libraries)	Digital photos and video files
Broadcasting / Digital radio / Cable / Interactive TV and other interactive media	Fashion/design	Health	Art works
Software / Computer and video games	Architecture / professional services		
Gambling	Training and adult education		
Mobile content / Telematic and wireless services			

Source: OECD based on various government publications. The list of examples in the four content categories is illustrative and in no priority order.

Table 1: Illustrative list of entertainment and non-entertainment-related content products (from OECD report: Digital Content Strategies and Policies[18]).

To better illustrate the new alignment of content products and industries, in the next paragraphs I describe some of the changes that have, and are occurring within the publishing, education, public agencies and business sectors. These changes have come about both as a result of considering content as product, as well as a result of the range of possibilities offered to content by ICT (Information and Communications Technologies) - or put another way - content that is digital.

Of course, the view that content is a commodity is not new to some industries, for instance publishing and the media. Traditional publishing industries with output such as books, newspapers, and magazines, as well as the entertainment content industry, especially music, film and video games[19], revolve around content, its creation, management and marketing (including advertising). What has changed is that although they keep traditional channels of output, they have started to embrace new technologies for production and distribution. For example, video games have developed innovative business models, such as licences for online multi player games, for which there is no equivalent in the traditional content industries. In this they have been very successful: for instance, the game World of Warcraft signed up 1.5 million players in the first four months of its existence (Shaw, et al. 2005).

For other sectors, content production has increased dramatically. The education content sector (grouping together both traditional publishers of educational material, and those involved in teaching and course materials creation) has seen a tremendous increase in learning and training content production, i.e. an increase in text books and courseware, and associated

[18] see p.10, Digital content policies and strategies (2006), Doc ref: OECD/DSTI/ICCP/IE(2005)3/Final,a vailable at http://www.oecd.org/dataoecd/54/36/36854975.pdf

[19] A useful description of the different payment methods can be found on the US Census forms, available at http://www.census.gov/eos/www/napcs/papers/516.pdf

adaptations for digital media, such as CD ROMs or online delivery (Black, 2004, Allen and Seaman, 2005). Also on the increase is the education sector's publications outlet comprised of scholarly output in the form of journals, (both traditional and online versions), conference proceedings, etc. that has grown exponentially in the last decade[20]. Several reasons are behind this. It can be seen, in part, as the result of improved and integrated desktop publishing technologies, enabling more of the preparatory work to be devolved onto the content creators and increasing the throughput of titles (Watts, 1992, Bull and Heslet, 2000), as well as, in part, the result of the need for more outlets for academic recognition in terms of published work (Odlyzko, 2000). Finally, more recently, making use of the opportunities offered by online journals for low cost and high availability; the production knowledge gained of the area by content creators; and in response to the high prices charged for 'established' scholarly print publishing; a plethora of such content is being produced (Willinsky, 2003, Getz 2004)[21]. In 2001 content from this educational sector was estimated to account for 20% of the total content[22] globally.

New players in the content sector, as the OECD report now acknowledges, are government services and public sector agencies. In fact, they have been, for some time now, producers of informational content. Fact sheets and pamphlets are the first line of answer to enquiries from the public. In addition, forms and explanatory notes accompanying forms are part of most government services. The conversion to on-demand online services has meant a corresponding increase in content as people are no longer writing letters or visiting or even phoning offices. Indeed, many offices are moving from a person based enquiry model to an information provision service model. (Peristeras et al., 2002)

A particular case of this is information for the public about medical and health issues. In the United States there has been for some time a strategy in place to encourage the public to inform themselves about issues to do with their health care, and play a greater part in the management of their ailments. This is so especially when these are issues in which several medical specialities might be collaborating (e.g. cancer cases, where oncology, radiation, chemotherapy, surgery, and nutrition experts may all be involved).This has resulted in specially designed websites for the public[23], and online support communities in partnership with governmental agencies[24]. In the UK, since the publication of the Information for Health strategy, (Burns 1998), there has been an

[20] Between 1986-2002, the number of scholarly journals published globally increased 58% see http://www.lib.berkeley.edu/Collections/crisis.html.

[21] Both of these references are in the context with the Open Access issue. Open Access can be defined as free online availability of digital content. It is best-known and most feasible for peer-reviewed scientific and scholarly journal articles, which scholars publish without expectation of payment.

[22] EMCC (2003) reported that educational and professional books and training accounted for 20% of the worldwide entertainment and media market in 2001 (based upon a report by PricewaterhouseCoopers, see p 5)

[23] For example, the National Institutes of Health http://health.nih.gov/

[24] For example, the Association of Online Cancer Resources with the National Cancer Institute, www.acor.org and www.cancer.gov.

expressed emphasis that the information technology (IT) strategy should focus on doctors and patients, rather than on the organisation management. At the present time, the NHS is actually tendering for the setting up of an NHS Information Authority in the UK to provide content to public[25].

A final group contributing to content products is businesses and organisations. They are normally regarded as being mangers of information, and less as producers of content. Their information management skills are owed to their long experience of working with ICTs. The information generated by businesses, and the information that they need to use to operate, have exploited several generations of ICTs. One might say that businesses have gone through data, information and knowledge phases of content management. From the first generations of work in the decade of the 70s on automating manual systems, and dealing with volumes of manual 'data entry', they progressed to information systems of various sorts in the 80s that relied upon shared databases, and helped eliminate duplicated activities. Around about the decade of the 90s, businesses began to make use of various types of 'knowledge management" that made use of data, such as storing and searching it ("data warehousing and data mining") using software based systems such as expert systems (ESs); decision support systems (DSSs); enterprise resource planning systems (ERPs); customer relationship management systems (CRMs), etc. In the present decade, with increases in speed, bandwidth and more widespread use of Internet by those inside and outside of organisations, there is more emphasis upon how they can publish, manage and use corporate content, (White, 2004; Panayiotou et al., 2005). Thus, businesses are now in the era of Content Management Systems (CMSs). These are systems that automate aspects of document creation and web publishing, and help with collaborative authoring of documents. The content they deal with can be any aspect of the information flow within companies (their intranets) and outwards towards supply chains (business to business e-commerce communications) and customer bases, (via public web sites). Given new business "norms" of transparency and corporate social responsibility in firms, in order to forge trust between companies and their workforces as well as between the companies and their customers, content creation and management now constitutes a major component of business operations (Rockley, 2003).

Finally to complete this historical perspective of content, in the Keynote address to the World Wide Web 2005 Conference last year[26], Berners-Lee made the parallel between the state of the Web in 1996 and that of the mobile web in 2004. He noted that the same problems of slowness, accessibility and lack of interoperability that were problems for the web in 1996, are now problems for the mobile web. However, he remarked that what was different was that back in 1996 there was a lack of content for the Internet, and now there is much potential content for mobile web.

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[25] NHS: Connecting for Health: Information Service for Patients
http://www.connectingforhealth.nhs.uk/publications/procurement/isp

[26] See Slides from WWW Conference Keynote 2005 at
http://www.w3.org/2005/Talks/0511-keynote-tbl/

'Potential' is still the operative word. Since 1996, it has taken another decade for content to show signs of being 'king'. The optimism that led to several business alliances between vertical sectors, such as Information Service Providers and film studios, did not lead to expected outcomes[27]. Even as recently as 2006, the Economist noted that the film industry was still not reaping the profits that it had envisaged a decade ago.[28].

It is possible to identify several sets of problems that have contributed to the slowness of professionally produced content to be traded in the volumes expected.

- The first set is connectivity oriented. At the beginning of the decade in question, bandwidth hungry content like films and online multiplayer games, needed more widespread deployment of cheap broadband. Broadband is only now becoming a reality in parts of Europe like Greece and is still expensive.
- The second set of problems reflects concerns of professional content creators such as publishers of books, music and film. Their main problems have been with finding new (implementable) business models: these range from how to charge for content; how to stop piracy; and how to safeguard/promote advertising revenue.
- The third set of problems centres on the customer/user. There is now a dawning realisation that the expectations of content consumers are more sophisticated than the old passive models of broadcast and media. Consumers want professionally produced (and reasonably priced) content they can manipulate: for example, saving playlists of favourite music, or video on demand (VoD). Furthermore, not only do consumers want to interact more with professionally produced content, they want to create and share their own "home made" content, especially personal communications, such as photos, emails, blogs, etc. Even as recently as 2005, the bulk of electronic content remains email, including unsolicited email (spam)[29], while blogs - a nd their readers - are increasing in number globally[30].

There is of course a further set of problems, that I loosely term the accessibility and usability, and ultimately, the meaningfulness of content. This affects all types of content, but in particular the World Wide

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[27] The TimeWarner -AOL merger in 2000, brought together media film and internet service provider industries, only for Time Warner to drop the AOL from its name in 2003, http://news.com.com/The+return+of+Time+Warner/2100-1023_3-5090205.html while Microsoft has been forging alliances with several film companies, e.g. with Alliance Entertainment in 2001 (movies, music and games), Time Warner in 2003, and Walt Disney in 2004, but yet to see any products or services http://news.com.com/Disneys+own+digital+divide/2009-1026_3-5157745.html.

[28] Old Media, King Content: http://www.economist.com/opinion/displaystory.cfm?story_id=5411930

[29] See, for instance: Rob McGann: The Deadly Duo: Spam and Viruses, January 2005 http://www.clickz.com/stats/sectors/email/article.php/3483541 and also the very interesting survey "How much information 2003" at http://www2.sims.berkeley.edu/research/projects/how-much-info-2003/

[30] Nielsen/Netratings Survey "Understanding the Blogosphere" (Press release of report (for subscribers only) available at http://www.nielsen-netratings.com/pr/pr_050815.pdf and State of the Blogosphere http://www.technorati.com/weblog/

Consortium's Web Accessibility Initiative[31] has highlighted the necessity for content on the web not to discriminate against those who are not mainstream technology users. The flexibility of digital content offers many possibilities: for instance the switch from analogue to digital TV in media broadcasting offers the chance to implement accessibility features into programming, such as subtitling etc. However accessibility and usability issues are far more than just presentation layer, or using different modes of communication. Accessibility and usability of content also needs to be understood in terms of interacting with content. Of course, interacting requires one to be able to access and use, but also, manipulate content in various ways, and to make sense of it, extracting or endowing it with meaning. As has been implied from the descriptions of content industries given in this section, there will be in the future much more content to interact with. However, to balance this, there will be much expertise developed in various content industries. This expertise will remain fragmented unless a need for deliberately designing content is recognised. In the next part of this introduction I introduce my conceptualisation of this emerging theme of concern: Content Design.

Content Design: a conceptualisation

As I tried to show in the first part of this Introduction, content - in all its manifestations - is viewed as a major commodity in the Information Age. More than just a commodity, it is poised to be a fundamental part of the way we work and live. If we accept this proposition, then it follows that we need to be concerned that we will actually be able to access, use and make meaning of content. At the present, a survey of the relevant literature views content from several perspectives including:

- A content industry perspective: publishing (books, newspapers and magazines, the press, scholarly publishing); entertainment (music and film; games, the broadcasting industry); content for websites and internet based services, including e-commerce and e-government, etc.
- A personal communications perspective: from traditional correspondence (letters and newsletters) to present day means (email, mailing lists, online web communities and weblogs) with both a one-to-one and one-to-many perspective.
- A telecommunications perspective: this is a view of the technologies and devices for sending and receiving content, for displaying and interacting with it.
- A rights management perspective: that is examining issues such as privacy, authentication, security, enforcing copyright, etc.
- A data management perspective: this includes technologies for creating, managing and delivering content. Managing content is a large category that can include, for instance, technologies for labelling

[31] World Wide Web (W3C)'s Web Accessibility Consortium WAI: http://www.w3.org/WAI/

content, so that it can be manipulated, in the sense of searching, filtering, ranking, it or aggregating it for re-use and re-purposing.

- A content consumer perspective: the need for new literacies (computer, information and media) due to the pervasiveness of content. In the words of the OECD director *"The skill sets of citizens will change: [..].citizens will need to know where to find information quickly, how to absorb that information, and how to assess its reliability and use it in a timely and well-articulated fashion"* (Johnston, 2006)

A Content Design perspective is absent from this list. I believe this is because we are just at the beginning of being able to understand that the different concerns represented in the list above are in fact all tightly related to content, and not isolated concerns. If content is the unifying element, then to talk of designing content one would need to take aspects each of these perspectives into account, thereby recognising that each perspective has something to offer the others.

At this point, it needs to be pointed out that the term 'Content Design' exists[32], but has a narrow definition (Parker, 2000; McGovern & Norton, 2001; Bucholz, 2003). It nearly always refers to the design of web sites, and usually refers to a wide spectrum of techniques for creating and structuring content for the web. These range from technical implementation matters such as how to render content so that it displays correctly to non-technical stylistic design guidelines for producing readable, comprehensible content, often of the type: "write short sentences". These have their roots back in rhetoric and literary techniques. There are also techniques and guidelines that focus on the organisation or structuring of content This is also known as "Information Architecture"[33], and is an area that is steadily gaining popularity, and an early witness to the need to gather together knowledge about Content Design issues (Wurman, 1997, Rosenfeld and Morville, 1998, 2002).

My conceptualisation of Content Design is much wider than just web site design or structuring of information. In my view, it needs to incorporate expertise and knowledge from all areas that are concerned with content, regardless of the type of content industry, e.g. news media or public information services. While it is true that each industry will have its own legacies from more traditional ways of dealing with content, they are already sharing internet based technologies for transmission and delivery of content. In the paragraphs that follow, I describe some of the activities associated with content, in terms of creation, management, manipulation and delivery, including rights access. At the same time, I try to separate

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[32] In the scramble to put up websites at the time of the 'dot.com' craze, many software developers with the technical expertise to make web sites found themselves charged with the creation and design of the whole site. The failure of websites to attract clients was attributed in part to their bad design, with the result that there was a sudden outpouring of articles and books with advice on content design and companies offering web design services, see Yang and Grove, (2002).

[33] Wurman defines the term information architect in the following way: *"I thought the explosion of data needed an architecture, needed a series of systems, needed systemic design, a series of performance criteria to measure it."*
http://www.informationdesign.org/special/wurman_interview.htm

these activities from the technologies and to draw out their relationships to traditional ways of dealing with content. The problems encountered and solutions devised in carrying out these activities will be useful to many domains, amassing experience that can inform the design of content both across industries and across activities.

- ***Producing*** digital content has become possible for non professionals with cheaper equipment and somewhat less need for specialist knowledge. There are now widely available desktop publishing and web authoring tools for creating text, animations, video and audio content; low cost and relatively easy-to-use cameras and scanners to capture and digitise content. Even before the advent of the Internet the need for rapid and copious information exchange was becoming apparent. Much of that content was work related. Word processors, photocopiers, fax machines, and finally the Internet were the technological answers to the need for content production and exchange, based upon printed documents, and soon to include other media (tapes, diskettes). Transmission was full of bottlenecks, many of these were expected to be solved with the widespread use of the Internet, the "information superhighway" that would speedily carry data, information, and knowledge. As we now know, with the increase in production and availability of content, new concerns came to the fore: namely, "information overload" and problems with finding content. Despite powerful search engines, for indexing, filtering and ranking content, we are unlikely to be able to put order into the chaos that is content on the Internet. Nor should we be too distressed about this. In the non digital world, we certainly did not have control over everything that was ever printed. Just as with traditionally produced content, digital content needs to be 'labelled.' This allows for search for and discovering content, as well as 'pushing' content to recipients who have expressed interest in receiving such content. The digital 'labelling' practices - currently activities like the Semantic Web (Berners-Lee, 2001, Shadbolt et al., 2006), folksonomies[34], etc. - should be seen alongside traditional ways of describing content (for instance, in libraries, with taxonomies) as an important source of knowledge for any design of content.

- Somewhat paradoxically, although the technologies for producing digital content increase[35], good 'professional' content is still expensive to produce, leading to much activity concerned with ***re-using*** **and/or** ***re-purposing*** **content.** This refers to several practices of reusing content, some as simple as for example, news broadcasts making extensive use of archive footage during "breaking" news stories, when they do not have up-to-date footage available. Since many of the roots of re-use/re-purposing are from traditional mass media, my next example also borrows from this industry. That is, another instance of re-use, also known as "multi-purposing'" is actually syndicating news: that is, not creating content, but using already created content, and enhancing it appropriately, for instance by localising it. Again this is not a new practice - Reuters was in business

[34]Wikipedia's useful definition of Folksonomy is at http://en.wikipedia.org/w/index.php?title=Folksonomy&oldid=63747765

[35] Although interestingly, digital printing still lags behind traditional forms of printing (Nomikos, Darzentas, Politis, Spyrou, Darzentas, 2003)

long before the Internet - but technologies such as RSS (Really Simple Syndication) make "newsfeeds" from multiple sources very easy and the practice of syndicating and aggregating content widespread.

The online learning standards research community is an enthusiastic supporter of re-using/re-purposing content (Hodgins, 2000, Littlejohn and Buckingham Shum, 2003). Their view is somewhat biased by an "object oriented" view of content, where content is broken up into the smallest unit that can have meaning, a learning object. This object is described with metadata so that with the help of search tools and aggregation techniques it can be reused and recombined. If one considers pieces of content as Lego bricks then this is a feasible way of considering content. However, if one considers content units as less neutral, like atoms that cannot combine with all other atoms, then one has a measure of the need for more than just an object oriented outlook on content repurposing. This is not to say that the education sector does not practice re-use and re-purposing. Again at a simple level, many textbooks and lectures are enhanced with content produced elsewhere and for other purposes. With digital technologies it is much easier for lecturers to incorporate such materials into their lectures, but it does require humans (Retalis, 2003; Collis and Strijker, 2004). Content re-purposing has been practiced extensively by the mass media industry, much of the available expertise and knowledge for media content design for effective communication might be found here. As an example, the UK's Open University[36] worked with the BBC to produce TV programmes on educational subjects using the skills of the media professionals. This was not just at the level of technical production expertise. The programme creators as media specialists, in combination with "chalk and talk" academics together created multimedia content that was designed to engage their audiences in educational experiences (Harris, 1987; Hawkridge, 1999) Thus content reuse and repurposing should be seen in the light of traditional media knowledge as well as the potential offered by new technologies.

- Another activity is that of content distribution, or ***delivery*** to a proliferation of devices, both static and mobile. Such approaches use the COPE (Create Once, Publish Everywhere) model (Tsakali et al, 2002, Boumanns, 2004). The newspaper industry has been the most successful at exploiting this, not the least because its content is such that it degrades very quickly with time. This means that journalists have a vested interest to get their content as quickly as possible to as many media (TV, radio, web) and devices (including handheld and mobile) as is feasible. At the level of technical interoperability, using metadata and common formats, (e.g. RDF and xml), this cross-media paradigm can be successful for simple content. However most content requires more than this to be successfully transferred. Content does not always transform gracefully to other devices, causing usability problems. Work on content adaptivity and user preferences is just beginning to address some of these issues (Eggen et al. 2000, Stephanidis, 2001, Watters et al. 2004). These issues

[36] The Open University in the 1970s was known as the "University of the Airwaves" emphasising the importance that was then given to media (radio and TV) delivered materials, over the traditional distance learning by correspondence course only.

have direct impact on accessibility and usability of content – important areas for Content Design.

- Many content related activities involve regulatory measures of some kind, such as **security; authentication; privacy; ethics,** and **rights management**. These are issues that serve the interests of various stakeholders, from the content providers to the content consumers. Many of these controls have had to be introduced because of the digital nature of content. That is, they do not have counterparts in the physical world, or in traditional content business. In trying to protect the one group of stakeholders, they may be running directly counter to some goals, such as interoperability and accessibility. As an example, ebooks offer tremendous possibilities for certain groups of people who are print disabled. However, controls, such as special software/hardware to read the books, effectively 'lock up' this content, by excluding those who are unable to use the controller mechanisms (Kerscher and Fruchterman, 2002, Cesarini, 2004). Another familiar example, are firewalls, measures to protect users but that can actually lead to frustrating isolation.

Of course, digital rights need to be protected, as do users, but so far most Digital Rights Management (DRM) has not been able to get the balance right, and are neither protecting content creators and nor helping content users (Doctorow, 2005). The tensions between control and access will continue, particularly as users themselves try to interact with content, adapting it to their needs and desires. There are recent developments in this area that go against restricted access, those of open access[37]. At the same time, there are some moves to create a legal definition of content and intellectual property rights that tries to abstract content away from its presentation layers, so that it is not the book or ebook that is to be protected and copyrighted, but it is the "concept and ideas concerned therein" (Uzuner and Davis, 2003, Uzuner, 2005)[38].

These new (and traditional) content related activities are sources of Content Design knowledge. However, there are other sources that predate these. Historically, textual content up until the mid 20th century was the

[37] A useful summary of Open Access is at http://en.wikipedia.org/wiki/Open_access

[38] A typical IPR agreement defines content in the following way: "Content" shall mean all works of authorship and products commonly understood as content in the entertainment, media, music and publishing industries, including products such as programming content, motion pictures, television programs and other audiovisual works or series, advertising and promotional materials, photographs, illustrations, images and other pictorial, graphic and sculptural works, dramatic works, choreographic works, sound recordings, musical compositions, books, articles and other publications, characters, animation, cartoons, video games, scripts, storyboards, titles, screenplays, synopses, plots, dialogue, stories, themes, treatments and other text, in any media, whether digital or otherwise, and any ideas, concepts or information contained therein, all copies, phonorecords and other physical materials embodying any of the foregoing, any materials used in preparation, development, promotion or advertising thereof and merchandise related thereto, in each case, whether or not protectable by Copyright, and all Copyrights, licenses and interests in Copyrights in and to any of the above. The list of items included in the above definition of Content is intended by way of example only and is not to be construed in any manner as an exhaustive or complete list of items covered by the definition of Content. Content does not include Software, Proprietary Information or Trademarks, and does not include any Software that is used to create Content. See Contract templates at http://contracts.onecle.com/time-warner/mediaone.ip.2002.08.20.shtml

province of professional writers, usually with some kind of education in literary studies and/or journalism. Gradually, in response to the need for manuals and other documentation[39], a distinct class of technical writers emerged. The design of content was the domain of several vertical industry sectors, for instance the mass media industry, the publishing industry, the entertainment industry, the education sector. These in turn, were served by a variety of professions and trades: journalists, authors, composers, playwrights, screenplay writers, academics, in collaboration with printers, filmmakers, artists and graphic designers, directors, etc.

In the western tradition of content creation, that stretches back to Aristotle and literary criticism traditions built upon his Poetics, textual content, whether as writing or rhetoric, had a mission to inform, and to instruct. These goals were to be achieved by appealing to both the emotions (*pathos*) by persuading, as well as to the intellect (*nous*) by convincing. These ideas were the basis for many 'Content Design' guidelines that still hold relevance for current Content Design contexts. Traditionally, they are broken down into those referring to form and those to content. Under form are the three elements or layers: structure, style and presentation. Structure is the innermost layer of form, refers to the organisation of the content, in the sense of how to structure argumentation, (for instance thesis, antithesis and synthesis). Style (or stylistics) refers to things like the choices in language, in terms of tense, register and tone. Presentation is the most outward layer of content, in text it corresponds to the layout on the page. All of these elements of form are subject to genre rules, where genre is an expected form of content. For instance, in theatre a play is based upon dialogue, scenes and acts that give a structure to the playwright to organise his content. In Aristotle's day there were conventions governing rhetoric (i.e. public speeches), theatre, and later on, history and the novel.

Adherence to these rules enabled audiences and readers to better understand the content. Certain forms created certain expectations. Even if these forms were blatantly put aside, as for instance in the plays of Ionesco and Beckett[40] the audience was still able to function by appreciating the defiance of conventions and the meaning(s) conveyed by that defiance. The actual terms relating to form in the classical sense are somewhat blurred in contemporary parlance, particularly when it comes to web content design, because they are used interchangeably. For instance, the structure of a web page can be marked up using Cascading Style Sheets (CSS)[41], a kind of template that allows changes to one page to be made uniformly throughout the document. A page that has been marked up in this way allows the reader to change the aspects of content presentation such as the colours, fonts and layout. It does not change the style as understood in the literary sense, despite making use of stylesheets to do so. Terminology borrowings such as this are not

[39] Society for Technical Communication http://www.stc.org/

[40] Eugene Ionesco and Samuel Beckett were among the among the best known proponents of the Theatre of the Absurd a deliberate flaunting of theatre convention, with no form and no content, that is in itself a message.

[41] The Cascading Style Sheets of the W3C is the an authoritative source for CSS http://www.w3.org/Style/CSS/

important, as long as they are clear. What is more important is to recognise that the form of content both at its innermost layers of structure and style as well as the outermost layer of presentation can profoundly influence the way a user accesses, uses and makes meaning from content.

The classical rules for content composition have their place in Content Design, enhanced by the experience of subsequent generations of content creators, particularly those involved with new media. Many of these although interested in technology, realise the importance of age old rules to engage audience. A study by the creators of a virtual reality experience, that was tested with many thousands of visitors to Disneyland, found that whatever technical enhancements were made to the environment, for example, maximising the comfort of the "ride", giving the visitor more autonomy to direct the virtual reality "tour", the visitors did not engage with the environment if they were not engaged to do so, by the simple literary device of involving them in a narrative (Pausch, 1996)[42].

Content Design cannot be seen without reference to the 'user' of content. In terms of the content consumer, the reliance on content is everywhere more apparent, and the demands that it makes more explicit. For instance, in a simple example, 'just in time' content for services such as information about traffic disruptions are available to help commuters adjust their journeys in and out of work. This is an information service that benefits consumers who avoid delays and trouble, and also helps traffic controllers "smooth out" congestion. However, it means that individuals are expected to be pro-active and inform themselves. This leads to people depending upon information and therefore needing to be assured that content is reliable, as well as available anytime, anywhere. It also means that people are expected to be able to use and interact with content.

The worry that this will not be possible for many of the population has led to concern expressed about the "Digital Divide". Several initiatives in the past decade that concern themselves with equipping people with "e-skills"[43] and new "literacies"[44] have been undertaken. The gloomy predictions regarding the elitism of knowledge workers (Angell, 2000) have not yet come to pass, but we are witnessing increasing "information dis-intermediation" (Brown & Duguid, 2000). That is, generally speaking, taking the 'middleman' out of the transactions between people and

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[42] "Technology for technology's sake", and "lack of narrative" were also reasons attributed to the failure of Disney's first venture with a full length commercially released computer animation feature film Tron in 1982 (Morie, 1998)

[43] In 2002, the e-skills summit was convened by the EU, and published a declaration, available at http://ec.europa.eu/enterprise/ict/policy/ict-skills/es-decl.pdf, In the UK, eSkills UK is licensed by the government, to work on eSkills actions http://www.e-skills.com/

[44] In the UK, the OFCOM (Office of COMmunication) is in charge of media literacy in the UK, and has published a series of reports on media literacy on various groups (adults, children the disabled, older people, etc.) available at http://www.ofcom.org.uk/advice/media_literacy/, and CILIP (Chartered Institute of Library and Information Professionals) has set up a working group on Information Literacy and published a definition statement http://www.cilip.org.uk/professionalguidance/informationliteracy
The US based, National Forum on Information Literacy has defined 7 types of literacy. http://www.infolit.org/definitions/index.html, see also Virkus (2003) for a recent review.

information. Dis-intermediation can be seen, for instance, in the trend to interact first with disembodied automated information sources, such as websites or recorded messages, with interaction with people being resorted to only when answers cannot be found otherwise. It can also refer to the way that this information comes to us, sometimes in its raw state. This is not always so desirable, for sometimes it is preferable to have the information 'processed'. For example, having direct access to the statistics on cancer deaths is sometimes less useful than a report that analyses those statistics. A third, slightly more remote example, we are witnesses to a greater emphasis in education of the pedagogic strategy of "learning by discovery". This is often practically translated into desk based research at earlier and earlier ages, in a deliberate attempt to also teach information seeking and retrieving activities, as well as develop critical faculties in regard to information sources and media literacy (Limberg, 1999; Bruce, 2002). What these three examples show is that our everyday lives, and those of our children, are becoming more and more content dependent, because content is central to many of our activities and because there are so many more ways to interact with it, and we are *expected* to interact with it, inform and educate ourselves[45].

Given the centrality of content, both as an economic force, and as a means of working and living in the Information Age, the importance of being able to use and interact with it seems clear. Content is something of a moving target, it is increasingly digital (requiring the user to have the necessary e-skills and media literacies) and it is increasingly expanding, both in volume and in form (most recently, blogs and podcasts). This means that ways to produce it, manage it and deliver it are the subject of much research and much knowledge is accumulating. That knowledge needs to be pulled together to inform the design of content. This does not mean that the aim is to reduce content to sets of guidelines, or rules. Rather the multidisciplinary nature of Content Design should be acknowledged: it can draw from areas as disparate as literary theory, copyright protection and communications technologies. Fundamentally, Content Design is the art and science of communicating meaning and experience.

To be able to do this, in the Information age, Content Design needs to consider:

- meaning making in traditional as well as new media,
- new literacies (information literacy, media literacy),
- that the variety of skills and knowledge required by the content designer will not be found in one person, but should be the result of multidisciplinary team work,
- ways to make bridges between islands of research.

[45] For example: a Google search on the exact phrase "expected to inform themselves" gets 212 hits: of these the majority are from education sites (Universities, Colleges and Schools) but represented as well are banks, insurances, investments, competitors for design competitions and several in the form of caveats such as "visitors to this (web) site are expected to inform themselves...".

Content Design is thus a 'problem space' that will need to draw upon resources from many different areas in order to solve some issues, and cast light on others in order to benefit from theories, methodologies, tools and techniques that altogether can help to increase the accessibility, usability and meaningfulness of content by design, not accident.

My vision of Content Design that would use a principled framework of reference for the design of information is elaborated in the section **"Towards a Theory of Content Design"**. In this section I attempt to describe the underlying assumptions behind my conceptualisation: that the content is the central vehicle for conveying meaning, especially in our information rich world where increasingly such information is not mediated by humans and new forms are being created very rapidly. As such close attention should be paid to its crafting. This would be more that just in terms of carrying the intentions of the creator, which is the usual emphasis given to composition based upon rhetorical principles. Rather, designing content would also respect the abilities, needs, wants and desires of the intended audience, and take steps to ensure that the content is retrievable, appropriate, and capable of being correctly transmitted. That is, the design of content with regard to its composition, (what needs to be said) in terms of audience reception (to whom) and its labelling or packaging (how). In this view, designing content would be about the accessibility and the usability, and ultimately the meaningfulness, of the designed content.

Methods and tools to achieve these attributes of content are to be found in various areas of expertise, each contributing to different aspects of accessibility and usability. My papers are situated in three different areas, that, broadly speaking, deal with the composition, the packaging, and audience reception. Accordingly, the next sections of this essay look at three interlinked aspects of the Content Design problem space. These are related to the publications supporting this explanatory essay, namely:

- **Section 1: Discourse Studies:** is a general term for a number of approaches analysing language, both in speech and in text. It looks at the principles governing the production and interpretation of language and contextual features such as participants and setting.

- **Section 2: The Uses of Content Metadata**: metadata can be understood to mean structured data about digital (and non-digital) content that can be used to help support a wide range of uses. These might include, for example: content description; searching for content; manipulating content (e.g. for re-purposing). There are many different types of metadata schemas.

- **Section 3: The Accessibility of Content:** I interpret more widely the notion of accessibility, from meaning the ability to access web based content, possibly with the aid of assistive technologies, to a more general meaning that the content is "accessible" in the sense of being available, perceivable, and finally, able to be comprehended. The introduction to this section attempts to justify this interpretation.

From a detailed explanation of these three areas, and my contributions to publications within these areas, I move to a high level account of these

three areas in order to show their relationship with the attributes or qualities of accessibility, usability, and meaningfulness. This account follows in the section entitled "Towards a Theory of Content Design"

Section 1: Discourse studies

Section overview

In this section, a brief introduction to important ideas from discourse studies is given, tracing in particular the development of discourse studies and their connections to information systems. Following that, the publications that made use of discourse studies are presented, drawing out those parts which are relevant to the Content Design discussion. The papers examined a variety of issues such as: trying to understand the structuring and use of explanations, including the use of visual material to illustrate or augment explanations; creating explanatory text to provide the rationale for recommendations from Decision Support Systems (DSS); ensuring that the text created was amenable to manipulation by the reasoning mechanisms used by the DSS. In addition, this work also tried to deal with the problem of making content accessible to, usable by, and meaningful for, its target audience. Next, some of the directions of interest to Content Design that are currently being investigated by Discourse Studies researchers are noted. Finally, in the conclusions to this section on Discourse Studies, the impact of my work is assessed.

Introduction to Section 1

The tradition of linguistic anthropologists in the 19th century was to gather languages from the people they studied, and preserve them in grammars and dictionaries as part of the general study of language. They sought to discover language universals, and establish general theories regarding language (Beeman, 1997; Wynn et al., 2002).

In contrast, the origin of discourse studies dates from the 1960's with the work on sociolinguistics by Hymes and Gumperz (1972) where the role of context in the interpretation of meaning was emphasised, and the 'speech event' defined. In this view, meaning can only be determined by first understanding the cultural 'event' within which words are spoken. This removed language analysis from the strict study of syntax and semantics with the result that meaning cannot be determined without convention and context.

This movement away from language universals in favour of studying language in a social context was partly based upon the ideas of the philosopher, Austin, (1962), who noted that linguistic study needed to be complemented by the study of the use of language, what he called performative utterance. That is, in common parlance, 'saying is as good as doing', or speech acts. Speech acts contain within them notions of illocutionary acts, and his student, Searle (1969) built upon this work, adding the notion of 'implicature', whereby the speech act implies different meanings, dependent upon the context of the utterance, and the relationships between speaker and listener. For instance: "*I'm cold.*" could be a declarative statement, or could be an implicit request to close a window.

In a further development of anthropology/ethnography studies, ethnomethodolgy is the study of the ways in which people make sense of their social world. (Garfinkel, 1987) sees the understanding of actions as being in the study of the detail of everyday events; this is a sort of "bottom-

up" approach viewing these events with reference to the larger picture. Sacks (1989) continued this work by analysing naturally occurring conversation. Thus ethnomethodology studies language-in-use as the basis for understanding how social convention is actually structured within the framework of talking, and that social meaning is continually constructed along with the social order it represents. What this means in practical terms, is that the things that do not need to be stated are in fact the clues to what is underlying the conversation, and the basis of the assumptions shared by conversants. Suchman (1987) has followed this tradition and worked upon incorporating these views into information systems, with her work upon plans and situated actions where people talk out loud about their interactions with artefacts. Her work was in contrast to the current thinking at the time that interactions should be based upon models of user's cognitive processes.

Although Discourse Studies focused upon spoken language, text was also studied. The work of Mann and Thompson (1988) on Rhetorical Structure Theory (RST) drew upon the Speech Act Theory according to Searle to propose text analysis that was based on the communicative purpose of text. Originally working on text generation, Mann and Thompson posited the notion of text coherence, that is, that every text segment had a function, and developed their theory to describe the functions and their relationship to one another, as well as a notation in the form of graphs to show the segments' relationship to each other. Since the purpose was communication, the theory also deals with understanding the communicative function of the segments. Although originally developed to guide text generation, RST has been used widely by the information systems researchers interested in computational linguistics (Taboada & Mann, 2006).

The various additions (Searle, 1969, Grice, 1989) to Speech Act Theory[46] that continue to highlight the distinction between pragmatics (language use) and semantics (linguistic meaning) also posit the view that language is based on a form of cooperation among the speakers. For language to be meaningful both the speaker and the listener must cooperate in the way they speak and in the way they listen, thus shifting meaning making to the recipient of content as well as the issuer of it. This view is also held by communication design specialists such as Sless (1987), who promotes a constructionist view, whereby we construct our social realities through communication, via dialogue, conversation, and public language; literary critics such as Fish (1980) with his notion of 'Reader-response criticism' and later 'interpretative communities'; in the work of Barthes (1969) who was also interested in the manipulative forces of mass media; and in the work of Foucault (1977) who regarded the space of meaning-making being a negotiation between the creator of content and the audience/ reader. This body of work is very important in current subfield of communication and media studies that are known as "audience and reception studies"[47].

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[46] Speech Acts were first proposed by Austin, his student Searle carried the on the work. Austin died in 1960 and his "How to do things with words" (1962) was not published until after his death

[47] For example, see new online journal on the subject: http://www.participations.org/

Besides the interpretative outcomes of discourse studies, its relevance to Content Design lies also in the relationship between discourse studies and information systems. This work dates from the late eighties and early nineties, when discourse studies of various types formed a sub-domain of Computational Linguistics, and were used by those searching for the laws that govern discourse in order to create models for automated discourse analysis, representation and generation (Webber, 2001), as well as attempts to create more natural dialogues between man and machine, looking both at spoken discourse and text as with RST.

The implications for Content Design are many. In the section that follows, work carried out in the early 1990s by the author and colleagues and the associated publications are described. This work made use of theories and methods from discourse studies and associated work on computational linguistics in the context of information systems design. They were used for knowledge elicitation; for studying explanation; explanation provision; and for creating descriptions (of content) that would be relevant to users.

The starting impetus for this work was studying explanation in speech and, by extension, explanation in text and other media. The other side to explanation, understanding, is fundamental to Content Design, if the content is to be meaningful. Although explanatory dialogues were being studied by others (Cawsey 1989), for generating dialogues, our interest focused more on the dynamics of the dialogue. We found that analysing the role of the explainee who marks his understanding by activities such as rephrasing, giving similar examples, etc. informed us of the importance of speech acts that achieve "justification" and "rationalisation". They function within explanations to make them understandable and learnable. The notion of relevance was also important to us to achieve the degree of mutual understanding required. That is, both the explainer and the explainee had to work to make the explanation relevant to each other. The work of Sperber and Wilson (1995) did not come to our notice until much later, it is interesting that we were working with similar intentions although we were basing our work in the practice of information systems design and they were grounding theirs in linguistic theory.

Contributions to the area (Section 1)

During the years 1989-92, I worked on a European Commission (as it was then known) funded project under the Esprit Basic Research Programme, entitled IDEAL (Interactive Dialogues for Explanation and Learning). Our team's brief was to investigate Intelligent Tutoring Systems, as these were to be the application area for interactive dialogues, and in particular to study the nature of explanations within learning (and non learning) situations.

In my investigations, it soon became apparent that many explanations use visual material, such as images, diagrams and graphs. Whether in teacher-student dialogues in the class room, or in explanations in text books, it was noted that extensive use is made of such materials. In an attempt to understand the function(s) of this visual material within explanatory discourse, work was carried out to collect of corpus of such material from various sources, and to undertake some experiments. Using

discourse theories, the use of visual material in various types of printed material was analysed and the results of this work were published in Sutcliffe and **Darzentas**, (1994) [1].

In this paper, the application of RST to visual material, such as graphs and diagrams, provided some insight into how textual explanatory text linked to explanatory diagrams, and the difference between explanatory and illustrative visuals. This insight was used to distinguish between those that were integral to the explanation, and those that were acting as reinforcement to a message already given. In the text, these are referred to as "augmentation" and "illustration". Ultimately, the aim was to seek guidance for the appropriate points within an explanatory dialogue to insert visual material, or indeed other multimedia.

This paper was cited by researchers Zhou & Feiner (1998)[48] working on automatic visual discourse synthesis. Reviewing the work of other researchers in the area offering taxonomies for characterising different visual presentations, they noted the fact that only our work mentioned visual *tasks*, such as 'highlight' and 'classify', in contrast to other researchers who stayed at the level of describing conceptual relationships between information seeking goals and various visual techniques. The Sutcliffe and **Darzentas** paper was also used as part of the research baseline for elaborating discourse models for multimedia explanations in a CHI 2000 workshop[49].

Work in progress (**Darzentas** et al.[50]) is a continuation on the directions started in this paper. Using the hypothesis that such analysis can be used to inform content creators when to include visual material and other media, a practical use might be to guide the textual content of alt tags and long descriptions (longdesc) for images and graphics, in accordance with World Wide Web (W3C)'s Web Accessibility Initiative (WAI) for Web Content Authoring Guidelines (WCAG)[51]. Often the text provided by the alt tags is very minimal. If the image is integral to the meaning this can mean that the person relying on the alt tag description is denied access to meanings that are apparent to those who can see the image. This work assumes that if there is an understanding of the function of an image within a text (i.e. whether it augments or illustrates the text) and of the type of knowledge the image conveys, (i.e. procedural, object property, etc) then there is guidance for designing the content of a text based equivalent to the image.

Other publications that I co-authored during this period where my contribution was largely based upon discourse studies concerned the use of explanation to aid decision making, and the content of that explanation. At that time, Expert Systems (ESs), and Decision Support Systems (DSSs) were very popular. The rule based expert system was useful for well understood and well defined problems, but with more unstructured and messy problems they were of limited use. With DSSs, the idea was to

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[48] The full reference to Zhou and Feiner is given in Appendix 2. Cited Publications, under the entry for Sutcliffe and Darzentas, (1994)

[49] http://www.cs.utep.edu/novick/nlchi/papers/Sutcliffe.htm

[50] see work in progress section in full list of publications Appendix 1

[51] World Wide Web (W3C)'s Web Accessibility Initiative (WAI) for Web Content Authoring Guidelines (WCAG) http://www.w3.org/TR/WAI-WEBCONTENT/

harness the power of the computer to sort out all the information pertinent to a decision making process in such a way as to support the cognitive process of decision making of users. In addition, the evolution of the DSSs brought with them greater attention to the user interface. In the beginning, some DSSs were little more than spreadsheets, but as they evolved, the accepted medium used for expressing interactions with the decision support system, as well as its output, was text.

In spite of the appearance and use of text, it appeared that relationship between the concepts of explanation and decision had not been well understood. Our reasoning was that decisions could not be reached, much less taken, unless the explanation or justification for DSS generated recommendations was available to the user to scrutinize, see Darzentas, **Darzentas**[52] and Spyrou (1993) [2]. In addition we needed some means for arriving at the text of the explanations themselves. In the publication cited above, these were based upon the notion that the information related to the explanations could be derived from the task at hand, and we used the framework of Task Knowledge Structures (Johnson et al. 1988) as reported in Darzentas, Loukopoulos, **Darzentas** and Spyrou (1991) [3]. In both papers we used the example of choosing between statistical tests. This is a real life problem often faced by social scientists who need these tools but do not always have a good understanding about which type of test is best for their data, hypothesis testing and context of use.

The experience of IDEAL was followed by working on another European funded project AMODEUS II (Assaying Means of Design Expression for Users and Systems)[53]. Our work here was to 'encapsulate' the knowledge generated by the project, and its predecessor (AMODEUS I) and find ways of transferring this to HCI designers. This knowledge was a set of "modelling techniques" or methods and tools relating broadly to users, systems and tasks. DSS seemed an appropriate vehicle to use for the task of encapsulating and transfer. It was to be presented as a 'toolbox' where computer systems designers could come to find help with their usability problems. Since for the users/designers to describe their problem situation using natural language input was not an option, I looked at how we could offer the users a variety of probable situation descriptions to choose from, of the type: *"Do you want to identify features that are sources of ambiguity and confusion?" "Do you want to document the design process?"* There were various descriptions and layers underlying these choices that could be examined by clicking on the descriptions. This 'point and click' approach was well before the web, however, the need for cutting down on what we would now call 'keyboarding', was a design requirement that had been specified by a group of prototype testers.

For the design of the content of the descriptions, I worked on extracting and abstracting textual explanations that would be relevant to the concerns of the user/designer. This task was very complex because the modelling approaches were techniques, rather than guidelines; they often overlapped in their application; they were multi-disciplinary (their

[52] **Darzentas** in bold refers to Jenny Darzentas, Darzentas (non bold) is John Darzentas
[53] AMODEUS 2: Assaying Means of Design Expressions for Users and Systems", ESPRIT, BRA 7040, 1992-1995 http://www.mrc-cbu.cam.ac.uk/amodeus/

originators being variously psychologists and cognitive scientists, computer scientists, etc.); some were techniques that required special skills (computer programming); and some were not readily comprehensible to all sectors of the intended audience (cognitive processing phenomena). Thus the descriptions had to be capable of representing the multi-disciplinary character of the techniques, representing elements that are common in the sense that they share similar goals, or they explain the same phenomena. The descriptions also had to represent the differences between the approaches by capturing their strengths and weaknesses in relation to specific design problems.

Summarising, the content of the explanation was seen as the arena for delicate interaction between what was on offer and what the designers saw as the problems facing them. On offer were 'tools' from AMODEUS relating to HCI design in the form of models about users, about systems, about tasks, as well as methods for capturing and structuring design rationale. However, given the wide variety of factors involved in the design of usable computer systems, designers needed help to decide which tool or method was useful to them for the type of problem they faced at a particular point in their design. The system was designed to take into account their inability to express their problems in the same terms as the modelling techniques, as well as the need they might have to 'try out' several 'tools' or examine several approaches. The system was called Designers' Decision Aiding System or DDAS.

Although the explanatory 'text' was derived from descriptions of the tools themselves, and of common problem situations, the actual recommendations from the systems (DDAS) made use of test score semantics from Fuzzy Sets Theory, in order to achieve a more natural way of evaluating options within a problem situation. This work also made use of Soft Systems Methodology (Checkland, 1981) to elicit and structure the knowledge about the problem space. Soft Systems Methodology uses the notion of Rich Pictures, and these were very useful for capturing the information related to the problem space (in this case how to inform designers about the AMODEUS tools)[54]. These aspects of the work were described in three publications that are part of my submission: Darzentas, **Darzentas**, Spyrou (1995a) [4], **Darzentas,** Spyrou, Benaki, Darzentas (1995b) [5], and Darzentas, **Darzentas** and Spyrou (1995c) [6] which described respectively the design of the DDAS, the process of creating the content and the DDAS itself.

Essentially, the DDAS functioned by offering a set of descriptions of problems for designers to choose from. This set had been created from descriptions of problems that the tools and techniques could offer help with in order to compile an overall set of descriptions representing designer concerns. This content based approach helped to explain further the use of the tools, by showing what problems they were good at solving. In this way the DDAS proved to be about more than just decision aiding, but as well a useful way to promote understanding and learning about the

[54] The "Rich Picture" work proved useful to others, the deliverable describing this work has been cited by three separate groups of researchers, see Appendix 2, "Deliverables Cited".

tools, as reported in Darzentas, **Darzentas** and Spyrou (1997a) [7]. A further strength of this decision aiding approach that was based upon making information relevant as well as furnishing explanations as justifications for decisions, was that it was found to be helpful in getting people to clarify their needs, and therefore understand their problems, and hence find appropriate tools. It was also suggested in Darzentas, **Darzentas** and Spyrou (1997b) [8] as a means to transfer results from research to the design practitioner community in a more attractive and relevant manner than by just providing large amounts of information to be digested. The approach was tested in other areas where humans are faced with a variety of alternate yet overlapping means to reach an end. In subsequent unpublished work, the DDAS architecture was used was used for capturing symptom description and relating it to the *materia medica* (a listing of substances, used in homeopathy, and their actions) for homeopathic doctors,[55] while students put the methods to test in creating the content needed for choosing holiday destinations and choosing institutions for postgraduate study, etc. [56]

With regard to evaluation, some of the work done in IDEAL was tested with cohorts of students, but this was not the focus of the funded 'basic research', so the work remained at the theoretical level as described in paper 1 (Sutcliffe and **Darzentas**). In the case of DDAS as noted in the papers (e.g. paper 5, **Darzentas**, Benaki, Spyrou, Darzentas), a proof-of-concept system was built and tested by researchers working on, and designers working with, the AMODEUS project, using the implementation described. The testing was mainly to check with the 'experts' that the representations of the modeling techniques were as accurate and as faithful to the original as possible. The researchers tried out the system, and were interested in the representations of each other's techniques and noted in a deliverable[57] that the use of the system had enabled them to gain new insights into their colleagues' work.

Current Situation

The work described in the introduction to this section represented discourse studies from the 70's and the 80's, and their contribution to information systems. Since then, many other themes have evolved, one which is of particular interest for explanation, and by extension, for Content Design, is that of narrative. Narrative is understood as one of the ways that humans make sense of and explain the world around them. Narrative then is a powerful tool that was explored, for instance, in scenario based design (Carroll, 1995) which put people into an imagined context in order to investigate possible interaction and design decisions. The use of narrative, and all the (literary) techniques that go with creating coherent and engaging narratives are some of the latest developments in the use of discourse studies to contribute to Human Computer Interaction

[55] "Helping homeopaths to choose remedies": presentation to audience of homeopaths, pharmacists and DSS researchers 7th Euro Working Group on DSS, Ispra, Italy, June 1996

[56] MSc thesis and final year project of undergraduate computer science students 1996-97, University of the Aegean, Research Laboratory of Samos.

[57] See Deliverable TA WP33, at http://www.mrc-cbu.cam.ac.uk/amodeus/abstracts/cp/cp89.html

and Design (Mateas and Sengers 2003) while both ACM CHI[58] and BCS HCI[59] have formed special interest groups looking into the use of literary techniques to HCI. The use of discourse studies, and narrative are also being looked at in other application areas, such as those of management. For example, in the call for papers for the EURAM 2005[60] (European Academy of Management) there is a whole track dedicated to 'Rhetorical Methods in Management Studies: Narratives, Metaphors, Conversation Analysis and Discourse Analysis'; in medicine there is interest in using narrative as a tool for improving the consultation process (Greenhalgh and. Hurwitz,1998; Cox, 2001)

Other present day research within discourse studies that are linked to Content Design include text summarisation. Within work on text summarisation, in the early nineties, discourse theories were studied with a view to providing generally applicable cues towards interpreting text content with regard to salience and for creating abstracts. As the possibilities of information retrieval moved to full text retrieval, the interest in both making queries more relevant as well as producing abstracts of large pieces of text resurfaces. For instance, an interesting application of this for legal case histories was undertaken by Uyttendaele, Moens, Dumortier (1998), the aim being to make the relevant parts of the cases easily accessible for lawyers. The next step was to work upon automatic text summarisation. Although this work on text summarisation uses other sub-disciplines such as cognitive studies of the human activity of indexing and abstracting, it also exploits findings from various sub areas of discourse studies, in particular from discourse structures and segmentation to generate the summaries automatically, so that the summaries can be broadcast on the web, and decrease information overload (Mani and Maybury, 1999).

Summary and Conclusions to Section 1

The publications described here were motivated by what was called at the time 'Intelligent Tutoring Systems', and Decision Support Systems. Although the application migrated from a teaching environment to a decision support one the aim of my contributions continued to be about leveraging the power of explanation and explanatory discourse to help 'unlock' the knowledge contained in the content. This was achieved in part by bringing relevant work from discourse studies into information systems, and contributing to the general transformation of DSSs from being quantitative and data driven to more human centred systems that took account of meaning in language and text.

The work on visual elements in explanations is still current and I am presently using this work to understand how to generate textual descriptions for those who cannot access graphics. In terms of the publications on text based explanations, my contributions were able to

[58] HCI and the arts:a conflicted convergence? SIG session in CHI 2003 http://portal.acm.org/citation.cfm?doid=765891.766044

[59] Understanding User Experience: Literary Analysis meets HCI: http://cise.sbu.ac.uk/hci2002/w4.html and CHI accepted SIGs 2002 http://sigchi.org/chi2003/docs/CHI2002_Accepted_SIGs.pdf

[60] See EURAM 2005 http://www.euram2005.de/site/flyer-paper.pdf

show how techniques from discourse studies could be used to help create explanations, as well as ways to better tailor these to the recipient, both for understanding in general, but also for accepting recommendations from Decision Support Systems.

Within the DSS research community[61], my work on making the DSS output more usable and its content more understandable was echoed by some DSS researchers who were concerned about the usability issues, (Pomerol and Brezillon, 1998, Turban and Aronson, 2001). However, it must be admitted that the community as a whole remained focused upon problems of expert knowledge elicitation, and reasoning mechanisms. Indeed the DDAS described in the papers was powerful because it used natural language as the basis of the reasoning mechanism, rather than numbers. This means that still today the researchers working on DSS are looking for ways to transform numerical model results into answers to decision makers, to help users to trust in the robustness of the answers by encouraging them to exploring the system; and to find ways to provide the significance of each question/answer. (Engelen, 2002; Tosato & Haurie, 2004; Faltings et al., 2005).

The DDAS work was also cited in an HCI publication by fellow project members (Buckingham-Shum & Hammond, 2004)[62]. They acknowledged its usefulness to the problem of encapsulating and transferring research results to software systems designers.

In terms of the theme of Content Design, the work represented by these publications, showed how the deliberate crafting of content for the knowledge base of DSS and attention to the recommendation can contribute to making content about various types of knowledge (e.g. HCI design techniques, homeopathic remedies, etc.) more meaningful and usable to the relevant practitioner communities.

Finally, it has to be stated that study of discourse, whether spoken or written, has a clear place in any discussion of Content Design. This is because in any communication, human spoken and written language is the most common tool used, reflecting the fact most humans cannot think or remember without internal verbalisation[63]. Language is the tool we use to filter and define the world.

The next section (Section 2) deals with an evolution of this work, both in the chronological sense, as well as in the shift of interest from composing and structuring content to how to package it. Entitled "Uses of Metadata", it looks essentially at two areas of application, those of libraries (the content repositories *par excellence*) and on line learning systems.

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[61] The Aegean team were active members of the European Working Group on DSS (EWG DSS) during the period 1994-1997

[62] See Appendix 2, section "Cited Project Deliverables" , for the citation by Buckingham-Shum and Hammond (2004)

[63] An interesting view on verbal internalisation and literacy can be seen in Kalman (2003)

Section 2: The Uses of Metadata

Section Overview

This section represents another strand of Content Design; that of the need for descriptions of content. This section confines itself to two main areas of application, those of libraries and online learning systems, since these are the areas that the publications refer to. In the contributions to the area, against a background of differing claims for metadata and conflicting sets of standards, the need for metadata over and above traditional database indexing technologies is traced and then the need for closer cooperation between content metadata and the users of the content is discussed. Finally, the current state of work on metadata relevant to the concerns of Content Design is noted in the conclusions to this section.

Introduction to Section 2

In the digital world, metadata (the "data about data") has variously been described as 'labelling' or 'packaging' content. Metadata provides a means by which various details about content (appearance, special characteristics, and even some semantics) can be described in a structured fashion for use by many varied applications or services. Metadata is used for content indexing, content retrieval, or resource discovery. In the networked world, it has as well other uses, such as ensuring the correct transmission of data packets (i.e. in the right order). However this can only work well if everyone agrees to metadata standards for the exchange and use of content. Closely associated with the rise in popularity of metadata were 'digital libraries'. Although since the seventies, libraries had been interested in harnessing the power of the computer to help with cataloguing tasks, it was with the increase in digitised content, or in the number of digital objects, in their collections, in the mid nineties, that metadata became the buzz word.

As with many buzzwords, it meant different things to different people. Two of the largest communities working on metadata were those of the library and those involved in learning systems. For the library professionals, metadata was a first and foremost a cataloguing issue. The use of metadata, as human readable data in some cases, would help them to classify and catalogue their collections, and scrutinize the collections of others. For the online learning community, in particular those members concerned with educational technology, metadata was descriptions of data, and the means to achieve interoperability. Put simply, metadata helped to understand what packets of data were being sent along networks. Metadata also served other purposes, such as ensuring quality of service (QOS), or ensuring synchronization for multimedia, (e.g. SMIL metadata)[64].

Given the wide range of uses for metadata, it soon became apparent that metadata schemas were becoming top heavy, leading to situations where sometimes the amount of information in the metadata was larger that the data itself. In an attempt to remedy this tendency, the Dublin Core researchers (Weibel 1998) proposed a metadata set that would not

[64] SMIL (Synchronized MultiMedia Integration Language) see www.w3.org/AudioVideo/

exceed 15 elements. However since the Dublin Core community was primarily a library community, the 15 elements proposed looked mainly at traditional library concerns, and left out rather newer preoccupations.

These newer preoccupations can be illustrated by other research communities, who proposed their own metadata schemas. Examples of such groups were those involved in Geographical Information Systems (GIS); those involved in e-commerce; and those involved in e-learning.

The GIS community needed a way to deal with the vast geospatial data sets they were acquiring as a result of the advances in satellite technology and other electronic surveying and mapping technologies. Specifically, the 1998 standard, FDDC-STD-001-1998 (Federal Geographic Data Committee, 1998) sought to develop the schemata by which metadata would enable four activities over the GIS data, i.e. to determine what data are available, to evaluate the fitness of the data for use, to access the data, and to transfer and process the data.

The commercial world also became aware of the potential of searching and indexing technologies and sought to leverage metadata for activities such as data mining and data warehousing for creating business intelligence and undertaking electronic brokerage services (Beynon & Maad, 2002). The legacy of these activities can be seen in the abundance of business related information management systems in existence currently, many of which use metadata as a basic building block. Publishers of music and print content also are interested in metadata for copyright management (Rust, 1998), a concern that took on larger proportions with the rise of Napster and its equivalents in peer-to-peer systems and the ease of 'piracy' copying (Bide, 2003).

For its part, the e-learning community was very coordinated in its efforts, working from the outset for standards, rather than proprietary solutions. In particular the work of the following groups should be mentioned: the U.S. led IMS Global Learning Project (or 'Organisation' as it now is)[65] which joined efforts with the European ARIADNE project (Alliance of Remote Instructional Authoring and Distribution Networks for Europe)[66]; the EdNA project (Education Network Australia)[67]; and the GEM project (Gateway to Educational Materials)[68]; and the ADL (Advanced Distributed Learning Initiative)[69] . These groups all contributed to the IEEE Learning Technology Standards Committee (LTSC)[70].

One of the driving goals of the e-learning community was to exchange learning content between institutions. Therefore an overriding concern was interoperability, not just at the technical level of data decomposition, transmission and re-composition; platforms and operating systems, etc. but also at the level of content meaning and in particular learner competence levels associated with content. For instance, a course on

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[65] IMS Global Learning Project http://www.imsproject.org/

[66] ARIADNE - Alliance of Remote Instructional Authoring and Distribution Networks for Europe http://www.ariadne-eu.org/

[67] EdNa - Education Network Australia http://www.edna.edu.au/edna/page1.html

[68] GEM - Gateway to Educational Materials http://www.thegateway.org/

[69] ADL - Advanced Distributed Learning Initiative http://www.adlnet.org/

[70] LTSC -IEEE Learning Technology Standards Committee http:// www.ltsc.ieee.org/

quantum physics from one institution could not just be described as "second year undergraduate". Instead it needed to be described in terms of the units and modules of knowledge that it contained in order for the institution accessing the course to know how it equated with their teaching programme, and what knowledge would be a prerequisite for students who followed this course. In addition to interoperability was the requirement for metadata for re-purposing of content, particularly prized in the e-learning philosophy which wants to tailor the learning experience to the student. That is, the modules of a course will be described in such a way that they can be used in a 'pick and mix' fashion by students who need only certain modules to complete courses, rather than requiring them to retake whole courses to acquire the missing modules. Thinking along these lines led to the situation where a learner profile should contain the information about learner achievements, competencies, and learning progress in general[71]. In this way, as learners worked their way through content, it would be marked up on their individual records or profiles. Gradually there was recognition that content should match a learner profile, and that the content metadata needed to have elements in it that were of use to the learners, such as a learner's competence level to be matched against the competence rating of pieces of content, expressed in metadata.

What has been presented in this introductory section was, on the one hand, a library community view that content metadata and its associated technologies had as primary purpose indexing, searching and retrieving information about content. This view was on the threshold of widening faced with the increasing possibility of accessing and delivering content itself. On the other hand, accessing and delivering content was a basic tenet for the e-learning community, and from interoperability concerns there was a gradual increase towards more sophisticated and user oriented concerns, such as using metadata to match content to users' profiles in terms of academic competence.

Contributions to the area (Section 2)

My contributions to this area begins in the mid-nineties, when I began working on European projects under the Telematics Programme for Libraries, and dates from a pre-metadata period.

In the DALI project (Document and Library Integration)[72] the work we were trying to do was to increase the capabilities for libraries to share resources or content, rather than just their catalogues, i.e. the information about their holdings. Part of this problem was for automated library systems to be able to work with each other and search each other's databases for requested material. At the time, we faced the incompatibility between the top layers of the OSI (Open Systems Interconnection) and the TCP/IP (Transmission Control Protocol/Internet Protocol). In Skourlas, Maroulis, **Darzentas,** Assimakis, and Murray, 1995 [9] this situation is discussed. In

[71] The first instances of user profile schema were more concerned with information that was related to administrative functions, such as: contact details; courses enrolled for; and whether the student had paid tuition fees.

[72] DALI (Document and Library Integration) Project Telematics for Libraries (1995-1996) http://www.cordis.lu/libraries/en/projects/dali.html

addition, this paper noted the need to think in terms of a coming transformation in the organisational model of traditional library services, widening it to include new roles and players in the market in response to emerging business practices enabled by communications technology. We suggested that old style libraries could now be viewed as Host systems (which could be any combination of libraries, networks of libraries, documentation centres, publishers, content repositories, etc.). Between them and the users, there was most probably to be intermediaries, the Service Providers. This view of the future was a direct response to the possibility for interoperability between library systems which was clearly emerging.

In the DALI project we were essentially trying to facilitate the interlibrary loan procedure. Traditionally, when a user wanted to borrow a book from another library, his library would handle the request and using joint administration procedures would arrange for the physical item to be sent to the requesting library for the user, and then returned to the lending library when the user had finished with it. In the case of journal articles, it was the practice for the requesting library to ask for a photocopy of the article to be sent, so that the return procedure was not necessary. Where holdings were digitised, or could be digitised (by scanning for instance), then the article or other resource could be sent to requesting library over networks for printing out by them directly, offering a quicker and more secure service. This was the goal of DALI. In DALI the mechanism used was email (between requesting and supplying libraries), with the requested material being sent as an attachment.

Apart from the problems relating to interconnectivity, that were solved using a variety of protocols, a problem we ran up against in many instances when trying to carry out this scenario was that the holdings had not been catalogued with sufficient detail to the format description, especially when the resources were electronic. For instance, the library catalogue might state that this was available electronically, but did not specify whether the item was an .rtf file from a previous scanning or a CD ROM with encrypted content. In other words, the lack of detail in the catalogue description (it was not called metadata) was preventing the librarians themselves from exploiting the potential of digital transmission.

In a subsequent European project, again for the Telematics Programme for Libraries, called UNIverse[73] the problem of the existence of multiple library catalogues using a variety of databases technologies, structures, indexing and cataloguing mechanisms was revisited, on a much larger scale. Following on from the small scale proof of concept achieved by DALI, the aim of UNIverse was to create a virtual union catalogue, so that various libraries could be searched as though they were one. Having solved this problem of search and retrieval over heterogeneous sources, then other services for patrons, such as interlibrary loan and document delivery developed in DALI could be exploited, along with services for libraries such as shared cataloguing and record supply. In a series of

[73] UNIverse project (Large Scale Demonstrators for Global, Open Distributed Library Services (Telematics for Libraries programme) (1996-1999) http://www.cordis.lu/libraries/en/projects/universe.html

three invited journal articles multi-authored by project members, (Clissman, [..]**Darzentas**, [...], (1997a 1997b, 1998) [10, 11, 12], the standards, software and systems that underpinned the work were presented.

These present a picture of great complexity, where in particular, traditional cataloguing and the resulting bibliographic records were woefully inadequate descriptions for content, especially when it came to describing digital resources. The reason for this could in great part be attributed to the fact that most catalogues of the large number of libraries that took part in the project were based upon MARC (MAchine Readable Cataloguing records) or variants of MARC such as UK-MARC, US-MARC, etc. MARC dates from the 1960's, and is essentially a bibliographic record, typically recording details such as title, author, date and place of publication, number of pages, and so on. Later versions of the MARC standard included a category to describe electronic publications, but as the pace of technology quickened, there was a struggle to keep up with descriptions and detail of descriptions and MARC itself offered no guidelines.

Nevertheless, UNIverse achieved many of its aims including de-duplication of bibliographic records and record syntax conversion, by creating ways for the different systems to 'talk' to one another. However the need for better descriptions of metadata was becoming very apparent. This was the motivation for **Darzentas,** (1999) [13]. This paper, aimed at a library audience, was to present to them the usefulness for metadata use in order to describe digital resources more widely. That is, not just for cataloguing purposes, but also for a whole range of other uses, for example, the format and delivery devices required to access and read the material. This was presented against a background of e-learning and the demands that managing on-line content would bring. As an example, a known resource, such as a textbook that had previously been considered as an entity for cataloguing purposes, might in fact have to be regarded as composed of many separate components which each carry separate cataloguing requirements.

At that time already many printed books had started to appear with accompanying non print add-ons, such as diskettes, videos and CD Roms. Now libraries were on the brink of being flooded with an influx of various types of digital content formats (.doc and .rtf for documents; .tiff and .jpg for images; LaTeX for formulas; mpeg formats for audiovisual material, etc) not to mention different operating systems and database languages. This meant that they faced a situation where their patrons, learners and users would need to use a variety of different systems to access different content. As a result the likelihood of overlooking relevant information increased as well as the time needed to undertake multiple searches. What was needed was a way to seamlessly search over various information repositories and this was one of the roles that metadata specifications were playing in the design of online learning technologies and systems.

It was already conceivable that libraries serving academic communities would be holding other content that was entirely electronic media, such as, for example; electronic presentation material; video clips; self assessment exercises; bibliographies with hyperlinks; etc. It is important to 'tag' all

these digital objects separately with metadata in order to describe them in a structured way. This then also allows for the possibility to aggregate./ disaggregate the objects so that they can be used in a modular fashion. The paper argued for the use of metadata but also for sharing metadata, as a way of reducing the burden of metadata creation. The paper was well received by the library audience and selected for journal publication. It has been cited by researchers in the library community as well as by those in the online learning community.[74]

The e-learning perspective[75] on this aspect of traditional library indexing and cataloguing work came from the research that had started, as the UNIverse project came to an end, on the GESTALT project (Getting Educational Systems Talking Across Leading-edge Technologies)[76]. Metadata was at the heart of this project, with Gestalt set to build upon the work that was being done for educational content metadata and extend it with metadata for transmission parameters to enable quality of service particularly where multimedia content was involved. The project maintained very close contacts with the groups working on standards.

Although not originally part of the planned work, the team at the Aegean pursued the theme that the metadata regarding content should be matched to the user profile. In Konstantopoulos, **Darzentas,** Koutsabasis, Spyrou, Darzentas, (2001) [14] I laid out the reasoning for this approach: that as more online education systems become available, users will be able to pick and choose from various modules, and that systems will need to cater for the need for customised courses. Tailoring the search to the user would both decrease the search time and make online delivery more efficient by blocking out irrelevant content.

Up until this point, although user profiles called PAPI (Public And Private Information) were part of the specifications input to the Learning Technology Standards Committee (IEEE LTSC)[77] for online learning environments, their use was seen mostly in an administrative role, for such things as authenticating users, checking on their rights to access resources, etc. While it is true to say that there was a section called 'Learner Preference Information', it was not well developed. It was a collection of suggestions for diverse attributes such as: "e.g., as useful and unusable I/O devices, learning styles, physical limitations, etc." (IEEE, 2001). There was no mapping envisaged between the Learner Preference Information and the content metadata.

Our work explaining the reasoning and suggesting linking the content metadata with the user profile was very well received by the groups working on the IEEE LTSC, and led directly to the work on bringing closer together user profiles and content metadata within the pre-standard. The paper was cited by Duval (2001), Pawlowski (2001) and Thomas (2003). This work was instrumental in the eventual discarding of the candidate

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[74] See Appendix 2 for the full list

[75] Elsewhere as well, the relationships between libraries and on online learning were being investigated, see for instance the series of Libraries Without Walls conferences http://www.cerlim.ac.uk/conf/index.php

[76] GESTALT (Getting Educational Systems Talking Across Leading-edge Technologies) (1998-2001) ACTS Project no.367http://www.fdgroup.co.uk/gestalt/about.html

[77] IEEE Learning Technology Standards Committee (LTSC) http://www.ieeeltsc.org

user profile specification, PAPI and its replacement with Learner Information Profiles (LIP) in the LTSC work.[78]

In Konstantopoulos, Spyrou, Koutsabasis, **Darzentas**, Lambrinoudakis, Darzentas, (2001) [15] the idea was further justified with the reasoning that the user profile should be portable, so that students could be supported both in their mobility and autonomy, rather than be locked into one learning system. The main thrust of this paper was to show how directory services (X500 and LDAP) could be used to implement the profiles. Although this is a rather technical paper, it shows for the first time a possible implementation of the mapping between content metadata and user preferences. It must be said that these were very limited. They offered alternatives such as language preferences for resources (Greek and English? Greek or English?) and preferences with regard to delivery; e.g. whether to receive a 'light' version of a resource (that is, without accompanying video clip). These were times when bandwidth was very much a concern.

Finally, in Konstantopoulos, **Darzentas,** Spyrou, Darzentas, (2002) [16] our work on information provision to individuals based upon their user profiles had evolved to reflect the next European project, GUARDIANS (Gateway for User Access to Remote Distributed Information and Network Services)[79]. In this project, learning environments and libraries had given way to content providers and brokers who would mediate between them and information seeking individuals (content consumers). The metadata describing content in the GUARDIANS project was now aimed at both internet sourced data, as well as broadcast content. In this paper I pointed out that in this broader view of individuals as consumers of content, a user profile that helps the content consumer to find appropriate information can be based upon roles. A content consumer can assume several roles, e.g. the citizen wanting to access information about government services; the learner seeking academic resources; the manager needing data about company operations etc. By splitting the profile into roles, the individual's privacy could be better protected, but more importantly, the mapping between content metadata and the profile would be tighter.

Thus with this set of papers we established the need for a good correlation between content metadata and user profiles, that we were to develop further with the notion of accessibility, that will be discussed in the more fully in the next section: Section 3: The Accessibility of Content: a wider interpretation.

Current Situation

In the larger world of metadata, since this work was carried out, the 'buzz' has moved away from metadata, but metadata continues to thrive. The need for standards is now well understood: only in this way will metadata be able to fulfil many of the claims for its use that rely on interoperability, i.e. searchability, extensibility, re-usability and scalability.

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[78] See section 2.3.4. IMS Learner Information Packaging Best Practice & Implementation Guide Final Specification Version 1.0 http://www.imsglobal.org/profiles/lipbest01.html

[79] GUARDIANS (Gateway for User Access to Remote Distributed Information and Network Services) project (2000-2002) ACTS Programme http://www.fdgroup.co.uk/guardians/

At the same time there is recognition that there can be no single metadata element set that will accommodate the functional requirements of all applications. The two communities mentioned in this section represented by the IMS group working on the IEEE LTSC (online education) and the Dublin Core Metadata Initiative[80] (libraries) announced co-operation resulting in the notion of 'application profiles'. These will allow designers to 'mix and match' schemas (Duval et al, 2002). One of the benefits of this approach is that the different communities can focus on standardising community-specific metadata in ways that can be preserved in the larger metadata architectures of the Web. In this way the metadata structures will still conform to the standards of the community while achieving cross-community interoperability.

The community specific approach to metadata remains important for communities with well defined boundaries, such as in e-government initiatives. For example, the U.K.'s e-GIF (e-Government Interoperability Framework), has at its heart an e-government metadata standard (e-GMS, 2004), which describes e-government content such as tax return information and forms, etc.

The creation of metadata continues to be a problematic area. While attempts to achieve automatic generation of metadata have met with some success, for instance in the work of the ARIADNE researchers for Learning Object Metadata[81], the semantics of the content remain problematic, unless the domain is tightly circumscribed with ontologies, controlled vocabularies, etc. Thus metadata still needs to be generated in many cases by humans, either the creators of the content themselves, or by specialists, most often still the cataloguers in the traditional library setting, working on abstracting content. One of the newest efforts in this area are Folksonomies, where people get together and collaborate on classifying content using keywords (Mathes, 2004). The huge interest in Folksonomies (Guy and Tonkin, 2006) is testimony to the extent of the bottleneck that is metadata creation, and that this has to be recognised in Content Design.

Another problematic issue in metadata use is that of the deliberate manipulation of metadata to engineer search results. That is an already current 'malpractice' already current whereby metadata is 'planted' (normally with key words and in the alt tags), so that this content will be 'picked up' by web search engines thus engineering more 'hits' for the site (content) owners. Such engineering is popular as a way to increase web site traffic, and consequently expose content to more visitors, regardless of whether it is really relevant to them. However, the spread of the Semantic Web and its associated technologies could help to cut out some of this practice by returning searches that are more precise, and therefore less susceptible to manipulation by unscrupulous people seeking to increase the rankings for their sites.

The problems faced by the Semantic Web are familiar to those who work with ontologies, that is, generally closed systems of well defined

[80] Dublin Core Metadata Initiative: http://dublincore.org/
[81] Automatic Metadata Generation see http://www.cs.kuleuven.ac.be/~hmdb/amg/index.php

knowledge where controlled vocabularies help to produce the semantics to associate to content. Those involved with semantics have long been aware of the limitations of fixed metadata schemas to adequately describe the semantics of content, especially when content itself shifts its meanings, and digital objects such as pictures, animations, video clips, and pieces of text, can easily be combined and recombined to suit various purposes and give rise to new content with new meanings.

Finally, a further area of metadata that has generated much interest is the syntactic (as opposed to semantic) aspects of metadata. Some of the problems with incompatibilities of technologies that hindered the early years of metadata are gradually resolving, for instance as XML becomes the standard encoding for metadata enabling interoperability even across different platforms and devices, e.g. different operating systems, and mobile phones and PDAs. This area of work is generally known as 'cross media' and is working upon how content can be shared technically across these devices, although the suitability of some content to be displayed or used on these different devices often generates usability problems, e.g. the screen is too small, etc. (Boumanns, 2004).

Given that content in the digital word needs metadata, all these issues are relevant to the theme of Content Design, however an issue that is of direct importance to the theme of Content Design as discussed in this essay is that of metadata describing the accessibility aspects of content. In the IMS initiative, there have been some of the most important work to date on accessibility metadata. As explained in the subsection above on contributions to the area, for some time, the accessibility issue was seen as part of the user or learner profile. That is, only the learner profile would record the preferences and needs of the user, both in the sense of the language that the resource is encoded in (e.g. user accepts HTML, does not accept Javascript), or the human language the material is written in (e.g. user accepts only English and Greek language content). Recorded in the Learner profile, or LIP (Learner Information Profile) in IMS 'speak', this was not sufficient for more complex issues of technical accessibility. Instead, it caused the users irritating problems such as that of not being informed about relevant resources that lay outside of their preferences, e.g. written in French, and potentially led to false assumptions about the availability of material.

However, just recently the IMS has released the long-awaited specification regarding accessibility metadata for content. Known as the IMS AccessForAll Meta-data (2004), this specification aims to enable the delivery of resources that meet a user's needs and preferences. Going beyond resource discovery, the AccessForAll Meta-data also claims to provide an interoperable framework that supports the substitution and augmentation of a resource with an equivalent or supplementary resource as required by the accessibility needs and preferences of a user's learner profile. For example, a text caption could be added to a video when required by a user with a hearing impairment or in a noisy environment. Thus the specification provides guidance on how to match accessibility metadata (i.e. a resource profile) to the needs and preferences defined in the learner profile), as well as defining the behaviour applications should exhibit in some specific contexts.

This work promises to map between the user and the resource in a much tighter fashion, although some of the responses may be too 'standard' and need to be adjusted. Further even when the framework is there to dictate the provision of equivalent/alternate version, unless this can be transformed or created on the fly when there is a need, it will require that alternative/equivalent content be deliberately created and cached. As has been shown by the consistent failure of content creators to produce text equivalents for images, producing equivalent and alternate versions of content is not a straightforward matter.

Conclusions to Section 2

This section presented a snapshot of metadata issues within two application areas, those of libraries and online education. These areas were dealing with complementary issues to do with describing content. The libraries were (and are) traditionally concerned with indexing and searching content while the online education researchers were focused on technologies for the delivery of learning content. However both communities used descriptions of content to carry out their work.

The earlier publications presented in this section have as their main purpose to set the scene. In 1995, the transformations that the Internet was about to bring to libraries, consistent adopters of new technologies, were just being glimpsed. It was already foreseeable that roles would change and widen. Without this background, it is hard to appreciate the problems caused by incompatible systems of a mere decade ago, and to understand the extent of the vistas that interoperability opened up.

My contributions concern firstly, the use of metadata for furthering interoperability between information (content carrying) systems. I discussed the problems with existing systems and noted the impending influx of new content from a wide variety of sources and in a wide variety of formats. I suggested that the metadata approach as it was being used by the online learning community could offer some solutions. One of the advantages of this approach for libraries was the sharing metadata, as a way of reducing the burden of metadata creation.

The second type of contribution concerns the use of metadata for characterising the content with attributes that contain information that is potentially user related in the sense that these attributes could be correlated to attributes in the user profile. The matching of such attributes helps to ensure that content is appropriate to the needs and capabilities of the user in terms of semantics (what the content is about) and many other features of the content from the type of language preferred by the user to the competence needed to interact with the content.

The impact of the work of linking learning object metadata with user profiles was considerable in that helped change the course of the relevant standards work. Also the publications in this section have been widely cited (see Appendix 2).

Thus the main ideas contributing to Content Design in this section came from work that straddled both the library and educational technology worlds. Unlike the work described the in the first section that used

discourse studies to guide the composition of content, this work was focused upon the descriptions of content, so that

- it could be searched for and retrieved, even across heterogeneous collections
- it could be used in a modular fashion, that is, decomposed into smaller parts, or aggregated into new collections,
- it would be suitable for the user, in terms of needs and preferences indicated in the user profile.

Ensuring that metadata describing the content matched the capabilities of the user, whether in terms of educational abilities, language competence or technological platform used, was beginning to cross the boundary into accessibility.

In the next section of this essay, the theme of accessibility is taken up as a third strand of work in Content Design.

Section 3: The Accessibility of Content

Section Overview

This section presents the third strand to Content Design, after those of discourse studies and metadata uses (sections 1 and 2 respectively). It begins with a brief overview of the term 'accessibility', noting that it has been sometimes interpreted in a web context as making electronic content 'technically' accessible, in the sense of the writing 'correct' code. However, such technical access does not automatically confer access to the use or meaning of the content. The publications that contribute to wider interpretation of accessibility are then presented. These are principally concerned with attempting to make issues pertaining to content accessibility usable and meaningful. This was attempted in three ways. Firstly by creating an (accessible) design support environment (DSE) for designers of content for Internet based products and applications. This led to work on adaptivity: that is, adapting content to the needs of the users of the DSE and other applications, including portals, by taking into account information about the user and the device used to access content. Thirdly, by working on designing curriculum recommendations for Design for All, the intent being that future generations of designers will learn about accessibility and how to design inclusively. The current situation regarding the latest developments in accessibility; the latest versions of guidelines and standards initiatives; the moves to make accessibility mandatory - and the implications of this - as well as an update on educational initiatives is noted. Finally, in the conclusions to this section, the contribution of the published work is assessed

Introduction to Section 3

In this section the accessibility of content is the main focus. Accessibility is something of a 'portmanteau' term - most people have a good understanding of the general meaning of the term - and it has acquired extended use and connotations. In the physical environment, we are used to it meaning to provide access, in the sense of being able to reach something or somewhere, e.g. "accessible by train". Some of the other ways that we use the term 'accessible' are: being *available* as in, "the collection is not currently accessible"; being *open*, as in "accessible to new ideas"; and *capable of being understood or appreciated* as in "the author's most accessible stories"[82].

In the last 30 years or so, accessibility has acquired a distinct meaning in the built environment as "accommodations made for people with disabilities": buildings are said to be 'accessible' if there is provision for wheelchair access[83]. Following this, in the last decade accessibility has been linked to content as a result of the efforts on making websites

[82] Definitions taken from Compact Oxford English Dictionary available via http://www.askoxford com ; Merriam Webster Online http://www.m-w.com/ ; and the Wikipedia entry for web accessibility http://en.wikipedia.org/w/index.php?title=Accessibility&oldid=63934621

[83] Looking up the definition of "accessible" in Merriam Webster Online, the page automatically brought up advertising for wheelchair suppliers

accessible for people with disabilities, in particular the work of the World Wide Web Consortium's Web Accessibility Initiative (W3C WAI)[84].

The W3C WAI began its web accessibility work in 1997/8, in response to the realisation that access to the web itself (in the sense of *being able to reach it*) was impossible or difficult for people who did not use standard web GUI browsers, or standard set-ups, such as keyboard and mouse. More specifically, the content of the web was inaccessible (in the sense of *unavailable*) for those who could not download large files, and inaccessible (in the sense of being *incapable of being understood or appreciated)* by those who did not perceive or were unable to interact with content (Foley and Regan, 2002). For instance, the designations of buttons labelled 'click here' cannot be perceived by people with vision impairments, and the button cannot be 'clicked' by those who have problems with controlling their hand and/or finger movements, and/or their hand – eye coordination.

Alternatives to standard PC equipment (i.e. screen, keyboard and mouse), known as assistive technology devices (e.g. screen readers, head pointers, sip and puff mechanisms, etc.) allow people to overcome some of these limitations, by finding other ways to interact with information. The problem was that most content on the web was not coded or marked up to so that devices could display the content. Furthermore, sometimes, even when it was marked up correctly, the content was still not usable or meaningful.

For content to be accessible means *designing* content so that it is accessible to disabled people from a practical point of view; you cannot interact with something you cannot perceive or that requires you to make movements you cannot make. It means designing content so that for instance it will have coherence if it is read aloud. One of the most common examples of inaccessible content is when there is an image that conveys information that is essential to understanding. If the image can't be seen either because it doesn't appear on the screen, or because the user is not using a screen, then the understanding of the content is impaired.

From a technical point of view, content needs to be separated from interaction actions (i.e. "click here') and this is difficult because web being hypertext simultaneously conveys pieces of content and relationships among them: for instance the 'links' to other pages, etc. Hypertext Markup Language (HTML), the language in which most web content was first coded, intermingled content with presentation. This made for problems when developers did not realise that what appeared well formed on a display, made no sense when read out by screen reading software.

The W3C WAI worked on guidelines for dealing with both the practical and technical aspects of accessibility. They set up three main groups, working on Guidelines for: user agents[85] (i.e. agents are the devices used by users to access web based content); for authoring tools[86]; and for content

[84] World Wide Web Consortium's Web Accessibility Initiative (W3C WAI): "*develops strategies, guidelines, and resources to help make the Web accessible to people with disabilities*" http://www.w3.org/WAI/

[85] User Agents Accessibility Guidelines (UAAG) http://www.w3.org/WAI/intro/uaag.php

[86] Authoring Tools Accessibility Guidelines (ATAG) http://www.w3.org/WAI/intro/atag.php

authoring[87]. In particular, the content authoring guidelines (WCAG) gave both practical advice (e.g. "Use clear and simple language") and technical instructions to developers and implementers. The WAI defines content as the information in a Web page or Web application, including:

> *"natural information such as text, images, and sounds and code or markup that defines structure, presentation, etc."*[88]

Generally, in the real world there has been more emphasis upon achieving technical accessibility than practical accessibility. This was recognised as early as 2001, by Coyne and Nielsen, (Coyne and Nielsen 2001) who noted that technical accessibility did not achieve usability. This study did not present any cross check of its findings with the WCAG Guidelines. However, the Guidelines have been accused of encouraging technical accessibility. This is probably due in part to their attempt to be rigorous by actually setting out a series of checkpoints and conformance levels, as a way of encouraging website content creators to achieve accessibility[89]. To meet these checkpoints and to claim conformance requires checking through pages (either all the pages, or by sampling). As sites began to proliferate and their pages increase, some way of automatically checking that certain guidelines have been followed was needed, and a series of automatic checking tools were created[90]. However, the use of tools by themselves cannot ensure usability and meaningfulness. The WAI is clear about this and states:

> *"Automated methods are generally rapid and convenient but cannot identify all accessibility issues. Human review can help ensure clarity of language and ease of navigation."*[91]

Nevertheless the technical accessibility versus practical accessibility - or accessibility versus usability - debate still continues (Theofanos and Redish, 2003; Dey, 2004; Di Blas et al., 2004; DRC, 2004; Richards and Hanson, 2004; Leporini et al 2004; Puhretmair and Miesenburger, 2005). It has contributed to the confusion over just what constitutes accessibility and whether it is really feasible for accessibility to be mandatory[92]. This debate will be discussed more fully in the following subsection: Current Situation.

An important result to emerge from the emphasis on technical accessibility is an understanding that accessibility is not just about disabled people and assistive technology. As we move to new ways of interacting using many different internet enabled devices, web content needs to know how to transform itself to be available on these devices. From the designers' point of view, an assistive device is like any other device, it carries with it

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[87] Web Content Authoring Guidelines (WCAG) http://www.w3.org/WAI/intro/wcag.php

[88] From Overview of Web Content Authoring Guidelines http://www.w3.org/WAI/intro/wcag.php

[89] The WCAG contains 14 guidelines, with 64 checkpoints in total and 3 conformance levels http://www.w3.org/TR/WAI-WEBCONTENT

[90] The WAI maintains a list of these tools at http://www.w3.org/WAI/ER/tools/

[91] See Appendix A Validation of Web Content Accessibility Guidelines 1.0 W3C Recommendation 5-May-1999 http://www.w3.org/TR/WAI-WEBCONTENT/

[92] Linking accessibility to usability is actually quite useful because it shows just how wide ranging the notion of accessibility is, and that it cannot be pinned down to technical accessibility.

constraints and restrictions over what it is capable of displaying, broadcasting or otherwise communicating to the user.

Thus work on technical accessibility has direct impact upon the use of various devices by all people. However, following and implementing more practical Content Design guidelines, such as using simple language, or ensuring that there is good colour contrast and choice of colours is also beneficial to everyone. Usability studies where comparisons were made between disabled and non disabled people using web sites, have shown conclusively that 'accessibly' designed websites are easier for everyone to use (DRC, 2004) not just the disabled. This is good evidence that content designed for overall accessibility results in "good content design": that is, designing content takes into account both the needs of the users and of the devices they use to access and interact with content. Accessibility therefore can be equated with Design for All[93], and more closely tied to usability. In this way, the definition of accessibility may be widened (Emiliani and Stephanidis, 2000).

Besides the proliferation of devices to access the increasingly ubiquitous web, accessibility must now take into account that websites are no longer static collections of information. They are often interactive applications, with dynamic information that may be aggregated from various sources. In the time frame of the publications to be discussed in this section, 1999 to 2005, there has been a very perceptible shift in the nature of content in the context of websites. Website content has moved from being static informational content to content within interactive and/or transactional (task based) sites. That is, the view of a website as a kind of electronic brochure[94], is being slowly but surely superseded. Increasingly websites are interactive applications, where users go for information but also expect to interact with the site undertaking tasks (buying, ordering, registering, booking, etc.) and to be able to communicate with the site owners.

In this more recent view of content as part of applications rather than simple web sites, accessibility research also has tried to tailor the interaction experience to the user. Relevant to this, there is a longstanding and wide ranging research community that has been working on customising content (and interfaces), if not at the level of the individual, at least to the level of classes of individual, e.g. 'the novice', 'the occasional user', 'the expert' or other distinguishing (group) characteristics (Schneiderman, 2000). This area is known as user modelling and adaptable and adaptive systems[95] (Brusilovsky, 1996; De Bra et al, 1999; Brusilovsky, 2001). It mostly refers to interactive computer systems that can be adapted or adapt themselves to their current users, and/or to the usage of user models for adaptation purposes. This work is now starting to be applied to web based systems, or elements of them (Fink and Kobsa, 2000; Brusilovsky and Maybury, 2002; De Bra et al, 2004). Briefly, in this research the emphasis is variously on the user (how to understand his

[93] Design for All is 'EU speak' for what is known as Universal Design in the US and Inclusive Design in the UK

[94] Such sites are now referred to rather derogatorily as "brochureware" see http://computing-dictionary.thefreedictionary.com/brochureware as an example

[95] Adaptable systems are those that are capable of adapting, adaptive are those that adapt dynamically

needs, and how to create a user profile); on the content (what adaptations of the content are needed); and on the system (how the system adapts content to the user). Some examples of the results of this work can be seen in applications to learning systems (Eklund and Brusilovsky, 2001; Santally and Senteni, 2005) and tourist guides (Fink and Kobsa, 2002). A typical situation in learning systems is where the content needs to be adapted to the learner's competence and abilities. In the tourism application, the content is adapted to the user's interests, his language abilities, etc. Some of the most applicable work on user profiles has been that relating to e-commerce "recommender" applications (Kobsa et al, 2001; Swearingen & Sinha, 2002). This type of user profile typically builds up preferences list concerning, for example, types of books, or music that a user likes/has purchased and builds upon other profiles with similar preferences to make recommendations about content that might be of interest to the user. Very little of this work (Manouselis, 2002) has specifically looked at users with disabilities although accessibility researchers (Fink et al, 1997, Stephanidis et al., 2001) suggested that there is potential, while the MultiRreader Project[96] made use of profiles to help a range of disabled users to use multimedia equivalents of content (Petrie et al. 2004, Petrie et al. 2005).

In the face of this complexity, where accessibility equates to adaptability of dynamic content to user needs, the paradigm of the website developer learning about accessibility and carefully coding static content is no longer relevant. Now everyone can publish to the web, without content being filtered by 'webmasters'.

Solutions to deal with this situation of inaccessible user generated content were envisaged several years ago. One idea was to create new authoring tools that would automatically ensure technical accessibility for content creators by prompting for missing code, or only allowing well formed code. The WAI group on authoring tools produced guidelines (ATAG)[97] but only recently are such tools becoming available[98] for creating web pages. However, research published in 2005 (Enabled Survey Analysis, section 2.2.2.)[99] claims that many developers do not know about these features, and/or have these features turned off. The accessibility authoring tools, the Analysis suggests, have usability problems.

This result highlights another way of dealing with accessibility of content also envisaged: the paradigm of educating developers and designers about accessibility and Design for All. Recent surveys (Enabled Project, 2005, Petrie et al, 2006) continue to show that web developers and those who commission websites do not know about accessibility. Even if they are aware of accessibility, they are not always clear about what is involved. In addition as discussed above, accessibility is not a technical issue, but a wider practical issue to do with usability. Ideally web designers need to be familiar with accessibility guidelines, the nature of

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[96] MultiReader Project (2001-2004) http://www.multireader.org/

[97] Set up in 1997, the group produced guidelines in 2000 W3C Authoring Tools Group http://www.w3.org/WAI/AU/#pubs

[98] For example: Microsoft's FrontPage in 2003 and Macromedia's DreamWeaver in 2004

[99] ENABLED (Enhanced Network Accessibility) Web Developer Survey, online at http://www.enabledweb.org/public_results/survey_results/analysis.html

disabilities, the assistive technologies used by disabled people, and the technologies used to create web sites. Above all, usability and accessibility experts recommend undertaking some usability testing of sites with people, and not only automatic testing with software tools that can only show up technical accessibility problems (Coyne and Nielsen 2001, DRC 2004, TechDis[100], WebAim[101]).

It is against this background of confusion about just what 'content accessibility' means and involves - not to mention the changing nature of web content from static informational sites to interactive applications - that the publications next presented are set. They represent a much broader view of accessibility than achieving 'technical accessibility' (that is, correctly coded content) although they do recognise its importance. They are of three main types and attempt:

- to provide practical, relevant assistance to designers of internet based applications, in the form of a Design Support Environment so that the content based products and systems they design are accessible. In addition, the Environment was designed to help designers learn about accessibility, in the sense of "learning by doing".
- to make the Environment accessible: this meant adapting its content to users and their needs, (including the devices they use).
- to tackle the problem of awareness and education regarding accessibility. This work was carried out in the framework of drawing up recommendations for a European curriculum in Design for All for designers and engineers. The immediate aim was to determine what skills and knowledge sets are required to acquire a broadly based understanding of accessibility.

Contributions to the area (Section 3)

The IRIS[102]project (Incorporating Requirements of People with Special Needs or Impairments to Internet-based Systems and Services) and the IDCnet[103] project (Inclusive Design Curriculum network) both for the EU's Information Society & Technologies (IST) 5th Framework programme, originated from the team at the Aegean, (although we elected in both cases not to be the project co-ordinators). With these projects we went firmly to work on the theme of accessibility.

In IRIS our guiding motivation was the problem of the abundance of information about accessibility, in terms of guidelines, methodologies, tools and techniques, etc. on the one hand, and on the other, the need for software designers to have some way to interact with this information. In Koutsabasis, **Darzentas**, Abascal, Spyrou, Darzentas (2001) [17], I elaborated upon the range of information that was available, and then noted the difficulty for designers to learn about accessibility. Furthermore,

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[100] Techdis see 'Technical Accessibility Issues' http://www.techdis.ac.uk/index.php?p=3_6_20051905120529_4

[101] WebAim see 'Beyond Technical Accessibility' http://www.webaim.org/articles/pour/#beyond

[102] IRIS (Incorporating Requirements of People with Special Needs or Impairments to Internet-based Systems and Services)project http://www.iris-design4all.org/

[103] IDCnet (Inclusive Design Curriculum Network) http://www.idcnet.info/home

I investigated the problems that designers experienced, even having learnt something about accessibility, to incorporate this knowledge into their working practices. This investigation was made using desk top research[104] into designer dissatisfaction with existing aids in the form of guidelines, etc. and suggestions into what they saw as solutions. Similar to the problem faced by the DDAS users (see Section 1), the designers wanted to learn "by doing", to obtain practical help with their specific problems, and to be helped to interpret guidelines and standards.

The results of this investigation were incorporated into the next paper, where our solution was to propose a Design Support Environment (DSE) for web designers that would aid them to produce accessible web content. This idea was motivated by that of the authoring tools proposed by the WAI. However we also wanted the Environment to be an educational reference point for designers, so that they could learn about accessibility in a wider sense. A further requirement was that the Environment should be usable by designers with disabilities, (some of our project members were in this category). Thus we made a further design decision, that the environment should be usable by people with disabilities. That is, by means of user profiles, the interface as well as the content of the DSE should adapt to user needs.

In Koutsabasis, **Darzentas**, Spyrou, Velasco, Mohamad, Darzentas (2001) [18] the problem area was described and a first view of the functional architecture of the DSE was sketched out. It included Design for All information and training; online development support; and an enrolment component based upon designer (user) profiles. These user profiles were templates that defaulted to some expected attributes (e.g. that a blind web designer would use a speech reader) although the template could be modified at any time by the designer to reflect personal needs and preferences. This led to further work, discussed later in paper 20, on adapting content to the user.

Other requirements from the designers were that in most cases they already had tools that they used for content authoring, and they did not want to abandon them to learn new ones, and lastly that they wanted access to several 'levels' of information about accessibility. For example: 'quick tips' and 'pointers' whilst they were in the midst of development, but also the ability to go from these and get more background detail. Thus in the final design specification for the DSE, we distinguished three layers of content:

1. from the briefest indication that something was wrong, (obtained by using the evaluation module using the checkpoints in the content guidelines (WAI WCAG);
2. then a more detailed justification linked to the guidelines so that designers could find out why their code was producing accessibility errors, e.g. what guideline they were violating;
3. finally, a more explanatory level was offered in training materials in the form of tutorials.

[104] In particular much useful information came from a survey carried out by the DASDA project, which shared draft deliverables with the IRIS project, see Cullen et al (2001):

More specifically, the first layer of content would just flag up an error, e.g. lack of an alt text against an image. If this was just an oversight by the designers they could just rectify it, but if they didn't know what the error meant, then the second layer of content information was the guidelines, and thirdly if they wanted to find out more about why they needed to provide alt text, there were tutorial material available.

In the implementation of the environment software designers were guided to create accessible content in a number of ways. These are briefly described in Darzentas [...]**Darzentas** [...] (2003) [19]. If designers were actually working on some content using their own editors, (e.g. Front Page) they could import the work into the environment and have the DSE evaluate what they were doing. Otherwise they could use the Online Development Support module (ODSm) of the DSE to directly author accessible code. The evaluation report would alert them to problems (Layer 1 content), and the corrective actions needed (Layer 2 content). The guidelines were used as the information, but if the designers wanted to gain a deeper understanding as to why they should adopt this solution, then it was possible for them to ask for the relevant parts of the guidelines, or even for related tutorials (Layer 3). Thus the designers were able to use the IRIS DSE to author, evaluate, or to receive some training material on, accessible content and interactive applications. This brief paper also gives details of the implementation technologies that were used. These were open standard and open access (also in the name of accessibility).

Making the DSE itself an accessible application, led us to user (designer) profiles for content adaptation. The work on the user profile module is documented in Viorres, Arnellos, Koutsambasis, **Darzentas,** Spyrou, Velasco, Mohamad, Darzentas (2003) [20]. The basic idea was that the profile templates would use 'stereotypes'[105] (investigated in project's user requirements phase) to have some initial ideas about user needs. The word 'stereotype' is used in the sense of a simplified mental picture of a group of people who share certain characteristics. This was necessary because the approach of asking users to supply all the information at an initial profile setup session is cumbersome, and non-pragmmatic. That is, either the terminology or the presentation mode (or both) can be incomprehensible to the user, and in addition many users are not knowledgeable about the technical characteristics of the devices they use. These stereotypes would have matches such as "user with hearing impairment = need for videos with captions" A further ingredient was the linking of device profiles, so that it would be possible to understand what kind of device the users were using at the time of their interaction with the DSE, for instance, it was very likely that a screen reader indicated that a user was blind, with the resultant consequences this might have for the presentation interface of the DSE enrolment phase.

Further content adaptation problems concerned the problem of how to cater for the need for different renderings and alternate versions of content. The DSE had a content repository containing tutorial materials.

[105] In computing, a stereotype is a concept in Unified Modeling Language, (UML) where it is used to describe behaviours. Thus, a stereotype is used as a vehicle for communicating software requirements and designs, and lacks the negative connotation present in general usage.

An important scalability issue in the past has been the need to cache different variants and renderings of content. This can make the repository very large, and involve large overheads in populating it. For the DSE the possibility of creating variants 'on the fly' was investigated. These renderings were created dynamically using web services technology. That is, by using software agents to search the web for transformation software and apply it. Implementations of this approach were trialled in a portal environment. In the event a mixed approach was used, with some variants (e.g. natural language variants) being cached, and some format transformations being rendered dynamically.

Regarding usability of the system, a large part of the IRIS project work was the implementation of the DSE and its evaluation with real users. These were mostly disabled designers recruited for the project by the ISdAC[106] partner. They were asked to carry out a series of tasks using the DSE, such as: creating a web page, both using the online development functionality to author content, as well as importing content from other tools; accessing and making use of the evaluation and the training modules. As 'proof-of-concept', two actual existing software products, a collaborative work environment and an e-shop generator were evaluated using the DSE. The outcome of this evaluation work was has been written up by project partners directly involved in this work (Grappa et al, 2004). One result confirmed the need for users with disabilities to be more likely to want/need to adapt content presentation styles

Thus in Velasco, Mohamad, Gilman, Viorres, Vlachogiannis, Arnellos, **Darzentas** (2004) [21] the theme of the paper was content adaption to users with varying needs. Using the experience from IRIS, the paper discussed users in general rather than just the case of designers of web applications. This paper took a wide-ranging look at some of the problems inherent in the area of adapting content to users. It discussed some relevant ongoing initiatives such as the work on standards for Alternate Interface Access as exemplified by the work on Universal Remote Controllers (Vanderheiden et al. 2005), and work in the area of metadata for accessibility.[107]

With regard to the use of profiles and the stereotypes used to populate them, there are many issues still to be resolved. One was the delicate balance between on the one hand giving users control over the settings in their profile, so they can adjust it, or on the other hand, giving them the 'fine tune' control, as the stereotypes can only ever be generalisations. Another issue is the need for interoperability in the sense of neutral terms and a common language. For instance, what does it mean for the application to know the user profile set to "user with visual impairment"? How can the application match this user profile information to content metadata that is labelled: "audio version", especially when this may not be what the visually impaired users want. They may perhaps want audio and

[106] ISdAC (The Information Society disabilities Challenge) is an association of disAbled people, one of their goals is to "challenge people with disabilities to demonstrate their abilities in an Information Society context by playing an active role in building a fully accessible Information Society in Europe." See www. http://www.isdac.org/en/index.php

[107] See for instance, the DCMI Accessibility Working Group at http://dublincore.org/groups/access/

visual material, because their impairment is such that they can use some visual material. More generally, we found that the problem of lack of neutral terms and common language was not just at the level of the profiles (device and user) but also at the human communication level. For users who characterise themselves as "deaf" does not always help describe their needs vis-à-vis communication for those involved in Content Design. What is needed is a 'lingua franca' for the different groups working in the area, users, technologists and content makers/designers.

This paper suggested a slightly different approach to the stereotypes. Rather than incorporate information about the devices of users into their profiles, the idea was to keep a separate device profile that could 'blend' the device features with the user profile to understand what were the content adaptation needs. Existing work on device profiles was not accessibility oriented at all, in the sense of aiding users with disabilities. This work from the W3C on device profiles known as Composite Capabilities/ Preference Profiles (CC/PP)[108] had its rationale in rendering content for mobile, handheld and in-car devices. Most of the specification work called User Agent Profile (UAprof) [109] had been done for mobile phones. We based accessibility related categories in the user profile templates on some of this work such as Input and Output preferences, Interaction preferences, Search preferences and Delivery/Context preferences. The idea was that these input and output preferences would be cross referenced with the device profile and the delivery context. This meant that a user could register various devices to the profile, as well as various content presentation preferences. The profile would then return content to the appropriate device (based upon the delivery context input) with the presentation of that content appropriate to both the device and the user preferences. We felt that this work was forward looking in its emphasis not only with regard to device profiles and the fine tuning of presentation, but because as the variety of the types of content increases; as devices diversify and proliferate; and as users increasingly own more than one device (PC, laptop, PDA, mobile phone) so the possibilities for variations in content presentation start to scale up.

This publication treated several parts of the content adaptation problem space, and has been reported in some detail, because of its importance to the accessibility strand of Content Design. It brings together all the parts of the equation that go to make up content adaptivity: that is, user profiles, device profiles and accessibility metadata for content, and the need for them to communicate. My personal contribution to this publication was the discussion about content metadata, and is discussed in detail in the Annotated List of Publications. There I note that content itself needs to be adapted to user and device needs. For that to happen some metadata describing either the capabilities of content to transform, or describing the equivalent or alternative versions of content is needed.

A recent piece of work by Vlachogiannis, **Darzentas**, Arnellos, Spyrou, Darzentas (2005) [22], continuing the content adaptivity work, examined

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[108] See Composite Capabilities/ Preference Profiles http://www.w3.org/Mobile/CCPP/

[109] See User Agent Profile
http://www.hpl.hp.com/personal/marbut/someQuestionsOnCCPP.htm

portals and their accessibility. Portals are increasingly popular as a way of replacing diverse websites, and offering a uniform interface onto content created by different authors. For instance, a University may have had each department with a separate website, and then tried a portal approach to unify them, without rewriting the content for each. The problem portals were designed to cope with is somewhat similar to that faced by libraries when they began to create digital gateways to access distributed catalogues. This 'uniform interface' philosophy seeks to offer a consistent "look and feel" to heterogeneous collections of information. From another point of view, portals are also a way of realising the information broker role we envisaged in the GAIA and GUARDIANS projects (discussed in Section 2).

However, a major accessibility problem with portals is that the content broker and the content creator are nearly always separate entities with no communication between them. This means that the portal owners/content brokers need to take a more active role in checking the accessibility of content over which they have no authoring control. It would be useful if they could check content and warn users about content that is problematic, and ask the content creators to provide accessible content or even make it a requirement that only accessible content will be accepted. Whether or not the portal owner can make such demands depends upon other factors, including the nature of the portal, (organisational or commercial) and the relationship of the portal owner with the content suppliers (brokers or creators). This is outside the scope of the paper, which concentrates upon understanding how accessibility guidelines can be applied to the content of a portal, since without this, there is no way for the portal owner to understand whether content is accessible, let alone asking for or requiring it.

This paper suggests how an adaptation of the WCAG can be applied to the hypertext and multimedia content of a portal. In addition, the paper suggests that the portlets which are the windows onto the content in a portal, can be equipped with an editor that follows the W3C WAI Authoring Tool Accessibility Guidelines (ATAG)[110]. This would mean that although the editing tool cannot change existing code, it can alert the portal owner to problems. For example, if an image is uploaded then the editor will prompt for an alt text.

Another issue of importance in portals is that of navigation. In contrast to websites, a portal may have several portlets (in addition to the portal page) to navigate through. A design solution for making sure that the portlets are accessible is for them to be tagged with metadata describing their capabilities and for this metadata to be visible to a user/device profile. The paper speculates that a more radical solution for content creators is that of separating content from presentation so that the navigation does not form part of the resource, but part of the control mechanism for viewing the resource. The issue of separating form from content in the sense of structure for navigation control is one that is gaining increasing interest. The ability to remove navigation concerns from content would allow users to dictate the type of navigation control they

[110] ATAG Authoring Tools Accessibility Guidelines http://www.w3.org/TR/ATAG10/

prefer. Since navigation is proving to be a major problem for all users, but especially elderly users, (Becker, 2004; Gappa et al, 2004) any measures to make this more controllable are useful. This would in essence mean that the portlet can be customised to the user and the device used by the user, in the sense of both of the presentation of the content as well as the means of navigating through it, even though the content viewed is coming from different sources and hence different content creators.

The contributions so far presented have dealt with content accessibility from the point of view of creating accessible content, (and learning about accessibility while doing this) and also from the point of view of how content might be adapted to users and the devices they use to access content. The final collection of publications tackles the accessibility of content from another angle: that of Design for All education and making content about accessibility and Design for All issues available in a way that is usable and meaningful for educators

This work took place in the context of the IDCnet (Inclusive Design Curriculum Network)[111] project. The focus of the work was given by a policy target from e-Europe[112] for the end of 2002 which set the goal of:

"the establishment of curricula recommendations for Design for All for designers and engineers".

The first task was to narrowing the curriculum area down to Information and Communication Technologies (ICT). Within that remit, it was important to go wider than pure web accessibility issues. This is the topic most commonly considered, as the web is increasingly either the 'front end' to many applications and services, or incorporated in products. Thus the wider picture of telecommunications technologies and devices, (e.g. phones, digital television, smart cards, 'intelligent' domestic appliances etc.) was considered. That is ways of designing them, and the services they offer, so that nobody is excluded. For this reason, web accessibility was not taken as one category, but is viewed with two distinct perspectives: that of Accessible Content and that of Input and Output software and hardware.

This was not the first time I had worked on curricula design:. I had already published results regarding Information Systems, (Theodoropoulos, Koutsabasis, **Darzentas**, Spyrou, Darzentas, 2001) [23] and place of HCI for in Industrial and Product Design (**Darzentas**, Hewett, Spyrou, Darzentas, 2001) [24]. Using the methodology for designing curricula recommendations established by the ACM[113], I set about trying to classify and taxonomise the vast amount of information about Design for All (DfA), and to identify the superset of core knowledge sets and skills from which potential DfA courses could be built up. This methodology begins by assembling and classifying content that falls within the widest definition of the domain. It is a useful exercise because it results in organising content and offering a common reference framework. This in turn eases

[111] IDCnet (Inclusive Design Curriculum network) (2002-2004) IST-2001-38786. http://www.idcnet.info/home

[112] eEurope: http://europa.eu.int/information_society/policy/accessibility/dfa/eeur_2002/index_en.htm

[113] http://www.acm.org/education/curricula.html

communication between the interested stakeholders, helps consensus building and the formation of recommendations for eventual dissemination to educational initiatives.

The result of this exercise was to come up with a nine category taxonomy that: covered the area; allowed linkages to computer science and user centred design; was neither too engineering nor too design based; and that was forward looking enough to allow for future (or futuristic) applications. These nine categories were grouped into two top level categories: a 'general' category where the labels of the sub categories (although not the content within them) were generic to all sorts of inclusive design areas, such as the built environment, or transport systems, etc; and a 'domain specific' category, for ICT based concerns.

The 'general' category was divided into four subcategories:

1. Awareness: understanding the limitations faced by those with disabilities, or those in 'handicapping' situations;
2. Why design for all?: rationale for doing Design for All organised into four groups under the headings, demographics, commercial, legal and ethical reasons;
3. Recommendations: the subcategory collecting together information on principles, standards, guidelines, etc;
4. Interpersonal Skills: a skills (rather than knowledge) category containing interpersonal communication and multidisciplinary team-working skills, emphasising working with people with diverse abilities.

The 'ICT specific' category was divided into:

5. The Accessibility of Content: referring to the intrinsic comprehensibility of text and multimedia, that is its capacity to be understood or comprehended;
6. Input and Output for Content: referring to hardware and software enabling interaction;
7. New Paradigms of Interactions, this category contained issue to do with forward looking interactions coming from areas such as ubiquitous computing, mobile computing, embedded computing, wearable computing, emotional computing, brain computer interfaces, ambient intelligence, etc. that could potentially open up or hinder accessibility, dependent upon whether they were designed for all or not;
8. User Centred Design: methods and tools relating to ICT systems and products design with based upon their use by humans;
9. Applications Areas e.g. e-health, e-education, e-government, e-leisure, e-health, etc. (These are all areas where Design for All considerations should be taken into account as these are areas addressing all sectors of the population).

The taxonomy is shown in Figure 1 below, where the General/Domain Specific super category is depicted, as well as the labels of the nine sub categories described above. Also depicted are indicative subcategories, those of the built environment and transport systems.

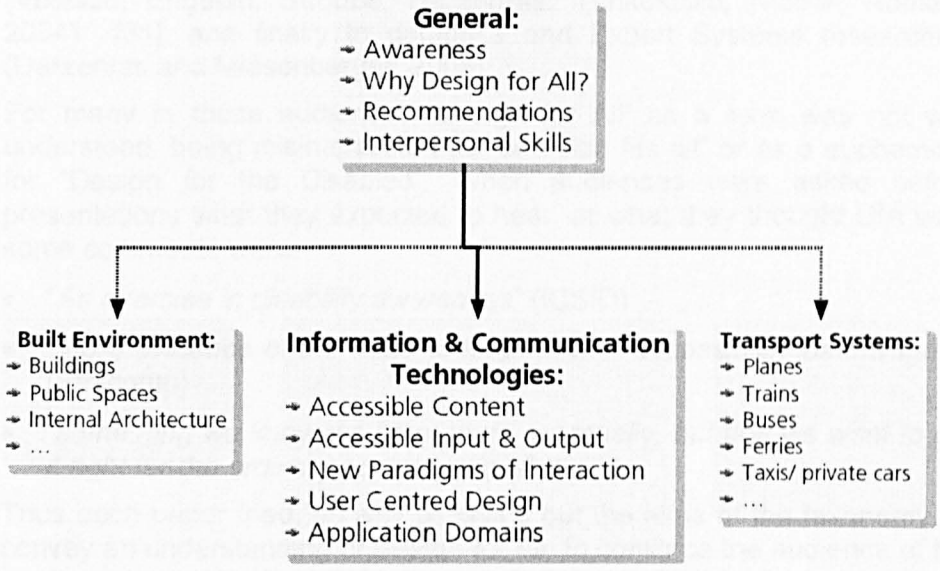

Figure 1: Taxonomy of Core Knowledge and Skills: General and ICT domain specific categories

The taxonomy was discussed and refined within a wide circle of colleagues, working on e-accessibility, gerontology, human factors and ergonomics, inclusive product design, HCI and computer science. It was praised for giving an overview of the interrelationships amongst various strands of Design for All work as well as the 'big picture'[114]. It was noted to be of practical help in structuring courses[115], and for seeing what other areas of work could be incorporated within current courses.

Presentations were made to various audiences in an effort to disseminate the work as widely as possible: e.g. researchers working on Ubiquitous Computing at the Future and Emerging Technologies (FET) sponsored "Tales of the Disappearing Computer" (**Darzentas**, 2003) [25]; to industrial designers, members of the International Council of Societies of Industrial Design (ICSID) (**Darzentas** and Darzentas 2003a) [26]; design engineers and design professionals at the INCLUDE series of conferences, (Nicolle, **Darzentas,** Strobbe, Tahkokallio, Velasco, 2005) [27]; computer scientists working on Computer Ethics[116] (**Darzentas** and Darzentas, 2004) [28]; HCI audiences of all types (**Darzentas** and Darzentas (2003b), Engelen, Strobbe, **Darzentas,** (2003)) [29, 30] as well as to audiences already

[114] See IDCnet Deliverable 3.3. (2004) Section 6 available at http://www.idcnet.info/documents

[115] Specifically, the Computer Science School of the Polytechnic of Madrid stated that the taxonomy helped them used it to help structure courses and to check input for future years, while the KTH Sweden noted that for a new course to start in 2004, the taxonomy had been used as the basis for the course. see Section 3 for respective institutions in Deliverable 3.3 available from IDCnet site: http://www.idcnet.info/documents

[116] This paper was marked out for special interest by the Centre for Educational Technology Interoperability Standards (CETIS), see Appendix 2, under the entry for Darzentas J.S. and Darzentas J. (2004)

working in the area of Assistive Technology (AT) and Design for All (Velasco, Engelen, Strobbe, **Darzentas,** Tahkokallio, Nicolle, Romero, 2004) [31]; and finally to database and Expert Systems researchers (Darzentas and Miesenberger, 2005).

For many in these audiences 'Design for All' as a term was not well understood, being misinterpreted as "one size fits all" or as a euphemism for "Design for the Disabled". When audiences were asked before presentations what they expected to hear, or what they thought DfA was, some comments were:

- "*An exercise in disability awareness*" (ICSID)
- "*more evidence of the trend to leap on the "accessibility bandwagon*"" (Ethicomp)
- "*something we know we have to do eventually, but first we want to get it right for the ordinary normal people*" (FET).

Thus each paper tried, as well as laying out the aims of the taxonomy, to convey an understanding of Design for All, to convince the audience of the good reasons to include it, and to break down prejudicial notions about it. The main messages were that Design for All should not really be a subject in its own right; but that Designing for Diversity should be part of every design activity. Designers would thereby reap the benefits from stressing new designs by trying them out with users with a wide a range of abilities. In addition, solutions for the disabled, have proved a source of inspiration for mainstream products, (e.g. vibrating mobile phones, etc).

This work was motivated by the belief that in order for inclusive design to become part of mainstream design, educating new generations of designers and creating a lively research community are two slow but sure processes. Organising, using and exchanging content about accessibility and related issues is an essential part of these activities.

The current situation

As was noted in the introduction to this section on Accessibility of Content, there is confusion as to what exactly accessibility means, and how far it can be stretched. In some circles, accessibility had its own meaning that had nothing to do with disability or the web. In the library community it is still possible to have papers about search and retrieval that report on people accessing information via searching the web with a search engine as opposed to searching a specialised library portal (Mombru, 2005). Similarly, again in the library community, problems were reported with the term 'accessibility metadata': where it was taken both as metadata to do with access rights, as well as metadata to make metadata itself more understandable (Nevile, 2002). This confusion within the library community has been helped by adopting the term AccessForAll metadata.

The understanding of what exactly constitutes web accessibility is also unclear. Some of the problem stems from the differing interpretations of technical and practical accessibility. Web content accessibility has been dominated for nearly a decade by the WAI's Content Authoring Guidelines. The limitations of these, such as being tied to HTML and the confusion perpetuated by those making business out of selling

accessibility, (Johansson, 2005)[117] are now being dealt with. WAI have been working for some time on a second version of the guidelines (WCAG 2.0) which is expected to be completed in 2006[118]. This second version has fewer principles and less reliance upon technologies that have tended, in the short life of the Internet, to become obsolete very quickly. The new version of content authoring guidelines tries to abstract away from technologies and to rest upon principles that will endure. These principles require that accessible content possess four attributes: it should be perceivable, operable, usable and robust.

In the UK the widely commented-upon[119] results of the Disability Rights Commission's report (DRC, 2004; M assie, 2004[120]) has helped to cut through some of the confusion surrounding the guidelines' use. This has encouraged users to return to the text of the guidelines, from which it is clear that they were never intended as a complete recipe for accessibility, but what they state they are: guidelines.

Some of the reason for this narrower interpretation may stem in part from the attractiveness of the apparent measurability of accessibility afforded by automated tools for checking code. This perception is in part fuelled by Governments introducing or adapting existing legislation to the effect that content must be accessible to all without discrimination. The legislation based itself in most cases upon the de facto WCAG 1.0 guidelines, or variants of them, and adopted the same or similar types of compliancy rules. For example in 2002, a European Parliament resolution (European Parliament Resolution, 2002) called for

> *"all public websites of the EU institutions and the Member States to be fully accessible to disabled persons by 2003 [...] for websites to be accessible, it is essential that they are double-A compliant, that priority 2 of the WAI guidelines must be fully implemented"*

However, a survey (EPAN, 2005) of 436 public sector websites across Europe reported in 2005 that only 3% of sites achieved a minimum standard of accessibility (Level A). No website in the sample met the double-A.

While legislation helps to publicise accessibility, some companies never achieve true accessibility for their content because they limit themselves to technical accessibility at the expense of usability. This is like putting ramps into a building that are too steep to use. Such lip service to accessibility, driven most probably by a need to defend against litigation,

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[117] Johansson wrote about 'Accessibility Charlatans" on his weblog which has been widely reproduced, with readers responding with examples of "cowboy" companies see http://www.456bereastreet.com/archive/200502/accessibility_charlatans/

[118] See explanation of working draft and move to recommendation at http://www.w3.org/WAI/intro/wcag.php

[119] See for example: WAI comment: http://www.w3.org/2004/04/wai-drc-statement.html; a legal perspective, http://www.legalday.co.uk/lexnex/eversheds04/e80160404.htm; a confused accessibility versus usability perspective http://www.webpronews.com/ebusiness/smallbusiness/wpn-2-20040505AWastedOpportunityfortheWebAccessibilityCause.html , and many more.

[120] *"The DRC's year-long investigation into web access recommended that automated testing on its own could not guarantee that disabled people could use technically compliant sites".*(Letter from Bert Massie, Chairman of DRC, Guardian 27 May 2004 http://technology.guardian.co.uk/online/story/0,3605,1225060,00.html

means that access to the use and meaning of content is confined to those who can manage to work with, or around, what has been provided. Most of all it shows no real understanding of what accessibility is about. Instead, it represents a mindset of minimum compliance that fails to understand that accessibility is useful for everyone, not just the disabled. Perhaps worst of all it hinders creative thinking about designing with a diversity of users in a diversity of situations (Regan, 2004).

The legislation in the UK is quite clear that the definition of accessibility is firmly linked to usability. The Disability Discrimination Act states that discrimination is judged upon *"access to"* and *"use of"* means of communication; and *"access to"* and *"use of"* information services, (DDA, 1995). Furthermore, the recently published publicly available specification Guide to Commissioning Accessible Website (British Standards Institute, 2006) sets out good practice for website accessibility and takes a process oriented as opposed to a product oriented view of accessibility. This is reminiscent of the usability standards approach for instance the standard for Human Centred Design Processes of Interactive Systems (ISO/DIS 13407 (1999)).

Finally, the EU is funding a cluster[121] of three projects[122]. It is hoped that the individual results from each (an observatory, a quality mark and benchmarking of tools) will together help to create a methodology for assessing web accessibility that can be harmonised European-wide. Within the BenToWeb project, there is an emphasis on user testing, on developing test suites for evaluation tools, and on creating evaluation modules (i.e. methods and tools) for guidelines such as "clear and simple language" and the use of colour. With a recent recommendation (June 2006) from the European ministers that all public websites should be accessible by 2010[123], compliance should be helped both by new guidelines and tools. Most of all it will be helped by widening the brief of accessibility to include all users using a variety of devices, and the understanding that accessibility is not confined to the (indefinable) subset of the population termed 'the disabled'[124] and that it overlaps with usability. Industry too is following this path, IBM has named "Ease of Access" its new internal initiative that is a convergence of usability (user experience/ease of use) and the work of the Accessibility Center (Keates, 2005); while Microsoft is also to use the "Ease of Access" terminology for its new Windows Vista operating system.

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[121] The WAB cluster (Web Accessibility Benchmarking Cluster) http://www.wabcluster.org/

[122] That is: the EIAO (European Internet Accessibility Observatory) www.eiao.net; EAM-Support (Supporting the creation of an European Accessibility Mark) http://www.support-eam.org/supporteam/default.asp and BenToWeb (Benchmarking Tools and Methods for the Web) www.bentoweb.org projects

[123] Ministerial Declaration 11th June 2006 available at http://europa.eu.int/information_society/events/ict_riga_2006/doc/declaration_riga.pdf

[124] See http://www.microsoft.com/enable/news/newsletter/apr06.aspx and also *"the Ease of Access Center is a redesigned version of the Accessibility control panel option. Microsoft is moving away from the "disability" or "accessibility" terms, as it found that users ignored the features since they didn't identify as disabled."* Quoted from http://www.isolani.co.uk/blog/

As was mentioned in the introduction to this section, an integral part of technical accessibility was making content related accommodations for assistive technology devices used by the disabled. Yet now assistive technology devices can be viewed as just another class of devices among the plethora of devices that can access the web. As the web goes mobile, the desktop set-up is losing its dominance, and with it, users' reliance upon standard input and output devices as well as standard modes of communication. The example of drivers in cars interacting with vehicle informatics navigation and wayfinding systems can be based mostly upon continuous auditory output, the assumption being that drivers are only occasionally able to take their eyes from the road and follow the route displayed onscreen. What this example shows is that the same content will be delivered using different presentation modes and communication channels.

For this to happen, content itself needs to be adaptable: that is, to have equivalent alternative versions available. In the multimedia context, content can be produced in several versions and users can choose the version and mode of communication (or combination thereof) that best suits them. As an example, currently a film in DVD form is packaged with subtitles or dubbing (audio translations) in several languages (a standard DVD has eight audio tracks) and sometimes with captions (descriptions of sounds in the film that are not obvious to people with hearing difficulties, such as doors closing, etc.) or audio descriptions i.e. an audio file that narrates the onscreen events, settings, costumes and character expressions, normally used by those who are vision impaired.

Another possibility, is that content can be dynamically adapted: a current example of this is synthetic speech provided "on the fly". Here there are usability as well as technical problems to be contended with. For instance, working with the same material in an inclusive classroom, the deaf pupil may need longer to view a signed version of material, than a child following an audio description. What is interesting is that in experiments done in such classrooms, children without disabilities enjoyed the full multimedia and did not turn off streams that were redundant (Pearson, 2004).

Understanding the dimensions of accessibility in terms of multimedia content work has been the task of the U.S. National Centre for Accessible Media[125] that has just released their latest set of guidelines (NCAM, 2006). Their primary motivation is the educational use of materials especially multimedia material. The researchers at the Centre are trying to understand how content may be made accessible to all learners[126]. They take into account all types of multimedia, with an emphasis on e-books and digital talking books. A particular concern is that of creating guidelines for producing alternate but equivalent versions of content, or, put another way, alternate but equivalent experiences. This is so that no learner has an unfair advantage or disadvantage (IMS, 2006).

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[125] National Center for Accessible Media, http://ncam.wgbh.org/

[126] This work forms part of SALT (Specifications of Accessible Learning Technologies) and was carried out in conjunction with the IMS Global Learning Consortium

The library based metadata standards community[127], has been working with the e-learning technology standards community[128] on accessibility metadata to describe content for educational uses of content, by making correspondences with the learner profiles specifications (Chapman et al, 2006). Both groups are in consultation with the W3C WAI (Gilman, 2004). This effort may be viewed as an attempt to create metadata to describe the *adaptability* of content. In fact, due to the problems caused by the term "accessibility metadata, the specification is called AccessForAll metadata[129] , while to underline this feature of (accessible) content, a proposal to change the Dublin Core 'accessible' element to 'adaptable' [130], is presently underway.

The Dublin Core library based metadata standards group are also working on a further dimension to the user-device input to content adaptability, that of time/place information. Made possible by Geographical Information Systems (GIS) technologies, it means that context sensitive and location awareness data may be incorporated to a user's request for content. In this way content may be adapted to suit the local conditions or time/place constraints of the person requesting content. (Nevile, 2005). To reuse the example of the car driver, a driver (context: driving car, limited use of visual senses) uses a mobile phone (device 1), to request directions to a certain destination (location 2) from a travel assistance agency that specialises in such content. The directions (the content) are sent to the car's navigation system (device 2) as an audio file (due to context). The content is tailored to describe the route to driver's requested destination from the location of device 1. A map for screen display is also requested, because unless otherwise instructed by the user, the primary mode of communication will be audio. In this scenario the content has been adapted to the user's preferences (the map); devices (telephone, in-car navigation system); context of use, (driving car) as well as location (location 1).

Finally, the Design for All Curricula work from IDCnet has officially been taken over by EDeAN (European Design for All and eAccessibility Network)[131] and its Curricula Special Interest Group. Education remains an important issue, and individual countries and groups continue to work on trying to incorporate accessibility and inclusive design into the existing curricula (Gibson et al., 2003; Petrie and Edwards, 2006) or into new areas, such as secondary education[132]. This effort relies as much on educational and training initiatives as on developing a strong research

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[127] Specifically the Dublin Core Metadata Initiative www.DCMI.org and the work of the group on accessibility: Dublin Core Accessibility Working Group. http://dublincore.org/groups/access

[128] Specifically the IMS Global Learning Consortium, and their work on Accessibility. http://www.imsglobal.org/accessibility

[129] IMS AccessForAll Meta-data: Specification v1.0 (2004). Overview available at: http://www.imsglobal.org/accessibility/accmdv1p0/imsaccmd_oviewv1p0.html

[130] See the proposal at http://dublincore.org/accessibilitywiki/NewElementProposal

[131] EDeAN (European Design for All and eAccessibility Network) www.edean.org

[132] A movement to begin education at earlier ages (in secondary schools) as well as to establish it as part of the obligatory curriculum in tertiary education has been started in Spain, (see IDCnet Deliverable 3.3 section 7, while in the US a secondary school curriculum for accessible web design has just been announced see http://www.washington.edu/accessit/webdesign/

community, with collaborative projects involving all stakeholders and dissemination to the wider academic world.

Summary and Conclusions to Section 3

There are many ways of making resources and information accessible to those who want to use and make sense of them. Some of these have been explored in the publications presented in this section on the accessibility of content. They include

- the design and development of a software environment to provide an authoring tool for creating accessible content, as well as to provide (educational) content concerning the topic of accessibility (the IRIS DSE). In addition, the environment itself was designed to be accessible.
- work on content adaptivity; (the IRIS and portal work)
- the collecting and classifying of information to do with accessibility issues as part of the groundwork for curricula recommendations (the IDCnet work).

The inspiration for both the software environment and the work on content adaptivity has its origins back in the work presented in the first two sections on discourse studies and uses of metadata respectively. In the publications presented in this section, the work had evolved to focus on the diversity in users, media and devices.

IRIS was first conceived as a kind of DDAS for web designers wanting to learn about how to design accessible web products. In DDAS we had wanted to tell designers about tools and help them decide what was useful for them – and, as an important by-product - help them learn about what was available and what problems there are in User Interface Design. However, rather than remaining as an educational resources centre, the IRIS Design Support Environment evolved into an 'activity centre'. In using the DSE, designers would be encouraged to create accessible code, to check code, and to learn about accessibility as a response to understanding what mistakes they were making. They were not expected to learn new tools, they could import already made web pages into the DSE and use the evaluation module to check them.

When we conceived of IRIS (circa 1998-1999) there were no authoring tools that could help people produce well formed code or validate existing code (according to WCAG). There was certainly no thought of authoring tools that would be able to be used by disabled authors. Such tools[133] have now appeared on the market, but they are expensive and not easy to use (WebAIM[134], ENABLED Survey Analysis, 2005).

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[133] At that time the most commonly used tools used were MS Frontpage and DreamWeaver. It was not until 2003 FrontPage brought out a version that produced accessible code, and 2004 that Macromedia (now Adobe) announced their DreamWeaver MX that prompts for accessibility date as it is entered and validates code. DreamWeaver MX is also promoted *"an accessible authoring tool that enables people with disabilities to author content"* see http://www.devarticles.com/c/a/Web-Design-Usability/Accessibility-and-Dreamweaver-MX-2004/10/

[134] WebAIM article: How to Make Accessible Content using FrontPage http://www.webaim.org/techniques/frontpage/

Thus with the IRIS work, three important accessibility goals were achieved. Firstly, the implementation of the DSE included an authoring tool based upon the W3Cs WAI Authoring Tools concept that enabled correct encodings and thus accessible content to be created. Secondly, the authoring tool was part of a software environment designed to help designers move beyond achieving accessible code and understand the reasons for doing so. Thirdly, we supported disabled web designers for whom authoring tools of any kind were very difficult, if not impossible to use.

Our work on content adaptivity took ideas from adaptive systems, along with user profiling and device profiles and used them to increase accessibility to content. Profiling the user in terms of "device capabilities" was suggested by the PAPI specification as presented in the section on the uses of metadata (Section 2: Introduction), but was not developed. Device profiling, as indicated in the discussion of paper 21, originated in the mobile telephony research community as a means to exchange content between web enabled devices. Yet device profiles as a concept can be particularly important for describing the characteristics of devices both for users who can use only one type of device such a piece of assistive technology, as well as for users who may use different devices to access content dependent upon factors such as location (in their office, in their home, etc.). In both cases there is a clear content access issue. Integrating the user profile with the device profile offers much greater scope for content adaptivity, since the user is not tied to one device, nor is the user profile 'burdened' with the device characteristics.

With regard to the work on collecting and classifying information to inform curricula design for Design for All (IDCnet), the most important part of this exercise was the creation of the taxonomy described in the previous subsection. This enabled a clear framework for discussing accessibility related content, going beyond web accessibility considerations, and encompassing a range of topics that are needed for an overall understanding of accessibility.

The importance of education in this area cannot be underestimated. The results of two recent separate surveys on web accessibility carried out by two EU funded projects[135] (ENABLED Survey Analysis, 2005, Petrie et al., in preparation) show that there is still much ignorance about web accessibility, and little standardised education: many web developers are self taught. A great number of 'web accessibility' courses are available, but there is no accreditation scheme and the truth is that many of these courses allow their students to achieve learning objectives related only to 'technical accessibility'. Yet it is clear that learners need to understand many more aspects of content accessibility than this, particularly understanding how real users (disabled and non-disabled) interact with content on the web.

[135] That is: the ENABLED (Enhancing Network Accessibility) project www.enabledweb.org and BenToWeb (Benchmarking Tools for the Web) project www.bentoweb.org

As stated at the beginning of this subsection, there are many ways of making resources and information accessible to those who want to use and make sense of them,

The main ideas of this section concerned issues to do with accessing content including web content accessibility; software environments for accessible content design; work on content adaptivity; and work on collecting and classifying information relating to accessibility and Design for All. The published papers contributed to these areas recognising that the accessibility of content can be examined under several perspectives including that of:

- Move from static to dynamic content: content of the web is changing, from 'brochure-ware' sites to interactive applications, and portals that aggregate content. This has repercussions for the ways content is access and used.
- The increase in richer content, text is commonly being supplemented with images video and audio
- Increased possibilities in terms of content being adapted to user needs, (whether this be dynamic adaptation, or supplying an available/cached equivalent alternative). Content needs to be able to adapt to constraints that can be dictated by the restrictions to do with:
    - Users themselves (who may be disabled or temporarily unable to use sensory or motor abilities)
    - The device(s) used to access content
    - The location/ time from/at which content is accessed
    - Any combination(s) of the above, including the freedom to change between them
- The need for more education regarding accessibility and design for all and more understanding regarding the breadth of issues encompassed by the term accessibility

The next section entitled "Towards a theory of Content Design" tries to move the discussion forward, by offering a vision of Content Design, that is linked back to a high level account of the three strands of work that have been discussed, as well as the attributes of accessible, usable and meaningful.

Towards a theory of Content Design

Overview

The preceding sections have discussed three strands of work, the purpose of this chapter is to examine how these strands relate to the vision of Content Design, what has been achieved and what is still required. As part of the argument presented, a high-level account is given of how discourse analysis, meta-data and accessibility fit within this vision. This account also explains how they, in their turn, contribute to the design of accessible, usable and meaningful content. The chapter then goes on to discuss what can be learnt from this work; how the work has been validated; the limitations of this validation; and how it might be better done in the future. The chapter ends with a future agenda for Content Design as a discipline.

Introduction

The emerging need to attend to the deliberate design of content is the hypothesis that is posited in this essay.

In the preceding three sections, publications were presented that treat three different aspects of content: put simply, its composition, its labelling and its accessibility. I contend that the effect of paying attention to these three aspects contributes to an overall goal of making content more *accessible* (humans can apprehend it); *usable* (humans can interact with it); and *meaningful* (humans can understand and make meaning from it).

I believe that these qualities are particularly important in the information age, where, as a result of new technologies becoming widely available, much content is being produced, delivered and received. This is happening with little awareness of the potentially disastrous consequences for that content in terms of its accessibility, usability and meaningfulness. In my view, this is in great part due to the problem that available support in terms of methodology, models and best practices for content producers are located in fragmented areas of expertise. This fragmentation contributes, in the worst case, to a lack of awareness on the part of would-be content designers. In the best case, it means that this information is not readily available for uptake by those who are aware of the importance of these qualities and would like to ensure that they are incorporated into what they produce.

A vision of Content Design: what has been achieved and what is needed as future work.

My vision for Content Design is that of a design discipline that tries to *build into the content itself* the concerns of creation/composition, transmission and reception. That is, it cares for:

1. how the content is *created or composed/assembled* so that it is of relevance, even when it is not always possible to know very much about the intended audience. I make no distinction between designers creating

content "from scratch", or making use of already existing components and composing/assembling them in such a way that the design activity can be said to be in this deliberate selection and arrangement of pieces of content.

2. how it will be *communicated/transmitted* to the audience (what mode, what media), and within this, what parts will be disassembled and reassembled, how these parts will be packaged and labelled. The labels carry both semantic (what it is) and syntactical (what format, what compatibility) information. Labelling of constitutive parts also enables the retrieval of these parts individually (e.g. querying Google for images will pick out images embedded in documents).

3. how it will be *apprehended and comprehended* (accessed and understood), so that receivers (readers/audience/users) can make meaning from it. That is, assisting meaning-making by trying to ensure that barriers to usability and accessibility of content are never unwittingly erected.

My vision of Content Design takes as its point of departure the Shannon-Weaver (1949) linear model of communication as reformulated by Berlo (1960), which is still current in the work of present day communication behaviour theorists (Berger and Calabrese 1975, Berger & Bradac 1982, Heath and Bryant 2000). In Berlo's reformulation, the Shannon-Weaver model of "source-message-channel-receiver" is fleshed out to show context and characteristics of the sender and receiver. That is, the sender ("source") and the receiver of messages who respectively encode (or create/compose content) and decode (interpret received content) are affected by at least five factors when carrying out these activities. Berlo postulates that these factors are their (levels of) communication skills; the (sorts of) knowledge they possess; the social system they belong to; and the culture and attitudes they have absorbed and reflect. The "channel" or medium of the message/content may make use of all human sensory attributes, e.g. seeing, hearing, touching, smell, taste. The message, or the content itself, is seen as an objective entity composed of elements to be structured, treated and encoded. This view is shown in Figure 2 below.

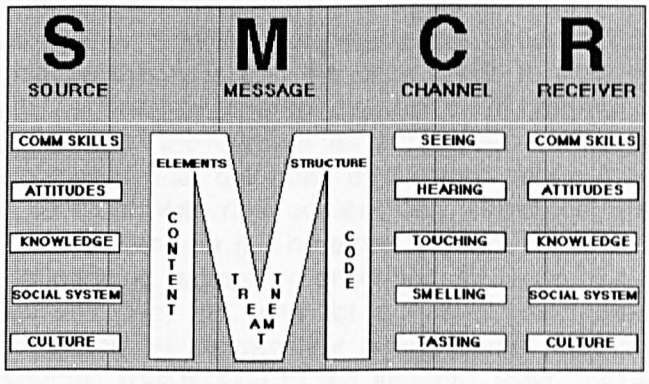

Figure 2: "A Model of the Ingredients in Communication" from Berlo (1960) The Process of Communication: An Introduction to Theory and Practice

Of course, neither Shannon & Weaver nor Berlo were focused on the "message" or content: Shannon & Weaver were interested in the transmission of communication and eventually the reduction of

uncertainty, while Berlo was interested in understanding the "ingredients" affecting encoding and decoding of what was being transmitted. Present day communication theorists researching interpersonal communication study human behaviour and the expressions of communication, rather than the content itself. However this communication model offers a useful framework and vocabulary against which to situate my concern of Content Design. Like the communication theorists I am interested how meaning is made, but I believe that careful design of content can facilitate some of the meaning making by the receivers of content. That is the source –assisted by Content Design- can deliberately craft content so that it is accessible to, and usable by, the receivers, and that they can make meaning from it. In this way my vision of Content Design acknowledges the source-message-receiver, but concentrates on message creation (encoding), transmission and reception.

I use Berlo's model to illustrate how I think Content Design should take ingredients like the five factors and use them into guide the deliberate design of content. That is, Content Designers can exploit what is known about the audience in terms of their (known or assumed) knowledge, communication skills, etc. so that such "speaks to the target audiences" in ways that they can understand or "decode". In other words, it is *relevant* to them.

Making content relevant to its audience is an important tenet of my vision of Content Design. Although it is common sense that the source and context of content will influence its reception -and these aspects are of great interest to communication theorists- it is also as true to say that very often, the message stands alone to be decoded by the receiving audiences. That is, the interpretation of the content takes place between the content and receivers with no external additional help. This is known as "dis-intermediation" (Brown & Duguid, 2000). Those making the content are not often aware of, or able to find, guidance on how best to 'encode' that content so that it can be successfully decoded. What this means in practice is that content is created or composed by a certain parties in a certain way with their own intentions regarding the meaning they want to convey, and decoded by receivers with their own sets of understandings.

Thus, the fundamental difference of perspective between Content Design and communication theory is that the latter tends to view content as an objective entity that has few inherent capabilities of communication of and by itself. This view of the content as a relatively static component in communication means that the body of communication theory does not concern itself so much with *how* content can "stand for" the source, but accepts that it *does* stand for it. Therefore, content will have incorporated the source's influencing factors as described by Berlo, e.g., a particular culture, set of attitudes, etc. and for communication theorists faithful "decoding" of content by the receiver needs some means of reference back to the source. This is akin to the semiotic view, that all content is referential, that is, content represents or "stands for" the intentions of the author/creator/composer.

The outcome of this emphasis on relationship between the source and the content means that content looks back to the source, rather than forward to the receiver. As a result, little or no direct guidance is offered on how to

create effective representations since the emphasis in the semiotic view, as in the communication theoretic one, is on deconstruction, in the sense of analysis and understanding, rather than on construction, in the sense of design and creation.

Examining this practically, what guidance is there for the design and creation or composition of content? If we take as an example text based content, most people can only fall back on reading and writing skills, and perhaps some rules of prose - rudimentary tools learnt at school. Let us say that for some, these tools may have been further honed by career choices, for instance, academic scientific reporting, or journalism. In these two cases, the rules of genre aids content production by guiding and constraining the composition in its structural parts and offering "best practice" examples in existing articles and thesis reports, or newspapers and magazines.

Moreover, these conventions help not only the writers but also the reception of the content. The readers have expectations that are conditioned by the outward forms of the genre. To illustrate this point, Waller (1999) relates how, in a redesign for the medical journal The Lancet, in order to make it more attractive to its readers, he departed from typographic conventions of text formatted in two columns to text formatted in one column. This was a signal to readers that the one column format contained lighter reading material (in the form of anecdotal material, comments and occasional letters) distinct from the serious scientific reporting couched in the traditional two column typographic convention for such work.

However, once away from academic or journalist environments, it is not at all certain whether these journalist and academics remain effective content designers in other genres or forms. As the example above shows, the content is effective because it is uses conventions that helps the content designer and content receivers who are knowledgeable about the use of such forms.

In addition, the content addresses itself to known audiences: in the Waller example, these are the busy medical practitioners who will study the serious articles, but also enjoy browsing the lighter material. Waller was able to build into his redesign knowledge that was not only about the Berlo factors, but also about the context of use of the periodical. In 1999, this was the printed form of the journal that might be taken into the coffee room and perused in that setting.

The question next has to be asked, what of the present day online version, and how is this studied or browsed?

This brings us to a second point in my vision of Content Design: that building accessible and usable features into content needs restating and reformulating for the Information Age, where the new ways of producing, transmitting and delivering content are also creating new forms that are 'driving' content, for example, online journals; game content; the blogs and wikis of the social networking world of Web 2.0.

Although it is true Aristotle made the distinction between content (*logos*) and form (*lexis*), this was only conceptual, since without *lexis* there is no

logos. Marshall McLuhan's "the medium is the message" -although misinterpreted by some as elevating form over content- was in fact more a comment on the very obvious way that form influences the reception of content, and in this case he was talking about the then new phenomenon of television (McLuhan, 1964). This becomes clearer when one thinks about the way TV programmes and content were created specifically to exploit the new medium, and how these differed from the immediate precedent of film, cartoons and newsreels made for cinema.

A more recent example is the way that the rules of writing are being revolutionised by the current new media. Writing for web screens has made us conscious that an exclusively linear style of reading is no longer standard: readers scan and enter web pages from many different points, jumping backwards and forwards though short paragraphs (Kress, 2004). This in turn has worked its way back into traditional print media, where the pages of book may make use of many features that interrupt a linear flow, such as call out boxes, side bars, and various types of illustrations, etc. not just because they are now technologically easier to produce, but because of new user expectations for such formats, (Waller, 1999; Kress, 2004). Indeed, Redish suggests that rules for prose should be disregarded and that all writing, even for paper based products, should be composed as though it was intended for the web. This, she argues, forces authors of content to be concise and structured in their writing (Redish, 2004), and modern readers want these qualities.

For the vision of Content Design, what needs to be retained is the importance of form to content. That is, whatever content there is embedded within a particular form, the content itself should be carefully designed to make the most of the form it uses as a vehicle. This means exploiting audience expectations of, and knowledge about, that vehicle to make assumptions about how they will 'decode' the content, and consequently encode it accordingly.

A final ingredient in my vision of Content Design, after recognition of the need to build into content qualities that will facilitate its decoding and to understand how to best to exploit new forms of media, is that of the audiences for content. Content Design acknowledges the immense variety of the audiences for content and the difficulty for present-day content designers to know much about them. In an age where mass communication to global audiences is the norm, the diversity within each of Bello's five factors affecting the encoding and decoding abilities of the sources and the receivers are vast. Thus, more than ever, content needs to seek to find some approaches and methodologies to guide its design so that it can be accessible to, usable by, and ultimately meaningful to, its decoders.

Thus my arguments for Content Design are based upon the fact that there are no comprehensive guidelines for making and/or assembling content in an age that is dominated by information, and new ways of producing, transmitting and delivering it, and where the target audience may be not be known and only assumptions can be used. What are the most important qualities of well designed content, and where can we seek for help? I have arrived at these questions from considering problems encountered in my published work. This has been divided into three

distinct strands, that reflect how I see that work is to be related to the concept of Content Design, and the qualities of being accessible, usable and meaningful, and the next section presents a high level account of this.

"Discourse studies", "uses of metadata" and "accessibility of content" and their relationship to the design of accessible, usable and meaningful content

The three background areas into which my papers are grouped reflect both the topics of the work carried out in the papers, but also areas that I feel offered understanding about:

- how to compose or assemble content so that it is *relevant* to its intended audience, even when it is not always possible to understand who that audience might be (discourse studies);
- how to ensure that content is retrievable, and that it can be transmitted without loss and displayed on different devices (uses of metadata);
- what it means to have truly accessible content that is usable by people, as opposed to narrowly technical definition of "correctly coded content" that has dominated much of the literature in this field (accessibility of content).

Further, the relationship between these three areas and my vision of Content Design is that I believe that each of these areas can offer methodologies and tools that enable content to be qualified as accessible and usable in order for users to make meaning from it. These are qualities of content that I consider to be essential attributes of content, and a main purpose of a discipline of Content Design should be to assist designers to achieve the incorporation of these qualities into information products. I see *Accessibility* and *Usability* as qualities that it is possible to design into (or "build into") content. By *meaningful* is meant providing the necessary enabling conditions for receivers to make meaning. That is, if one cannot access content, or interact with it, then one cannot make meaning from it.

More specifically *Accessibility* has three dictionary meanings: that of being available; that of being perceived; and finally, that of being understandable. However, the literature on accessibility of content tends to merge all three meanings into one, and concentrate on the perceptibility of information, assuming that the other two meanings will flow from this. The literature also blurs the boundaries of accessibility with usability, accessibility being a first step to perceive that then enables interaction.

In my understanding, the availability of content (as in "the collection is accessible") is an important definition of accessibility and one that is facilitated by the application of metadata. This works both by making sure that data is labelled for retrieval purposes or "findability" as well as what is available. Availability is especially important when a particular version of content is sought, for example, an audio version as opposed to a textual version of an interview, or a particular DVD encoding. If these versions are not labelled, then the content although it exists, may not be findable or apparently available.

To perceive content means that it is able to be apprehended by users who may have some form of (usually sensory) disability that inhibits them from perceiving content expressed in a particular form or mode. The guidelines from the W3C for dealing with the accessibility of content suggest the provision of equivalents and alternatives to uni-modal content, so that users with sensory disabilities may use another channel to access content. It is this meaning of accessibility that is the main meaning of the literature and of the motivation for much of the work in the third strand. It must also be said that this meaning of accessibility merges with usability, in the sense that once the user is able to perceive the content, he may then interact with it: either cognitively - he can understand it, or physically - using a preferred input channel. Ways to achieve accessibility of content are discussed in the third strand, for instance the creation of an extended authoring environment (IRIS) that would assist content creators to correctly code and achieve compliance with guidelines and techniques for content accessibility as well as understand the reasons for doing so.

Finally, accessible content (as in "this is the philosopher's most accessible work") refers to content that is understandable, in the sense that its meaning is more transparent to the receiver. One of the ways of achieving this kind of accessibility is to facilitate the comprehension of the receiver by using rhetorical forms (e.g. explanations) or genres (story telling) that are recognisable to the receivers, and relevant to their situation. It is here that discourse studies, with frameworks such as such as Rhetorical Structure Theory and its notion of text coherence offer tools to help build this type of accessibility into content.

With regard to the quality of *usable: t*his is defined by being able to interact with the content. This interaction is of two types. Content is *usable* when it allows for users to interact with it both cognitively and at the level of giving physical responses to it by using an input channel: e.g. filling in a form, responding to a decision support system, in other words, interacting physically with the content. Content may be said to be cognitively usable when it is relevant to users: they can relate it to their previous knowledge, assimilate to existing content they know about, and even create new knowledge.

Some measure of cognitive usability is facilitated by using methods from Discourse Studies, for instance in content that is created/composed following the rules of a particular genre. That is, the content exploits user expectations of these forms in aspects such as presentation (e.g. typographic) or structure (sequencing of the content) in this way reinforcing human information processing mechanisms such as memory, recall and inference. As an example, our work for the DDAS showed that decision recommendations are not acceptable to users unless the reasoning leading to the recommendation is revealed. This role of justification is a basic component of user understanding and acceptance.

At a very practical level, deliberate cognitive usability can be engineered if versions of content are suitably labelled. Put another way, content may be labelled as appropriate for a particular audience. One of the uses of metadata in the online learning environment was to classify content according to competency levels. In the real world, organisations providing

medical content often provide versions suited to different classes of user, e.g. physician, layman, nurse, pharmacist.

Finally, in terms of physically interacting with content, most of the models of content and communication found in the literature are based upon static content (Jacobs and Huxley, 2002; Neuhauser and Kreps, 2003). Yet the interactive nature of today's content is based on dynamic features. These range from being able to control presentation features (colour and font size); language version (especially interesting now that content can be translated online); to actually influencing the flow of information, in terms of its direction, (for instance, by completing information on a booking form or replying to a diagnostic questionnaire); and even contributing to the final form of its outcome (collectively creating articles in wikipedia).

Some of the physical usability of these applications may seem dependent upon the physical input devices used. Although this is partly true, cross-media work and that on the accessibility of content has distinguished the need for making content independent of input and output devices. Specifically, it asks for non dependence on cursor and mouse, both of which present insurmountable difficulties for the vision impaired. Instead feedback may use a variety of devices (keyboard, touch screens, and lately eye gaze, gesture, brain computer interfaces, neural impulse actuators, etc.) all of which make use of different sensory channels and combination of channels (e.g. seeing and touching). The decoupling of the content from input and output devices means that it must be labelled as to what it is and what channels it uses (audio, visual) and what devices it can work with. Metadata can provide the means to mark up content so that it ensures that the content transmitted to users is of the type and format suitable to them and their preferred information devices.

Further, when content contains uni-modal material (for instance, an image) accessibility of content suggests that textual equivalents or other alternatives be created. However, it does not suggest any detailed guidance on how to do this. Particularly in the area of creating textual equivalents, this activity can be informed by discourse studies, which can help to understand what function is served by the image and ensure that this function is translated into words. That is, whether a picture augments a text or whether it serves as an illustration of what has been said in words, or is merely decorative. Discourse studies, can offer understandings of, for instance, website design (which abstracts away from the visual presentation to concentrate on the structure of the content. This means that the content can be rendered in other channels, e.g. audio. In this way, content may be said to be usable in the sense of users being able to physically interact with it, using their preferred means of interaction.

The tabulation below attempts to show these dimensions of the qualities of accessible and usable (both cognitive and physical aspects) and how discourse studies, uses of metadata; and accessibility of content can offer some guidance to achieve some measure of each of these qualities in

content. Each of these areas has been mapped to creation/composition, transmission and reception of content.

	Accessible	Usable (physical)	Usable (cognitive)
CREATION/ COMPOSITION Discourse Studies	Understandable (uses known constructs e.g. explanation, etc.)	Creation of alternatives/equivalents to uni-media, uni modal content	Use of appropriate message encoding enabling acceptance, recall, inference, etc.
TRANSMISSION Uses of Metadata	Available (findable, retrievable)	Mark up of content to both user profiles and users information/ communication device(s)	Can interact with (at level of knowledge competence)
RECEPTION Accessibility	Perceivable (by those with sensory disabilities)	Content allows multimodal, multimedia physical input/response	Understand and make use of content (meaning making)

Table 2. Relationship of discourse studies, metadata and accessibility (creation/composition, transmission and reception) with accessible and usable qualities of content

Laying out the dimensions of the qualities in this way makes it possible to see some important distinctions between the qualities. For instance, at the level of reception/ accessibility, content that is accessible (perceivable by the senses), and usable (allows user to interact with it physically) may still not be meaningful, if the user is not able to make sense of it, that is, interact with it at a cognitive level. Again, it is not always necessary for users to interact physically with the content, if accessibility and cognitive usability is assured, then meaning making can occur.

In this high level overview of the three strands of work, I have tried to show how each works in an interdependent manner to make content accessible and usable in such a way as to enable meaning making by the receiver of the content. Of course, the vision of Content Design recognises that no content, however well designed, can ever claim to be transferred from source to receiver with no distortion, and that in the final instance, the interpretation of the content lies with receiver. This being said, designing into content the qualities of accessibility and usability, can only promote meaning making.

Contribution of this work to science

I believe the contribution of this work to science is firstly the recognition of the emerging theme of Content Design that is particularly relevant in the information age, with its reliance upon content as a principle commodity. The existence and importance of content *per se* is well recognised, and increasingly applications are being content driven, (for instance social networking applications like Facebook, TripAdvisor, etc.). Yet content is not included in design theories, methodologies and approaches. The amount of information in our daily lives is constantly increasing and

incessantly changing its structure. To deal with this, content should be *designed* just as other products and systems.

Next I believe that the strands of work that I have noted offer important methodologies and methods for enabling the qualities of usability and accessibility to be designed into content – qualities that I argue are essential to promote meaning making.

These methodologies and methods represent tools that are often at a remove from practitioners in the field of content (information designers, journalists, writers, filmmakers, graphic designers). In my opinion, it can be considered a strength of these methodologies and methods that they are not tied to particular professions, and can therefore work at a level that is more abstract and yet still be pertinent to various professional content producers. For example, the definitions of accessibility and usability as I have given them apply to content in all formats and for all types of audiences; they are not tied to a particular form, language or culture.

In addition, within the individual strands I have tried to indicate that each of these includes other areas of work, such as text summarisation or studies of narrative that I also think could offer useful results for use in the design of content. This is work that I have not published on, so I could not discuss them as part of this essay, but only note them in passing as subareas of the strand to indicate the rich potential of already existing work.

This point leads to the next argument: namely, the fragmentation of expertise that I believe could be drawn together to serve Content Design. Having over the years worked in several different application areas (HCI, digital libraries, e-learning, e-accessibility and Design for All) I have seen that often different perspectives are complementary, especially if the focus is the information use and knowledge transfer. Too often communities of research do not communicate, and the results of their work remain sequestered. My personal interest in understanding the effectiveness of well designed information showed up the lack of interest in designing content, and the tendency to leave it as an afterthought or rely on conventions that are not always very suitable for a particular communicative purpose.

Furthermore I have come across much evidence that both practitioners and researchers are troubled by the need to adapt content. This adaptation may be for different audiences; for cultural or educational reasons; for repurposing, for example, rearranging material for entertainment use from an educational context; or simply adapting for another medium (books to film, film to video game, paper brochures to interactive sites). In each case the difficulty is to find rules or guidelines to follow. There may be plenty of technical advice relating to particular channels and their requirements, but little about how the content can be adapted so that it still remains accessible and usable, while exploiting the opportunities offered by the new forms. As an example, even something considered relatively stable, such as typefaces have been found wanting when transferred to screen and necessitated the creation of new typefaces to satisfy legibility criteria (Gill, 1998).

Educators also recognise that in an age where children are learning to point and click with a mouse at the same time that they are learning how

to hold a pencil to write the alphabet, there needs to be a new type of literacy that takes into account the possibility for hypermedia and multimedia forms (Heba, 1997). On the whole, however, the emphasis for those concerned with the new literacies (information literacy, multimedia literacy) has encompassed the whole range of human interaction with new forms of content from search and retrieval, understanding and analysing, to meaning making (Bruce, 2002). It has not been in its brief to begin to talk about content creation or composition.

My contribution is to bring methods and techniques from various disciplines to help make Content Design a scientific enterprise, and help to formulate recommendations in the form of desired qualities or even principles, guidelines, that will help all those engaged in the design of content. My work distinguishes the activities of content creation/composition, describing (labelling or packaging) content, and the meanings of content accessibility, and elaborates the primacy of two attributes above all others in the design of content, that of being accessible and usable so as to aid meaning making.

Validating the work

The work described in the publications was sometimes theoretically based, and other times practically based and discussed implementations that were carried out. For instance, as reported in the metadata work, (Section 2) these implementations, when tested, showed that improvements were made in terms of item retrieval times and accuracy of items retrieved with respect to user profiles.

Other more theoretically based work, such as that described in Section 1 on DDAS was carried out with the intention of assisting with the transfer and uptake of results from the research community into real world practice. The limits of the project meant that this work was never tested with designers (the intended users of the system), but assessed by peers who were problem owners (the HCI modellers). Further testing of this theoretical work were decision support systems built by MSc students using the same principles for other application areas (homeopathy, choosing postgraduate courses). These applications were tested with real users and their implementators reported that they were effective both in helping users make decisions and also for users learning more about the problem situation as a whole.

Validation with users was carried out in work, (discussed in Section 3), concerning the creation of a curriculum for Design for All. The conceptual two level, nine category based taxonomy of key knowledge and skill sets I developed was validated firstly with a small group of educators in the project and then with the extended network of members of the IDCnet project (circa 30 members). The validation asked users to explain whether the taxonomy was representative of the field, and what parts of the taxonomy they use, would adapt or would enhance. The methods used were questionnaires, interviews and workshops. Besides the internal validation of the taxonomy, by-products of this validation process were: helping educators (and researchers) in the field to situate their areas of expertise, and assisting them to define their course offerings with reference to the overall taxonomy. The same taxonomy has provided a

framework of reference to further evaluation exercises with a larger group of researchers (members of the EDEAN community (2008)), and is being used both for collection of teaching materials and training the trainers.

In the work described in Sections 1 and 2, the limitations of the different kinds of validation are apparent: there was no empirical work in target user testing, no user input apart from peer groups. Instead the work was based upon theoretical assumptions. To defend these limitations, it has to be said that user evaluation was rarely the focus of the work. For instance, DDAS was trying to find a new way to transfer knowledge and devoted its effort to a new way of presenting content that was relevant to, and engaging for, the user to interact with, and to do this in some other form than a written text report. The work to create relevant problem descriptions used theoretical frameworks from Rhetorical Structure Theory and Task Knowledge Structures to validate its approach. Further, the literature on DSS proposed that decision recommendations should be more representative of real life, where problems are messy and ill defined. Therefore, our work on the DDAS focused on designing and implementing the use of fuzzy as opposed to crisp weighted operators for manipulating knowledge in the knowledge base. This was done in order for the system to make recommendations more relevant to users, and the composition of the text of recommendations more representative of the real world decision making process (needing rationale and justifications, etc.).

In a similar way, the metadata work was interested in devising metadata schema and testing them on machines with test cases, using mostly quantitative methods of evaluation and thereby validating the work technically.

In the future, work on aspects of Content Design should include user participation, at all stages of design (user requirements, testing and evaluation). Some related reported research from information designers (Sless, 2004; Pettersson, 2007) on asking users to evaluate the design of information noted that users tend to react in individualistic and subjective ways ("what I like, what I don't like") (Sless, 1987) and rarely produce clear directions for the information designers. Albers notes that all information will always have a signal to noise ratio and that the job of the information designer is to reduce the noise where ever possible. He suggests using findings from cognitive research on human information processing to guide design (Albers, 2004).

In my opinion, more scientific rigour could be introduced by making use of experience and knowledge from other disciplines, notably HCI which has a strong tradition of user participation. Thus from methods carried out for the collection of user requirements, through user testing, to user evaluation (e.g. focus groups, ethnographically based observations), the design of content could be informed regarding specifically the two qualities I have described, that of accessibility and usability. Assumptions regarding creating/composing and labelling content can be tested with task based experiments. These would be helpful to understand whether designs reach a sufficient level of accessibility and usability, and in what contexts. Particular aspects of these qualities could be evaluated: such as whether accessibility covers the needs of availability (users can find it) and

perceptibility of content (users can apprehend it) as well as whether users can interact with it both in a physical and a cognitive sense.

Of course the role of aesthetic considerations and how these engage content users is also of great importance. It is not something I have studied although I appreciate that it is an integral part of content, both in the way content is presented and in the way it engages the senses. This is a limitation that would need to be addressed, not only as part of validation work of Content Design, but as part of its theory. Some frameworks of reference for this aspect of content range from low level presentation concerns- perhaps from graphic design which defines itself as the organisation and presentation of data into information that is attractive to the user (Shedroff 1999), to deeply philosophical notions and properties of aesthetics (Budd,1999; Clercq 2002).

In a practical sense, well designed validation should help to create some principles to guide content providers who have understood from user based testing that content is problematic, but do not understand how to progress from diagnosis into corrective action.

As an illustration, in a study of museum guides on handheld devices at the Tate Modern, analysis showed that users had technical difficulties that were to do with the accessibility of the interface of the PDA's but they also had problems with the content itself (Burton & Proctor, 2004). From users' responses to questionnaires (over 800 users of all ages, genders and nationalities) it was revealed that users wanted different levels of content according to their knowledge levels (e.g. specialist, amateur) regarding the exhibits in the museum. The researchers have recognised that content and its design still remains the most difficult, as well as the most central, problem to solve. Put another way, users are not interested in spending time to learn to use handheld guides if the content is no more exciting than a rendering of the existing exhibit labels onto a screen.

A further interesting area to investigate is that of the description of content. Task based evaluation to study how users classify and label content so that they can find it again (availability and retrieval concerns), as well as how they classify knowledge competency levels would reveal usability aspects of content. Related evaluations would be to study the mechanisms of folksonomies and tagging as part of metadata creation, and their applicability of that metadata to different populations of users.

Beyond my experience of discourse studies, uses of metadata and accessibility of content, interesting experiments would be those to examine context effects and their influence on usability and accessibility. These might be contexts such as moving from individual user to group reception of content, as a way of observing effects on the perception (accessibility), interaction (usability) and understanding (meaning making) of messages, and how feedback from individuals influences group dynamics in these situations. Other context effects could be those that arise primarily from behavioural and emotional responses to the presentation of content.

For such experiments, methods and techniques that could be brought to play include:

- low cost observation software, which would enable more precise understanding of how users "scan" content on a web page/computer screen, how they distinguish entry points etc.;
- the use of qualitative analysis on natural discourse to understand belief systems. This could bring insights into what people expect from content, especially content that is found in new structures. Already social scientists are studying contemporary phenomena of 'social networking' and other aspects of the Information Society (Social Informatics), in an attempt to understand the way societies are being changed as a result of new technologies and what new behaviours are emerging (Livingstone, 2005, Mansell, 2005);
- traditional quantitative (text) content analysis methods can be applied to both traditional print and modern screen displays, etc. to examine the types of changes occurring in linguistically based expression.

Whatever the methods and techniques used, and from whatever viewpoint or discipline, the purpose of validation work would ultimately be to elucidate aspects of Content Design and contribute towards building an elaborated body of content design theory/ methodology.

The future agenda for Content Design as a discipline

In my vision of Content Design, I have noted the three strands of work of which I have some knowledge through my publications. As previously noted, I believe that these are related to composition of content, the labelling/packaging of content and the accessibility of content. However, I believe that a fuller framework of reference for Content Design would have to be based upon the intersection of groups of contributing disciplines as shown below in Figure 3. In the main, these would be disciplines that relate to content creation; content reception in terms of human cognition, perception and social behaviour; and finally, a range of technical knowledge concerning the transmission as well as the production and delivery of content.

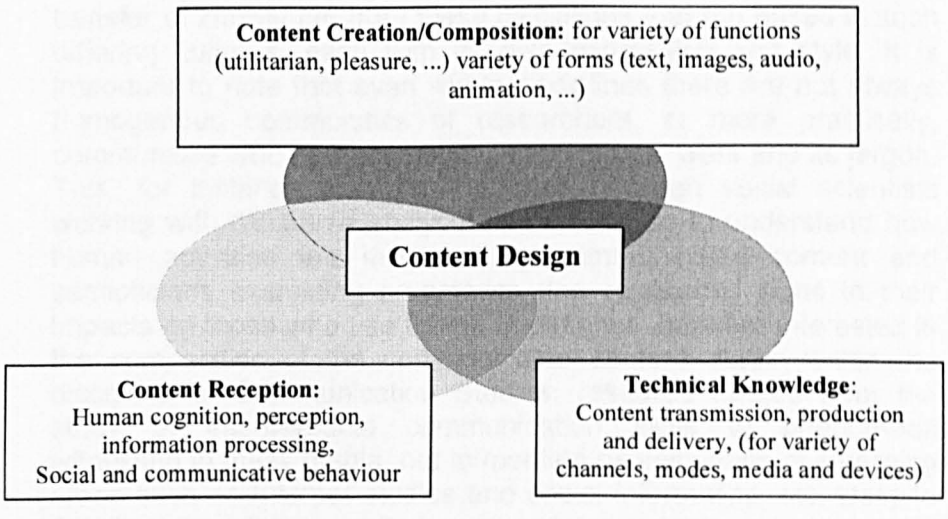

Figure 3: A conceptual view of the contributing discipline areas for Content Design theory

Contributing to the group of content creation/composition are: discourse studies, semiotics, rhetoric, literary criticism, linguistics, etc. along with communication based disciplines, all of which already offer valuable insights on how communicative effects are achieved. These insights could be used to generate principles and guidelines for the creation of content. In the content reception group are those disciplines that study: human cognition and perception, -in particular, mechanisms of understanding such as learning, remembering content (e.g. cognitive science); human behaviour with regard to engagement with content (psychology); and human communicational behaviours (from sociology, and research in social informatics, Internet society, etc.). This group could help to elucidate how content is "decoded". The final group of disciplines contributes to technical knowledge about producing, transmitting and delivering content, as well as allowing feedback from the receiver. This knowledge comes mainly from domains such as computer science and HCI. Content Design requires knowledge that pertains to any type of content using any type of *mode* (text, audio or visual or any combination of multimedia); and any type of *channel* (text, web, film, performance); and any kind of *delivery* (live, recorded, on demand); and *device* (screens of TV, film and computers or handheld devices, headphones and earphones, touch screens, haptic devices, force feedback, etc). In this area would be where I would include knowledge about the machine uses of metadata.

For Content Design to exist in its own right, it would need to build up its own theory and methodology. To elaborate such a theory, a first step would be to examine those disciplines that I believe are contingent to content and its design, to see what each can offer directly in terms of frameworks of reference, methodologies, methods and techniques. These offerings need to be mapped into the areas shown by the diagram, and consequently examined to see how they can be used to build up a theory that has the activity of designing Content Design at its centre.

Some caveats must be made.

1. To enable such mappings, a *lingua franca* needs to evolve to ease transfer of knowledge from these disciplines that are based in such differing cultures, each with its own expression and style. It is important to note that even within disciplines there are not always homogenous communities of researchers, or more practically, communities who can understand each others' work and its jargon. This, for instance, can be the case between social scientists working with discourse analysis methodologies to understand how human activities are mediated by communicated content and semioticians examining pragmatics (the relation of signs to their impacts on those who use them). In essence, both are interested in the composition of the communicated content. Again within the discipline of Communication Studies, research ranges from the study of interpersonal communication skills to phenomena witnessed in mass media, not to mention examinations of emerging areas such as Internet studies and social informatics, etc. Despite this diversity, all have at their core an interest in the processes and practices of communication and its products. It is this that makes

them interesting for Content Design, which is examining those products.

2. The boundaries between these groups of contributing disciplines (Figure 3) are not distinct. For instance, HCI could easily claim to straddle both the areas of technical knowledge and content reception, since it studies humans' use of technologies.
3. Furthermore, in my vision of Content Design, other qualities of content that I have not been concerned with, such as those appealing to aesthetics and emotion, would be included. I see these as further qualities that would need to be designed into content. However, I do not think that the contributing areas (content creation, content reception, technical knowledge) would change as a result of this. Figure 4 below illustrates this position.

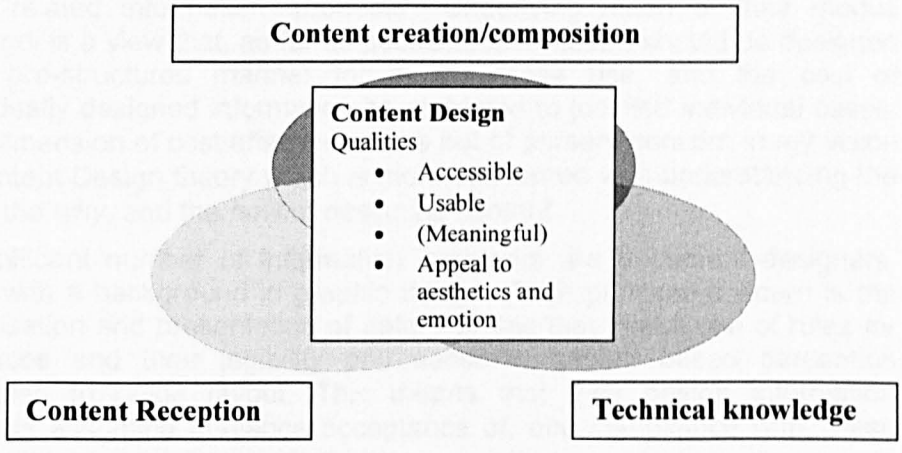

Figure 4: A conceptual view of the main qualities/attributes of Content Design

4. This is not the work of one person, but of a group, and just as with any discipline, Content Design will subdivide itself into smaller areas of interest. However, I would hope that the qualities of usable and accessible would belong to the "big picture" for all to share, just as for instance, the discipline of HCI unites researchers from varying backgrounds (designers, psychologists, computer scientists) under commonsense goals of usability and effectiveness, efficiency and user satisfaction.
5. The emphasis in these disciplines reflects different perspectives, for instance: some emphasise production and professional preparation; others take a humanities and/or social science perspective; while HCI gathers many different perspectives, including those from psychology, cognitive science, computer science, design, etc. I would hope that Content Design would encompass all these perspectives so as to reap the benefits of a multidisciplinary background and pursue both epistemological concerns and practical output.

As an illustration of the agenda process for elaborating a theoretical framework for Content Design, the next paragraphs critically review the

fast evolving discipline of Information Design, which appears to be closely related in its purpose and goals to Content Design. Information Design, and some Information Architecture, focus on content and its creation/composition, in the sense of designing communication or information products. Just lately, it has been trying to define for itself some theoretical underpinnings. It is these attempts that I will try to map to my vision of Content Design, to better determine its defining characteristics.

Information Design is a branch of design that has not yet defined itself satisfactorily as a research area. Information designers are typically professionals constrained by economic concerns. For instance, information architects see the activity space for information architecture at the intersection of content, users and business context (Rosenfeld & Morville, 2003). The types of content they tend to deal with are utilitarian in nature: e-commerce web sites; forms; leaflets; advertising material; and other related information "products". Underlying much of their modus operandi is a view that, as far as possible, information should be designed in a pre-structured manner for multi-purpose use, and the cost of individually designed information be restricted to justified individual cases. This dimension of cost effectiveness is not of primary concern in my vision of Content Design theory which is more concerned with understanding the *what*, the *why*, and the *how* of designing content

A significant number of information designers are document designers, often with a background in graphic design. Their principle concern is the organisation and presentation of data. For this they make use of rules for typefaces and their legibility and sensorial gestalt based perception principles to guide layout. This means that they design information products assuming audience acceptance of, and compliance with, these tried and tested rules and principles.

The shortcomings of this way of working have now been noted by information designers themselves. In response, new models that put the user at the centre of the design have been suggested. Carliner (2000) proposed a three layer model for the design of information. His model describes a physical layer, whose purpose is to help the user find the information, (it will be well structured, with headers, paragraphs, pictures, etc.); a cognitive layer, to help the user understand the information (this layer will appeal to the intellect) and an affective layer that will help the users to perform (this layer will be that which engages the reader). Carliner notes that his model is based upon instructional systems design models used to help learners achieve learning objectives. He himself admits that the distinctions between the layers are sometimes difficult to make. His process for designing in this way tries to retrofit traditional design methodology (requirements, specification, design, test, implement, evaluate) and graphic design working practices to the model.

Compared to my vision of Content Design, Carliner's model does not pay enough attention to the composition of content, but only to the structure of content; it assumes a given audience (of willing learners) and has no sense of the meaning of accessibility. It does however put the user of the information at the centre of the model (even if it is only a stereotype learner), and it does differentiate between intellectual appeal and appeal

to the senses. Finally it is concerned with the usability of the content, although this is restricted to his notion of a physical layer.

Technical communicators are another group of, primarily, document designers, who are motivated by their concern for the usability of their content. Their area of interest is situated in the provision of information to novice users of technological products. Documentation about these products was based on a paradigm of technical specifications. As the documentation became more like an instruction manual, the paradigm moved from being less about presenting complete specifications of technological artefacts to presenting information in a task oriented way. The work of technical communicators was rich enough for them to form a special interest group chartered by the ACM, called SIGDOC. At first they concentrated on documentation for hardware and software, but in 2003, SIGDOC refocused on the design of communication, especially the potentials, practices and problems of multiple kinds of communication technologies such as Web applications, user interfaces, online and print documentation.

Influential in this area is Redish. A linguist by training, she started her career working on government documents in the 1970s in a movement called Plain Language whose aim was to make official documents more usable for their audiences. She moved to IBM to help with manuals and began usability testing, borrowing methods and techniques from HCI. She noted that in many instances people are not reading, but "reading-to-do". This led her to defining usability as the capability to quickly scan and pick up instructional material.

The same definition was applied to websites. Here problems were diagnosed as content not being user focused (not what users need); poorly organised (the writing having too many unnecessary words and sentences as well as paragraphs that are too long); and unattractive (not enough visual appeal) (Redish, 2004). Accordingly, she and her colleagues concluded that what people want in content are three qualities: those of sufficiency, usability and accuracy. The remedy is summed up as "Give users all the information they need in a way they can use" (Theofanos et al. 2004).

This clear view of usability is helpful for Content Design, it is also interesting to see that the influence of linguistic training, combined with the use of HCI based usability testing methods, has allowed Redish and colleagues to carry over essentially the same definition of usability into new types of communication media. However, a main limitation when compared to my view of Content Design would be that her work applies to the subset of content that is instructional in nature, and that not all content is utility based. The three qualities of sufficiency usability and accuracy are to be seen in the light of the task-based view of content usage. Again, although Redish notes the need for aesthetics and visual appeal, she does not enlarge on this.

Amongst figures seriously engaged trying to provide a theoretical background for Information Design is Pettersson, Professor of Information

Design at Mälardalen University in Sweden. For him the main goal of information design is that of clarity of communication. He considers information as both verbal and pictorial. He has studied the literature on graphic design and visualisation as well as that on human perception, and arranged his findings into four categories For him, these categories relate to, what he terms, the "functional, administrative, aesthetic and cognitive" aspects of information design, and for each of these categories he has proscribed principles (Pettersson, 2007).

For example, under the category "functional aspects of information" he suggests six principles. Principle 1 is "Defining the problem", while principles 2 - 6 are respectively: "Providing Structure"; "Providing Clarity"; "Providing Simplicity"; "Providing Emphasis"; and "Providing Unity". Further, under each "providing" principle he proposes guidelines governing the legibility (clarity) and readability (simplicity) and emphasis in text, pictures, layout, symbols, numerical values, maps and colour.

As can be inferred from this description, his "functional" principles are, to my understanding, a mix of process steps and practical recommendations for the presentation of information informed by graphical design and visualisation. Under the functional principle "Defining the problem" -which is actually a design process step- he suggests analysing the sender; the representation (his term for content); the receivers; and the context. This is interesting because it displays the same centrality for the representation within the linear communication model as I claim for Content Design (Figure 2). In other words, he has the same view of the place of content in communication although he does not assign the same characteristics to it. By referring to content as representation, he reduces the designing to the surface layer of message presentation. Content Design, on the other hand, attempts to encode and deliver meaning and experience as well representation.

His suggestions for guidelines to follow to analyse the sender are to: "define what the user wants to achieve; when this is to happen; what the project budget and any other requirements are" (p.31). From this it is understandable that the perspective of the information designer is firmly rooted in a business context of services to be rendered. In this case, the rendered service of 'encoding' messages for the sender in such a way as to ensure maximum "decoding" by the receivers.

This service is also the activity of Content Design, but abstracted away from a business context. I believe Content Design should achieve the maximum of 'encoding/decoding' by firstly paying attention to the qualities of accessibility and usability, while Pettersson, with his background in visual languages, sees the primacy of clarity.

With regard to information- or representation as Pettersson calls it- he distinguishes message (content) and medium (form). His guidelines here (p.33) counsel:

> *"-Define the purpose and the objective of the message, always keeping the intended receivers in mind*
> *-Collect and review necessary facts for later use in the design process*

-Consider the use of words, images and graphic form"

Pettersson is obviously concerned to turn research results into a set of easy-to-find and easy-to-use principles and accompanying guidelines, and to present these in a clear and consistent manner for practical use. He refrains from being prescriptive, and indeed his book is entitled "It Depends". He suggests that these principles "may assist the design of messages and information materials that are well suited for the intended receivers" (p.7), but that the information designers will always have to use their judgment regarding the applicability/suitability of the guidelines.

The category of "administration" principles includes concerns of access, costs, ethics and quality. He sees 'access' as being divided into external access (for example, the type of (physical) binders information is stored in) and internal (for example, the kind of content indexing used). As can be understood this use of access has none of the richness ascribed to accessibility in Content Design but is weak version tied to the notion of availability.

Finally, to complete the description of the four categories, the main "aesthetic" principles referred to are those of harmony and proportion. Under the category of "cognitive principles", ("facilitating attention; facilitating perception; facilitating processing and facilitating memory"); he tries to again to provide, within each of these, guidelines for text, pictures, symbols, layout, and colour.

Thus, from this brief overview of Pettersson's work (which was published subsequent to my completing this thesis), we can understand that he is concerned with gathering together and organising principles which can influence the design of content, and that he is driving this concern with a traditional design methodology that is based in practice However, compared to my vision of designing content, Pettersson is restricting the responsibility of information designer to a graphic design perspective of organisation and presentation of data. Tellingly, he notes that "Dissatisfaction with execution of the message may cause dissatisfaction with the content of the message". This means that the execution of the message or encoding stop for him at the level of its presentation, and does not enquire more deeply into the composition of the content itself.

Mapping Pettersson's approach onto to my vision of Content Design assists in a better definition of the latter.

- To begin with, although I see practical outcomes for Content Design, I do not see these only in a business or professional context, but hope that Information designers could learn from the multidisciplinary background of Content Design, and work at theoretical, or social and even artistic levels on their designs.
- Secondly, Content Design is more deeply concerned with the "encoding" process than just the surface layer of presentation. It wants to understand how to design into content multidimensional aspects of accessibility and usability, which impinge upon content creation, transmission and reception.

- Thirdly, Content Design must include the aspects of content which appeal to the senses of the audience. Although I have never considered this in my publications, there is work on aesthetic principles (Pettersson, 2007), attractive layer (Carliner 2003), sensorial design (Shedroff, 1999) that could be a starting point for understanding the relationship between this quality (appealing to senses) and its place within Content Design.
- Finally, however removed Content Design theory may be from the real world, it will need to recognise the economic constraints and practical conflicts in real world designing and help content designers find ways to overcome such constraints and conflicts, based upon a body of theoretically validated knowledge.

Another opportunity to understand and define the dimensions of a theoretical framework for Content Design is by examining the properties of content. Information Designers, working on an international curriculum, recently drew up a list of no less than fourteen desirable qualities that information should possess (IDX, 2007). According to this document, designed information should be: accessible, appropriate, attractive, believable, complete, concise, errorless, interpretable, objective, relevant, timely, secure, understandable and valuable.

My view of these properties is that they could be seen as secondary to those of accessible, usable and appealing. In addition, they may be more heavily dependent upon the designers of content knowing beforehand who their audience is and what their informational needs are. This would be the case for the attributes of appropriateness or completeness. It remains however that if content is not accessible or usable, it will not be possible to talk of it being appropriate or complete.

As yet these attributes are simply listed by the IDX consortium. That is, they are not explained further, nor do the educators elaborate on how these attributes might be achieved. However, it is encouraging for my vision of Content Design that their graduate profile aims for students who can

> *"design information by creating relationships between people and information and by providing evidence that the information is accessible and usable to an agreed high standard" (IDX p.1)*

The curriculum document also describes a process method for information design that follows the typical design steps of identifying goals and tasks of information; defining users; composing the information; deciding on media and distribution; integrating feedback, documenting the information elements for maintenance purposes; performing user testing and refining of information; assisting clients with implementing the information. Other than a brief paraphrasing description of these stages, there is no further information on composing the information, on labelling it, or even on specific concerns about accessibility and usability, despite the graduate profile definition.

Information Design was used as an example of how the agenda for Content Design as a discipline, requires that theories and models from other disciplines that use content need to be examined and mapped to

content. In this way a robust grounding can be provided and coverage be elaborated and refined. It is only by drawing in and integrating the wealth of prior work that Content Design can avoid unnecessary re-inventing of the wheel and hope to progress.

The next section is the concluding section to the whole explanatory essay where the theme of Content Design is briefly re-visited, in the light of the contributions from the strands of work that have been discussed, and the responsibility of the role of the Content Designer is acknowledged.

Summary and Conclusions: Content Design revisited

The purpose of this essay was to offer a critical analysis of work supporting this PhD by Prior Publication. My published papers presented within the essay are viewed as contributing to an overall theme, that of Content Design. The essay has posited the increasingly central role of content in the Information Age and the subsequent emergent need for paying attention to the deliberate design of content.

In the introduction to this essay a broad definition of content was offered, and content was then examined from the point of view of: the centrality of content in the Information Age; the rise of content related industries, and the widespread and increasing expertise and knowledge that content related activities produce. In addition, the changing role of content consumers was noted, in terms of their greater reliance on information, particularly in the context of the ubiquity of the web; their need for new skills and literacies; and, paradoxically, their increasing role as producers as well as consumers of content. The presence of all these factors and conditions I argue, demonstrates a need for research and study into the deliberate crafting of content, paying attention to its creation, transmission and reception. I call this activity Content Design and believe that much relevant expertise and knowledge already exists. Indeed some of it dates back to Aristotle. However, it tends to reside in communities of research and practice that are separate and isolated from one another.

To illustrate this position, the body of the essay presents three distinct research areas: those of Discourse Studies, the Uses of Metadata and Accessibility of Content. Within each of these areas, research results are presented that are my contributions to the publications submitted in support for the PhD by Prior Publication. Broadly speaking the publications in each of the three areas may contribute to knowledge needed for Content Design in the sense of composing content, describing content and accessing content.

Discourse Studies offered useful theories and methods to understand how content, in particular explanatory content, is composed. Notions of text coherence and the differing functions of segments, offered useful theoretical frameworks within which to analyse explanations. In particular, these were: the use of visual material in explanations; the necessity for 'justification' text segments within the explanation/ recommendation output of Decision Support Systems, and the composition and structuring of the 'dialogue' (the input) of the user of the DSS. This was achieved by restricting the descriptions presented to the users to those that were representative of their concerns rather than of domain knowledge. This made the system more amenable to users who were able to explore choices through problem descriptions that were relevant to them.

The same theories and methods, along with the work on the analysis of visual material used in explanation, are currently providing guidance for the composition of textual equivalents to images.

The Uses of Metadata. Describing content, so that it can be indexed and searched, is an important Content Design activity, especially for digital content. Without such descriptions there is no way to search through large collections of content, or even to know what is in them. In information systems, metadata is a way of describing content (the source data). There are two parts to this activity: namely what aspects to describe (or markup), as well as how to describe them (the encoding). The markup of metadata is a way of making explicit the distinctions the computer makes when it processes a string of bytes. The markup schemata (what aspects to describe) depend upon purpose of the description: i.e. what one wants to do with the content. For instance, metadata markup can be analogous to the traditional library cataloguing record, containing bibliographic type data such as author, title date and place of publication, etc. Creating the records or descriptions of content is a laborious process, so ways of making this process easier, such as cooperation in sharing labels or records between libraries is useful. If content is described with metadata using the same markup schema and encoding, the sharing is considerably facilitated.

In this section, the uses of metadata by two different communities (those of libraries and those of the online learning researchers) were examined. The content held by libraries and used by the online learning community are complementary and tending towards some overlap. Content, or 'learning objects' in the online learning terminology, may be course notes or recommended text books. Each community had its own mark-up schema for content. On the one hand, the library metadata focused mostly upon extending traditional concerns: that is, bibliographic type data for searching and indexing tasks. On the other hand, the online learning community, in addition to typical bibliographic data, required that 'pedagogical' aspects were described, such as the level of competence needed to use the material. Unlike the library community that concentrates primarily upon content, an online learning system must also have some conception of the user of the system, i.e. the learner. A user model is required be able to match learners with appropriate content, however an individual instance of a learner, captured in a learner profile, is required to further refine the matching process to deliver appropriate content to the needs of a particular user.

The publications presented in this section show a logical extension to the use of content metadata, i.e. to link it to metadata describing characteristics of content users so that there is correlation between the two entities. In addition these publications show how our work took the field forward: contributing not only to metadata schemata for user profiles but also to Learning Technology standards.

The Accessibility of Content. Facilitating access to content, and ensuring that content is understandable are twin aspects of the activity of making content accessible. That is; accessibility describes both the efforts made by the content designer to enable content to be accessed by the devices used by individuals, as well as the ability of the user to access content that has been well designed and is therefore easy to understand and use. The publications present three approaches to accessibility:

- to provide practical, relevant assistance to designers of internet based applications, in the form of a software environment that would support them in authoring accessible code, as well as provide an educational experience in the sense of "learning by doing".
- to use work from the field of user modelling and adaptable and adaptive systems, as well as extend the ideas on correlating content metadata and user profiles, for content adaptivity. That is, adapting content to users and their needs, (including the devices they use).
- to tackle the problem of awareness and education regarding accessibility by collecting and classifying of information to do with accessibility issues as part of the groundwork for curricula recommendations. The aim of this groundwork was to determine what skills and knowledge sets are required to acquire a broadly based understanding of accessibility and Design for All.

Content Design can be seen as a horizontal theme within which the three research areas of Discourse Studies, Uses of Metadata and Accessibility of Content can be accommodated. These are important structural components of Content Design. They have offered useful results that take account of the moving target that is content, and particularly web based content.

In this essay we have seen that content is increasingly

- digital (requiring the user to possess e-skills and media literacies);
- dynamic (content located in interactive applications and aggregated in portals);
- expanding (both in volume and in richness, more and more content is multimedia)
- innovative (among the most recent, blogs and podcasts);
- adaptable (to user needs and device constraints, as well as to requirements suggested by location awareness and context sensitivity)

This means that ways to produce, manage and deliver content are the subject of much research and, as a result, much knowledge is accumulating. That knowledge needs to be pulled together to inform the design of content. The multidisciplinary nature of Content Design may draw from areas as disparate as literary theory, to offer meaning-making in traditional as well as new media; and new literacies, such as information and media literacy, to gain insight into how content is being received.

Fundamentally, Content Design is the art and science of communicating meaning and experience. A major role will be to oversee the design aspects of content so that it is accessible, useful and meaningful. *Accessible* will mean able to access the content, technically as well as cognitively. *Usable* will mean being able to interact with the content that is appropriate to one's needs and expectations. *Meaningful* refers to the content having some message for the audience (not necessarily sense-making, since some content appeals directly to the emotions) that will communicate with, and integrate with, the personal experience of the

recipient of the content. The accessibility and the usability of the content will facilitate the meaning making activity of the receivers

Finally, in the introduction, content was described as a commodity. As such, it is without doubt that access to it equals access to power. From the point of view of the design profession, designers of all sorts are increasingly aware of the social responsibility of their role. This goes beyond the artefacts they design, to the systems (organisational, educational, cultural and social) wherein their artefacts reside. If we subscribe to this notion, then the design of content that is a defining characteristic of the Information Age in which we now find ourselves, should also be considered as more than a product or commodity, but as part of the fabric of life around us, and designing it, part of purposeful action.

Commentaries on Selected Publications

The publications discussed in this essay are mostly multi-authored. This is due to the fact that often they represent results from large European funded multidisciplinary research projects. The commentaries that follow are on a selection of 8 papers from the total of 31 that I am submitting in support of the PhD by Prior Publication. This selection was made with the aim of providing a clear indication of concepts, approaches and tools that were my personal contributions, and which I feel best illustrate the Content Design issues that are central to this essay.

For each of the 8 papers in the selection I have tried to bring out four points. Firstly, I have tried to make clear my contribution to the paper including the part I played in the research that led to the production of the publication. Secondly, given that the papers are set in a variety of research areas, such as those surrounding Intelligent Tutoring Systems, Decision Support Systems, Digital Libraries, Online Learning, etc., I have briefly described the background to each paper, and the salient parts of the paper. Thirdly, in the light of the information given about the background, I have attempted to assess the impact of the paper. Lastly, I have tried to show the relevance of the work to the theme of Content Design

The section and paper numbers that are given at the end of each of the 8 annotated papers refer to the full list of 31 publications that can be found in Vol. 1, immediately after the Table of Contents (pages 4-7). All 31 publications are also referred to within the body of the Explanatory Essay in the sections on: Discourse Studies (Section 1, papers 1-8, pp. 35-43) Uses of Metadata (Section 2, papers 9-16, pp. 44-54); Accessibility of Content (Section 3, papers 17-31, pp. 55-76).

Scanned copies of the original publications are to be found in Volume 2, Appendix 4. Each paper is referenced by the section in which it is discussed in Volume 1, and where the original (scanned) version is located in Volume 2.

Sutcliffe A.G. & Darzentas J.S. (1994) The Use of Visual Media in Explanation. In *Cognitive aspects of Visual Languages and Interfaces. Human Factors in Information Technology*. Eds. Tauber, M.J., Mahling, D., Arefi, F. Elsevier, Amsterdam. pp. 105-132

(Vol. 1: Section 1: Paper 1 and Vol. 2: pp. 44-74)

My contribution to this paper was to select and assemble a corpus of static images that were part of an explanation. This involved identifying appropriate sources and selecting material that satisfied certain criteria. The aim was to have as varied as possible a range of both images and explanation types. 29 images drawn from 17 different sources were collected, and the range covered task based explanations (how to decorate a cake, plant a tree, etc.); conceptual explanations (concepts in Prolog, concepts in Homeopathy, etc.); as well as different types of images (graphs, sketches, diagrams, sequences of images, exploded images, etc.). The images were analysed along with the accompanying textual explanations of which they were part. In this corpus there were no images that did not have text.

This work was part of an overall interest in investigating explanatory dialogues for Intelligent Tutoring Systems. My co-author also set up a dynamic dialogue with a student and expert using an image as part of the explanation and analysed the resulting video tape. The general aim of the paper was to understand more about how visual content is used in explanations, whether in text or in dialogue.

The static images were analysed using Rhetorical Structures Theory (RST) (Mann & Thompson, 1988) and some parts of Task Knowledge Structures (TKS) (Johnson et al., 1988). Very briefly, RST is a theory of text organisation that provides a model of textual function based upon rhetoric. It describes the relationships between segments of text according to their communicative purpose. In the paper, RST was used first to analyse the text surrounding or accompanying the image, and then the image itself. Image analysis was a three step process. First the references within the text, both explicit and implicit, were noted. Next a series of sentences was composed that expressed approximately the knowledge portrayed in the image according to the references in the text. Finally areas in the image were labelled to give the sequence of image reading and the sentence order. It was this rendering of the image that was then analysed by RST. To summarise, the use of RST was to give a means of mapping out the text segments and image (and /or part of the image) in relation to the whole of the explanatory discourse, in terms of their communicative functions.

From TKS, the categorisation of types of knowledge used in tasks was used. TKS is a theoretical approach that assumes that people possess knowledge structures in memory that relate to tasks. TKS taxonomises the types of knowledge relating to objects, their relationships and their behaviours. For example: "object – property": refers to any descriptive properties of an object; and "procedure": refers to 'how to do it' type information. In this paper the knowledge categories were used to classify

the information portrayed within the image along with the surrounding text: e.g. procedural knowledge.

A four category classification was used to describe the relationship of the image to the text. This ranged from "aesthetic", i.e. the image was purely decorative, to "communicate", i.e. the image is the sole means of delivering information and there is no supporting text. Two other intermediate categories were "illustrate": all or most of the information in the image is in the text, and "augment": the information in the image complements the text, and studying the image is required if one is to acquire all the information needed. Images were also assigned categories according to the instructional purpose they served, e.g.: "highlight"; "animate"; "locate"; etc.

Thus the images were analysed along several dimensions, including;

- Their relationship to the text: e.g.: were they decorative or functional?
- The type of instructional purpose they offered: highlight, animate, locate, etc.
- The type of knowledge they conveyed: e.g.: spatial; object – property; procedural, etc.
- The whole/parts relationship between the images and text, (or coherence) following RST categories, e.g. justifying an explanation, giving background, etc.

The corpus of images was such that there was always accompanying explanatory text. The image analysis work used the explanatory text to infer the interplay between the text and the image. A main outcome of the analysis was to enable us to better understand the function of visual content in an explanation. The images were classified as illustrative or augmentative. That is images that are illustrative do not provide extra information, whereas images that are augmentative convey information not present in the text, and therefore deletion of an augmentative image would impair the explanation.

With regard to the theme of Content Design treated in this Explanatory Essay this paper deals with the communicative purposes of text and images and tries to see what *meaning* is contained where meaning is defined as the function of a text segment or image (or part of image) and type of knowledge conveyed. The images were analysed in relation to the accompanying text and were considered integral to a whole discourse.

I believe that results from the analysis described in this paper can also be of help to guide those involved in creating content that is equivalent or alternative to the image. That is, this kind of analysis can be used to determine the functionality of images within texts and be used for the creation of textual equivalents achieves to ensure that they achieve that functionality. Thus this work described in this publication promises to be

useful for some very current concerns, and briefly I would like to illustrate this point with work that is in progress[136].

Good practice in web accessibility recommends that when an image is present, a text alternative should be available for those who cannot see the image. However, the creation of this alternative text so that it conveys both the knowledge carried by the image, and the function that the image served is not very easy. I am trying to show that the kind of analysis carried out in this paper can guide the creation of alternative text so that both the original communicative functionality and discourse coherence is preserved.

Following this methodology regarding the coherence of text segments, and the functionalities of each part in relation to the whole, it is possible to build models of different discourses, e.g. explanation, rationalisation, justification. ,

Both this paper and this work in progress are put in the overall context of Discourse Studies (section 1) of the Explanatory Essay to offer aid in composing/creating content.

[136] Working Title "Darzentas, J.S. et al: "Putting words to pictures: guidance to text content for alt tags and longdesc", in preparation, see "Appendix 1: "Work in Progress" section.

Darzentas, J., Darzentas, J.S., Spyrou, T. (1995a) Designing a Designers' Decision Aiding System (DDAS). *Journal of Decision Systems*, Vol. 4, No 1, pp. 9 – 22

(Vol. 1: Section 1: Paper 4 and Vol. 2: pp. 113-126)

My contribution to the Decision Support System (DSS) work on the Designers' Decision Aiding System (DDAS) focused upon how to create operational descriptions of an array of HCI tools and methods collectively known as "modelling techniques". These descriptions were operational in the sense that they were to be used within the DDAS for manipulation purposes, and to form the core of the knowledge base used by the DSS.

These modelling techniques had been developed by HCI researchers[137] to deal with various usability problems. However, unless the computer systems designers were able to understand what kind of problems the techniques could help with, they were not likely to make use of them. The difficulty for the designers to use the techniques was further compounded by the number of techniques; their varied and overlapping coverage of aspects of the HCI 'problem space'; and the fact that some of the techniques required specialised knowledge on the part of designers to be able to use them. It was because of this complexity that some form of automated help, in the shape of a DSS, seemed a sensible solution.

Put simply, a DSS is a recommender system that has as main components a knowledge base, a reasoning mechanism and a communication module. Challenges for DSS are the eliciting of the knowledge for the knowledge base and the reasoning mechanism. In the case of the DDAS a large part of the content of the knowledge base was formed by the descriptions of the techniques. These descriptions were deliberately crafted and adapted so as to be relevant to the designers looking for appropriate tools or methods. That is, the descriptions were oriented towards the designers and their concerns, rather than being 'stand-alone' descriptions of each of the techniques and how to use them. In addition, to be relevant to the designers they had to be couched in terms of the problem space.

To make up the descriptions, I used discourse modelling and Soft Systems Methodology (SSM) approaches. I had at my disposal a corpus of existing information about the purpose and potential use of modelling techniques supplied by the HCI researchers, the creators of the modeling techniques. I 'distilled' the information about the techniques to summarise what each of them were able to do, (as opposed to how they did it, or what knowledge is needed to use them). This was achieved using discourse modelling techniques such as RST (which helps understand the functional organisation of the text) and to a lesser extent, informed by theoretical

[137] The HCI researchers were working on the EU funded AMODEUS project, at that time one of the world's largest multidisciplinary HCI consortiums, which was in existence for 6 years. 1989-1992 AMODEUS (Assimilating Models of DEsigners, Users and Systems) Esprit Basic Research Action 3066 and 1992-1995 AMODEUS 2 (Assaying Means of Design Expression with Users and Systems) Esprit Basic Research Action 7040 see http://www.mrc-cbu.cam.ac.uk and http://kmi.open.ac.uk/people/sbs/amodeus.html

views on context, such as those from Speech Acts (Austin and Searle) and Implicatures (Grice)[138]

The role of the SSM approach was to help 'define' the problem space (the system), or aspects of the problem space (the subsystems), that the techniques were designed to help with. The primary use of SSM, which is applied to "messy situations", is to analyse and understand complex situations where there are divergent and ill-defined views about the definition of a problem. These are 'soft' problems and SSM starts by trying to capture these divergent views in "Rich Pictures" formed from the input of all parties involved. In our case these were: the designers of computer systems; the researchers with their modelling techniques; and ourselves, the designers of the DDAS. The Rich Pictures helped create an understanding of the designers' problems, that is, what was significant and relevant to them, so that the techniques could be described in these terms. In SSM terminology, Rich Pictures of the relevant subsystems help to build "Root Definitions". These Root Definitions make explicit and encapsulate the essence of the subsystems and they are used to build conceptual models of fundamental activities. They give a place to 'softer' but equally important aspects of the 'culture' of an activity - in our case the designing and building of computer systems - so that solutions are culturally feasible. A typical cultural aspect examined here was the fact that the working practice of design is not the linear or hierarchical process described by theorists. Therefore, it is hard to ascertain when in the design process a particular technique should be used.

Thus, each technique was eventually described in terms of activities like 'identifies', 'constructs', 'records', 'evaluates', etc. Figures 1 and 2 in the paper show some of the analysis of just two of the techniques. These descriptions of the capabilities of the techniques, combined with the Root Definitions and Rich Pictures were then further used to create networks of relationships between the problems that described strengths and weaknesses of particular techniques in relation to those problems, as well as commonalities of approaches and of goals, between and within subsystems. The outcome of this exercise was to derive menus of what had now become 'problem descriptions' for the designers to choose from. What this means then, is that the DDAS was not comparing and contrasting the techniques, but comparing and contrasting the problems, or aspects of problems, that the techniques could tackle.

In this way, the content of the DDAS knowledge base was eventually formed by my work on the textual descriptions of techniques and the problems and sub-problems they solve, and the relationships between the problems and sub-problems. My colleagues were responsible for work upon the reasoning mechanism that was able to make use of linguistic quantifiers and fuzzy logic to evaluate each technique against each set of design problem descriptions selected and weighted by a designer. That is, the designers were encouraged to choose as many problem descriptions as they wanted, and were also able to assign to them differing degrees of importance. The reasoning mechanism evaluated 'discourses' or linguistically expressed relationships between the descriptions and

[138] In Section 1 Discourse Studies, the work of Austin, Searle and Grice is described.

provided recommendations about which modelling techniques would be useful to the designer based upon the final problem descriptions selected.

Finally, the descriptions not only provided the domain knowledge for the DDAS, but, in addition, after the reasoning mechanism gave an output in the form of a recommendation; the same domain knowledge was used to help form a textual explanation that offered the rationale for arriving at that recommendation. This was important for making the recommendation more acceptable to the user.

In terms of Content Design, the processes followed to arrive at the textual descriptions were used with the aim of making the content of the knowledge base relevant to the receipients of the information. (the designers who had problems and wanted to know which were the best techniques for them to use. Although this content was designed to be the knowledge base for making recommendations for users of the Decision Support System, it was expected that the users would want to explore the options, and in this way learn more about the techniques. It was tested with the original source of the content, the creators of the modelling techniques. The latter expressed interest at how these representations enabled them to better understand their own work and that of their colleagues[139].

The work described in this paper was at a theoretical level only. The next paper in this set of commentaries discusses in greater detail the approaches used to create the descriptions and the content of the knowledge base of the implemented system. The theoretical work set out the need for content that was relevant to designers problems (the problem descriptions) so that it was accessible (in the sense of meaningful) to them as well as usable (they could interact with it at a cognitive level).

[139] This is documented in deliverables from the AMODEUS project and publications and discussed in Section 1

Darzentas, J.S. Spyrou, T. Benaki, E. Darzentas, J. (1995) A Designer's[140] Decision Aiding System. *Proceedings of the Fifth National Conference of the Greek Computer Society*, Vol.2, pp. 615 – 627

(Vol. 1: Section 1: Paper 5 and Vol. 2: pp. 128-142)

This publication deals with the same application as that described in paper 4 above, that is, a kind of Decision Support System we called "DDAS" (Designer's Decision Aiding System). The main purpose of the paper was to describe an implementation of the DDAS, and, as first author, my personal contribution to this publication was firstly to present the case for the DDAS; and secondly to write up the detailed description of the knowledge elicitation process. This included explaining how the information was used to create the content for the knowledge base and also the content for the communication with the system, (sections 1 and 2). The actual development was carried out by my colleagues, and together we wrote up the description of the example run-through of the implemented system (section 3) and conclusions.

The knowledge elicitation process was a four stage process. The first stage was to compose a set of statements describing the potential of the techniques. The second stage was to derive from this set of statements a further collection of statements describing the problems (or parts of problems we termed 'sub-problems') that the techniques could assist with. The third stage was the determination of the relationship of the problem to the technique in terms of how well the technique dealt with the problem (or sub-problems). Finally, the fourth stage was the determination of the relationships of problems and sub-problems among/between them. The paper describes in more detail the methods used to arrive at the results needed in each of the four stages, (such as formulating questions and submitting them to the experts, etc). The previous paper in this annotated list[141] noted the theoretical approaches used: i.e. RST and a series of linguistically based discourse modeling approaches to analyse the existing texts describing the modelling techniques, and SSM to analyse the problem situation, and both types of analysis were needed for the stages described above.

To better understand the importance of this work in terms of the theme of Content Design, it is necessary to understand that the use of textual descriptions was not usual in DSS.

The then contemporary view of DSS (circa 1992-3) was more akin to the use of a spreadsheet today. Very often the domains were based upon collections of data that could be used for their quantitative nature. For instance, a knowledge base in a DSS for helping a user make a decision

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[140] The correct name of the DDAS is "Designers' Decision Aiding System", (i.e. designers in plural).

[141] That is: Darzentas, J., Darzentas, J.S., Spyrou, T. (1995a) Designing a Designers' Decision Aiding System (DDAS). *Journal of Decision Systems*, Vol. 4, No 1, pp. 9 – 22 **(Section 1: Paper 4)**

about buying a car would probably have been mostly made up of 'quantitative data' such as: prices of various models and makes; their engine capacity; their fuel usage rates; the resell value, etc. If the user is looking for the best value for money, the recommendation from the system may be fairly easy to compute. The strength of such systems lay in their being able to deal with large amounts of information or criteria, leading to a whole branch of DSS dealing with multi-criteria decision making (MCDM).

This is very different from the qualitative content in the DDAS knowledge base which consisted of the descriptions of the modeling techniques, the problems they could deal with, etc. It is true that the main thrust of this work was the use of Test Score Semantics from Fuzzy Sets Theory to provide the means to "compute" the linguistic content of the propositions. However, it was crucial to the outcome that the whole descriptive textual approach of the DDAS was indeed representative of the artifacts (the techniques and the problem situations) it described.

With regard to Content Design, the implemented Decision Support System designed the content at the interface to be more meaningful to the users (designers with problems) in two distinct ways. That is, the text describing the techniques was transformed to be problem centred, rather than technique centred; the users were able to move between techniques oriented by being able to select and de-select problems and sub-problems. Secondly, the recommendations that were output by the system were backed up by explanations that explained the rationale underlying the recommendation. These explanations were generated from the combination of the choices of problems made by the user, guided by knowledge of text coherence and task knowledge structures. This is an example of creating composing content in a way that makes it highly relevant to the target audience.

Darzentas, J. Darzentas, J.S. Spyrou T. (1997b) Helping the User to Make Use of the Tools: Transferring Research Results from the Laboratory to the Market by means of Intelligent Decision Support. In *Human Comfort and Security-Advanced Interfaces for the Information Society.* Springer Verlag, pp. 193 -213

(Vol.1: Section 1: Paper 8 and Vol. 2: pp/183-204)

My contribution to this publication was to give an overview of the whole rationale for the DDAS type work seeking to show that the results could be generalised to other domains, where help is needed with "messy" problems. I authored the paper which reported upon work carried out jointly with the co-authors. The paper was written to appeal to a wider audience that those working in DSS or HCI. The emphasis was on three outcomes that I believe are all issues related to the design of content.

The first outcome was to demonstrate that it was possible to create usable and understandable recommendations from such systems. This was a concern that was starting to receive some attention at that time, since previously the research had centred mostly upon knowledge elicitation and reasoning mechanisms. It was now understood that users would not readily trust recommendations that did not allow them to understand the reasoning behind the system output. Henceforth there was a focus upon the content of the recommendation. For a while this work came to be known as "active DSS"[142]. The focus on the content of recommendations remains a concern even up to the present, particularly in DSS for Critical Safety Systems, where users are asked to accept system warnings, sometimes rather blindly. This is discussed further in the conclusion to Section 1.

The second outcome was to do with the frustration that was felt between research communities and practitioners over the uptake of research results[143]. For instance, in the HCI project[144] of which the DDAS work was a part, many strategies had been used to try to transfer results. One strategy had been to attempt to integrate all the modeling techniques into an overarching theory, but this had not proved possible. Another attempt was made to target specific specialties within the computer systems design community, for example, software engineers, or human factors specialists. However the ill-structured nature of design, and of the HCI

[142] The definition of Active DSS was rather varied. The common constant was the need for more support to the user in terms of explanation both of the problem domain and the outcome of the use of the system. See, for example, the CFP for Active DSS from colleagues of the EURO Working Group on DSS available on line at http://csdl2.computer.org/comp/proceedings/hicss/1998/8245/05/82450004.pdf

[143] At the time of this work carried out as "basic research" and funded by the European Union, 'official' information about research projects tended come in two varieties: jargon fraught indigestible chunks - also known as "deliverables"- and tantalising fact sheets that were too skimpy to satisfy. There was a growing recognition that dissemination activities that were better targeted to the audience needed to be undertaken. Gradually, the appearance of whole workpackages tasked with transfer of results began to become an expected part of all projects

[144] AMODEUS 2 (Assaying Means of Design Expression with Users and Systems) Esprit Basic Research Action 7040 http://www.mrc-cbu.cam.ac.uk

practitioners' role in design, meant that this approach was not sustainable. A more practical strategy had been to invite designers to specially organised workshops with theoretical and practical sessions. This was not particularly successful as commercial designers would not commit easily to such activities.

The designers expressed their needs as: not having the time to "wade through" theory; they wanted useful end results in terms of tools and techniques to help them incorporate usability considerations; and having understood that there was a variety of such techniques, they needed some way to distinguish what was useful for what aspect of design. In these respects, they were voicing concerns similar to many other areas where the information flow from the research community to the practitioner community is too overwhelming. A current example that could be cited might be that of medical researchers and physicians engaged in clincal practice.

Thus the work that was carried out for the DDAS implementation involving the transformation of the AMODEUS project results was a direct response to the needs expressed by the practitioners. Essentially the content describing the techniques was transformed into problem-centred descriptions that then referred back to the techniques. That is, they made the designers' concerns the starting point for the content about the techniques.

The third outcome is based upon the consequences of the use of SSM and can be described as that of "encouraging exploratory learning" about research results. The DDAS system was designed to allow its users to 'discover' the techniques by firstly going to the heart of their concerns, i.e. their problems, and helping the users to express those problems. Then the users were able to investigate the available techniques and the ways they could be relevant to tackling their concerns.

The use of DDAS seemed to show that making the content problem-centred encouraged exploration. It appeared that users liked to click through the problem descriptions and make 'mini-decisions' leading them to weight differently the descriptions, yet safe in the knowledge that they could reverse the decisions and change the weightings. Users who evaluated the system and who were experts in the techniques noted that exploring in this way enabled them to learn about other researchers' work[145].

With regard to Content Design, this book chapter was invited from a group whose primary concern was the lack of transfer of research results to communities of practice. It was written to show how a new vehicle might be used to engage practitioners and make them aware of research results, not only for immediate uptake, but also to learn about them by exploring them. However, along with the new form for content in the shape of a decision support system, we saw that the content presented to the users for them to interact with, as well as the content of the decision recommendations output by the system needed designing so that they

[145] This is described in greater detail in Section 1.

were respectively relevant to the concerns of, and acceptable by, their intended audience.

Darzentas, J.S. (1999) Sharing Metadata: Enabling Online Information Provision, *OCLC Systems and Services*, Vol. 15, no.4, pp. 172-178

(Vol.1: Section 2: Paper 13 and Vol.2: pp. 248-254)

This is a position paper I wrote for a library audience, from the perspective of the burgeoning online learning research community. At that time, (circa 1995-99) I was involved in separate projects researching library issues and online learning concerns. From this vantage point it seemed to me that the two communities were grappling with issues belonging to the same problem space, namely, descriptions of content, or metadata. Each community, due to its background, had a different viewpoint on the nature and purpose of metadata. At the same time, however, both communities were beginning to share a common vision of what future developments would bring in terms of online information provision, that is, content delivered straight to the desktop.

That future vision of online information provision, central to the existence of the online learning community, was then becoming technologically feasible, in the sense of having networks with sufficient reach and capacity. The challenges still lay in data exchange and interoperability of systems. Basically networked systems had to be able to accept a request for data packets or streams, to retrieve them from repositories, send them to the requester in the correct order, and ensure that the compatibility existed between the data format and the requesting platform. Widely understood descriptions of the data packets (metadata) were an essential part of this process.

For the online learning community, creating common specifications of metadata was the key to this dream of interoperability. Metadata to them was primarily machine readable data that would help systems to identify content and help it move through networks, to finally be displayed to a learner on the appropriate platform of software and hardware. In online learning systems, content is defined as modular pieces, termed "learning objects". Each learning object has its own set of metadata, describing aspects such as what it is (e.g. a photo of an orangutan), its origin, its format, usage rights associated with it, etc.). A number of learning objects, each with their metadata, are combined to create learning content.

What was not very prominent in this vision was the actual *searching* for content. If learners are to search for material, then they need access to catalogues of that material. It is upon such assumptions that, generally speaking, the view of metadata for the library community was based. As experts in cataloguing and indexing issues by the very nature of their profession, librarians traditionally perceive metadata as 'bibliographic type' data and data describing the semantics of the content. Librarians had been battling for decades with problems of interoperability of records; with cataloguing tools and systems that had evolved over time to deal with non standard, and ultimately transitory, formats of content (audio visual material, tapes, cassettes, microfiche and microfilm); and other such problematic aspects of 'labelling' content. About the time of writing this paper the term "hybrid library" began to be heard, denoting a library of

physical and electronic content, where the latter might actually be remotely situated.

Given this state of affairs, in this paper, I posited the possibility of the need for libraries to be able to catalogue their content in such a way that it could be searched to the level of detail required by the on line learners and their learning systems. The paper justified this need for enhanced catalogue records by noting the then current predictions regarding online learning in the Information Society. It was expected that there would be an increase in 'exploratory learning' where the emphasis is on finding information (termed "resource discovery")[146]. In this scenario, libraries were to assume a greater role in education, in the sense of mediating learners' explorations of (primarily digital) content. This was especially the vision for academic libraries. The scenario also foresaw that the libraries of large corporations and public organisations, as well as public libraries, would act as 'information brokers' capable of managing distributed information and of mediating access to it.

Since such expectations, even if they were not as detailed as the online learning community foresaw, would necessarily increase the cataloguing load, the paper describes how the sharing of metadata between libraries as part of a collaborative cataloguing strategy could be used. This could help to reduce one of the heaviest areas of workload in the typical library environment. This suggestion was backed up with the experience of a group of Greek academic libraries, whose work I coordinated, that formed part of a Telematics for Libraries European funded project, called UNIverse[147]. The paper describes, at a high level, the process of collaborative cataloguing. The UNIverse system was based upon the concept of a virtual union catalogue. That is, bringing together physically distributed catalogues and databases so that they look like one catalogue but in fact remain physically distributed. Each library could download records, merge records, enhance records, and de-duplicate records. It could also upload records for use by other libraries. Each library could be both a supplier and a receiver of records. Although simple to describe, there were many technical problems to be overcome. However, one of my main conclusions from this experience, as reported in the paper, was that the problems encountered were due as much to technical incompatibilities as to the legacies of working practices and ultimately difficulties in 'human networking'.

Of course, libraries were not strangers to notion of collaborative cataloguing, and the paper briefly reviews some of the efforts that were made to deal with issues of cataloguing; such as "record supply" i.e. purchasing/obtaining ready made records from other libraries; increasing the type and the amount of information in the record (such as formats and access rights) and work on subject gateways: (essentially human intensive classification and cataloguing of internet content).

Up till this time, library researchers had been concentrating much of their effort on the goal of accessing in a seamless manner records in various

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[146] See for instance the discussion in Ip et al, (2001)

[147] UNIverse (Large Scale Demonstrators for Global, Open Distributed Library Services): http://www.cordis.lu/libraries/en/projects/universe.html

formats of content located in different databases. The increase in the use of Internet brought new possibilities. Using the perspective of the online learning community, who by definition, wanted content delivered to the desktop, and describing the technical achievements of library projects that I had participated in, this paper tried to show how both goals were part of the same problem space, i.e. searching and retrieving records describing content and actually pulling down the content itself.

In terms of the importance of the work to the theme of Content Design, I believe the contribution of this paper to be twofold.

Firstly, I would like to claim that its academic merit lies in examining two research communities concerned with labelling and packaging content and describing how their viewpoints could complement each other. I further maintain that these are not just technical questions but require 'human networking' between the different research and practitioner communities. There were, of course, others who were interested in the use of metadata by both libraries and online learning technologists, but there was quite some confusion owing to differences in motivations, culture and jargon use. The paper tries to bridge these gaps and has been cited by researchers from both groups (3 from online learning and 4 from libraries), thereby demonstrating, I hope, that its content, although aimed at the library audience, was useful to others.

Secondly, the whole issue of 'labelling' content is a fundamental Content Design issue. What to record on the label, and how to organise those labels separate from the content have occupied librarians for centuries, from the time of the first large library collections like those of the ancient library in Alexandria, with the first recorded use of a subject catalogue (the "pinakes"). Without such classification systems content cannot be found or therefore used, (unless one stumbles upon it randomly or goes systematically through all holdings, which is not possible when collections are large). The problem is even more acute in our modern era of vast amounts of digital content in the form of intangible bits and bytes that are without physical equivalent and that can only be apprehended by the appropriate access platform of software and hardware. Without some means of describing the characteristics of the content, or the technical requirements for display and manipulation, etc., much content would simply be invisible. In terms of the qualities of content, labelling content for "findability" ensures accessibility in the sense of availability

Konstantopoulos, M., Darzentas, J.S., Koutsabasis, P., Spyrou, T., Darzentas, J. (2001) Towards Integration of Learning Objects Metadata and Learner Profiles Design: Lessons from GESTALT *Journal of Interactive Learning Environments.* Vol. 1, pp.1-24.

(Vol. 1:Section 2: Paper 14 and Vol.2: pp.256-282)

The main areas of my contribution to this paper were in the argument that formed the basis for the work the paper describes and in the background to that argument. The paper focused on the semantic and structural relationships between, on the one hand, metadata for content and, on the other hand, metadata for users (termed "Learner Profiles"). It argued that both types of metadata should be correlated since there needs to be a correspondence between the characteristics of users and those of content. In order to situate the argument, the paper begins with a review of concepts and issues relating to metadata for content and user centred metadata. More specifically, firstly a comprehensive review of the concept of metadata, and in particular content metadata in education, was made. Subsequently, the issues surrounding the use of user profiles, and how these relate to Learner Profiles were described. Finally, both content metadata and Learner Profiles were viewed in the context of the then current accepted abstract model of a learning technology system architecture[148].

The discrepancy between the two sets of metadata had come about partly because the online learning community in its standards work up to this time (around 2001), was concentrating mostly on establishing metadata for pedagogical content, known as Learning Objects Metadata (LOM)[149]. As explained in the paper, data models for user profiles did exist, but standards work was driven mostly by the needs for identifying content and for interoperability concerns. There was a tremendous emphasis on the definition of the LOM, and little or no attention to metadata to describe Learner Profiles. With hindsight it is easy to see that this perspective was governed by the anxiety over the uncontrolled spread of content on the web. Unless content was self describing, it would be lost, or un-apprehendable. However, by this time it was becoming clear that because of the wealth of information that could be returned from searches, some means of reducing the irrelevant search results, and at the same time increasing the relevancy for the searcher, had to be found.

Thus, the impetus for this work arose, in part, out of my profound concern that not enough attention was being paid, in the design of online learning systems, to enable the learners to express their personal requirements for content. This concern was guided by the broker metaphor: in a human to human context, a broker consults with the client to ascertain client needs,

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[148] This work on the Learning Technology Systems Architecture, (LTSA) was then an active working group of the IEEE sponsored Learning Technology Standards Committee (LTSC), which is chartered by IEEE Computer Society Standards Activity Board to develop accredited technical standards, recommended practices, and guides for learning technology. http://ieeeltsc.org/

[149] Learning Objects Metadata (LOM) was also part of the LTSC work (see footnote 16 above and http://ieeeltsc.org/wg12LOM/

before starting to act for the client. In this I was influenced by the broker metaphor that had been, and was to be, the basis of work in other projects (GAIA[150] and GUARDIANS[151] respectively). It seemed to me essential that when searches for content were made, there needed to be some way of including user considerations. The scenario I posited for this was that of a learner being presented with content that was pedagogically appropriate (correct subject, correct level of competence, etc.) but that was unusable or even meaningless to the learner if it was written in a language of which the learner had no knowledge, for example, modern Greek.

At the time the paper was written the first implementations of learning technology systems were being developed, and the need for better specifications of the Learner Profiles, and better mapping between them and the content metadata were becoming apparent. Nowhere was this more so that in the GESTALT project's[152] demonstrator. This was because it was based upon a functional architecture that considered learners performing two main tasks: firstly, selecting learning content from a Resource Discovery Service (RDS), and secondly, engaging in learning/instruction tasks by interacting with the content within the Learning Environment. The GESTALT Learning Technology concept was based upon the assumption that in a world of multiple learning objects, there would have to be a well developed part of the system to act as a broker, to help users search for content.

When the GESTALT demonstrator took the then current IEEE Learning Technology Standards Committee (LTSC)[153] candidate Learner Profiles data model, called PAPI[154] (standing for Public and Private Information) and tried to implement it, problems began to show up. These problems were at both the technical and at the conceptual level.

At the conceptual level, the problems had their roots in the fact that learner profiles covered a very large area, and that different groups had different interests. For example, at that time, the PAPI data model divided learner information into four types that ranged from personal information to information about a learner's educational achievements. This information was, in fact, the student records that needed to be shared with different parts of a 'learning organisation', as well as to be maintained (e.g. amended, updated and archived). Some of this information was needed for several purposes, e.g.: personal contact information was needed by the administration and by the tutors; some information was for tutor records, e.g. information about student performance in tests, whereas student performance in exams needed also to be shared by administration. Conceivably some of the records, even though they were specific to a learner, were not expected to be available to that learner, for

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[150] GAIA (Generic Architecture for Information Availability) see a fact sheet at http://cordis.europa.eu/infowin/acts/rus/projects/ac221.htm

[151] GUARDIANS (Gateway for User Access to Remote and Distributed Information and Networked Services) see http://www.fdgroup.com/guardians/home.html

[152] GESTALT: (Getting Educational Systems Talking Across Leading Edge Technologies) http://www.fdgroup.com/gestalt/about.html

[153] See footnote 16

[154] PAPI: The notes on PAPI at UKOLN give a picture contemporary to our paper. The links to IEEE no longer work, since the IEEE LTSC stopped working on PAPI http://www.ukoln.ac.uk/metadata/resources/people/

example tutor evaluations. Thus our work showed that the four types of learner profile were confusing, and that boundaries between them needed to be redefined, especially because of the access levels that needed to be incorporated. Most of all, the learner profiles needed to contain information that would help to refine searches over educational content.

At the technical level it appeared that there was a conceptual correspondence between the learner preferences type of information (that specified a learner's preferred input and output media), and the part of the LOM that referred to the technical characteristics of content. In reality, however, there was no easy mapping between the two. That is, if a Learner Profile expressed a preference for listening to material, and if the particular learning object was available as an audio file, in spite of the correlation between preferences and availability, the two descriptions were not expressed in ways that could be easily matched.

The GESTALT demonstrator extended the learner preference information to include missing elements, like language preferences, while at the same time showing how different levels of access could be achieved. It pointed to the problems of converting between the terminology used by the content metadata (the LOM) and the Learner Profiles. In this way it was able to show the inherent danger in continuing to emphasise content metadata at the expense of the user-centred metadata.

Partly as a result of this work being brought to the notice of the LTSC, the online learning research community began to turn its attention to the question of user profiles. The paper was well received and had quite some impact in the standardisation work. It contributed indirectly to the discarding of the candidate data models for Learner Profiles, (PAPI), by the LTSC[155]. Work on the Learning Information Packaging (LIP)[156], specification from the IMS[157] in which profile information was treated in a more modular fashion has become the de facto standard and better able to map with the content metadata from IMS[158]. In the meantime, the PAPI data model, which has since been accepted as a specification for use in other sectors (Health Information Systems), also underwent some transformations to include a wider set of information categories[159].

The relevance of this paper and my contribution within it, to the theme of Content Design is that of leveraging the power of metadata to make searches for content more appropriate for users. This paper had noted that aside from instruction, which is a principal function of any distance

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[155] The European Learning Technology Standards Observatory dates the dropping of the PAPI work from the LTSC from the end of 2001 http://www.cen-ltso.net/Users/main.aspx?put=230, see also http://isotc.iso.org/livelink/livelink/fetch/2000/2122/327993/755080/1054033/2787945/JTC001-N-6296.pdf?nodeid=3912833&vernum=0 for the influence of GESTALT

[156] Learner Information Packaging LIP http://www.imsproject.org/profiles/lipinfo01.html and contemporary view from Learning Technology Standards Observatory (LTSO) at http://www.cen-ltso.net/Users/main.aspx?page=168

[157] IMS stands for Instructional Management Systems. The IMS started as a project but now is a consortium that includes many industries and works on specifications for interoperability of Learning Technologies. These open specifications have become 'de facto' standards. see http://www.imsglobal.org

[158] See meeting notes from http://incits-v36.org/doc/V36030025.pdf, section 6.3

[159] See http://edutool.com/papi/ for different versions of PAPI

learning system, a basic requirement of such systems is providing the student with materials, or online content provision. The work in this paper shows that this requires not only ensuring that the content metadata is adequate to support searches, but that it is integrated with information about the user's requirements. In terms of the qualities of Content Design elaborated in Section 4, "Towards a theory of Content Design", the use of metadata described in this paper provided not only accessibility in the sense of findability or availableness, but also cognitive usability. That is, the content was marked up with metadata relevant to the competence level needed by students to be able to understand or interact with it.

Velasco, C., Mohamad, Y., Gilman, A S., Viorres, N., Vlachogiannis, E., Arnellos, A., Darzentas, J.S. (2004) Universal Access to Information Services - the Need for User Information and its Relationship to Device Profiles, *Journal of Universal Access in the Information Society,* Vol 3, no1, pp. 88-95

(Vol.1: Section 3: Paper 21 and Vol.2: pp.346-353)

My main contribution to this publication was to author the section about content accessibility metadata. That is, metadata relating to the accessibility features of content. Content is one of five components or 'actors' that the paper identifies as being involved in the use of information services. The other four are the user; the device; the application to deliver the content; and the author of the content. The case of authoring content is not considered within the paper, which concentrates mainly on the blending of the user profile and the device profile. These profiles are represented as the abstractions of the user and the device, just as the content metadata represents the abstraction of content.

At the time of writing (2003) there were several groups interested in the accessibility of content, but there were no specifications for metadata describing the accessibility of content[160]. One of the reasons for this was the difficulty to understand just what are the accessibility features of content. As I pointed out in the paper, these cannot be understood in isolation. They are a function of user needs, and so have to be understood within the context of a user profile at the very least, and preferably with some understanding of the device used to access the content, i.e. the device profile.

The paper discusses in detail the user profile, which includes information about user preferences for interaction (for instance hardware and software input and output devices). It explains how this can be blended with the device profile which contains information about the capabilities of a device. The impetus for device profiles came from mobile telephony research[161], but assistive technologies can also make use of their device profiles framework, with some adaptation, as described in the paper. The blending of user and device profiles can be used with the content delivery application to ensure that the content delivered is appropriate to the user's needs and wants, in terms of controls and display presentation.

As the paper notes, it is not inconceivable that the device be equipped with GPS or other context awareness technology. What this would mean then, is that the device can inform the content delivery application about the fact that it is in a noisy situation. In this situation audio files are not

[160] This paper was written in 2003, appeared in 2004. At the time of writing, the Dublin Core Metadata Initiative (DCMI) had chartered a working group in 2001. It was not until early 2004 that they adopted the AccessForAll information model for user preferences from the IMS Global Project (see footnote 24 above) as a model for accessibility, see http://dublincore.org/groups/access/access-2004.shtml

[161] The Composite Capabilities/Preferences Profile (CC/PP) see http://www.w3.org/Mobile/CCPP/

suitable because their content will not be accessible. The content metadata is checked to see if there is a suitable equivalent: for example, a captioned video instead of a video with an audio file. Thus content needs to be described with appropriate metadata so that if alternative versions of content are available these are labelled as such. In the above scenario, the user profile is cross checked for conflict, a captioned video normally being inaccessible to a vision impaired user.

Thus choice of alternative version could be dictated by the user profile representing the preferences and/or needs of the user. That is, if the user profile states that there is hearing impairment, then audio files will be avoided at much as possible, alternatives sought, or transformations done whenever possible, (perhaps for instance transcript and/or signing avatar). User requirements may as well be expressed by the device capabilities. For example, a user with a PDA will need content that fits the display capabilities of that device.

The situation is extremely fluid, since a user may use more than one device, and the devices themselves are capable of being configured to individual users needs. Again, users may override certain features of the user profile or of the device settings depending upon their needs that may vary over time or with circumstance.

In terms of content then, accessibility metadata, the metadata that describes accessibility features of content, would have to be such that it can interoperate with the profiles. It would need to respond to requirements for different formats or for alternative/equivalent content. It would have to be able to describe the nature of interaction with the content; (i.e. requires speech input), as well as whether the content can be transformed, (e.g. can it be rendered by the devices). Three main communities were responsible for developing metadata to specify the accessibility features of content. The library community[162], focused upon describing content, especially as part of a content discovery scenario, asking: "Does this description of content support accessibility needs?" The online learning community[163], approached the question of metadata for describing the accessibility of content from the point of view of learner needs, trying to answer the question: "Can the learner use/interact with the learning content?". Finally, the work that was being carried out by organisations whose main focus was accessibility[164] helped considerably both the library and online learning communities to clarify their views on defining metadata for accessibility, as well as to ensure consensus between all three groups.

This paper contributes to the theme of design of content because it widens the range of use of content metadata. From 'labelling' content mainly for discovery by the user, now accessibility metadata 'labels' content so that the appropriate version or format can be discovered by the profiles working on behalf of the user. The metadata describing the semantics of

[162] Dublin Core Metadata Initiative (DCMI) http://dublincore.org
[163] IMS Consortium http://www.imsglobal.org/accessibility
[164] Such as the World Wide Web's Web Accessibility Initiative (W3C WAI) http://www.w3.org/WAI/ and the Adaptive Technology Resource Centre (ATRC), http://atrc.utoronto.ca/ especially the work they did in The Inclusive Learning Exchange (TILE) project http://inclusivelearning.ca/

the content may still dictate how the user is matched to content, that is, it is content driven (for example, "this is an audio file"). In contrast the metadata describing the accessibility of the content is driven by the user and device profiles' requirements ("this is an audio equivalent of a text based file, suitable for use with an MP3 Player"). The content is no longer considered as a single entity, but may exist in different formats and different versions, or even be capable of transformation on the fly via the content delivery system.

In essence, once the semantics of the content have been matched to the user, then the user (through the user and device profiles) stipulates the 'format' of the content. Thus the user is matched to the content semantics, but the content 'format' is matched to the user. This is exploiting the potential of digital content to come in the 'size and shape' that is best for a user. It means breaking away from fixed structures, (like documents with the structure of the physical book and pages) or 'standard' delivery modes (for instance, to the desktop PC). Instead the user is able to make use of flexible user driven modes of accessing content. This can be any combination of: an alternative equivalent form of content; content over which the user has control; and content which is transformed for delivery to the device of the user's choice. In this sense, it is making content more accessible (available and perceivable).

Darzentas, J.S. (2003) Design for All: Designing for Diversity in *Tales of the Disappearing Computer*, Kameas, A. & Streitz, N., (eds) CTI Press, Patras, Greece, pp. 165-176

(Vol.1: Section 3: Paper 25 and Vol.2: pp.385-395)

The relevance of this paper to the theme of Content Design belongs to my concern for more widespread education on accessibility and Design for All. The paper describes a classification scheme for the wide range of material relating to accessibility and Design for All issues so that this content can be more easily accessed and used by educators and learners.

This particular publication, published as a book chapter, was originally a conference paper given to an EU funded Future and Emerging Technologies (FET) group of researchers working on Ambient Intelligence concepts. The theme of the group was "The Disappearing Computer". It was part of a special session entitled: "Design Education in the Time of the Disappearing Computer". The paper describes the definition of the types of content, or categories of knowledge, that were a basis for curriculum recommendations in Design for All. This reflected work which was my direct responsibility within the EU funded IDCnet project[165]. In this paper, I emphasise those categories that are most relevant to those researchers in the FET community, while expressing the importance of all the categories for teaching aspects of Design for All.

The paper argues that as technologies are converging (for example wireless and sensor technologies for wearable computing) and pervasive computing was becoming a reality, it is the responsibility of 'technology insiders' to be aware that users have a wide spectrum of needs and desires. As front liners in developing applications of leading edge technologies, these researchers should try to avoid unwittingly erecting barriers. This paper puts the responsibility firmly on the technologists because their work is so new that it is hard for prospective users to imagine it. The paper suggests that they should try to find out about users needs and abilities, and not make assumptions.

The paper also argues that it was to the technologists' benefit to include all types of users, and points out that many aspects of current mainstream uses of technology are the result of designers being inspired by solutions to overcome disability, e.g. the vibrating alarm on mobile phones.

Within the taxonomy of core knowledge and skill sets for Design for All curriculum recommendations, there is a category called "New Paradigms of Interaction". This category describes work that is technologically 'state of the art', and often involves innovative ways of using technology. The paper notes that the qualification 'innovative' applies as much to the users as the technologies. As an example, I refer to a Norwegian study (Tollefsen, 2002) that showed that the blind found videophones a useful tool for independent living[166].

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[165] The aim of the Work Package 3, of which I was leader, was to "Identify knowledge sets and skills that should be part of a curriculum for DfA in ICT". IDCnet (Inclusive Design Curriculum network, IST-2001-38786. http://www.idcnet.info/home

[166] Unable to see the screen themselves, they could use the videophones to transmit pictures of, for instance, paper based mail, messages and menus on mobile phone

The paper points out that designs for innovative uses of future technologies that rely upon one mode of physical or sensory input/output, would by their very nature exclude people with disabilities or in 'disabling situations', e.g. only auditory output excludes people with hearing impairments, or people in noisy situations.

The paper generated quite some discussion with researchers admitting that they "designed for normal people first", and that they had little real knowledge about the abilities or capabilities of disabled people, or their responsibilities towards them. They expressed interest in finding out about how diverse user groups used present day technologies, confessing that they had "never really thought about it."

This was yet another occasion when it was demonstrated to me the very real need for accessible, usable and meaningful content on Design for All and ICT issues, and to take this content whenever possible out to groups other than those specialising on accessibility.

In terms of Content Design, this paper, and others on the same topic that were presented to varying audiences showed that outreach work could be better managed by creating a flexible set of materials that could be adapted to the target audience. In my case, I was able to make well informed assumptions about the audiences (designers and HCI researchers in Future and Emerging Technologies; database experts; a mixed audience at the EU ICT annual conferences, etc.).

For the written papers I was constrained by the format set by the conference organizers, and I did my best within these to address concerns that I felt would be uppermost in their minds, and where I felt they would see their responsibility. For example, with the paper described above I emphasized that this kind of future looking work often could not be tested with a range of users, because of its innovative nature, and that technologists needed to be aware that designs that are unimodal (e.g. currently the iPod) leaves out some user groups (those without manual dexterity, those who cannot see).

For the actual presentations, I used a variety of forms to convey content besides the expected slide projection, for instance visual aids like photographs and cartoons, or short (captioned) videos. While presenting the visual aids, I described them for people who were not able to see them (because of visual impairment; the location of their seat in the auditorium; or because they were remotely located and listening in to a teleconference system. In this way I hoped to demonstrate to the audiences how to "practice what we preach".

By these means, that is: changing the basic content to reflect the concerns of the audience; giving papers that were delivered in more than one channel (verbal and visual), I tried to design the content to be more accessible, usable and meaningful for my audiences, while the publications themselves have been tagged with keywords to act a

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screens, and even place themselves in front of the camera so that the sighted person they were communicating with could tell them if their appearance was as they wanted it to be (e.g. whether clothes match or are clean).

metadata for retrieval, not just on the subject of Design for All, but also on type of audience they address, in an endeavour to give some measure of cognitive usability.

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