Practice Theory & the Foundations of Digital Document Encoding

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ABSTRACT
Designing digital documents in complex, changing information environments presents a number of challenges for both academics and practitioners. In particular, a number of contradictory views about the nature of digital documents raise questions about what factors shape the task of document encoding. To date there have been few studies that explore the relationship between human document encoders and the documents they produce, where the process of documentation embedded in encoding is the focus. In this paper we argue that to support and improve the processes of digital document development it is essential that we gain a clearer understanding of context and the situated, inter-subjective nature of human engagement in documentary practice. We present a methodology for understanding such documentary practices, which considers digital representation through the lens of practice theory and presents a conceptual framework for understanding the complex and changing dimensions of document encoding that are challenging both research and practice.

Categories and Subject Descriptors
I.7.2 [Document preparation]: Markup Languages

General Terms
Documentation, Design, Human Factors, Standardization, Languages, Theory.

Keywords
Practice theory, documentary practice, methodology, information management.

1. INTRODUCTION
Designing digital documents in complex, and rapidly changing information environments is not without its challenges. Yet the cultural, social and organizational consequences associated with technological change and the way people are working with digital documents are now so widely discussed, in so many diverse fields of literature, that it is hard to agree with the occasional claim that digital document design remains unexamined or under-theorized [14]. Information managers often view digital documents pragmatically as objects that present a technological challenge for acquisition, storage, cataloging and dissemination to interested users [23][26][35]. However documents are far more than the simple containers of ‘contents’ for communication and it is hard to limit any discussion of the phenomenon to the traditional custodial roles of information management. Documents are a deeply embedded constituent element of human culture [3]. They serve evidential roles as records, they facilitate memory, they are acknowledged works of art, and increasingly they are presented as business products and commodities that add organizational value. On the Internet, documents are concomitant with technology: new information services are taking on documentary roles never anticipated and contributing to a social space that has captured the imagination of scholars, commentators and the public alike. In this space new dialogues are shaped and reshaped with rhetoric, even argument, embedded in the changing mediums and genres of our communication [30][34][43].

For the encoders of digital documents the design task is often presented with confusing messages. On the one hand, documents are just containers of data to be managed through metadata [40], while on the other hand they are the complex and knowledge intensive “...formal containers of ideational contents.” [16] As a result, it is often, not the technical activities of storage, management and retrieval, but the meaningful intention of documents that is being brought to task as different organizations approach the redesign and distribution of their information digitally [38]. What concerns us in this study is that document encoders with a primary motivation that is often simply to share information resources are also faced with the inherent complexity of the big picture, where questions of digital identity, authenticity, reliability, accuracy, verification and integrity are never too far away from this task [21].

Discussion of the activities traditionally associated with information management, documentation, librarianship and the organization of knowledge can now be found in widely different research and development projects; in a wide variety of research communities; and in a wide variety of professional publications [5]. There has also been significant research in areas close related to this study, particularly through socio-informatic studies of digital document systems and communicative genre analysis of document ecologies (both within organizations and on the World Wide Web). While genre analysis often presents a document focus, its emphasis tends towards the communicative roles of genres in terms of human interactions (through communication) and the activities that are mediated by documents [28][43][46]. In this study we have moved
the focus towards the encoded architecture of the information resource itself, to ask questions about the relationship between document and document encoder to improve our understanding of that practice. In the application of markup languages many of the traditional documentary problems associated with information management, through classification and the designation of meaning, have resurfaced and are being revisited or discovered anew in a context of digital design that was largely unanticipated. There is now a growing number of case studies presenting the experience of individuals involved in document encoding projects and a growing number of projects automating the analysis of tags embedded in sample populations of web documents being reported that, when brought together, give some understanding of the issues involved [9][45][47]. However, to date few studies have focused on exploring or understanding the activity of document encoding as it is being experienced by the human-encoders of documents. This study aims to explore these dimensions to develop an integrated and shared level of understanding of the practices of encoding digital documents. We argue that to understand and improve the processes of digital document design implicit here it is necessary to develop methodologies that will provide for a much richer understanding of encoding as a documentary practice.

Through the Markup Analysis Project (MAP) we have begun this work by looking at the well-established global, community of document encoders that have formed around the Text Encoding Initiative (TEI). The MAP investigates how digital encoding projects are arriving at an understanding of the digital document in situ, within this community of practitioners through their engagement with markup languages. 130 institutions around the world were invited to participate in this study; the response to the study and its objectives has been extremely favorable with a total of 32 participants from 12 countries taking part.

In this paper we set forth in greater detail:

- The nature of the problem and the need for a clearer understanding of documentary practice
- The role of practice theory in guiding the research project
- A conceptual framework to support the analysis of a differentiated practice
- The key elements of the research design and methods employed in this study

2. THE MARKUP ANALYSIS PROJECT

2.1 The Text Encoding Initiative

The TEI is an international endeavor to develop guidelines for the preparation and interchange of texts for scholarly communication. It presents a tag set (vocabulary expressed as XML) that utilizes the same ‘tag’ style popularized by HTML (<element-name>text</element-name>) to mark the internal structure and properties of documents for computer processing. The tag set provides over 400 named elements along with guidelines for their use [42]. The contents of documents are prepared using the tag set with the understanding that all compliant files are describing the same type of information in the same way. It is this standardization and uniformity in the preparation of files that provides the opportunity to implement sophisticated computer operations for the management of documents. Although TEI aims to provide descriptive elements for source texts of all descriptions, it is weighted towards the scholarly editing of works in the humanities. It is supported by a vital user community that continues to develop the markup language as a vocabulary adequate for academic, library and archival description of source materials. The relative maturity and stability of the tag set, which commenced as a Standard Generalized Markup Language (SGML) in 1987, has ensured it a position of familiarity that is attractive to a large number of projects and it has been widely adopted as the standard for the production of electronic versions of scholarly texts [42]. Importantly the TEI is observed by a much larger community of content developers and has been the model for other markup languages, including Extensible Business Reporting Language (XBRL) [16]. The key reason for selecting the TEI community is the maturity, flexibility and diversity of its vocabulary, which has been designed to structure very complex documents, making it a natural starting point for the investigation of documentary practices that are likely to extend across, and inform, other complex and semantically rich document domains, such as health and legal document communities.

2.2 The nature of the problem

Over the last 20 years there have been sporadic debates within the TEI community on the value of markup languages with implications that are far wider than might be expected. As with all markup languages the TEI assumes that there are general textual features of documents that are structural rather than simply presentational. The identification of these structural elements reveals deeper and more stable characteristics of a text than mere presentation can show. The advantage of markup languages in assigning ‘meaning’ to these structural elements, by bracketing data streams with tags that can be processed by computers, is widely acknowledged. Undertaking this task is often presented as though it is a simple case of indentifying the information present within the file and encoding it. Yet when a practitioner decides to represent information within a text by encoding some elements and not others, particular aspects of the document are being presented as though they are the document. There is an ontological question at the heart of this, that asks, ‘what is text, really?’ [31] Irrespective of the various realist and constructivist positions that have been taken around this question in the TEI community over the years, the debate itself is not superfluous to practice. It is engaging practitioners because there are some inherently complex philosophical issues that underlie the designation of meaning and the implementation of ‘ontology’.

With a development path that now extends over forty years, markup language technologies present an advanced toolkit for supporting and sharing information resources over computer networks. Yet at the same time there has been a growing amount of mostly anecdotal or subjective evidence suggesting that there are many difficulties in designing, implementing and utilizing markup technology to its full advantage [25]. Although there are guidelines, with strong community support in place for most vocabularies, it is increasingly apparent that simply providing organizations with the apparatus to construct digital objects does not resolve the issues that arise when designating the content of information in a document [13]. Problems arise as generalized community ‘standards’ and encoding rules are brought into local contexts, or applied to specific documents, and practitioners may be finding these hard to overcome [9]. The issues that surround content definition are certainly not limited to the TEI community, in a previous paper we reported on document design issues faced by the Australian Prudential Regulatory Authority in implementations of the Extensible Business Reporting Language (XBRL) for the communication of mandated reports [44]. Our paper joined a growing number of studies pressing the case for an
improved understanding of implementation issues faced in the adoption of markup languages [30]. There are also a growing number of case studies presenting the experience of individuals involved in document encoding projects, just as there is a growing number of studies counting the tags embedded in sample populations of web documents in a bid to gain a clearer understanding of the phenomenon [6][45][48]. These latter studies are particularly interesting for their capacity to analyze the properties of massive numbers of encoded documents by querying frequency of tag use; the depth of encoding, the relationship of tag use to document size; and the resulting structure of document trees. Automated approaches like these are likely to yield significant results, particularly in terms of developing tools to interact with encoded documents and the semantic web. However, it must be observed (as researchers undertaking the work have themselves remarked) that these studies do not address the questions that surround human decision-making in document encoding [45]. Put simply, these studies cannot address the complex, inter-subjective nature of human engagement in digital document projects. Yet the projects that have reported back through case studies over the past decade are often isolated, they are from disparate fields and advance our understanding of encoding work only slowly and in piecemeal fashion. At the moment it is hard to gain a clear understanding of practice beyond these isolated accounts of practitioners and indeed because of this, difficult to know just what questions to ask of practice.

When it comes to markup analysis it is tempting to think of, and focus on, isolated research issues. Questions about software design, requirements definition, implementation methodologies, standardization and classification, communities of practice, funding concerns, innovation and diffusion, are all relevant. But it is hard to know which of these issues are important questions in the field. Markup language vocabularies are variously, a community of users, a standard for representing information, a set of guidelines for implementation, an innovative technology project and, a large and growing corpus of encoded documents. There is also much that is, undoubtedly, going right in every project. Practitioners are after-all continuously advancing markup implementations. The difficulty is that much of the existing work has placed the experience gained from project to project well ahead of the identification and reporting of shared experiences, common methodologies or cohesive conventions that could be used to inform theory and improve document management in practice.

In this study we have sought to address these limitations by extending Dalstrom’s and Gunnarson’s call for a re-evaluation of the starting point in information management research to one that is document centric [14], focusing on the activity of document encoding itself. Rather than hypothesizing on the influences we have adopted a phenomenological flavor, preferring a view that brackets the outside world and seeks its answers from within the document communities and their practice.

3. DOCUMENTARY PRACTICE

3.1 On commentary in documentation

Integral to any understanding of information management is the importance of the material architecture designed to support the information resources. It is the way that information resources are structured, described and organized to satisfy the primary task of managing information that underlies much of our practice:

“…the description of documents, their contents, features and purposes, and the organization these descriptions so as to make these documents and their parts accessible to persons seeking them or the messages they contain. Knowledge organization encompasses every type and method of indexing, abstracting, cataloguing, classification, records management, bibliography, and the creation of textual or bibliographic databases for information retrieval.” [4]

We take this definition as encompassing markup languages where the description of documents is embedded inline with the data streams of content. Here then the primary concern of information management is a design question. It asks: “How can access to recorded information be made most rapid and effective? [5]”

Undertaking the task is premised on principles of meta-description that have been developed to ensure documentary evidence is preserved, stored, accessed and presented to users correctly. There is at the heart of this a paradigmatic ambition of professional objectivity. Yet it is wrong to assume that documents somehow present their own proper description and simply await the neutral hand of an encoder to reveal it. Documents are not so self-interpreting that they determine the best manner of their own encoding and description. These are human decisions bound by context and circumstance. Furthermore the underlying motivation of document description has always extended beyond custodial maintenance of artefacts to goals of authenticating, witnessing, verifying and presenting the context of information. Judgments, rhetoric, even arguments, are inherent in the documentation that supports information resources and information managers have always been aware of this subjective agency even while holding to principles of normative, objective description [24]. In, Towards a Politics of Text Encoding, Paul Caton has voiced concern about what he considers to be a falsely attributed and unspoken assumption about the neutrality of text encoding. He argues that the premise of normative encoding, “…is a signifying practice strongly implicated in a politically conservative humanist ideology [11].” In a similar vein Dahlstrom and Gunnarson contend that information managers have approached the task of document design too simply, “…as transparent and self evident, almost axiomatic starting points, offering little or no room for problematization or discussion [14].”

Document encoding is an activity in judging what should or should not be categorized. In this sense, we consider markup to be just one form of documentation that joins with a much wider tradition of commentary about documents, all of which make judgments about a document for a particular purpose [41].

There is intentionality within the determinations that information managers make about the content of a message that reflects their field of practice (the institutions, standards of evidence, forms of argument, intended audience). Markup languages present an opportunity to dissect, repackage and present information according to new priorities and the possibility of losing context during this has concerned other commentators [2]. While digital encoders have a wide variety of tools at their disposal for digital content creation and management, “the digital world is still insufficiently mature to have developed a framework for context capture and retention to be a routine part of digital object creation and management.” [2] The issue is how we go about refocusing our understanding of document centric processes and this can only be known through the empirical observation of practice itself. It is the embedded social context of a document in a descriptive practice that is central to our
understanding of what it truly means to take a document-centric view.

As a conceptual framework for this study we propose that the relationship between document and the documenter should be at the centre of documentary practice. In so doing, we are extending the focus of the central unit of analysis in document studies towards the activity of documenting.

3.2 Practice theory

Although explanations of practice theory diverge among different researchers there are a number of common elements framing practice theoretical approaches that have shaped the theory and methodology in this study that:

1. Gives priority to the array of activities that converge on the phenomena
2. Considers practice as being more than the routine and normative aspects of activity
3. Aligns with a social constructionist epistemology, emphasizing the relational idiom between people and artefacts
4. It is an interpretive approach to research
5. Presents practice as theory

For the practice theorist, understanding and meaning, are human aspects of being in the world in relation to an object. We cannot make representations without this foothold in reality [8][20]. There is at all times an emphasis on the relational idiom between people, artefacts and things that is discursive in its nature. It is this discursive relationship that allows practice to extend beyond the immediate performative aspects of routine because our activities are both meaning producing and practice generating.

Understanding the specific structures of a field of practice does require apprehending the material configurations of activity. It involves identifying, ordering and interpreting the commonalities, continuities and regularities that occur within a social group [8][37]. However practice theory also seeks to distinguish the ordering of a shared practice from routine and rule following by comprehending the meaning and intent evident in the task. This is achieved by describing the complex and dynamic relationships that take place between people and the artefacts as they interact in both physical and social dimensions [20].

Understanding documentary practice then, requires not only an understanding of documentation as an intentionial subjective and constitutive act, it also requires an understanding of where the document is situated in relation to the document encoder at different stages in a process of description, in different public and institutional contexts. Increasingly much of the literature surrounding documentation is prioritizing the need to understand the complex inter-subjective environment in which description takes place [15][18][27], however to date there have been very few studies investigating this activity. The practice orientation brought to this study asserts that the actual deliberations and decisions documentary communities make in adopting and applying a markup language are important to our understanding of digital document design.

3.3 Differentiating practice

The problems faced at this stage raise questions about the processes and material structures of document encoding to primary significance. There is a need to understand both the situations in which practice occurs and the impact those situations have on design choices. It requires being able to differentiate the factors that are most significant when considering all the human choices that influence the material definitions of documents. To date this has been difficult because very few frameworks have been presented to support the differentiation of all that is involved in document encoding and clearly such a typology is required [2] [15]. Two authors that have guided our work in this direction are Geoffrey Nunberg [27] and Bernd Frohman [18]. Both authors clearly demonstrate a practice where document encoders are engaged in a discursive relationship with the documents they encode: where the materiality of the document configure (and is configured by) practice; where institutional and organizational influences must be accounted for; where the social discipline of the particular documentary domain must be understood for the role it plays; and where the broader social and historical circumstances of the activity must be understood [18]. In this study we have worked from these broad parameters as a starting point with two central premises in mind:

1. That the methods applied for data collection and analysis must be able to account for the material form that document representation takes throughout the process of document design.
2. That the methods applied for data collection and analysis must be able to account for the discursive relationship between the material definition of the document and the social, organizational and individual circumstances of the encoder.

Put simply, a unified view of both document and document encoder is essential. The origins of the conceptual framework presented here are derived from an extensive review of relevant literature and informed from our understanding of the field. Most influential has been the International Federation of Library Associations (IFLA), entity relationship model of the Group 1 entity types for, Functional Requirements for Bibliographic Records (FRBR), (Figure 1) which has allowed us to develop a conceptual framework that we consider to be derived from practice itself.

4. A PRACTICE FRAMEWORK

4.1 Adapting FRBR

Our research presents the underlying heuristic of the Library Community’s Functional Requirements for Bibliographic Records (FRBR), Group 1 Entity Model (shown in figure 1 below) as a significant conceptual framework for advancing both research and practice in digital document projects [19].

For Librarians FRBR presents a model for understanding the information required to document information resources in their custody.
Sometimes paraphrased as WEMI the model presents: the ideational notion of a Work (e.g. a title or subject); its Expression (e.g. the languages it occurs in); its Manifestation (e.g. the various published editions it may occur in) and its Items (e.g. the details that locate a single physical instance of the work) as segmented information to record about a Work. Brought together the model presents a conceptual framework that encompasses the terminology, procedures, routines, and rules that go into the librarian’s practice of describing an intellectual work and all the forms it might take. It provides the steps in a process of transformation, from the abstract notion of a Work to its concrete form, so that a bibliographic record describing a Work and all its different versions (items) can be created. It is this last aspect of FRBR we consider to be most compelling.

FRBR is “a profound and influential model for intellectual content” [32]. It has informed a wide variety of projects ranging from initiatives in the development of ontology and vocabulary, to database implementations in libraries and museums [7][17][22][36]. Yet it is not without its difficulties. As an entity relationship model for the implementation of bibliographic databases it has often been criticized because the distinctions between each entity are not always clear and unambiguous. As a formal ontology of logical types the model presents even greater challenges that have been outlined in a series of papers by Allen Renear, David Dubin, et al. [32][33]. Despite these challenges FRBR has still made a significant impact on researchers considering its relevance to content development in ways that go beyond its original intent as a bibliographic record [1][32][33]. We contend that this is because FRBR is an extremely compelling conceptual framework for practice:

1. It is an empirically grounded approach to the description of intellectual material: The FRBR model describes a practice that has been in place for some time. It first appeared within formal guidelines for Library cataloguing at the Library of Congress in the 1960’s and has antecedents in both bibliographic and art history that go back further [12][23].

2. It is a documentary practice: FRBR does not model a Work, it models a record about a Work, determining what information needs to be recorded for the purposes of its management.

3. It is a sense-making framework: One of the greatest advantages of conceptual frameworks is that they “… facilitate understanding and manipulation of complex entities by rendering them less complex.” [12]. FRBR is being used to support people going about their work of organizing and creating representations of complex information sets. [39].

Most importantly, there is a process of transformation within FRBR, from very high levels of abstraction through to the definition of concrete objects, which allows relationships between conceptual states in content development to be distinguished, analyzed and evaluated for the purpose of deciding what should be documented. We think the reason FRBR is finding so much traction is because this process of transformation (from abstract to concrete) is universal in the definition of digital content. In our research we have postulated that an investigation of markup usage through identifiable conceptual states will help us to better understanding document encoding projects by supporting the distinctions of a differentiated practice along a pathway.

While the FRBR Group 1 model has informed our study, we have modified and adapted the underlying framework significantly, bringing to it our understanding of documentary practice. Although the terminology used by FRBR is similar, the conceptual states in the material definition of a document presented here (Type, Expression, Manifestation, Instantiation) should not be interpreted as a direct application of FRBR or as an entity model.

It should also be emphasized that the framework we have developed is not a hypothesis for testing. We have not used the model for content development, nor to make predictions about behavior in the documentary world. We have continued to take a practice theoretical approach to our work, and consider the conceptual framework presented below to be a sense-making device suitable for the task of differentiating practice.

4.2 Type, Expression, Manifestation, Instantiation

Figure 2: Conceptual Framework for Markup Analysis

We consider three primary levels of interaction in practice (figure 2 above) as document encoders engage in the process of defining and encoding digital documents; from abstract notions of a type of
document to concrete implementation: these levels are the Community level of interaction, the Organisational (Institutional) level of interaction and the Implementation level of Interaction.

Critically the unit of analysis identified for this study is always a relationship, between the document and document encoder, with the parameters of that relationship not simply set but comprising a complex of inter-subjective influences that interplay with the task of document encoding itself; that is between people and the artefacts they interact with.

In the model Type is the highest level of abstraction in the development of a document’s material structure. It can be thought of as an agreement, or at least, the intent of an agreement about the types of documents a community of interest requires to represent its information. It is ontological in the sense that it is presenting the properties, attributes, qualities and behaviors that meet the community’s documentary requirements. The ontology is often undefined until its schema is given a formal expression. An Expression is the agreed upon representation of a type. The Text Encoding Initiative has defined a schema for texts, but the same types of documents could be expressed differently, e.g. by using the DocBook schema. Expressions are the vocabulary and rules for defining a document type within an information systems domain. There can be as many functional states derived for a document as can be manifested from an expression. For example the encoded typescript of an author’s work can occur in many different states: facsimile, print, html display, pdf file format are some common examples that result from encoding. In markup language terminology the expression is prescribed by a document type definition (or schema file), along with guidelines and reference materials. Together type and expression represent a community’s endeavours towards the standardisation of their content domain.

Manifestation is the clarification of an expression for use in a local context. A manifestation does not assume the physical embodiment of a document. It is the rules or plans an organisation considers in the development of its own content. An organisation’s understanding is informed by the expression of a document type and is aligned to meet its local requirements and purpose. It is often influenced by other externalities, such as collaboration and funding. In this sense a manifestation is a local state model of a document type, or put another way, the realisation of a conceivable state. Organisations are usually encouraged to modify document rule files by changing, extending or reducing vocabularies and schemas (within the boundaries of standardisation) to suit their needs, and they often do this.

An Instantiation is the realisation of a local model (i.e. it is the physical embodiment of a document with inline markup). Although it results from the manifestation or local state model, it does not simply replicate the local model. Encoders usually apply only those components of the model necessary for the representation of an individual document and often make immediate choices in the activity of encoding that will vary one encoded work from another. Note, an Instantiation as it is considered here, is a single document, materially defined, but it is not the only possible occurrence of that document. It is the unit of information that has been popularised by XML proponents as the ‘multifunctional’ master document from which many different object instances, files and displays can be rendered.

5. RESEARCH DESIGN

Understanding documentary practice requires a view of practice that allows us to investigate digital documents as artefacts that are in the process of being materially defined while making sense of the complex interactions that influence that definition. By observing the use of a markup language and asking questions about the context of that use we have the opportunity to gain a clearer understanding of the characteristics of document encoding and an emerging field of practice in digital document design. Addressing the research objective of this study through the empirical observation of practice inevitably boils down to asking document encoders what is taking place in this process of transformation?

The conceptual framework set out in the preceding section allows us to structure our investigation at different levels of understanding in the material definition of a document from abstract and ideational notions of the documentary task through to the resulting artefacts. Most importantly it sets the parameters of investigation and allows for appropriate methods to be defined that address the research objectives.

Three interrelated data collection techniques have been adopted to support and triangulate an empirical observation that accounts for both sides of an encoding relationship (the documenter’s relationship to the document) that we consider essential to understanding the field of practice: (1) a questionnaire based survey of practitioners; (2) an in-depth automated analysis of encoded text batches supplied by practitioners (3) interviews with the practitioners.

We commenced data collection with a questionnaire to survey practitioners involved in the process of document markup. Data collected in the questionnaire is tabulated and grouped according to the three major categories we have derived from the framework; i.e. between (i) community objectives and their representation; (ii) organizational objectives and their manifestation; (iii) individual encoders and their implementation of the vocabulary. Approaching the data in this way allows us to group findings first at the highest level and then explore relationships to identify themes of significance in each category, as well as emergent, unexpected or incongruous themes. We next undertook an in-depth automated analysis of the markup occurring in the encoded texts to see what the documents themselves can tell us about the categories and themes we identified as significant from the questionnaire, looking in particular for a correspondence of relationships: e.g. if collaboration drives document encoding projects, does this result in uniform encoding among project partners? Are there other influences of greater significance (e.g. geographical location or genre)?

By taking this approach to thematic analysis we are engaging in a process of qualitative interpretation of markup usage to discover what it can tell us about this field of practice. We have also completed interviews with practitioners to deepen the survey and text analysis findings. The interviews have been transcribed and further thematic analysis is being undertaken to tell us how they inform and extend the themes we are identifying. Although a detailed discussion of the design and application of each survey method and the survey results is outside of the scope of this paper, Figure 3: Summary of Markup Usage Study presented above provides a summary of the approach taken.
6. CONCLUSIONS

Understanding the encoding of digital documents as a documentary practice is an important aspect of information design. To do this we have taken a practice view to research a phenomenon that requires both conceptual and analytical frameworks that enable us to investigate a discursive practice between document encoders, encoded documents and the organizational settings in which they are constructed. The differentiation of practice shown here will support the comprehension of document design across many complex environments allowing us to understand document encoding as part of a field of digital communications where many of our interactions are dependent on the interactions between computers and markup.

It is envisioned that over time, the development of conceptual frameworks and analytical procedures commenced in this study will contribute to:

- Managing changing standards for document description
- Comparing, synchronizing and merging different information sets
- Educating and training document designers in the application of markup based systems
- Supporting research specific to organizational content development and academic enquiry

7. REFERENCES

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