The role of metadata in managing knowledge

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The Role of Metadata in Managing Knowledge

by

Christina Apostolou

Doctoral Thesis

Submitted in partial fulfilment of the requirements
for the award of
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Abstract

Organisations make use of a variety of knowledge management systems (KMS) in order to facilitate the creation, storage, transfer and reuse of organisational knowledge. Metadata is used to describe knowledge by its attributes and to provide the context, quality, condition or other characteristics of knowledge assets. This thesis explores the way in which metadata is being used in KMS. It provides an analysis of the types of metadata used for the description of knowledge documents at the semantic level and complements other research on the evaluation of KMS by focusing on the use of metadata, adopting a user perspective.

The empirical work was carried out through case study research in two highly knowledge-intensive companies, a motorsport engineering company and a pharmaceutical company. Data collection tools included field visits, documentation, surveys and interviews.

The findings demonstrate the level of users' satisfaction with the KMS and metadata and their readiness to create metadata when contributing a knowledge document to the KMS. Demographic factors, such as gender, age, qualifications, and years working with the company, are analysed in conjunction with attitudes towards the KMS and metadata. The two metadata schemes used in each company are mapped semantically to the widely used Dublin Core Metadata Element Set (DCMI), in order to identify good practice in designing a metadata scheme for a KMS. From the mapping, the basis of a metadata framework is created, intended to be used as a checklist for the development of comprehensive metadata schemes for the description of knowledge documents. The metadata management processes of the two companies are analysed to propose guidelines for the development of a metadata management strategy.

Keywords: Metadata, Knowledge Management, KM, Knowledge Organisation, Knowledge Management Systems, KMS, Dublin Core Metadata Element Set, DCMI, Case Study
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Contents

List of Tables ............................................................................................................. viii
List of Figures ........................................................................................................... x
Chapter 1. Introduction ............................................................................................ 1
  1.1. Theoretical Framework .................................................................................... 2
  1.2. Aims and Objectives ........................................................................................ 3
    1.2.1. First Aim: The Role of Metadata in Managing Knowledge ............... 4
    1.2.2. Second Aim: Guidelines for the Creation of Metadata Scheme .......... 5
    1.2.3. Third Aim: Guidelines for Metadata Management ................................ 5
  1.3. Research Methods and Environment ............................................................ 6
  1.4. Thesis Outline .................................................................................................. 7
Chapter 2. Literature Review .................................................................................. 9
  2.1. Knowledge Management ............................................................................... 9
    2.1.1. Introduction to Knowledge Management ........................................... 9
    2.1.2. Aims and Benefits of Knowledge Management .................................... 14
    2.1.3. Knowledge Management Processes ................................................... 16
    2.1.4. Knowledge Organisation ....................................................................... 20
  2.2. Knowledge Management Systems ................................................................ 21
    2.2.1. Types of Knowledge Management Systems ........................................ 21
    2.2.1.1. Enterprise Search ........................................................................... 26
    2.2.1.2. Windows SharePoint Portal Services ............................................. 27
    2.2.2. Metrics and Evaluation of Knowledge Management ......................... 28
  2.3. Metadata .......................................................................................................... 31
    2.3.1. Introduction to Metadata ....................................................................... 31
    2.3.2. Two Main Schools of Thought for Metadata ........................................ 33
    2.3.3. Characteristics of Metadata .................................................................. 37
    2.3.4. Typology and Functions Served with Metadata ..................................... 38
    2.3.5. Standards and Standardisation ............................................................ 40
    2.3.5.1 Dublin Core Metadata Element Set ................................................ 41
    2.3.6. Return on Investment in Metadata ....................................................... 46
    2.3.7. Subject Metadata Used for Knowledge Organisation ........................... 48
  2.4. Metadata and Knowledge Management Systems ........................................ 49
    2.4.1. Case Studies on Metadata and Knowledge Management ................. 53
    2.4.2. Metadata Schemes Developed in Corporate Settings ............................ 55
  2.5. Knowledge Management in the Two Industries .......................................... 57
    2.5.1. Knowledge Management in the Motorsport Engineering Industry ..... 57
    2.5.2. Knowledge Management in the Pharmaceutical Industry ................... 61
  2.6. Summary ......................................................................................................... 64
Chapter 3. Methodology ......................................................................................... 65
  3.1. The Qualitative and Quantitative Approaches ............................................. 65
6.4. Metadata Management Strategy in the Two Companies
6.4.1. Metadata Creation
6.4.2. Metadata Types
6.4.3. Crosswalk Analysis of the Metadata Schemes
6.4.4. Interaction of the Data Management Model and the Bibliographic Control Model
6.5. Users' Attitude towards the KMS and Metadata
6.5.1. Attitude towards the KMS
6.5.2. Searching and Browsing
6.5.3. Attitude towards Metadata
6.6. Metadata Framework
6.6.1. Rationale and Objectives
6.6.2. Metadata Framework
6.7. Development of a Metadata Management Strategy
6.7.1. Rationale and Objectives
6.7.2. Metadata Management Strategy
6.8. Summary

Chapter 7. Conclusions
7.1 Summary of Findings
7.2. Contributions of the Research
7.3. Reflections and Lessons Learnt
7.4. Areas for Further Research
Bibliography
Appendices
Appendix A: Preliminary Questionnaire
Appendix B. Preliminary Questionnaire Design, Administration and Results
Appendix C. Questionnaire for the Users of Case Study A
Appendix D. Interview Schedule for the Users in Case Study A
Appendix E. Interview Schedule for the Information and Knowledge Managers in Case Study A
Appendix F: Recommendations Made for Company A
Appendix G: Thesaurus Developed for Company A
Appendix H: Questionnaire for the Users of the Case Study B
Appendix I: Interview Schedule for the Users in Case Study B
Appendix J: Interview Schedule for the Information and Knowledge Managers in Case Study B
Appendix K Recommendations Made for Company B
List of Tables

Table 1: Critical success factors for KMS success .......................................................... 30
Table 2: Major cataloguing codes and their underlying principles ........................... 35
Table 3: The 15 Dublin Core Metadata Elements ...................................................... 42
Table 4: DCMI recommended qualifiers ................................................................. 43
Table 5: Gantt chart of the racing car development .................................................. 59
Table 6: Coding Example ......................................................................................... 89
Table 7: Metadata Elements used Across Document Libraries .................................. 96
Table 8: “Document Category” Values ....................................................................... 96
Table 9: Subject Terms across site document libraries ............................................. 97
Table 10: Demographics of the respondents .............................................................. 100
Table 11: When did you first use SharePoint? ............................................................... 101
Table 12: How often do you use SharePoint? .............................................................. 101
Table 13: Cross-tabulation of the groups and their attitude towards the navigation and site structure ............................................................... 109
Table 14: Cross-tabulation of the groups and their attitude towards the folders’ structure ............................................................... 110
Table 15: Cross-tabulation of age and satisfaction with the search results ............... 115
Table 16: Cross-tabulation of qualifications and satisfaction with the search results .................................................................................................................................. 115
Table 17: Correlation of the variables “Frequency of use” and “Advanced search” ................... 116
Table 18: Correlation of the variables “Comfortable in searching” and “Access to information” .................................................................................................................................. 117
Table 19: Correlation of the variables “Less time” and “More easily” ......................... 117
Table 20: Correlation of the variables “Comfortable in searching” and “Useful to managing resources” .................................................................................................................................. 118
Table 21: Metadata Elements Used Across the Folders of ABC .............................. 144
Table 22: Demographics of the respondents .............................................................. 147
Table 23: When did you first use the ABC? ................................................................. 148
Table 24: How often do you use the ABC? ................................................................. 148
Table 25: Preferred option for information seeking .................................................... 150
Table 26: Cross-tabulation of gender and ease in filling-in the document properties ................................................................. 161
Table 27: Cross-tabulation of qualifications and preference for someone else filling-in the document properties ................................ ..................................... 162
Table 28: Cross-tabulation of years worked in Company B and accomplishing tasks more quickly ........................................ 162
Table 29: Cross-tabulation of years worked in Company B and accomplishing tasks more easily .................................................... 163
Table 30: Correlation of the variables “Comfortable in searching” and “Browse Infospaces”, “Navigate ABC” and “ABC Advanced Search” ............. 164
Table 31: Correlation of the variables “Satisfied with Results” and “Navigate ABC”, “ABC Basic Search”, “Basic AZ Search” and “Brand Basic Search” .................................................. 164
Table 32: Similarities and Differences between the Two Case Studies .......... 181
Table 33: KMS critical success factors in Company A and B ...................................................................... 185
Table 34: Types of metadata used in the two cases .............................................. 192
Table 35: Metadata mapping matrix of schemes used in Company A and B ........................................ 195
Table 36: Metadata mapping matrix of schemes used by Respondents 4, 5 and 6 ........................................ 196
Table 37: Metadata schemes from the literature ................................................................. 197
Table 38: Metadata mapping of all collected schemes ............................................. 201
Table 39: Non DCMI Elements potentially applicable across industries ........ 203
Table 40: Business-specific Metadata ................................................................. 204
Table 41: Metadata for the evaluation of knowledge documents ............... 212
Table 42: Metadata Framework ................................................................. 216
List of Figures

Figure 1: The knowledge management cycle ..................................................18
Figure 2: The aerodynamic parts life cycle ..............................................60
Figure 3: The drug development process, adapted from Kankhar 2006 ..........63
Figure 4: The data collection process ......................................................74
Figure 5: The data analysis process ..........................................................84
Figure 6: Simplified organisational chart of Company A ...............................92
Figure 7: For which purposes do you use SharePoint? ...............................101
Figure 8: I am comfortable in searching for the information or knowledge that I
need ........................................................................................................102
Figure 9: Most of the time, I manage to find the information that I am looking
for .........................................................................................................103
Figure 10: I prefer to browse for information .............................................103
Figure 11: I prefer to use the search engine ..............................................103
Figure 12: I prefer to use the advanced search ...........................................104
Figure 13: I find it easy to fill-in the metadata fields ..................................106
Figure 14: I find it time-consuming to fill-in the metadata fields ....................106
Figure 15: I think it is important to fill-in the metadata fields......................106
Figure 16: The documents found on SharePoint are accurate, up-to-date, reliable
and comprehensive ..............................................................................107
Figure 17: I am satisfied with the overall efficiency of SharePoint ................108
Figure 18: SharePoint is the first port of call when I am looking for documents
and/or information .................................................................................108
Figure 19: SharePoint has improved access to technical information ............108
Figure 20: SharePoint is a useful tool for managing our knowledge resources 111
Figure 21: I generally trust the content found in SharePoint ......................111
Figure 22: SharePoint is useful to exchange information with my colleagues 111
Figure 23: SharePoint is useful to share knowledge with my colleagues .......112
Figure 24: Simplified organisational chart of Company B ............................139
Figure 25: Information architecture in Company B ....................................142
Figure 26: For which purposes do you use the ABC? ...............................149
Figure 27: Preferred option for information seeking ...................................150
Figure 28: I am comfortable in searching for the information or knowledge that I need. ....................................................................................................... 151

Figure 29: Most of the time, I manage to find the information that I am looking for. ....................................................................................................... 151

Figure 30: It is important for me to search in the full text of the documents. ....................................................................................................... 152

Figure 31: I am satisfied with the results I am getting from my preferred search engine. ....................................................................................................... 152

Figure 32: I find it easy to fill-in the document properties. ....................................................................................................... 154

Figure 33: I find it time-consuming to fill-in the document properties. ....................................................................................................... 154

Figure 34: I think that it is important to fill-in the document properties. ....................................................................................................... 155

Figure 35: The documents found on the ABC are accurate, reliable, up-to-date and comprehensive. ....................................................................................................... 156

Figure 36: I am satisfied with the overall efficiency of the ABC. ....................................................................................................... 156

Figure 37: ABC is the first port of call when I am looking for documents and/or information. ....................................................................................................... 157

Figure 38: ABC has improved access to information. ....................................................................................................... 157

Figure 39: ABC is a useful tool for managing our knowledge resources. ....................................................................................................... 158

Figure 40: ABC is useful to store knowledge resources that are important for my colleagues. ....................................................................................................... 158

Figure 41: ABC is useful to exchange information with my colleagues. ....................................................................................................... 159

Figure 42: ABC is useful to share knowledge with my colleagues. ....................................................................................................... 159

Figure 43: Metadata management in Company B. ....................................................................................................... 189

Figure 44: Metadata management in Company A. ....................................................................................................... 190
Introduction

Chapter 1. Introduction

Knowledge management (KM) is a multidisciplinary field, where concepts of management science, computer science, organisational science, cognitive science, anthropology and sociology, among others, meet to form an extensive body of research and practice. Information science has also contributed to KM. The underlying goal of this research is to explore how information science influences KM practice.

Information science has developed extensively over the last three centuries and has strong theoretical foundations. It has been concerned with the concept of information and the ways in which information should be managed effectively in order to be easily accessible. Knowledge on the other hand, which is the focal point of KM, cannot be equated with information but is a very closely related concept. This thesis will not contribute to the ongoing debate of how information is different from knowledge; instead, it will, rather, focus on some of the common attributes of the two. Taking this into consideration, this research aims to explore whether some of the practices and the theoretical foundations developed from information science are applicable to KM and to what extent. More specifically, the research is focused on metadata (as it has been developed from information science) and how it is applied to KM as a tool for knowledge organisation.

Organisations make use of a variety of knowledge management systems (KMS) in order to facilitate the creation, storage, transfer and reuse of organisational knowledge. Metadata is used in KMS to describe knowledge by its attributes and to provide the context, quality, condition or other characteristics of knowledge assets.

This chapter introduces the research goals of the thesis. It begins by presenting the theoretical framework of the research, providing an overview of the current state of KM and metadata and why this research is useful. The aims and objectives are detailed and the research methods and environment are briefly discussed. An overview of how the thesis is structured, outlining the contents of each chapter is given at the end of this chapter.
Introduction

1.1. Theoretical Framework

This research is based on the information science concepts of information organisation through cataloguing (i.e. metadata) and indexing, their impact on information retrieval, and attempts to apply these in the process of KM. Metadata in this research is defined broadly as the necessary and structured data associated with either an information system or an information object for the purposes of description, administration, legal requirements, technical functionality, use and usage, and preservation (El-Sherbini & Klim 2004, pp.238-248).

Knowledge management includes those activities undertaken to facilitate the creation, capture, organisation, retrieval, sharing and dissemination of knowledge within an organisation (Dalkir 2005, p.3). The processes of knowledge capture, sharing and dissemination have attracted more interest and are studied to a greater extent than knowledge organisation and retrieval. Knowledge organisation refers to the actions that are necessary to provide access to the knowledge documents in a meaningful manner. It includes a number of activities, such as the codification or description and indexing of knowledge documents. The retrieval of knowledge documents is then possible, based on the infrastructure created during the stage of organisation (Smiraglia 2002, pp.330-349). How these two processes, knowledge organisation and retrieval, are exactly performed in large organisations is not well-documented. The majority of organisations rely on various kinds of information systems, i.e knowledge management systems, to execute these tasks in an automated way. Since these two processes are equally as important as the processes of knowledge capturing and sharing, they are the main processes under examination.

Information organisation is based on strong theoretical foundations and makes extensive use of metadata. On the contrary, the research undertaken so far on KM has not addressed the possible benefits of the systematic use of metadata for the organisation of knowledge. The use of metadata in this context has been addressed only from a technological perspective, at the level of knowledge mining or discovery. In this case, metadata is assigned to knowledge documents automatically by the tool used. These metadata schemes are underdeveloped and they have not addressed the needs of the user community in depth. As a result,
Introduction

the description of both the content and the context is very limited, causing major difficulties in the retrieval of knowledge documents. This practice reflects one of the schools of thought on metadata, the data management approach, with origins and major proponents in computer science. Examples of subject domains that have followed this approach to metadata include the geospatial, astronomical and statistical domains.

The other major school of thought on metadata is the bibliographic control approach, proposed and used in librarianship. Library practices such as cataloging, indexing, abstracting and classifying have been applied to large data sets for years. These practices are based upon agreed rules and codes that refer to the syntax, semantics and the structural form of the resource described. Examples of these are the Anglo American Cataloging Rules and the International Standards for Bibliographic Description. The major weakness of the metadata standards that librarianship has produced is that they focus only on the descriptive elements of the content. As a consequence, they do not have provisions for the description of context and have very limited administrative elements.

The goal of this research is to combine the strengths of the two schools of thought of metadata and expand the discussion to elements necessary for knowledge organisation for the purposes of KM practice.

The main contribution of this research is the exploration of KM practices related to metadata, especially in specific industries. Although KM has been studied and applied extensively in various industries, there was not any research undertaken on metadata and how it is being implemented in KMS. This research provides a detailed account of how metadata is being used and managed in two companies. Based on this, recommendations for good practice can be made and lessons learned.

1.2. Aims and Objectives

The aims and objectives of this research were prompted by both the lack of a metadata standard for KM and relevant guidance on how to develop and manage metadata in a KMS. With knowledge being different from information, it
Introduction

was necessary to explore whether more metadata and which metadata is needed to describe knowledge. This research had three aims.

1.2.1. First Aim: The Role of Metadata in Managing Knowledge

The first aim of this research was to examine the role of metadata in the organisation of knowledge for the purposes of KM. The specific objectives to support this aim were as follows:

1. To identify and document the metadata elements currently used for the description of content created in the process of KM.
2. To determine the perceived usefulness of metadata, in terms of retrieval efficiency and trust towards the system.
3. To analyse critically the metadata management strategy of the organisations studied.
4. To investigate the cost-effectiveness of the application of metadata, both human- and system-generated.
5. To explore the interaction of the data management model and the bibliographic control model of metadata and the potential of the two models in KM practice.

The first aim was developed due to the discovery of a lack of relevant literature. Although there are numerous publications on the use of KMS and user acceptance of them that mention the importance of good search engines and retrieval of knowledge documents, there were not many articles on the users' attitude towards metadata. Reports of KMS failing to retrieve relevant pieces of knowledge led to testing the assumption that metadata can facilitate the search capabilities of the KMS. With metadata being a costly investment, it was necessary to examine how metadata should be managed: which elements would be used, who would create metadata, which metadata would be produced automatically by the KMS and how metadata would be kept up-to-date and valid. Automated metadata presents significant advantages because it saves time and effort for the users of the system. On the other hand, it is not very reliable. The
Introduction

cost-effectiveness of metadata creation needs to be studied to provide an indication of how metadata should be created and to justify the investment to metadata. The two models of metadata provide a different perspective into which metadata elements will be used and who will create them.

1.2.2. Second Aim: Guidelines for the Creation of Metadata Scheme

Building on the findings of the first aim, the second aim was to propose a framework or guidelines for the creation of a comprehensive scheme, which would be composed of the necessary descriptive and administrative elements that would effectively describe knowledge in the context of an organisation’s memory. The specific objectives to support this aim were as follows:

6. To identify the elements that may be specific for the description of knowledge.
7. To map semantically the elements identified for the first objective to widely known and used metadata schemes.

The second aim was formed as a solution to the lack of a metadata standard for knowledge documents and for business environments. The understanding that each industry may have different requirements led to the proposal of a metadata framework, instead of a metadata scheme. The framework can provide sufficient guidance on the creation of metadata schemes, according to the needs of each organisation or industry. The comparison and cross-walk analysis of metadata schemes used in different sectors and industries showed which elements should be always present.

1.2.3. Third Aim: Guidelines for Metadata Management

A third aim was to propose a set of guidelines for efficient metadata management strategy. The proposed set of guidelines aims to cover all stages of
metadata management with the allocation of sufficient resources. This aim was supported mainly by the third objective above.

The third aim came as a result of taking a holistic approach to metadata. Even if an organisation develops an excellent metadata scheme, it will be of little value if it is not applied efficiently or managed according to the changing needs of the organisation. A clearly formatted, documented and communicated strategy for metadata is needed if metadata is to serve its purpose, i.e., to facilitate the retrieval and management of knowledge documents. The proposed set of guidelines aims to cover all stages of metadata management, i.e., scheme development, creation and update, with the allocation of sufficient resources.

1.3. Research Methods and Environment

This research followed a pragmatic approach, using elements of both the qualitative and the quantitative approaches. The qualitative approach was suitable because in-depth contextual information was critical in understanding how each organisation organises its knowledge documents and why it has developed its practice. However, the user satisfaction part of the research was conducted following a quantitative approach because it allows the collection of data from a larger population. As a result, this data reflects more accurately the attitudes of a larger number of employees towards the KMS and metadata.

The need to collect extensive and in-depth data meant that case studies were the most appropriate method of research. In contrast to surveys, where only a relatively small amount of data is collected from each case, a case study enables the collection of large amounts of information and across a wide range of dimensions (Neuman 2003, pp.33-35). In addition, the intention was to study naturally occurring social situations, instead of created cases, as is common in experimental research. It was also suitable because the aim was to explore an area where not much research has been done. More specifically, a multiple-case design was required to provide some indication of the possibility for generalisation of the findings (Yin 2003, pp.46-53). For purposes of data triangulation, each case study was carried out through site visits and examination of the KMS, documentation, a survey and in-depth interviews.
Introduction

The research was undertaken within two highly knowledge-intensive organisations with active KM programmes. This helped to understand how real organisations use KMS and metadata and the problems they encounter. The two organisations were a motorsport engineering company and a pharmaceutical company.

Company A is a well-established motorsport engineering company with a long and successful history. Knowledge creation and sharing play a significant role in maintaining its competitiveness and ability to win races. It is based in the UK and has approximately 500 employees. It was an exciting opportunity to work with them because this sector is characterised by secrecy and not many studies have been undertaken in the past with similar organisations. Being a very fast-paced organisation, this case study provided interesting insights and implications for KM and KMS.

Company B is one of the leading global pharmaceutical companies, strongly engaged in the research, development, manufacture and marketing of medicines. It is a multinational company with over 12,000 R&D staff and its broad range of products is available across the world. Having so many employees and being active on a global basis, Case Study B presented different needs for KM and KMS. Thus, the comparison of the two case studies was particularly challenging and interesting.

1.4. Thesis Outline

This thesis comprises seven chapters. The second chapter is the literature review. It introduces the topics of knowledge management, knowledge management systems and metadata. Relevant research and case studies are presented to define the focus of the present research. The motorsport engineering and the pharmaceutical industries are briefly presented in order to identify the characteristics that define them as knowledge-intensive industries. The literature review also highlights some of the gaps in the existing research that are addressed in this thesis.

The third chapter consists of the methodology. It presents the method selected to carry out this research. The rationale for selecting the pragmatic
Introduction

A research paradigm is presented, after critically discussing the positivist and interpretivist paradigms. Then, the selection of case study as the research method is justified and the process of selecting organisations as case studies is outlined. Last, the data collection tools are presented and the data analysis process is explained.

Chapter Four and Five describe the case studies undertaken with the collaboration of the motorsport engineering company and the pharmaceutical company. They provide a short background description of the two companies and the description and analysis of the data collected. The structure of the two chapters was kept as similar as possible to enable the comparison of the results. Some of the findings presented in these two chapters have been also presented to an international audience. They were written up in Apostolou et al. (2007).

Chapter Six compares the findings from the two case studies. It presents the proposed framework for the creation of a comprehensive metadata scheme and a set of guidelines for efficient metadata management strategy.

The final chapter summarises the research contained within the thesis and relates the findings back to the aims and objectives in Chapter One. It presents the contribution of this research in the field of metadata and KM. Reflections on the research process and suggestions for further research are also included.
Chapter 2. Literature Review

This chapter introduces the topics of knowledge management, knowledge management systems and metadata. A thorough literature review was conducted with the aim of exploring the role of metadata in KM and how it is used in KMS. Relevant research and case studies are presented to define the focus of the present research. In the last sections of this chapter the motorsport engineering and the pharmaceutical industries are introduced in order to identify the characteristics that define them as knowledge-intensive industries.

2.1. Knowledge Management

Knowledge is widely recognised as a valuable commodity and therefore the ability of organisations to manage it effectively has become increasingly important in the knowledge economy (Abell & Oxbrow 2001, p.4). The creation and diffusion of knowledge within an organisation have become important factors in its competitiveness. This development has created “a strong need for a deliberate and systematic approach to cultivating and sharing an organisation’s knowledge” (Dalkir 2005, p.2).

An extensive number of studies have been conducted on KM and a new industry of services and information systems has been developed. The following sections provide an overview of KM and KMS.

2.1.1. Introduction to Knowledge Management

Knowledge management was presented as a new approach at the beginning of the 1990s, though it is mostly a compilation of theories and techniques that already existed in other fields. It is multidisciplinary and draws, among others, from management science, communications theory, organisational dynamics and learning, computer science, psychology, and information
Literature Review

management. Many KM practitioners and scholars have defined the term in different ways based on their organisational needs and research objectives. For example:

Some put more emphasis on people and organisational learning.

"The effective learning processes associated with exploration, exploitation and sharing of human knowledge (tacit and explicit) that uses appropriate technology and cultural environments to enhance an organisation's intellectual capital and performance."

(Jashapara 2004, p.4)

Others focus on processes, methods and techniques.

"Knowledge management can be defined as a method to simplify and improve the process of sharing, distributing, creating, capturing and understanding knowledge in a company. Knowledge management is description, organization, sharing and development of knowledge in a firm. Knowledge management is managing knowledge-intensive activities in a company."

(Gottschalk 2005, p 1)

Some focus on managing knowledge assets:

"An emerging set of strategies and approaches to create, safeguard, and put to use a wide range of knowledge assets (e.g. people and information). Thus, these assets flow to the right people at the right time so that they can be applied to create more value to the enterprise."

(Hasanah 2004, p 57)

Last, some follow a holistic approach and see it as an initiative across the entire organisation:

"Knowledge management is the deliberate and systematic coordination of an organisation's people, technology, processes, and organizational structure in order to add value through reuse and innovation. This coordination is achieved through creating, sharing,
and applying knowledge as well as through feeding the valuable lessons learned and best practices into corporate memory in order to foster continued organizational learning."

(Dalkir 2005, p 3)

Definitions from the previous decade put more emphasis on the control and management of knowledge and the achievement of business benefits from it. Being a new concept, KM, there was a strong need to showcase the benefits from it and to justify the investment. Earlier definitions of KM include:

"KM is the process of capturing a company’s collective expertise wherever it resides - in databases, on paper, or in people’s heads - and distributing it to wherever it can help produce the biggest payoff."

(Hibbard 1997)

"KM is the explicit control and management of knowledge within an organization aimed at achieving the company's objectives."

(van der Spek 1997, p 43)

"The overall purpose of KM is to maximize the enterprise's knowledge-related effectiveness and returns from its knowledge assets and to renew them constantly."

(Wug 1997, p.2)

Some scholars have tried to define three generations of KM (for example Carter & Scarbrough 2001, pp.215-224; Snowden 2002, pp 100-111; McElroy 2003; Metaxiotis, Ergazakis & Psarras 2005, pp.7-8, Dalkir 2005, pp.18-19) The first generation of KM took a technology-oriented approach with the development of robust KMS to consolidate the various intranets, databases and other sources of information and knowledge. Many initiatives focused on defining KM and investigating the potential benefits for businesses, as shown in the previous definitions. The second generation was signposted by a shift of interest and focus to more human aspects of KM, such as collaboration and
learning. It was emphasised that KM is about systemic organisational change where management practices, measurement systems, tools and content management needed to be co-developed.

A few years ago, a new, third generation of KM emerged with new methods and results. According to Wlig (2002), “One difference from the earlier KM generations is the degree to which the third generation is integrated with the enterprise’s philosophy, strategy, goals, practices, systems and procedures and how it becomes part of each employee’s daily work-life and motivation.” The third generation of KM

“brought about an awareness of the importance of shared context: how to describe and organize content so that intended end users are aware it exists and can easily access and apply this content... This phase is characterized by the advent of metadata to describe the content in addition to the format of the content, content management, and knowledge taxonomies” (Dalkir 2005, p.19).

The time limits of each generation cannot be easily defined; each study of the generations offers different timelines. It is also very interesting to note that the KM practitioners and the academic community are working at a different pace. Whereas the academic community now focuses their study on human aspects of KM, the impact of Web 2.0 and how it integrates with employee’s daily work life, KM practitioners apply KM to their organisations based on the resources and needs of the organisations. Thus, in organisations where KM was not applied before and they only start to use KMS, it may seem that they still work based on the technology-driven theory of the first generation. In other organisations, where KM processes and systems have been consolidated through many years of work, KM practitioners are able to experiment with new theories and drive the KM debate forward.

The underlying goal of KM is to use the knowledge embedded in the organisation to maximise its effectiveness and competitiveness. It presents a holistic approach to manage both explicit and tacit knowledge according to the business processes and aims and objectives of the strategic plan. Explicit knowledge is knowledge that can be expressed formally and therefore can be
Literature Review

easily communicated or diffused. It can be object based, i.e. when it is codified in strings of symbols (e.g. words, formulae), or rule based, i.e. when it is codified into rules, routines, or standard operating procedures. Tacit knowledge is the implicit knowledge used by organisational members to perform their work and to make sense of their worlds. It is uncodified and difficult to diffuse (Zack 1999, p.46). It is hard to verbalise, because it is expressed through action based skills and cannot be reduced to rules and recipes. It is learned through extended periods of experiencing and doing a task (Choo 1998, pp.111-112).

Some of the characteristics of knowledge that are important for the purposes of KM are.

- Knowledge is a human act.
- Knowledge is the residue of thinking.
- Knowledge is created in the present moment.
- Knowledge belongs to communities.
- Knowledge circulates through communities in many ways.
- New knowledge is created at the boundaries of old, (McDermott 1999).

In their attempt to define knowledge and KM, the majority of scholars have made a clear distinction between data, information and knowledge (for example Davenport & Prusak 2000, pp.2-6; Rollett 2003, pp 5-6, Jashapara 2004, pp.9-11; Dalkir 2005, p.7; Rowley 2007, pp 163-180, Martin 2008, p.386-387). The criteria suggested to distinguish knowledge from information and data include temporal sequence (knowledge is based on information, which in turn is based on data), the role of structure, context and interpretation (knowledge is structured, contextualised and interpreted information), value (knowledge is more valuable than information and data) and the potential of action (knowledge, unlike information, can be directly acted upon). In summary:

- Data is directly observable or verifiable; a fact.
- Information represents analysed data
- Knowledge is actionable information.

This hierarchy is furthered by some with the notions of wisdom and truth to complete the continuum of human thinking (Lebowitz 1999a, p.5).

These definitions of data, information and knowledge are over simplified and too broad to offer much guidance in practice. This has led to a discussion on the distinction between information and explicit knowledge. The documents
stored in a KMS occasioned a debate about whether they include solely information or explicit knowledge, i.e. knowledge that has been externalised. It is possible that documents include knowledge in the sense that some documents are the products of thinking and knowing, such as, for example, a product drawing. For the purposes of this research, these documents will be defined in section 2 1.3 as knowledge documents.

2.1.2. Aims and Benefits of Knowledge Management

One of the underlying goals of KM is to use the knowledge embedded in the organisation to maximise its effectiveness and competitiveness. It is important to note that it has to take a three-tier approach and be applied in three levels within an organisation, in order to be effective: the individual (taking a human aspect of sharing and having knowledge, thus facilitating personal KM), the group or community (focusing on the social aspect of sharing knowledge) and the organisation itself (following a systematic approach to KM) (Dalkir 2005, p.3) In this way individual learning will become organisational learning and vice-versa. Intellectual assets need to flow from individual to individual, within the members of a community and then back to the organisation itself in order to constitute the organisational memory.

Following this three-tier approach, benefits from managing knowledge can be identified for the individual employees, the communities of practice and the organisations.

For the individuals, KM:
- Helps them to do their jobs and save time through better decision making and problem solving;
- Builds a sense of community bonds within the organisation,
- Helps them to keep up to date; and
- Provides challenges and opportunities to contribute.

For the community of practice, KM:
- Develops professional skills;
- Promotes peer-to-peer mentoring;
- Facilitates more effective networking and collaboration;
Literature Review

- Develops a professional code of ethics that members can follow; and
- Develops a common language.

For the organisation, KM:
- Helps drive strategy,
- Solves problems quickly;
- Diffuses best practices;
- Improves knowledge embedded in products and services;
- Cross-fertilises ideas and increases opportunities for innovation;
- Enables organisations to stay ahead of the competition better; and
- Builds organisational memory (Dalkir 2005, p 20).

In addition to the above, KM helps organisations to achieve shorter new product development cycles, reduce the impact of employee turnover and to increase user confidence in data, information and knowledge documents. Thus, it allows organisations to improve decision-making, process efficiency, product and service quality, productivity, employee and customer satisfaction, and cost reduction (Wig 1999, pp.3-1; Jennex et al. 2007, pp.193-200c).

Emphasis should be put on the benefits to individuals. If the individuals are not able to see the value of knowledge sharing or indeed any other KM activity and do not contribute to the organisational memory through collaboration and collective effort, then it is highly unlikely that there will be great benefits for the communities or the organisation as a whole. For KM to be beneficial for both individuals and communities and the organisation, it is understood that the organisation needs to embed KM practices in the already given tasks of the individuals. Knowledge sharing should not be a task on top of their job, but part of their work habits and ethics.

It is obvious that the above mentioned benefits of KM are intangible and thus very difficult to measure. In the early years, when KM was introduced as a new project, possibly with set up costs of KMS, there was a greater need to calculate the effect of managing knowledge in monetary value. When KM was integrated in the organisation’s goals, systems and processes, it became clearer and accepted that the benefits could not be directly measured. Nevertheless, its impact should be evaluated.
2.1.3. Knowledge Management Processes

Knowledge management can be viewed as a broad collection of organisational practices, such as knowledge creation, capture, organisation, sharing and application, with the aim to provide the right knowledge to the right people at the right time through a compilation of processes, technologies and tools. Some key challenges for KM are to manage content effectively, facilitate collaboration and help the organisation to learn and make decisions based on complete and valid data, information, and knowledge (Dalkir 2005, p.20). The KM cycle includes the following processes:

- Knowledge creation at an organisation level can happen in various ways, such as the product knowledge coming out of an R&D department, or process knowledge originating anywhere in the organisation during everyday work and accidentally (Rollett 2003, p 45). The most frequently cited framework for knowledge creation is the one by Nonaka and Takeuchi (1995) They define knowledge creation as the result of a social process between individuals involving the interaction of tacit and explicit knowledge. The knowledge spiral describes the evolution of explicit and tacit knowledge within an organisation and suggests that creating new knowledge in an organisation can be managed as a process.

- Knowledge capture aims to identify and record high quality knowledge from internal and external resources. It is very important for purposes of knowledge continuity, i.e. retaining knowledge from exiting employees. It is debatable which knowledge is worth capturing and how this can be done “The focus can be on selectively capturing only knowledge of particular value to the company” (Rollett 2003, p 60).

- Knowledge organisation puts knowledge into a form that makes it accessible to those who need it. It will be examined more extensively in the next section.

- Knowledge sharing happens ad hoc as individuals and groups of people communicate, exchange information and mutually influence each other’s views. Spontaneous, unstructured knowledge sharing is vital to an organisation’s success (Davenport & Prusak 2000, p.89).
Literature Review

- Knowledge application is the final step in the cycle, when knowledge that has been captured, organised, and shared is put to actual use. If this step is not accomplished successfully, all of the KM efforts will have been in vain (Dalkir 2005, p.145).

It has to be noted though, that not all scholars agree with this life cycle. There is no clear consensus among the scholars and practitioners on the existence of a specific stage of knowledge organisation in the KM life cycle or KM frameworks. Apostolou and Mentzas (1999, p.130) have distinguished four groups of frameworks: those that focus on knowledge generation, those that focus on knowledge processes, those that focus on technology, and those that are “holistic”. The first group puts emphasis on the generation of new knowledge within organisations. An example of this is the Nonaka and Takeuchi framework. The vast majority of the existing frameworks, however, focus on the knowledge processes that are taking place during the knowledge life-cycle, such as the APQC framework, developed by Arthur Andersen and the American Productivity and Quality Center, which depicts the knowledge life-cycle within organisations and identifies the key enablers that support it (Holsapple & Joshi 1999). The third category is the frameworks that put emphasis on technology and the last is the “holistic” frameworks that emphasise the interdisciplinary nature of KM in the sense that they explicitly, and with equal weight, include technology, processes, organisational structures and cultural issues. It is usually the holistic frameworks that include the process of knowledge organisation.

Liebowitz (1999b, p 37), for example, identifies eight processes of a KM framework. The fourth is the storage, or the representation of corporate memory in knowledge repositories with various knowledge schemes. In general, it is common in the literature, when describing a KM framework, to include the process of organising knowledge (Lee & Hong 2002, pp17-26, Lytras et al. 2002, pp.40-52; Maier 2002, Rollett 2003). Literature usually refers to knowledge description and classification, but rarely reaches to the point of using metadata to describe and organise knowledge. However, classification is based on the description of the content, which is an element commonly found in metadata schemes, as will be discussed in more detail in Section 2.3.7.

Knowledge management processes do not happen in a linear way (Figure 1), but run in parallel (Martin 2008, p.391). The borders, especially between
knowledge creation, sharing and application, cannot be strictly defined as they happen *ad hoc*. Nevertheless, knowledge capture and organisation are supporting processes and need to be developed and managed.

![The knowledge management cycle](image)

**Figure 1: The knowledge management cycle**

Emphasis on either knowledge capture or knowledge sharing dictates a different KM strategy. Organisations that tend to stress knowledge capture are said to be following a codification strategy (Hansen et al. 1999, pp.106-116). Codification focuses on making tacit knowledge explicit and available to multiple recipients. The basic idea behind the codification strategy is to focus on the efficient reuse of knowledge by making it independent of particular individuals, i.e. connecting people to documents (Rollett 2003, p.41). “The key knowledge is too valuable to be held by one person; it must be replicated to the extent possible so that the absence or loss of a key knowledge holder will not impair the performance of the team” (Reay 2000, p.25). Context - temporal, spatial, cultural and social - is an important consideration in codifying knowledge (Cowan et al. 1997, p.225). Davenport and Prusak (2000, pp.68-69) identify that the primary difficulty in codifying knowledge is the codification of knowledge without losing its distinctive properties and turning it into less vibrant information or data. They further set the basic principles of knowledge codification:
Literature Review

1. Managers must decide what business goals the codified knowledge will serve.

2. Managers must be able to identify knowledge existing in various forms appropriate to reaching those goals.

3. Knowledge managers must evaluate knowledge for usefulness and appropriateness for codification.

4. Codifiers must identify an appropriate medium for codification and distribution.

Codifying all corporate knowledge would be a very expensive and time-consuming, i.e. a futile undertaking, therefore clear business goals are necessary, in order to be able to distinguish which knowledge resources need to be codified and in what form and medium. The kind of knowledge, such as rich and intuitive tacit knowledge or rules-based explicit knowledge, as well as the users' needs are the critical factors to determine the medium for codification and distribution. On the other hand, emphasising knowledge sharing, i.e. the personalisation strategy, focuses on dialogue between people, i.e. building networks of people and dialogue between individuals, connecting people to people (Rollett 2003, p.41). Both of these approaches may be part of core KM, although many organisations emphasise one or the other (Hansen et al. 1999). The size and the business of the organisation largely determine the KM strategy followed.

Irrespective of the KM strategy that the organisation has opted to favour, i.e. personalisation or codification (Hansen et al. 1999), knowledge documents need to be managed effectively so that their retrieval is then possible, based on the infrastructure created during the stage of organisation. Arif et al. (2005, p.10) define knowledge documents as those that contain the specific knowledge that the organisation uses to create unique value for its customers in the form of products and services. These documents can be the actual products of the organisation, especially in the case of knowledge-intensive firms, such as product drawings, workflows and process instructions. They can also be the products of the knowledge capture and codification process, such as best practices and lessons learned. All these would need to be managed effectively in order to be at every employee's disposal.
2.1.4. Knowledge Organisation

Knowledge organisation refers to the actions that are necessary to provide access to the knowledge documents in a meaningful manner. It includes a number of activities, such as abstracting and summarising, indexing and describing the knowledge documents (Gottschalk 2005). Apostolou and Mentzas (1999, p 132) also include the interpretation, analysis, codification, aggregation, filtering, synthesising, packaging, archiving, and linking of knowledge to its context. They emphasise that, after knowledge has been acquired or created, it must be carefully organised and preserved. Knowledge management systems or tools, including knowledge repositories, navigational devices, user interfaces, and taxonomies, must be designed to facilitate this process. A critical task is continually refreshing the material, by deleting and adding information to retain its currency.

Knowledge organisation is a very important process in the KM cycle because “for knowledge to be useful and accessible, it must be organised” (Wiig 1993, p 106). The main purpose for knowledge organisation is to facilitate knowledge retrieval, i.e. “to increase the efficiency and effectiveness of retrieving knowledge when it is needed: to find only relevant knowledge and to find all relevant knowledge” (Rollett 2003, p.69). It should be more extensively studied and strategically managed at the corporate level because it facilitates and supports knowledge creation and sharing. Knowledge creation and sharing can and does happen ad hoc; but it is more efficient when a company's knowledge and experience is captured, organised, and easily accessed (Lindvall et al. 2003, p 137). Then, employees can refer to and use knowledge resources as a springboard to create further knowledge and be innovative. They can also distribute and access resources geographically dispersed and without time limitations.

Beyond retrieval, knowledge organisation is important for managing knowledge in general. It facilitates the identification of knowledge gaps through knowledge audits and the development of measurements for KMS. Thus, Lambe (2007, p.3) concludes that “knowledge organisation is a fundamental precondition for managing knowledge effectively.”
Literature Review

A detailed user needs analysis investigating which knowledge and which functionality users will need to accomplish knowledge tasks is the first step to successful knowledge organisation. How knowledge organisation is performed in large organisations is not well-documented. The majority of organisations rely on various kinds of information systems, i.e. knowledge management systems to execute these tasks automatically.

2.2. Knowledge Management Systems

The proliferation of the available information and knowledge within an organisation has been driven by the rapid technological advances in the domain of IT, with information technology adopting a supportive role in most KM programmes. It is reported that knowledge workers tend to suffer from information overload with direct implications for the quality of their work (Edmunds & Morris 2000, pp 17-28) According to results of a recent Accenture survey, "middle managers spend more than a quarter of their time searching for information necessary to their jobs, and when they do find it, it is often wrong" (Hatter & Trapasso 2007) Large organisations are choosing to employ advanced technological solutions to solve this issue. Knowledge in the context of KMS is perceived to constitute a new form of information not previously addressed in other systems such as Management of Information Systems, Decision Support Systems, and Executive Information Systems (Alavi & Leidner 1999, p.23).

2.2.1. Types of Knowledge Management Systems

As early as the first generation of KM applied in organisations robust information systems were implemented as a means of solving the issues of information and knowledge sharing and storing. Organisations acknowledged that they hold significant knowledge documents for their operations' and company's success. Information systems evolved over the years and an emerging line of systems, which targets professional and managerial activities by focusing on creating, gathering, organising, and disseminating an organisation's
Literature Review

knowledge, as opposed to information or data, was produced. These systems are referred to as Knowledge Management Systems (KMS) (Alavi & Leidner 1999, p.3).

Early KMS were very similar to content or document management systems mainly because organisations lacked systems that would organise and store their vast amounts of information and knowledge. With the shift of focus to more human aspects of KM, such as collaboration and learning, KMS integrated more features to facilitate knowledge sharing, communication and collaboration, such as bulletin boards and discussion forums. At present, KMS provide the necessary infrastructure for organisations to implement most of the KM processes and they have appeared in various forms and formats in different industries. Benbya et al (2004, p.204) classified KMS in four categories:

- Content management tools: Tools that offer abilities to integrate, classify, and codify knowledge from various sources.
- Knowledge sharing tools: Tools that support sharing knowledge between people or other agents.
- Knowledge search and retrieval systems. Systems that enable search and retrieval and have some knowledge discovery abilities, also known as enterprise search. They will be further discussed later in the section.
- General KMS: Systems that propose an overall solution for a company’s KM needs.

Gutierrez-Segura et al. (2004) classified KMS in four slightly different categories of tools; they identified tools that:

- Manage explicit knowledge.
- Formalise capturing and analysis of knowledge.
- Exchange knowledge (unstructured knowledge and collaborative work).
- Help create new knowledge.

The classification that Benbya et al. proposed takes as a starting point the components and functionality that KMS offer, whereas the classification of Gutierrez-Segura et al. focused on the desired outcome of the use of KMS. Thus the two classifications are not contradictory but work in a complementary manner. Jasmuddin (2005, pp.27-32) argued that if knowledge is not stored or transmitted, it has limited value. Therefore, a general KMS that supports all KM functions is preferable. Knowledge must be easy to be shared across the
organisation, it must be organised and stored properly so as to be easy to retrieve and it must be managed in such a way that it will be of high quality and ready to be used again as a foundation for new knowledge. As a result, users of KMS should be able to find the right quantity and quality of information and knowledge, determine the relevance of information and knowledge and understand its context and find the same information and knowledge from multiple starting points. In addition, they should be able to trust the authority of information and knowledge and find out who else has relevant knowledge.

To achieve the above, Chua (2004, pp.87-98) proposed a three-tiered KMS architecture, which identifies three distinct services supported by KM technologies.

- Infrastructure services include the basic technology platform and features needed to implement KM. The two main infrastructure services provided by technology are storage and communication.

- Knowledge services are intended to help achieve the goals of KM directly. The three primary goals are to promote the process of generating new knowledge, encourage the flow of knowledge among organisation members and ensure the ease of access to knowledge repositories. The underlying knowledge processes of these three KM goals are knowledge creation, knowledge sharing and knowledge reuse.

- Presentation services are primarily concerned with enhancing the interface between the user and the information/knowledge sources. Two common features of presentation services are personalisation and visualisation.

Organisations have the option to acquire an off-the-shelf product or develop an in-house solution. A major issue concerning off-the-shelf products is whether organisations want to follow the practices embedded within the software. In addition, these products sometimes provide more generalised results as every organisation has different knowledge domains, specialisations and needs. As a result, heavy customisation is necessary to address the organisation’s needs. In-house solutions on the other hand, are usually more costly. Buckman (2004, pp.76-78) believes that software and systems developed in-house rarely provide the payback necessary to justify the expenditures of time and money they require. Some criteria for the selection of a KMS are knowledge modality,
Literature Review

which determines the depth and accuracy needed, and knowledge longevity and maintenance. Chalmeta and Grangel (2008, pp.742-755) proposed a methodology for the development of a KMS in an organisation in order “to successfully carry out a KMS development and implementation project, while at the same time reducing the degree of complexity.” The general methodology is divided into five phases:

- Analysis and identification of the target knowledge
- Extraction of the target knowledge
- Classification and representation
- Processing and storage
- Utilisation and continuous improvement

This methodology involves defining the tasks to be performed, the techniques to be used, the modelling languages for representing the knowledge and the technological infrastructure that allows knowledge to be stored, processed, and distributed, depending on the roles that have been defined.

Examples of KMS are intranets, knowledge portals, knowledge repositories and groupware or other collaboration software products. Groupware applications are being adopted by organisations to improve collaboration and knowledge sharing. Groupware systems include email, electronic bulletin boards, and group support systems (Artoli 2006, p 551). The positive implications of the use of a KMS for knowledge sharing include the creation and maintenance of knowledge bases, which lead to the efficient and effective access and usage of the knowledge stored, as well as the facilitation of communication and establishment of acquaintances between remote community members (Evangelou & Karacapildis 2005, p.257). Online and both asynchronous and synchronous communication, eliminating the requirement for users to work at the same place or at the same time, is usually provided by such systems. This flexibility becomes increasingly important in the way modern organisations work (Coakes 2006, pp.579-593).

Recently, the term KM 2.0, following Web 2.0, was introduced to note the use of Web 2.0 applications for the purposes of KM. Web 2.0 has been used largely metaphorically to suggest a major software upgrade to the World Wide Web, promising a more powerful, more engaging and more interactive user experience (Tredinnick 2006, pp.228-229). The applications that have been
Literature Review

associated with Web 2.0 are mainly blogs, wikis and RSS. Blogs offer a simplified way of publishing to the web, wikis are tools to enable collaborative authoring and RSS provides a means for users to keep track of updates in specific websites. Web 2.0 is also associated with new approaches to organising information, such as folksonomies and social bookmarking. Folksonomies are the classifications that emerge when users bookmark or tag information for their own ends. The main difference between folksonomies and taxonomies, as presented in Section 2.3.7, is that folksonomies present a bottom-up approach to developing the classification whereas taxonomies are a top-down effort. Most of these applications are incorporated in KMS and used by organisations to facilitate communication, collaboration and knowledge sharing. In particular, blogs are being used for customer communications, tracking, reporting, project management, web content management and promotion of new services and products. Wikis are used for facilitating collaboration between business units, distributing materials related to meetings, supporting brain-storming sessions and developing presentations in collaborative mode (Sinclair 2007, p 257). A possible drawback is that these applications encourage knowledge sharing but they put less emphasis on the management of that knowledge. As a result, there is a growing need for organisations to devote time and resources in order to understand what is critical knowledge and how it can be retained and disseminated. Federated search facilities, which would be able to retrieve relevant content from all these applications, are becoming increasingly important.

Most systems that are being used for the purposes of KM tend to focus on codified or explicit knowledge and use metadata to describe the knowledge assets. What metadata is being created is not always fully known, because every vendor uses its own scheme and it may vary in the product implementation and customisation as well. What is known is that the metadata most commonly seen in KMS is that which organises knowledge by subject matter.
Literature Review

2.2.1.1. Enterprise Search

Enterprise search is the term commonly used for knowledge search and retrieval systems used in private portals to search for company information. The major challenge for enterprise search is the federated search, i.e., the indexing of documents from a variety of sources such as KMS, email, internal databases and external websites and databases, and their presentation in a consolidated list of relevance ranked documents from these various sources. There are many technologies used in enterprise search, such as parametric search, which uses the metadata that users assigned to knowledge documents to execute precise queries. Faceted search can present the search results in clusters and allow the user to further refine the search results using the facets.

Most KMS have a built-in search facility. Acquiring an additional search engine for a KMS is a complex task. Wallace (2008) presented a six-step process to successfully implement an enterprise search.

1. Understand business needs (this includes user interviews to understand what kind of information they are looking for, the time pressures etc)
2. Set the information landscape (repositories, metadata, compliance, policies, volume and quality of data)
3. Map tender requirements (according to the case definitions from the users' interviews, how relevance will be calculated, how results should be presented)
4. Identify candidate products (factors that should be taken into account are the integration with other platforms, requirements, cost, experience and support from the developer)
5. Assured delivery (successful implementation requires successful delivery, business and technical resources, test, prototyping, measurement of effectiveness, governance and stakeholders' buy in)
6. Plan for the long term (analyse how well it works, maintain user engagement)
Literature Review

2.2.1.2. Windows SharePoint Portal Services

This section presents one of the most common KMS. Windows SharePoint Portal Services (or MOSS) is a component of Microsoft Windows Server that enables a customised corporate intranet to be created that allows for multiple levels of secure access and a high level of functionality across a range of applications in KM and collaboration (Microsoft Windows SharePoint Services 3.0 2008).

It offers document storage and retrieval with check-in and check-out functionality, version history, custom metadata, and customisable views. Besides the common document management functions, it can work as a groupware and collaboration package in the sense that it can store event calendars, contacts, web links, discussions, issues lists and announcements, and the user can set up individual alerts for the areas that are of interest to him/her. Users have the ability to create sites, to control site membership, to monitor site usage directly, and to moderate content submissions. It also enables the administrator to track which sites are created, who owns them, and how long a site has not been used.

Programs in the Microsoft Office System, including Microsoft Office Word, Microsoft Office Excel, Microsoft Office PowerPoint, and Microsoft Office OneNote, are seamlessly integrated with SharePoint. With Microsoft Office Outlook, users can view calendars and contact lists stored on SharePoint sites and can create and manage sites devoted to editing documents and organising meetings (Dowler 2003).

SharePoint Portal Server’s search facility works in two different ways. First, there is the full text search. This searches across all of the text in every document that is in the index. Second, there is the property (or metadata) search. During the indexing process, the IFILTERs, which extract the text out of the documents, put property information into special property buckets that are kept separate in the index so they can be searched separately. This allows users to set properties in documents, such as department, project number, author, keywords, etc., and then have the ability to search on those fields individually (Bogue 2005).

SharePoint is currently being used as a platform for KMS by a large number of organisations. It facilitates KM because it offers document
management, collaboration and search features. A great advantage of this platform is that, with only minor customisations, the out-of-the-box solution provides the basic features and functions needed for a collaborative community, including membership directories, threaded discussions, document repositories, photo galleries, online surveys and links to relevant external Web sites (Rushton & Hanley 2005, p.218). When advanced customisation is required, additional applications can be used on top of SharePoint to add functionality. On the other hand, it is not very user friendly or intuitive and searching for a particular document or library on a SharePoint site can be problematic.

2.2.2. Metrics and Evaluation of Knowledge Management Systems

Organisations have experienced difficulties in effectively using KMS. Literature reports that KMS may be successful and help the organisation to leverage its knowledge or they may fail to deliver effective services (for example: Malhotra 2003, pp.87-112; Stenmark 2003, pp. 207-216; Chua & Lam 2005, pp 6-17).

A number of factors and variables have been reported to determine the diffusion of KMS in organisations and the reasons for their success or failure. The most significant factors are top management support, organisational culture, expectations from the KMS and benefits to individuals. The last one is perhaps the most important for the success of the diffusion of a KMS, as individuals will not accept KMS as an integral part of their daily routine if they cannot identify clear benefits in using it. Like any information system, its success lies in its effective use. Table 1, adapted from Jennex and Olfman (2005, p.39), summarises these factors.
### Literature Review

<table>
<thead>
<tr>
<th>Critical success factors</th>
<th>Related literature</th>
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<tr>
<td>A knowledge strategy that identifies users, sources, processes, storage strategy, knowledge and links to knowledge for the KMS</td>
<td>Calabrese &amp; Orlando 2006&lt;br&gt;Akhavan et al. 2006&lt;br&gt;Jennex &amp; Olfman 2005&lt;br&gt;Barnard &amp; van Beuningen 2004&lt;br&gt;Yu et al. 2004&lt;br&gt;Holsapple &amp; Joshi 2000&lt;br&gt;Sage &amp; Rouse 1999</td>
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Literature Review

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<tr>
<th>Critical success factors</th>
<th>Related literature</th>
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</thead>
</table>
| Information systems, including content, capabilities, user interfaces, level of difficulty and how they fit with the work environment | Chalmeta & Grangé 2008  
Nevo & Chan 2007  
Calabrese & Orlando 2006  
Copper 2006  
Akhavan et al. 2006  
Qian & Bock 2005  
Jennex & Olfman 2005  
Chua & Lam 2005  
Yu et al. 2004  
Cross & Baird 2000  
Alavi & Leidner 1999  
Sage & Rouse 1999  
Davenport, DeLong & Beers 1998 |
| Measures to assess the impact of the KMS and the use of knowledge | Calabrese & Orlando 2006  
Cooper 2006  
Akhavan et al. 2006  
Chua & Lam 2005  
Alavi & Leidner 1999  
Sage & Rouse 1999  
Davenport, DeLong & Beers 1998 |

Table 1: Critical success factors for KMS success

It is important to try to develop metrics to assess benefits of KMS in order to be able to improve its use and efficiency. Brown et al. (2005, p.50) argue that both quantitative and qualitative measures are needed to address the multiple and varied stakeholder needs and concerns. System level measures include number of downloads, number of users, number of contributions and searches. Additionally, socio-organisational objectives should be addressed in the evaluation process. It is also important to know that different stakeholder groups are interested in various aspects of KMS evaluation. Brown et al. (2005, p.54) have highlighted that different information is important for each group of stakeholders.

- Executive management is interested in how well the organisation is using technology to work effectively and support education and learning; how it compares in the marketplace; how much technology support costs relative to what it provides in terms of benefits.
- KMS management is interested in how well the KMS supports the users and how KMS processes, technologies and content can be improved.
Literature Review

- KMS users are interested in how the KMS can be improved and how much the content they have contributed is being used.

The development of meaningful metrics for measuring the value, quality and quantity of knowledge is a key factor for long-term success and growth of KMS. To this end, KM initiatives should be directly linked to explicit and important aspects of organisational performance. In other words, organisations need to find leverage points where enhanced knowledge can add value, and then develop a KMS to deliver the required knowledge.

2.3. Metadata

Metadata describes the content, quality, condition, and other characteristics of other data or information (El-Sherbini & Klim 2004, p 239). In other words it provides further information about the object it describes. The terms meta-information and meta-knowledge have also been used (for example in Tiwana 2002, p 84, Maier 2002, p.195), with very similar meaning to put emphasis on the description of information and knowledge documents respectively.

2.3.1. Introduction to Metadata

There are a number of definitions for metadata One that summarises the key points of most of these definitions is the following. “Metadata is structured information that describes, explains, locates, or otherwise makes it easier to retrieve, use, or manage an information resource” (Hodge & National Information Standards Organization 2004, p.1). Since metadata is a broad term, it covers many types of structured “data about data”, i.e. from traditional resources such as library catalogues, subject indexes, and abstracts, to new forms of technical and descriptive data for Web resources ranging from digital signatures and digitised map co-ordinates to online mail-order catalogues.

Haynes (2004, p.1) characterises metadata as “an enabler of the information systems that underpin the knowledge economy, e-commerce and e-
Literature Review

government.” It is a key component of information systems, as metadata is produced in every phase of the life of an information object in a digital environment. According to Gilliland-Swetland (1998, p. 8), during the phase of “Creation and multi-versioning”, objects enter a digital information system by being created digitally or by being converted into digital format, and some administrative and descriptive metadata may be included by the creator of the object. In the next phase, “Organization”, objects are automatically or manually organised into the structure of the information system and additional metadata for those objects may be created through the registration, cataloguing, and indexing processes. Stored and distributed objects are subject to search and retrieval by the system’s users. The computer system during this phase, which can be named “Search and retrieval”, creates metadata that tracks retrieval algorithms, user transactions, and system effectiveness in storage and retrieval. “Utilization” of the information objects can be recorded by metadata related to user annotations, rights tracking, and version control. In the last phase, “Preservation and disposition”, information objects undergo processes such as refreshing, migration, and integrity checking to ensure their continued availability. Information objects that are inactive or no longer necessary may be discarded. Metadata may document both preservation and disposition activities.

The main purpose of metadata is to act as a tool for the organisation and effective management of information objects, which may include data, information or knowledge. In general, information objects, regardless of the physical or intellectual form they take, have three features: content, context, and structure; all of which can be reflected through metadata:

- Content relates to what the object contains or is about, and is intrinsic to an information object.
- Context indicates the “who”, “what”, “why”, “where” and “how” aspects associated with the object’s creation and is extrinsic to an information object.
- Structure relates to the formal set of associations within or among individual information objects and can be intrinsic or extrinsic (Gilliland-Swetland 1998, p. 1)

By providing this kind of information about an object, metadata can then be seen as a surrogate of this object. From the viewpoint of the user, metadata
Literature Review

enables the user to find a resource; to decide whether or not it is of value to them; to discover where, when and by whom it was created, as well as for what purpose; to know what tools will be needed to manipulate the resource; and to determine whether or not they will actually be allowed access to the resource itself (Miller 2004, p.4).

2.3.2. Two Main Schools of Thought for Metadata

The first use of the notion of metadata can be traced back to antiquity appearing in the earliest libraries (Chan 1994, p.6), while Eden (2002, p.6) argues that its purpose and meaning have been around as long as humankind. More formal approaches to create metadata systematically were made in the subsequent centuries with the development of cataloging codes and rules for specific collections or libraries by librarians, with the codes developed by Sir Anthony Panizzi and Charles Ammi Cutter being the most important (Gorman & Oddy 1998, p.159). In the twentieth century, cataloging codes became more elaborate, usually prepared by a professional committee. A milestone in cataloging was the publication of the Anglo-American Cataloguing Rules, Second Edition (AACR2) in 1978 (Taylor 2004, p.59). By that time, a very structured metadata scheme had been developed and bibliographic principles had been established. This scheme and its principles, as well as the fact that metadata had been created by an authoritative source, i.e. a library or cataloging agency, enhanced trust in and authority of traditional metadata. AACR2 became the international standard for most descriptive attributes of a publication; in other words it became the standard for bibliographic description. Table 2 presents the major cataloging codes in the English language and the bibliographic principles that are evident in them. In the case of subject description, which some might argue is the most problematic area of metadata, there is less agreement on the appropriate controlled vocabularies, thesauri and list of subject terms.
<table>
<thead>
<tr>
<th>Date</th>
<th>Person or Body Responsible</th>
<th>Title</th>
<th>Contents and Underlying Bibliographic Principles</th>
</tr>
</thead>
<tbody>
<tr>
<td>1841</td>
<td>Sir Anthony Panizzi</td>
<td>&quot;Rules for the Compilation of the Catalogue&quot; – &quot;91 Rules&quot;</td>
<td>- Objectives of the catalogue</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- description</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td>1850</td>
<td>Charles C. Jewett</td>
<td>&quot;On the Construction of Catalogs&quot;</td>
<td>- description</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- subject entries</td>
</tr>
<tr>
<td>1876</td>
<td>Charles A. Cutter</td>
<td>&quot;Rules for a Printed Dictionary Catalog&quot;</td>
<td>- objectives of the catalogue</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- description</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- corporate authorship</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- subject entries</td>
</tr>
<tr>
<td>1908</td>
<td>American Library Association (ALA), Library Association (LA)</td>
<td>&quot;Cataloguing Rules, Author and Title Entries&quot;</td>
<td>- description</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
<tr>
<td>1941</td>
<td>ALA</td>
<td>&quot;Catalog Rules, Author and Title Entries&quot;</td>
<td>- description</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
<tr>
<td>1949</td>
<td>ALA</td>
<td>&quot;ALA Cataloguing Rules for Author and Title Entries&quot;</td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- description of non-book materials</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- name authority</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- uniform headings for works</td>
</tr>
</tbody>
</table>
The first published use of the word “metadata” in the sense of “data about data” may have been in the first edition of NASA’s Directory Interchange Format Manual published in 1988. Ever since, the term has been used extensively in the sense of the information necessary to make computer files useful to humans, mostly by communities involved with the management and interoperability of geospatial data, data management and systems design. For these communities, metadata referred to a suite of industry or disciplinary standards as well as additional internal and external documentation and other data necessary for the identification, representation, interoperability, technical management, performance, and use of data contained in an information system (Gulishand-Swetland 1998, p.1). One of the first specifications to call itself metadata was the Federal Geographic Data Committee’s Content Standard for Digital Geospatial Metadata, version 1, which was issued in 1994 (Caplan 2003, p.1)
The proliferation of the Web with its search engines resulted in the limited use of metadata and made "free text" searching the norm (Ding 2005, p 219), although it has significant limitations. Web search engines make limited use of metadata, since the majority of Web documents are not structured or described with it. Instead, search engines use algorithms, which are popularity and affinity based and context driven. They are very powerful tools to automatically index a vast amount of Web documents and retrieve a known item or Web site. However, when searching for a topic, the user has normally to browse several Web pages to find what he/she was looking for because Web search engines do not allow for very precise queries. Normally Web search engines have a high level of recall, but a very low level of precision. It has to be kept in mind that they have been designed as such, in order to respond to specific qualities of the Web and the Web documents, which usually have insufficient structure, stability and organisation. There are studies, though, that show that the use of metadata in Web sites could improve the precision of information retrieved by search engines (Kobayashi & Takeda 2001, p.155, Zhang & Dumtroff 2004, p 318) Metadata come again to the fore with the discussion on the semantic web. In addition, metadata are being used in specialised search engines to provide better search functionality.

Traditional metadata needed to be adapted for Web-based and other digital information, as it has been always driven by the technologies available (Hyatt 2003, p 3). Library science and related communities adapted their metadata schemes to efficiently describe digital resources. The term metadata was widely adopted with the creation of the Dublin Core Metadata Element Set (Caplan 2003, p 2) At the beginning of the twenty-first century there are two main approaches to metadata that have emerged from library science and computer science respectively: bibliographic control and data management (Burnett et al. 1999, pp.1209-1217) The bibliographic control approach is focused on developing information systems to organise and provide access to large collections of information-bearing entities. It is criticised as expensive and too elaborate. The data management approach is concerned mainly with the technical aspects of metadata, such as data security, data sharing and data integrity. During the process of adjusting and exploring, these two approaches are moving closer to one another.
Literature Review

2.3.3. Characteristics of Metadata

There is no single international standard for metadata, but many community-specific standards and other schemes that have become the *de facto* standards within the domain that are being used. All these exhibit different characteristics and attributes.

Metadata can come from two sources: the internal metadata generated by the creating agent for an information object at the time when it is first created or digitised and the external metadata that is created later, often by someone other than the object creator. Further, there are two main methods for metadata creation. The first is the manual metadata created by humans and the second is the automatic metadata generated by software (Gilliland-Swetland, 1998, p.6).

The nature of metadata varies also. One approach is to use elaborate and specialised schemes, such as Machine-Readable Cataloging (MARC), which is the most commonly used scheme in libraries across the world. This requires time, money and qualified staff and will probably only be used on a small, choice selection of valuable and stable resources. The other approach is to create a simple scheme, such as Dublin Core (Section 2.3.5.1), that could be used by the author of a document to create a bibliographic record. The controversy created by having the author of the resources create the metadata instead of a trained cataloguer is still unresolved. Massive numbers of electronic resources that need metadata led to the conclusion that some metadata can be created by authors, while trained librarians can evaluate and enhance some of these records. Trained cataloguers could provide an invaluable service when specific analysis of a collection is required (El-Sherbini & Klim 2004, p.241).

Some of the metadata types are meant to be read by humans, while others are designed to be processed directly by computers. Metadata can be embedded in a digital object or it can be stored separately. It is often embedded in HTML documents and in the headers of image files. Storing metadata with the object it describes ensures the metadata will not be lost, obviates problems of linking between data and metadata, and helps ensure that the metadata and object will be updated together. However, it is impossible to embed metadata in some types of objects, for example, in artefacts. Also, storing metadata separately can simplify the management of the metadata itself and facilitate search and retrieval.
Therefore, metadata is commonly stored in a database system and linked to the objects described (Hodge & National Information Standards Organization 2004, p.1). Further, according to Burnett et al. (1999, p.1215), metadata elements may be roughly divided into two categories: intrinsic, i.e. those that are related to resource identification and discovery, and extrinsic, i.e. those that are related to administration and other non-bibliographic data.

According to their status, metadata can be static or dynamic, long-term or short-term. Static metadata are those that remain as they have been created, because they provide unchanged characteristics of the information object, whereas dynamic metadata change with use or manipulation of the information object, to document all the changes made on the object. Long-term metadata are necessary to ensure that the object continues to be accessible and useable. Short-term metadata on the other hand, are mainly of a transactional nature and therefore are important for shorter periods of time (Gililand-Sweitland, 1998, p.6).

Metadata types range in their structure from simple formats to rich and complex formats. They can be unstructured data that do not conform to a predictable structure or set of rules. These metadata can be automatically extracted from resources and indexed for use by robot-based services. They can follow structured formats, which are simple enough to be created by non-specialist users. In this case metadata is normally manually created, but some data may be extracted automatically. An example of that is the Dublin Core Element Set, whose main purpose was to be simple enough, so as to be used by the information object's creator. They can conform to structured formats, i.e. have a predictable and standardised structure. These are normally rich and complex, with the aim to organise complex relations between objects or collections of objects. Examples include MARC and TEI headers (El-Sherbini & Klim 2004, p.241).

2.3.4. Typology and Functions Served with Metadata

No single type or scheme of metadata can suit every application, every type of resource, and every community of users. Rather the broad diversity of
Literature Review

potential metadata needs can best be met by a multiplicity of separate but functionally focused metadata schemes. Despite that, it is prevalent in the literature that different metadata serve common functions. Therefore, various authors conclude with a similar typology of metadata, according to the functions they serve.

The typology proposed by many authors (Gilliland-Swetland 1998, p.3; Eden 2002, p 10; Caplan 2003, p.3-5; Haynes 2004, p.14; Taylor 2004, pp.147-152) is the following:

- Descriptive: Metadata describes a resource for the purposes of discovery and identification of relevant information. Typical examples of descriptive metadata are the title, keywords or abstract of a source. It serves the same functions in resource discovery as cataloguing does by:
  - allowing resources to be found by relevant criteria;
  - identifying resources;
  - bringing similar resources together;
  - distinguishing dissimilar resources; and

- Structural: This refers to the structure and relationships of a set of digital resources. It is important because the structure of an information object is an indicator of that object’s meaning. An example is how the paragraphs, pages and illustrations are structured within a resource. In addition, it can describe relationships between resources, such as the relationship between a report and an executive summary written in a different language.

- Administrative: This provides information to help manage a resource, such as when and how it was created, its file type and who can access it.

- Technical: This is related to how a system functions and how metadata behave. It may include the hardware and software documentation and authentication and security data.

- Rights management: This deals with intellectual property rights. It may include a note stating whether the content can be used outside the borders of the organisation or not.
Literature Review

- Preservation: This contains information needed to archive and preserve a resource, such as data refreshing and migration.
- Use: This is related to the level and type of use of information resources. Beyond use and user tracking, it may contain, for example, information on content re-use and multiple versions of it.

According to Schottlaender (2003, p 22), the number of metadata types and categories are proliferating as the resources, which metadata are intended to manage, proliferate as well. Besides these broad categories, other types of metadata are mentioned, serving such functions as security, personal information, commercial management and content rating. The extent to which any particular metadata scheme incorporates elements to address all the previous named functions varies depending on the needs of the community responsible for its development and the age of the metadata scheme, that is, whether the metadata format is newly developed or based upon an existing structure (Vellucci 1998, p.192)

2.3.5. Standards and Standardisation

The large number of metadata schemes developed has led to the attempt to achieve interoperability between various metadata standards. Interoperability is the main reason for creating a standard in the first place. Therefore, standards have been proposed that enable the communication between metadata. If metadata is data about data, meta-metadata is data about metadata. Meta-metadata allows metadata schemes to map or crosswalk with one another, supporting interoperability and intersystem translation (Koehler 2002, pp 22-27). But, meta-metadata schemes are not “perfect” when mapping from one system to another and information is frequently lost in the translation.

To avoid losing information, metadata schemes need to be created according to a standard. Currently, there is no metadata standard for metadata used in corporate settings. Each industry and organisation has specific needs based on unique types of documents, management styles, corporate cultures and archiving practices (Obershaw 2002, p.28). Thus, they are so different from each other that it is impossible to standardise the metadata used. In addition, there is
Literature Review

no strong need for commercial organisations to have interoperable information systems. “Except where there is a business or regulatory requirement to share information, the private sector has little interest in interoperability with repositories outside their organisation. Most applications that seek to gather metadata into databases so that document-like content can be found and re-used when needed, occur behind the firewall” (CWA 15247)

For the private sector, standardisation and interoperability would be beneficial in two instances. Firstly, a company may develop or acquire more than one information system, which at some point would need to communicate. Having a common metadata scheme will make this communication more efficient. Secondly, it is common in some industries that companies need to work closely together with their suppliers or business partners and exchange data and information. Interoperability between the information systems of the two companies would facilitate greatly the collaboration.

The next section describes one metadata scheme that has achieved standard status, the Dublin Core Metadata Element Set. Although it was developed as a generic scheme, it has been recognised as a standard and there are groups promoting its application in the corporate sector.

2.3.5.1. Dublin Core Metadata Element Set

The Dublin Core Metadata Element Set grew out of a workshop sponsored by the Online Computer Library Center (OCLC) and the National Center for Supercomputing Applications in 1995. Now it is managed by an international board of trustees, but most of the direction and maintenance of the standard has been led by the OCLC in Dublin, Ohio. It is intended to be a basic collection of metadata elements, a lingua franca for metadata. It was created as an international set of elements from an interdisciplinary consensus about what are the most basic and necessary elements to support successful resource discovery. DC was originally conceived for use by content creators, but interest has become widespread among specialised resource description groups, such as museums and libraries. It has been used extensively for describing internet resources and various projects (Zhang et al. 2003, pp.129-135) It is described as
Literature Review

an efficient and simple metadata for electronic articles and digital objects (El-Sherbini 2001, pp.238-248; Taylor 1999, p 87)

In contrast to MARC, which contains numerous fields and subfields, the DC contains just 15 metadata elements in three groups, content, intellectual property and instantiation. Table 3 presents these elements.

<table>
<thead>
<tr>
<th>Identifier</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Content</td>
<td></td>
</tr>
<tr>
<td>Title</td>
<td>A name given to the resource.</td>
</tr>
<tr>
<td>Subject</td>
<td>The topic of the content of the resource.</td>
</tr>
<tr>
<td>Description</td>
<td>An account of the content of the resource</td>
</tr>
<tr>
<td>Source</td>
<td>A reference to a resource from which the present resource is derived.</td>
</tr>
<tr>
<td>Language</td>
<td>A language of the intellectual content of the resource</td>
</tr>
<tr>
<td>Relation</td>
<td>A reference to a related resource.</td>
</tr>
<tr>
<td>Coverage</td>
<td>The spatial locations and temporal duration's characteristic of the resource.</td>
</tr>
<tr>
<td>B. Intellectual Property</td>
<td></td>
</tr>
<tr>
<td>Creator</td>
<td>The person(s) primarily responsible for the intellectual content of the resource.</td>
</tr>
<tr>
<td>Publisher</td>
<td>The agent or agency responsible for making the resource available.</td>
</tr>
<tr>
<td>Contributor</td>
<td>The person(s), such as editors and transcribers, who have made other significant intellectual contributions to the work.</td>
</tr>
<tr>
<td>Rights</td>
<td>A rights management statement, an identifier that links to a rights management statement, or an identifier that links to a service providing information about rights management of the resource.</td>
</tr>
<tr>
<td>C. Instantiation</td>
<td></td>
</tr>
<tr>
<td>Date</td>
<td>A date associated with an event in the life cycle of the resource.</td>
</tr>
<tr>
<td>Type</td>
<td>The genre of the content of the resource, such as novel, poem, or dictionary, home page.</td>
</tr>
<tr>
<td>Format</td>
<td>The physical or digital manifestation of the resource.</td>
</tr>
<tr>
<td>Identifier</td>
<td>String or number used to uniquely identify the object, such as URL or ISBN.</td>
</tr>
</tbody>
</table>

Table 3: The 15 Dublin Core Metadata Elements

Each DC metadata element can also have sub-type and sub-scheme information. For additional needed information about a resource, a qualified Dublin Core has been developed, which consists of the element and its qualifiers (Sugimoto et al. 2002, p.26). The idea is that the basic elements may be further enhanced by use of these qualifiers, with the purpose of informing the user on
how to view or interpret the content of the element. These qualifiers are defined as element refinements and encoding schemes. Examples of qualifiers, recommended by DCMI, are presented in table 4 (Sugimoto et al. 2002, p 27). The phrase “simple DC” is used to refer to DC metadata that does not make any use of encoding schemes and element refinements and in which each statement only contains a value string.

<table>
<thead>
<tr>
<th>Element</th>
<th>Element Refinement</th>
<th>Encoding Scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Alternative</td>
<td>LCSH, MeSH, DDC, LCC, UDC</td>
</tr>
<tr>
<td>Description</td>
<td>Table of Contents, Abstract</td>
<td>DCMI Period, W3C-DTF</td>
</tr>
<tr>
<td>Date</td>
<td>Created, Valid, Available, Issued, Modified</td>
<td>DCMI Type Vocabulary</td>
</tr>
<tr>
<td>Type</td>
<td>Extent</td>
<td>MCMI Type Vocabulary</td>
</tr>
<tr>
<td>Format</td>
<td>Medium</td>
<td>IMT</td>
</tr>
<tr>
<td>Identifier</td>
<td>URI</td>
<td>URI</td>
</tr>
<tr>
<td>Source</td>
<td>URI</td>
<td>URI</td>
</tr>
<tr>
<td>Language</td>
<td>ISO 639-2, RFC 1766, RFC 3066</td>
<td>URI</td>
</tr>
<tr>
<td>Coverage</td>
<td>Spatial</td>
<td>DCMI Point, ISO 3166, DCMI Box, TGN</td>
</tr>
<tr>
<td>Temporal</td>
<td>DCMI Period, W3C-DTF</td>
<td>DCMI Period, W3C-DTF</td>
</tr>
</tbody>
</table>

Table 4: DCMI recommended qualifiers

Since it is easy to understand, extensible and not domain specific, DC has the potential to be adopted by many communities that are searching for a metadata scheme to control their resources (Obershaw 2002, pp.27-42). It helps that many tools for generating Dublin Core elements are free and online. Specialised groups may need to develop their own lists to extend DC. Dublin Core concentrates on resource discovery, and does not cover other requirements, such as resource management or access restrictions (Milstead & Feldman 1999,
Literature Review

pp.32-40). DC is primarily a descriptive metadata schema that does not address administrative functions. For this reason, some metadata necessary for business purposes may fall outside the scope of the DC. “Because of the rapid pace of change in a commercial setting, there is an inherent conflict between slowly evolving standards and the immediate need for a working model to use for business purposes” (DCMI Global Corporate Circle Community 2008).

To address this issue, the 2002 Dublin Core annual conference and workshop started a new effort to involve members of the corporate world in the evolution and application of the DC. The DCMI Board of Trustees created a self-directed forum, run by and for members of the corporate world using Dublin Core, to share best practices and provide direct input to the standard from their point of view, the Global Corporate Circle Community (DCMI Global Corporate Circle Community 2008). The issues raised by the Global Corporate Circle included the following:

- “Effective implementation of content and document management systems, portals, search engines and knowledge management applications. Software vendors do not provide any meaningful Dublin Core schema support.
- Generating standard attribute value sets including taxonomy, thesauri and controlled vocabularies. Standard attribute value sets would be enormously valuable.
- In corporations, KM and corporate IT are the DC users, not the librarians/information service providers. Applications of DC occur mostly in the corporate web presence, not the corporate intranet.
- Demonstrating the value of industry standards to the organisation. Collaboration is not part of the corporate culture, competition is.
- Identifying the business problems the DC can help:
  - engineering effective content creation scenarios and adding value to that content,
  - generating top hits in web searches,
  - ensuring document-level security (controlling access).”

In addition, a number of corporate user needs were identified:

- “Industry best practice; case histories of process to arrive at corporate metadata standards,
Literature Review

- ISO/NISO validation,
- ROI cost benefits, e.g., studies that show the cost before and after DC has been adopted,
- Validation of DC compliance by vendors,
- Input to DC usage, e.g., specialized attribute value lists, type encoding extensions,
- Dublin Core enabled search engines, such as Alta Vista, Autonomy, Verity, Inktomi.”

The effort undertaken by the global corporate circle of DCMI showed the increasing interest of the corporate world in metadata. The participants seem to understand the benefits of the use of metadata for content organisation. DC is probably the most suitable metadata scheme for the time being to cover corporate needs, because it has very few elements. Its implementation is therefore relatively easy and it can be extended according to the specific needs of each industry or organisation.

An important outcome of this community was the publication of the “CWA 15247 - Guidance for the deployment of Dublin Core metadata in corporate environments” in 2005 by the European Committee on Standardization (CEN) (CWA 15247 2005). It is based on a series of in-depth interviews to identify the actual metadata practices in large companies. It includes five Guidance Areas:

- DC usage
- DC extensions
- Tools and methods used to create and maintain metadata
- Controlled vocabulary usage
- Specific guidelines that are needed

The conclusions of this document are further analysed in Chapter 6, in comparison with the findings from the empirical research.

The Global Corporate Circle was deactivated in December 2007 and in November 2007, a new group was established, the DCMI KM Community, that is intended to address issues that should be of interest to corporate users of Dublin Core metadata (DCMI Knowledge Management Community 2007). The community is a forum for individuals and organisations with an interest in the application and use of the Dublin Core standard in KM and the objectives are to:
Literature Review

- "Promote the application and use of the Dublin Core standard in KM.
- Coordinate with developers and information providers to ensure interoperability with applications that facilitate reuse, awareness, cooperation and learning within and among organizations.
- Develop a body of work that provides best practices, case studies and examples of how Dublin Core is applied and implemented in KM. Examples include what elements are used, how they are interpreted, values/controlled vocabularies, tagging methods and return on investment."

The development of this community shows active interest in the application of metadata for KM purposes. This literature review showed that the use of metadata, and DC in particular, for KM is not well-documented. The work of this community will hopefully facilitate the collection of such evidence and the development of a body of best practices. This research aims to contribute to this effort.

2.3.6. Return on Investment in Metadata

The use of metadata for knowledge organisation requires an extensive investment of financial, time and human resources. In the traditional information management sector, it is reported that producing MARC catalogue records is arguably among the most expensive tasks in the library with an oft-quoted number of 50 American dollars per full original record. Shared cataloguing drives the cost of cataloguing to affordable levels, at a few dollars per record (Calhoun 2007, p 179). Thus, it is important for an organisation to be able to measure the impact of its investment in metadata. Consequently, the effect of using metadata for the description of knowledge has to be measured. This will help to balance the cost, quality and functionality of metadata.

Unfortunately, there is no easy way to measure the impact of metadata on the effective creation and use of knowledge assets. It would also be very useful to be able to calculate directly how much the whole process of creating metadata costs in monetary value and time. The formula for calculating the cost of MARC records cannot be used directly because the circumstances of creating metadata
**Literature Review**

In KMS are very different; MARC records are created by highly trained and dedicated cataloguers. For a large organisation, the cost of manual creation or refinement of metadata for all knowledge assets might be very high. It could be also examined whether the description of intellectual capital only or core knowledge assets could be a solution towards cost reduction.

One of the most common ratios used to calculate the success of an investment in monetary value is the Return on Investment (ROI). ROI is calculated as the average benefit over a specified time period divided by the cost. Thus, its use has been proposed by DCMI to measure the success of metadata application and KM. The difficulty is that the benefits of using metadata and of KM are intangible and hard to calculate. There are aspects that, in theory, can be measured, such as the exact time spent to retrieve a relevant piece of knowledge.

In reality, though, and in the scale of a large organisation, it is difficult to calculate the total time saved by the total of employees in finding information through good metadata over a period of a month or a year. Therefore, alternative methods to measure the value of metadata need to be developed. Measurements such as whether metadata has enhanced the use of and trust in the codified knowledge could be undertaken through user satisfaction surveys. It could then be calculated whether that knowledge is being reused and the consequent benefits for the organisation.

Academic research has not explored this issue in depth. It is mainly practitioners who have tried to identify ways to calculate ROI or other metrics for the benefits of using metadata. The DCMI Global Corporate Circle has presented an approach to calculating ROI (Doe 2006). It describes the standard ROI process in three steps:

1. Identification of the impact space (top areas of real benefit, impact to company/group and stakeholders);
2. Quantification of the benefits and costs within the organisation;
3. Utilisation of the standard ROI models and calculations to assess the value-add to the organisation.

Possible benefits of the application of metadata that have been identified are: business benefits, user productivity, reduced support costs, reduced IT costs, integration, information reuse, increased usage and content, and reduced information redundancy. Possible costs of the application of metadata include:
Literature Review

infrastructure costs, training and education, application software, consulting and personnel, ongoing operations, integration and process changes, organisational changes and communications. Calculating costs is generally the easier of the two activities.

2.3.7. Subject Metadata Used for Knowledge Organisation

It has been noted that metadata is used as a tool to organise and manage data, information, and knowledge. Controlled vocabularies, taxonomies, thesauri, ontologies and topic maps, which are based on subject metadata, are also used extensively to organise information and knowledge both manually and automatically.

- A controlled vocabulary is a closed list of named subjects, which can be used for classification.
- Taxonomies arrange the terms of the controlled vocabulary into a hierarchy.
- Thesauri display the terms not only in a hierarchy, but they show relationships between the terms, such as hierarchy, equivalence and association.
- Ontologies conceptualise a vocabulary of terms and complex relationships among them.
- Topic maps are organised around topics, which represent concepts.

All these methods are based on subject-based classification, which is any form of content classification that groups objects by the subjects they are about (Garshol 2004, p.380). There is no general standard for these methods, although there are common principles. The relation between subject-based classification and metadata is that the metadata tags that describe what the objects are about, by listing discrete subjects, use a subject-based classification. This basic feature is common to all subject-based classifications. This means that metadata may include subject-based classification and other information about the knowledge asset. These methods are very useful for indexing and visualisation purposes. They may be used in addition to metadata, in order to have the advantages of both.
2.4. Metadata and Knowledge Management Systems

Metadata has been developed so far with the aim to manage data and information. KM, however, deals with knowledge, which is one step beyond data and information management, with respect to dimensions such as context, validation and human referencing. "It involves components, which are strategic, such as intellectual capital management and organisational core competencies, and tactical, such as knowledge creation and transfer mechanisms, KM roles and incentive measures" (Rao 2005, p.27). Mahesh and Suresh (2004, p.11-22) have identified an important distinction between knowledge and information metadata; while data and information metadata is about the container or embodiment of the knowledge, knowledge metadata is about the knowledge contained in the container.

An extensive literature search was undertaken to identify research in the domain. It has to be mentioned that the literature is rather limited. Most of the scholars who are concerned with the issue generally agree that metadata can play an important role. They comment on the benefits of effective metadata management for organisations and they identify it as a sound practice for creating a knowledge repository, intranet, portal etc, but they do not explore the topic further into what kind of metadata are needed and what should be the metadata management strategy (Rao 2005, Rollett 2003). Studies exploring or measuring the impact of metadata use for KM were not found either.

It is interesting how Tiwana (2002, p 84) uses the term "meta information", where the term metadata was expected. He describes the knowledge platform and the different technologies of which it is composed. In his KM architecture he includes seven layers, one of which is collaborative filtering and intelligence. In this layer, indexing and meta-tagging are taking place (Tiwana 2002, p 234). He uses the analogy of the library card catalogue, by explaining that the knowledge server creates a reference to each new document that is similar to a card in a library card catalogue. Each card captures key metadata, such as author, subject, and title, as a standard set of properties and maintains a link to the original content, which the server indexes in a text-search engine. On the basis of the text index and the metadata properties captured for each card, the knowledge server automatically organises cards in a hierarchy that
users can browse, typically, on the intranet. He further mentions that meta-information provides automated content aggregation and electronically catalogues new information as it gets added to the knowledge server. He claims that meta-information provides insight into information users, types of data and information being accessed.

In the same way, Maier (2002, p.195) uses the term "meta-knowledge". He mentions that knowledge services work on the basis of a knowledge repository, which handles the organisation's knowledge elements and meta-knowledge describing these elements. The structure and the relationships of these knowledge elements are handled by the visualization and taxonomy layer, which contains knowledge maps and directories that are required to perform knowledge services. What he describes is very close in theory to metadata and the indexes that are created automatically in a relational base.

Although there are no metadata standards for the description of knowledge, there is evidence in the literature that metadata can describe codified knowledge as well as information or data and, as a consequence, play an important role in KM (Rollett 2003, p.148; Tiwana 2002, p.234; Maier 2002, p.195, Rao 2005, p 5; Heath 2003, pp.184-189) It is believed that metadata can contribute significantly to the processes of KM, as it can help condense, codify and link knowledge for reuse in other steps of the KM life cycle. Codified knowledge needs to be well-organised, maintained and stored so that it can be retrieved, accessed and reused where appropriate. Knowledge organisation is necessary because it reduces redundancy, enhances consistent representation and hence improves efficiency of the system and the quality of the search results. Metadata facilitates significantly the description and retrieval of objects, such as images, drawings and videos, since retrieval based on the actual content is not optimum yet.

Qian and Bock (2005) found that search ability matters for user satisfaction with a knowledge repository and users put emphasis on whether accurate and quick search results can be achieved through system search engines. Similarly, Jennex and Olfman (2004) have identified the search, retrieval and visualisation functions as one of the twelve success factors for a KMS and stated that these functions support easy knowledge use. Efficient querying in a KM
system has been discussed also by Stojanovic et al. (2002, p.514). They argue that efficient searching depends on:

1. the quality of the knowledge in the portal, i.e. if knowledge resources reflect the needs of users, and
2. the quality of the searching process, i.e. when a relevant resource exists in the repository, how easily the resource can be found. This problem can be divided into two sub-problems:
   a) if a resource which is relevant for the user's information and knowledge needs can be found by the querying mechanism, and
   b) if the resource which is highly relevant for the user's information and knowledge needs can be found easily by the user in the list of retrieved results.

They further argue that the quality of the searching process depends on the clarity of the expression of the need in the query, and the quality of the annotation (indexing) of the resources in the repository. In other words, the quality of the searching process depends, to a great extent, on the quality of the metadata used.

The use of metadata has a significant impact on knowledge characteristics and other factors that are critical to KM. For example, knowledge is very context sensitive (Desouza & Awazu 2005, p.767). In order for knowledge to be used effectively, contextual information must allow the user to comprehend the nature of the task that led to the creation of this knowledge asset, the conditions under which it was created and, most importantly, the qualifications or peculiarities of the person who created it. Metadata concerned with the applicability of knowledge include the intended target audience, background assumed, ratings and reviews, author's knowledge profile, and conditions or constraints to be considered in applying the knowledge. Metadata enables more effective application of the knowledge by:

- Normalising against differences in language and usage, culture and views of the world, terminologies used, and domains of interest.
- Providing grounding for a knowledge document in the space of all knowledge present in the organisation by linking it implicitly with other assets in related areas or through other similarities in knowledge attributes.
Literature Review

- Taking the KM solution beyond the content of knowledge by representing attributes of applicability of knowledge to specific contexts of re-use (Mahesh & Suresh 2004, p.15).

Furthermore, trust is a key ingredient for the success of KM (Ford 2003, p.553). In terms of codified knowledge, both trust in the KM system and the content is required. Trust in the KM system can be ensured by the selection and use of an efficient and stable system. Trust in the content is harder to achieve. Desouza and Awazu (2005, p.765) found that most knowledge workers abandon KM tools because they are not maintained properly and, as a result, search times have become very long. In addition, knowledge may be incomplete and outdated, multiple versions of the same knowledge asset may be present and the cost of re-using or even searching for existing knowledge could be greater than recreating the knowledge asset.

Metadata can address the aforementioned problems of KMS and help in their management and maintenance in general. Thus, it helps build trust in the content of the system and offer the “comfort factor” (Sturdy 2001, p.35). The “comfort factor” represents relevancy and validity of the content retrieved from the system. Validity can be ensured through the authorship and audit trail of the codified knowledge. Human referencing and annotations to the content, as well as ratings of quality or relevancy to the user needs may be included to further evaluate the knowledge object. Relevancy in retrieval is highly enhanced through metadata because the user can perform more precise and accurate queries; as a result the user may spend less time searching for the knowledge objects s/he needs.

Tochterman (2003, p.29) identifies another benefit of metadata for KM. He proposes a shift in focus to personalisation, with the aim of overcoming the problems of KMS. Personalisation of a system is the adaptation of its system features, the content managed by the system and its structural components for organising content, according to the internal model of reality, states and activities system users have (Tochterman 2003, p.35). Many KMS vendors produce systems that are overly feature-based. This brings the risk that the application of personalisation concepts in KM focuses on the feature level only. Instead, Tochterman suggests placing the emphasis for personalisation concepts in KM on the metadata, the content and the structure. More specifically for metadata, a
metadata element consists of a metadata name and a metadata value. Based on this, there are three different possibilities to personalise metadata. (1) the metadata name can be personalised, (2) the metadata value can be personalised, (3) both the metadata name and the metadata value can be personalised.

2.4.1. Case Studies on Metadata and Knowledge Management

A number of KM case studies were reviewed to identify the metadata elements used by corporations. Not many were found and these were not very detailed. Mostly case studies mentioning that metadata were used in specific implementations or naming one or two metadata elements were found. Rao (2005, pp 5-8) discussed several cases where metadata are used by corporations for the purposes of KM. Unfortunately he does not give many details of the cases. It is mostly subject-based metadata that are mentioned, such as keywords and abstracts. The use of taxonomies is also reported quite frequently. A compilation of the relevant mentions to metadata is given in the next paragraph.

At J.D. Edwards, now acquired by Oracle Corporation, it is important to manage properly content up front so that costs of re-use can be kept down. Metadata are important for content re-purposing. The KMS at Siemens AG is supported by a Global Editing Team, which checks the quality of each document and provides support in writing powerful abstracts. In addition, a context-sensitive content taxonomy is used to ensure workflow-oriented content structure for easy retrieval of knowledge. Blue Cross Blue Shield of Florida uses software tools for taxonomy generation as well as automatic categorisation. Such tools can identify important noun phrases, unused categories, uncategorised documents, and statistics on the degree of balance of the taxonomy. At Sopheon Corporation tools are used to build and test new taxonomies along the dimensions of depth, breadth and detail. Johnson Controls Inc. has an explicit taxonomy team charter, whose mandate is to ensure that the right people can connect to the right information. The key lessons from Ford Motor Company include among others the importance of documentation, professional usability design, adherence to content templates and taxonomy.
Davenport and Prusak (2000, p.123) mention the case of HP. The company has implemented the Electronic Sales Partner (ESP) system containing white papers, sales presentations, technical specifications and pointers to external materials. Everyone in HP can submit a document for possible inclusion, which is then reviewed for its uniqueness and appropriateness. The selected documents are classified automatically based on “metaknowledge – classifications of the type and format of knowledge” (Davenport and Prusak 2000, p.124). This classification is then “furnished by the submitting employee”. In other words, HP has selected a method to apply only subject-based metadata created both automatically and manually. This system has received very positive critiques from its users, although a major concern has been raised. “the only difficulty cited by HP involves navigating among the vast number of documents – a problem that will probably get worse before it improves.” In addition, according to Alavi and Leidner (2001, p.121) the primary content of one system in HP is a set of expert profiles containing a directory of the backgrounds, skills, and expertise of individuals who are knowledgeable on various topics. They name this content metadata in the sense that it is knowledge about where the knowledge resides. Andreu and Ciborra (1996, p.120) argue that this knowledge proves to be as important as the original knowledge itself.

The case of a large European bank is presented by Newell et al. (2002, pp.109-114). The bank set up the Global Transaction Services (GTS) division to provide an integrated service for global customers. GTSNet was a simple, HTML, browser-based system to support this service. It contained information and knowledge on countries, trade, cash management, people in the network and general information of the bank. It was used by employees in 17 countries. However, users were complaining that the content of the intranet was not up to date. The solution to monitor content, which was implemented as a response, can be considered a metadata approach. Each item was given a rating so that users could assess the credibility of the knowledge they were accessing. The rating scale was: (1) fully approved content by the KM team, (2) content monitored by the KM team and (3) content for which the KM team takes no responsibility. Rating is a metadata element that is commonly used in bibliographic databases and it ranks the relevancy of the content to the query. It is a very useful element for the presentation of the results to the user.
Literature Review

One of the few cases where the impact of metadata was reported indirectly, was in an interview with Debra Logan, Research Director in Gartner Group, conducted in September 2003 by Rao (2005, p.61). The interviewee mentioned the case of the European Court of Human Rights in Strasbourg, France, which used a content management system and workflow tool based on Hummingbird to save a million euros in its first year and improve process efficiency. It was able to respond to increased demand for its services (e.g., court case entry, tracking) despite limited resources. Its website provides access to all 44 member states of the Council of Europe. The success of the system was attributed to the preparation before implementing the system. Six months were spent in interviewing users prior to project launch to determine their information and metadata needs.

2.4.2. Metadata Schemes Developed in Corporate Settings

The review of the literature revealed only a few attempts to formulate actual metadata schemes within a company.

Doran (1999, pp.42-50) describes Weyerhaeuser Library's Intranet Content Management project, which started with the realisation that the librarians knew where to find information on the intranet, but the average user did not. Weyerhaeuser Company Limited is a forest products company that employs around 35,000 people in North America. The development of the intranet started as a grassroots effort and content was added without prior organisation or quality control. Since searching was not effective, the librarians realised that they need a metadata framework to facilitate searching and set the standard for managing intranet information. They decided that they needed to tailor a metadata scheme directly to Weyerhaeuser's information needs, instead of using an existing one, because it would address concerns about intellectual property, KM and accountability as well as capturing simple content. They decided that they needed a scheme with 19 elements that would contain basic bibliographic information, information describing a page's content and accountability and document management information. Based on the Dublin Core model they created the bibliographic and descriptive fields and adapted that
format to create the fields for accountability information. Their scheme had some required fields and some that were created automatically by a template, such as “File Type”. For the subject and category fields the user had to choose one or more terms from the controlled vocabulary they created. They divided the fields into three sections. Each section corresponded to one of the types of information they identified. Administrative (accountability information), General (bibliographic information), and Subject/Category (descriptive information). They created two other fields, AddSubject and AddCategory, to capture additional (uncontrolled) terms. The user or content creator was expected to fill a template with metadata when he/she would post something on the intranet. The results of the project and the comments they received from employees were fairly positive.

Another example, in a forestry company again, is reported by Holder (2003, pp.49-55). Forintek Canada Corp. is a forest products research laboratory. Forintek’s libraries developed virtual information services to support staff research goals by creating a dynamic database of internet links. The information managers created a digital compendium of internet resources, which included pointers to both internal and external information sources and hypertext links to resources. The project goal was stated as “to create a comprehensive, international compendium of value added and secondary manufacturing sources of information, knowledge and expert resources”. They decided to create their own metadata scheme for digital resources, based on MARC, the Dublin Core, the AngloAmerican Cataloguing Rules and ISBD (Computer Files). They found that Dublin Core provided the best list of elements for their purposes and used the elements as field names in their database. They arrived at 27 fields plus fields for parallel French content where text in both languages is necessary.

Mahin (2008) presented the metadata scheme used in the KMS of the law firm Mourant du Feu & Jeune. The scheme includes the metadata: “Title”, “Author”, “Submitter”, “Updater”, “Keywords”, “Taxonomy terms”, “Practice Area”, “Summary”, “Published Date”, “Previous Review Date”, “Next Review Date”, “Document Type”, “Access Type”, “Link to Item”, “External Source”, “Jurisdiction”, “Legislation and Cases”, “Rights” and “approved”. They have also attached a “Health Warning”, to flag knowledge documents that are not of the expected quality or they need reviewing. They have developed a KMS where
Literature Review

only super-users were allowed to approve and upload content and create metadata of high quality. They selected this approach of quality control of both the knowledge documents and metadata, because for them it was of crucial importance that core knowledge will be readily available. Search was parametric utilising solely the metadata to make sure that very precise queries will retrieve all relevant knowledge, especially when they were searching for similar cases that set precedent

Obershaw (2002) has conducted a very interesting study to identify which metadata elements are used in corporate intranets. He collected ten schemes from large multinational organisations and compared them with the Dublin Core (DC). The Dublin Core was selected as a basis for developing a full-featured intranet metadata scheme, because it was designed to be discipline independent and versatile enough to allow communities to enhance it according to their own specific needs. His study will be further analysed with the cross case analysis of the findings of this research in Chapter 6.

2.5. Knowledge Management in the Two Industries

As mentioned in Chapter 1, this research is based on two case studies of large highly knowledge-intensive companies. The following sections present briefly the two industries, the motorsport engineering and the pharmaceutical industry, where the case studies were undertaken. The characteristics that define these industries as knowledge-intensive are discussed to justify their selection as case studies. Relevant studies are also examined to see how this research compliments them.

2.5.1. Knowledge Management in the Motorsport Engineering Industry

Motorsport (also known as automobile racing, autosport or auto racing) is a sport involving racing automobiles. Motorsport began in France in 1895 and is now one of the world's most popular spectator sports. There are many categories of motorsport, including rallying and the single-seater racing with cars designed
Literature Review

specifically for high-speed racing. Motorsport is centred on modern technology from major international car and engine manufacturers with a lot of corporate sponsors and politics involved. Formula One is, by any measure, the most expensive sport in the world, with some teams spending in excess of 400 million US dollars per year, and has the largest television audience in sport with over 55 billion viewers every year (FIA 2004b).

Most of the motorsport events are governed and managed by the Fédération Internationale de l'Automobile (FIA). The FIA World Motor Sport Council:

- Administers international motorsport;
- Encourages and implements the adoption of common regulations for all forms of motor sports and series across the world, and
- Promotes continuously improving safety standards in all forms of motor sport (FIA 2004a).

Motorsport teams must adhere to the technical regulations dictated by the World Motor Sport Council. These rules are extensive and voluminous. Grey areas in these rules allow the teams to strive for competitive advantage. It is common that every two or three years there is a major review of the rules, allowing the teams to innovate. Speed, reliability and safety are the main objectives.

The motorsport environment is highly competitive. The ultimate goal is to improve the performance of the car and win the championship. This should be the result of a joint effort from the drivers, engineers and mechanics in the garage and engineers in the factory. Drivers' knowledge is crucial in the development of a winning car, as they collaborate in the process of testing the cars, making suggestions for improving them. In addition, during a race, they are the main source of information regarding the car's performance. They report information that is not easily captured by electronic sensors and their experience and skill at interpreting the performance of the car adds significantly to the competitive edge of the team. Most of the relevant knowledge is implicit and therefore there is a need for a high degree of coordination and trust in the team (Andreu & Sieber 2001, p.92).

Teams try to improve the car constantly, with development and testing continuing between races (Table 5). Each year and each race presents different
Literature Review

challenges for the car, the drivers and the engineers. As a result, the cars need to have different components and settings for each race of the season. As driving styles may be very different, each car is adjusted to accommodate the driver. Anecdotal evidence suggests that there is an engineering change on average every twenty minutes.

<table>
<thead>
<tr>
<th>Racing Car Development Time Plan</th>
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</thead>
<tbody>
<tr>
<td>New Car</td>
</tr>
<tr>
<td>Testing</td>
</tr>
<tr>
<td>Racing</td>
</tr>
<tr>
<td>Next Car</td>
</tr>
<tr>
<td>Preparation</td>
</tr>
</tbody>
</table>

Table 5: Gantt chart of the racing car development

The continuous development of the car results in the production of a wealth of data, information and knowledge. Along with the numerous designs, reports and technical documents, each team and car has a large number of IT systems that produce data and information, such as telemetry, control, strategy, and fuel systems. The production life cycle is relatively short. The average life cycle for aero parts of the car is four to six weeks only (Figure 2). Working with such a short life cycle means that knowledge is more than just an asset, to be protected and valued; it is a vital component in a team's key activities, which must be identified and put to work if its value is not to degrade with time (Reay 2000, p 25).
There are some key needs linked to the application of knowledge in motorsport: speed of effective response to change, zero tolerance to failure, accurate data capture and immediate transfer to information, a constant need to refresh knowledge from information, knowledge replication and knowledge security and access to effective innovation (Reay 2000, p.21).

Besides continuous research and development, teams try to learn from their competitors by observing the cars and replicating new ideas, and by attracting and hiring staff from other teams. This results in relatively quick staff turnover and the loss of valuable knowledge (Henry & Pinch 2002, pp.146-147 and p.157). Teams also gain expertise from their suppliers. These include suppliers of tyres, fuel and components. The component suppliers make bespoke items of the team’s design, with a substantial contribution of their own expertise (Beck-Burridge & Walton 2000, pp.168-171).

How KM is practised in the motorsport industry is not well studied or documented, although most teams produce large amounts of knowledge, both scientific and procedural. The very short production cycle with continuous improvement and adjustment phases increases the demand for accessible knowledge at the right time to the right people. “While F1 teams are technology-based and highly-organised to meet multiple targets, they are also very flexible
Literature Review

and people-oriented. In this sense, they are close to the ultimate knowledge organisation" (Reay 2000, p 21)

Most of the studies regarding KM in the motorsport engineering industry are concerned with the role of knowledge in gaining competitive advantage, the absorption of knowledge (Jenkins & Floyd 1998), or the processes by which knowledge is generated and the implications for strategies based on innovation or imitation (Jenkins 2000). How communities of practice can help with knowledge sharing and knowledge flow (Reay 2000, pp.20-25), and the technology partnering and knowledge transfer between suppliers and customers in the automotive industry (Beecham & Cordey-Hayes 1998, pp.191-205; Jenkins & Floyd 2001, pp 945-969, Manotti & Delbridge 2003) are also studied. Additionally, a number of studies relate to the use of knowledge aided engineering tools (for example Succa et al. 2000, pp.235-249). There were no papers found reporting studies on knowledge organisation or metadata practices in motorsport.

2.5.2. Knowledge Management in the Pharmaceutical Industry

The pharmaceutical industry has a profound impact on people's health and welfare. It is dominated by a small number of very large multinational companies, although it includes national and niche companies. It is heavily research and development based, with companies engaging in the development and/or manufacturing of drugs (Abell & Oxbrow 2001, pp. 203-208). Competition is fierce between these companies, each of them aiming to develop new medicines and to reduce the time required to do so. The economic and operational demands on the industry are quite extensive with average expenditures to put a drug on the market being about $1 billion American dollars. Only one third of drugs that are marketed deliver a positive return on investment (Kankhar 2006). Therefore, companies must continue to improve their research and development process in order to reduce cost and the time required to produce a drug.
The main characteristics of this industry are the long lifecycle for the development of new drugs, the extensive volume of data and information produced and the regulatory process for the drugs (Figure 3).

The usual drug discovery, development and approval lifecycle spans over 10 to 12 years. The long life cycle means that employees may leave their position or the company before the end of a project, thus the ability to retain information and knowledge is very important for the pharmaceutical companies. It is imperative for the companies to store their information in one central place, make it available, and manage it over time with the owners and through version control and access control. The background and context of past projects need to be kept in the organisational memory, so that employees can refer back when designing new projects. New research or competitive information may bring new opportunities for past projects (Wang 2006, p.209).

Within the course of developing new drugs, each company produces large amounts of data and information, which must be available in a timely manner in order to reduce the long life cycle (Liebowitz 2000, p.253). In addition to the information produced within, the pharmaceutical companies require extensive information from external resources, such as the research literature, marketing and competitive information. Contract Research Organisations (CRO) are becoming increasingly common. They are academic or non-profit laboratories that supply part of the drug discovery process to the pharmaceutical companies. "In recent years, knowledge in the biological science has grown to touch so many different disciplines that it is almost impossible for a specific R&D laboratory to keep up to date with all this complexity" (Cordella 2006, p.8). The knowledge and skills required are so broad and, simultaneously, so specific that only specialised organisations can produce it. At the same time the management of data, information and knowledge produced requires careful consideration.

To bring a new drug to the market, each company must be granted permission by a regulatory agency, such as the Medicines and Healthcare Products Regulatory Agency in the UK. To acquire permission, the company must maintain extensive information about the discovery and development of the new drug (research data and clinical trial records) over an extended period of time. These records have to be carefully managed in accordance with strict rules governing electronic information. In order to comply, i.e. to be able to prove the
authenticity, integrity, and confidentiality of the electronic records, companies are being driven toward centralised repositories for managing information to ensure consistent, compliant ways of developing and using information across the company.

Figure 3: The drug development process, adapted from Kankhar 2006

The above characteristics define the pharmaceutical industry as a knowledge-based industry, where profitability is based on the ability to create and exploit new scientific knowledge (Bierly & Chakrabarti 1999, p.236). The competitive advantage lies not only in finding new compounds, but also in the ability to effectively shorten the drug development cycle and penetrate the market efficiently (Koretz & Lee 1998, p.54; Roberts 1999, pp.655-670).

There is a number of studies published on the practice of KM in the pharmaceutical industry. Some authors focus on more social aspects of KM, such as knowledge production (Cordella 2006), organisational learning (Pisano 1994, pp-85-100; Ingelgard et al. 2002, pp.65-77), knowledge transfer (Schweizer 2005, pp.315-331) and innovation (Roberts 1999, pp.655-670; Styhre 2005, pp.197-205). Braganza and Mollenkramer (2002, pp.23-33) report the findings of a case study on a failed KM initiative. They focus on the role of IT and some of
Literature Review

the issues they described were the lack of functionality of the KMS, the lack of relevancy of the content and the lack of context of knowledge. All these issues are identified and further studied in the following chapters.

2.6. Summary

This chapter has provided an extensive review of the literature and presented the current state of KM and KMS linking them with metadata. The use of metadata in KMS is not well-documented. The number of studies on the use of metadata for the purpose of KM is limited, especially in the case of the two industries under study. Although there is consensus that metadata can facilitate the use of KMS and provide a better user experience through improved search and navigation functionality, there is not much information on which metadata elements organisations use to describe their knowledge documents or how they manage their metadata.

Before attempting to address these issues, Chapter Three will present the research method and the rationale for selecting the particular method for this research.
Chapter 3. Methodology

This chapter presents the methods selected to carry out this research. After a critical discussion of the positivist and interpretivist paradigms, the rationale for selecting a pragmatic research paradigm is presented. Then, the selection of case study as the research method is justified and the process of selecting organisations as case studies is outlined. Lastly, the data collection tools are presented and the data analysis process is explained.

3.1. The Qualitative and Quantitative Approaches

The two main strands of research philosophy, positivism and interpretivism, are founded upon mutually exclusive views of the social world. Each strand is associated with different traditions in social theory and diverse research techniques (Neuman 2003, p.70).

Positivism, broadly defined as the approach of the natural sciences, is the oldest approach and is widely used. Positivism sees "social science as an organised method for combining deductive logic with precise empirical observations of individual behaviour in order to discover and confirm a set of probabilistic causal laws that can be used to predict general patterns of human activity" (Neuman 2003, p.71). Positivists argue for an objective science, i.e. science that can produce true explanatory and predictive knowledge of reality that is not based on values, opinions, attitudes or beliefs. Therefore, they prefer precise quantitative data, they seek rigorous, exact measures, and they test hypotheses by carefully analysing numbers from the measures. Positivists remain detached, neutral, and objective as they measure aspects of social life (Gorman & Clayton 2005, p 9). The criticism of positivism is that it reduces people to numbers and its concerns with abstract laws or formulae are not relevant to the actual lives of real people (Neuman 2003, pp.70-75).

In contrast to positivism’s orientation towards exact measures, the interpretive approach adopts a practical orientation. Interpretivism is "the
Methodology

systematic analysis of socially meaningful action through the direct detailed observation of people in natural settings in order to arrive at understandings and interpretations of how people create and maintain their social worlds” (Neuman 2003, p.76). Researchers recognise their role within the phenomenon under investigation and they may follow a nonlinear research plan. They usually conduct detailed examinations of cases that arise in the natural flow of social life and they try to present authentic interpretations that are sensitive to specific social-historical contexts. The interpretive paradigm believes that scientific knowledge is socially constructed and socially sustained, therefore, its significance and meaning can only be understood within its immediate social context. The study of the social context produces qualitative data, which need to be analysed as a text (Neuman 2003, pp.75-80).

From the above, it is noticeable that quantitative data are linked with positivism and qualitative data are linked with interpretivism. Quantitative data are often characterised as “hard data”, i.e. data in the form of numbers for precise measurement. The quantitative approach, in general, tests hypotheses, concepts are in the form of distinct variables; and measures are systematically created before data collection and are standardised. The analysis of quantitative data proceeds by using statistics and by discussing how what the data show relates to hypotheses. Qualitative data, on the other hand, are “soft data”, i.e. in the form of words, pictures, impressions, or symbols. They give rich information about the social processes in specific settings. Concepts of the qualitative approach are in the form of themes, motifs and generalisations and the analysis of qualitative data proceeds by extracting themes from evidence and by organising data to present a coherent picture of the phenomenon (Neuman 2003, p.145).

The two approaches, quantitative and qualitative, may have differences in the way research is to be designed and conducted, but this does not imply that both approaches are mutually exclusive and cannot be used for the same research project. The term “triangulation of methods” or “multiple strategies” implies the mixing of qualitative and quantitative style of research and data. Since the two styles have different, but complementary, strengths and there is only partial overlap, a study using both styles is more comprehensive (Neuman 2003, p.139). A pluralist view of the research project dictates that consideration should be given to the different dimensions of a real situation, to the tasks involved in the
**Methodology**

different stages of the research project and to the research context. Based on these, a mix of methods should be used (Tashakkor & Teddlie 1998, pp.11-13; Mingers 2001, p 256)

Following the basic principle of the pragmatic paradigm, this research used different philosophical and methodological approaches, which were considered useful for the specific tasks of the project (Goles & Hirschheim 2000, p 258). Pragmatism was chosen because it philosophically embraces the use of mixed methods and because it presents a very practical and applied research philosophy (Tashakkor & Teddlie 1998, pp 29-30). Therefore, this study used both research approaches in parallel, with more emphasis on the qualitative approach. A qualitative approach and data were suitable, because in-depth contextual information was critical in understanding how each organisation organises knowledge and why it has developed its practice. The primary reason for adopting a mainly qualitative approach was the need for exploration. However, the use of some quantitative methods could lead to a greater reliability of the findings. The user satisfaction part of the study was conducted using a quantitative approach, because this allows the collection of data from a larger population than the qualitative approach. As a result, this data reflected more accurately the attitude of a larger number of employees towards the KMS and metadata. The following sections will discuss the method used, as well as the data collection and analysis techniques.

**3.2. Case Study Research**

Two case studies were used to provide the necessary data on the practices followed for knowledge organisation and the metadata schemes used for the description of knowledge in two organisations. The dependence on a single case renders it incapable of providing a generalising conclusion, which is a frequent criticism of case study methodology, whereas, this multiple-case design provided some indication of the possibility for generalisation of the findings, since Yin (2003, p 31) suggested that analytic generalisation can occur when two or more cases support the same theory.
Methodology

Replication strategy was followed in both the data collection and analysis, to see whether the same patterns would arise. Each case study was selected so that it would predict similar results, a literal replication (Yin 2003, p 47). Each case study followed an embedded case study design, in other words, included more than one sub-unit of analysis, each of which was explored individually. The results of these units were then drawn together to create a holistic perspective of the case (Rowley 2002, p.16)

Case study research was a suitable method because this study was examining contemporary events, the relevant behaviours could not be manipulated and contextual conditions were important (Yin 2003, p.13). The aim of this study was to explore knowledge organisation as it is being conceived currently in organisations. There was no intention to alter or to manipulate the behaviour of the organisation on this matter and moreover, contextual conditions were important as it is believed that they determine how knowledge organisation is being done. It has to be mentioned that the organisation’s behaviour was not expected to change significantly due to the presence of the researcher. The researcher aimed to study the organisation’s behaviour as it was and not to change it. The Hawthorne Effect, i.e. the possibility that individual’s behaviour may be altered because they know they are being studied, is generally an important consideration (Neuman 2003, p 256). In this study organisations were not likely to change the way they organise knowledge during their participation in the study. Rather, changes were likely to occur once the researcher’s recommendations had been implemented. In addition, the behaviour of the individual employees in terms of knowledge organisation was not expected to change because it is determined primarily by the availability of the resources as well as from the practices that the organisation adopts.

Furthermore, a case study provided detailed and extensive data of the case. In contrast to surveys, where only a relatively small amount of data is collected from each case, a case study enabled the collection of large amounts of information and across a wide range of dimensions. In addition, the intention was to study naturally occurring social situations, instead of created cases, as is common in experimental research (Gomm et al. 2000, pp.2-3).

In case study research, cases may be chosen randomly, although random selection is neither necessary nor even preferable (Eisenhardt 2002, p.12). For
Methodology

This study it was appropriate to select organisations with specific characteristics, instead of using random samples. The characteristics chosen included highly knowledge-intensive organisations with an active KM programme. Both organisations have in place a systematic way of organising and storing their knowledge assets by creating metadata, so that direct comparisons were possible.

Lastly, for this piece of research the case study method was selected because it aimed to explore an area where not much research has been done before. According to Eisenhardt (2002, p.32) this type of research method is particularly well-suited to new research areas or research areas for which existing theory seems inadequate. As seen in Chapter Two, the literature review of this study has indicated that few similar studies have been done before; therefore this study is exploratory in its nature. Case studies have been often viewed as a useful tool for the preliminary, exploratory stage of a research project (Rowley 2002, p.16)

To establish the quality of the case studies, four tests have been used: construct validity, internal validity, external validity and reliability (Yin 2003, pp.33-39). Construct validity was facilitated by using multiple sources of evidence at the data collection phase. Also, the information and knowledge managers in both companies reviewed and approved the case study reports. Internal validity was facilitated at the data analysis phase by trying to build explanations. External validity was achieved by using replication logic in the two case studies. The reliability of the case studies was addressed at the level of the quantitative and qualitative data, by collecting as reliable data as possible.

The researcher’s role in case studies is to gain a holistic, in other words systemic, encompassing, integrated, overview of the context under study, its logic arrangements and explicit and implicit rules (Miles & Hubermann 1994, p.6). To achieve this, the data collection methods that were used in both case studies were field visits, documentation, questionnaires and interviews. These methods are commonly used in the case study research design and their combination allows for triangulation of the findings. They are described in detail in Section 3.5.
3.3. Questionnaire Design Principles

A review of the literature regarding research methods and, in particular, data collection methods was used to make sure that appropriate techniques would be used and common mistakes would be avoided in the data collection process. On designing questionnaires and interview schedules, it is interesting to note that, during the last decade the majority of authors have formed a common typology of questions and a set of principles on designing and administering a questionnaire. These principles apply equally on mail, telephone and web surveys or interviews, with each medium having some unique characteristics and requirements. The principles refer mainly to the wording of questions and the structure of the questionnaire. The types of questions and the main principles, as discussed by Oppenheim (1992), Moser and Kalton (1992), Fink (1995), Weisberg, Krosnick and Bowen (1996), Peterson (2000) and Bourque and Fielder (2003) are summarized below:

- Types of questions: the two basic types of questions are open-ended and closed-ended.
  - Closed-ended questions provide the respondent with fixed responses from which to choose and therefore are easier to answer and the answers are easier to compare. If the responses are graduated to measure a continuous construct, such as an attitude, opinion, intention, or preference, the question is referred to as a monadic scale or rating scale. If the possible responses are only two, then questions are termed dichotomous questions.
  - Open-ended questions permit an unlimited number of possible answers and respondents can answer in detail and can qualify and clarify responses. They are used very frequently as follow-up questions, to probe for more details or elaborate analysis, or to seek for explanations.

- Question wording: the words used in a question will always influence how participants answer the question; therefore, it is very important to pay particular attention in the formulation of questions. The main points to keep in mind are:
Methodology

- Questions should be kept as brief as possible because long questions tend to be confusing.
- Questions should be phrased as objectively as possible. Biased and leading questions imply that a certain answer is desired.
- Questions should be as concrete and unambiguous as possible; therefore, highly technical words, infrequently used words, acronyms, abbreviations and jargon should be avoided. Vague quantifiers, such as "very", "quite", "much", "most", "often", "several", should also be avoided.
- Multiple-choice questions should have answers that are exhaustive and mutually exclusive. The option "other", "not applicable" or "I don’t know" should be included when appropriate.
- Double-barrelled questions, i.e. double questions in a single question, should be avoided.
- Double-negative questions should be avoided because they tend to be confusing.
- Presuming questions, i.e. questions that imply something about the respondent, that, for example, he/she necessarily possesses an opinion or knowledge on the subject, or that he/she engages in a particular activity, should be avoided.
- Questions asking about hypothetical situations should be also avoided.
- Embarrassing questions or sensitive questions should be phrased very carefully.

- Questionnaire structure: it is of equal importance to design a short, clear questionnaire with attractive layout:
  - Questions should be relevant to the research.
  - Questions should be organised in a logical order, starting with the easiest and proceed with more complex or sensitive questions. Demographic questions should be placed at the end of the questionnaire because many people find them either boring or intrusive.
Methodology

- Questions should be formatted consistently, especially in rating scales.
- Questionnaire instructions should clearly inform the respondent on whether only one or more answers are acceptable and how to navigate through the questionnaire.

3.4. Identification and Selection of Case Studies

The first questionnaire designed for the purpose of this research, following the above stated principles, was used primarily to select the organisations that were willing to participate as subjects in the case studies. It included a set of basic questions exploring the current KM practices of UK-based management consultancies and their suitability to participate in the next step of the research. In the first instance, management consultancies were selected because they are knowledge intensive organisations that are usually highly involved with KM and may offer KM consultancy. Their primary activity is the acquisition, creation, packaging, and application of knowledge (Apostolou & Mentzas 1999, p 129). As a result, their capacity to compete on the basis of accumulating knowledge is a defining feature of their industry and therefore they consider KM to be a core capability for achieving competitive advantage (Dunford 2000, pp 295-296). Additionally, the literature on KM presents numerous examples from the management consulting industry (Werr 2003, p 881). The objectives of the questionnaire were the following two:

- To collect basic data about the KM practices of management consultancies, and
- To solicit companies' participation in the next step of the research.

The choice of using a questionnaire to meet these two objectives was justified with the fact that the questionnaire was considered a convenient and efficient method to present the research to a relatively large number of companies and ask for their participation. The actual questionnaire can be found in Appendix A and a detailed description of the results can be found in Appendix B.
Methodology

Since none of the respondents of the questionnaire committed to participate further in the research, it was decided to broaden the scope of the research into other industries. Two of the industries, which have provided examples of the successful application of KM, are the engineering and the pharmaceutical sector. Therefore, the preliminary questionnaire was distributed to one company from the motorsport engineering industry and one from the pharmaceutical that were willing to participate as case studies.

3.5. Data Collection Methods

The unique strength of case studies is the ability to gather and analyse a variety of evidence, such as documents, interviews and observations (Yin 2003, p.8) Once the organisations willing to participate as case studies were identified, the following data collection techniques were used: field visits, questionnaires, interviews and documentation. The data collection tools focused on 6 main topics, which reflect the research objectives1:

1. Metadata scheme (O1, O6, O7)
2. System development (O3, O4, O5)
3. System administration (O3, O4)
4. System use (O2, O4)
5. System evaluation (O2, O4)
6. User attitude (O2, O4, O6)

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1 Objectives as stated in Chapter One

1. To identify and document the metadata elements currently used for the description of content created in the process of knowledge management
2. To determine the perceived usefulness of metadata, in terms of retrieval efficiency and trust towards the system
3. To critically analyse the metadata management strategy of the organisations studied
4. To investigate the cost-effectiveness of the application of metadata, both human- and system-generated
5. To explore the interaction of the data management model and the bibliographic control model of metadata and the potential of the two models in knowledge management practice
6. To identify the elements that may be specific for the description of knowledge
7. To map semantically the elements identified for the first objective to widely known and used metadata schemes
Methodology

Each tool addressed different issues under these topics, as appropriate. Investigating the same topics with different tools helped to triangulate the data collected and thus improve validity. The data collection process is shown in Figure 4.

![Data Collection Diagram]

Figure 4: The data collection process

3.5.1. Field Visits

When the two organisations agreed to participate as case studies, field visits were made in the first instance to meet the information and knowledge managers of the two organisations. The initial visits included a presentation of the project by the researcher, gaining of the company's agreement to the proposed plan and the development of a tentative time plan for the case studies. After the necessary confidentiality agreements were signed, subsequent field visits were used to gain familiarity with the companies and their efforts to manage knowledge. The KMS were also examined, in terms of functionality and metadata, and their retrieval efficiency was tested through simple, informal tests.

These site visits provided the opportunity for direct observation and produced extensive field notes, both of an observational and analytical nature.
Methodology

The observational evidence was useful in providing additional information (Yin 2003, p. 93); for example, the open plan office environment should be taken into account when discussing the knowledge sharing practices of the users. The field notes include information about the companies, the user groups and the development and management of the KMS, the metadata used and the major functions of the KMS. An informal evaluation of the KMS, the content found in it, the quality of the metadata and the search efficiency is also included.

The information and knowledge managers played a key role in the case studies as a whole. In both companies, it was they who agreed for their company to participate in the research and who arranged the field visits and the interviews. In particular, for the field visits, they provided valuable information about the companies and the KMS through informal discussions (Yin 2003, p. 90). These discussions were not recorded but some of the points raised were captured in the field notes.

3.5.2. Documentation

The analysis of documents relating to the KMS was used to corroborate and augment the data collected through the field visits, questionnaires and interviews, as is commonly done in case study research (Yin 2003, p. 87). These documents were collected from a number of sources. They included technical documents on the KMS published by the vendors on their website. Other case studies with organisations using the specific software were selected from the literature. Most significant, though, were the documents provided by the information and knowledge managers of the companies. The documents referred to the selection process and business case for the KMS, as well as some system statistics and other guidelines.

The documents were collected both before the first field visits and during the data collection process. Background information about the two companies was used before visiting them, in order to understand the environment in which the companies operate and the likely requirements of the KMS. Relevant documents, such as journal and magazine articles, white papers and web pages,
Methodology

were constantly used during the two case studies, in order to learn about the companies, the respective industries and the kinds of KMS used.

The benefits of using documentation in a case study is that documents contain exact names, references and details of an event and may have broad coverage, in terms of time, events and settings. They should be used though with caution because they may not be lacking in bias. They are also unobtrusive, in the sense that they are not created as a result of the case study (Yin 2003, pp 85-88). For the specific cases though, it was quite intrusive to ask for a company’s documents that included details on the system purchase and evaluation. Therefore, detailed information on purchasing was not asked.

3.5.3. Questionnaires

Questionnaires were distributed to the employees of the participating companies to examine their attitude towards the way knowledge was being organised, retrieved and reused. They addressed issues related to metadata, such as what and how much metadata they perceived to be useful and whether they would be willing to create them.

The choice of using questionnaires to collect the users’ attitudes towards the KMS and the metadata was justified with the following benefits of using a questionnaire:

- A questionnaire has low requirements in time and expenses; therefore, it provides the opportunity to collect data from a larger sample of the population.
- Respondents can complete as many questions of the questionnaire they feel appropriate at a time suitable for them. It was very important to take into consideration the time constraints of the target group and allow them to provide the data at their own convenience (Neuman 2003, p.289).
- Respondents are more likely to provide frank answers, when the researcher is not present.
- Questions are predefined and fixed, thus avoiding variation in the questioning process and interviewer bias.

The disadvantages of using a questionnaire were also analysed.
Methodology

- A questionnaire is often completed hastily and carelessly, resulting in poor data quality.
- It may generate low response rates.
- Misunderstandings cannot be corrected and the wording of the questions can have a major effect on the answers (Neuman 2003, p.289).

3.5.3.1. Questionnaire Design

The questionnaires were specific to each company and were developed based on the field notes. The aforementioned principles of questionnaire design in Section 3 3 guided the design of these questionnaires, too. In general, the respondents’ perspective was kept in mind and questions were constructed in such a way that respondents would be able to understand the questions and their answers would be meaningful (Neuman 2003, p.268). An effort was made to keep the questionnaires as short as possible given that the respondents would probably not be willing to spend much time from their working day filling in the questionnaire.

When writing the questions, multiple proofreading was necessary to ensure that there was no jargon or abbreviations, which the respondents would not understand. A short definition was provided for the term “metadata”, to make sure that all respondents, irrespective of their background, would have a common understanding of the term. The questionnaires included open-and closed-ended questions, which followed one another in order to adhere to the logical sequence of concepts and to make the questionnaire more pleasant to fill out (Moser & Kalton 1979, p.346). A large number of close-ended questions was in the form of Likert scales. These provided an ordinal-level measure of the user’s attitude. Seven scale steps were used to increase reliability. A neutral category (Undecided) was used, so that respondents would not be forced to agree or disagree with statements, for which they did not have strong views or have no view at all Filter and contingency questions were included to cover all possible answers about the use of KMS and metadata (Sudman & Bradburn 1983, p.225). Double-barrelled questions were avoided and only one concept was included in each question (Labaw 1980, p. 154). Response categories were mutually
Methodology

exclusive, exhaustive and balanced by offering bipolar opposites where necessary (Robson 2002, p.244). None of the questions included in the questionnaires were mandatory, respondents could answer only the questions they preferred.

3.5.3.2. Questionnaire Content

Although the two questionnaires were customised to each company, effort was made to keep them as similar as possible to allow for the comparison of the results between the two companies. In both questionnaires, the questions were organised in topics and each topic was addressed in a different web page. The content was organised as follows:

- Introduction (information on the research project, the scope of the questionnaire and a definition of the term “metadata”)
- Use of the KMS (frequency and purpose of use)
- Information and knowledge seeking preferences (searching, browsing and satisfaction levels)
- Metadata (significance and creation)
- Content quality (This set of questions, although not directly linked to the research objectives, was included because, in other research projects, it has been reported that users abandon KMS because of the poor quality of the content (for example, Desouza and Awazu 2005, p.765) Consequently, this factor had to be tested.)
- Overall user satisfaction
- Demographic profile of the respondents (These questions were included at the end of the questionnaire rather than in the beginning so that they would not seem as intrusive or threatening for the respondents).

The actual questionnaires can be found in Appendix C and Appendix H.
3.5.3.3. Questionnaire Administration

The questionnaires in both case studies needed to be tested and approved by the information and knowledge managers in each company. Their input was very valuable because they clarified details about the company terminology that otherwise might be confusing for the respondents. A small number of users was used in each company to pilot the questionnaire before its distribution, in order to predict data collection problems and to improve the survey outcomes (Presser et al. 2004, p.124). The pilot test provided useful feedback on some of the questions and minor modifications were made to address the issues that the users mentioned.

In both case studies, an electronic format for the questionnaire was necessary to allow quick, cost-effective distribution. For Company A, it allowed employees working remotely to have access to it and for Company B, it facilitated the distribution of it in more than one site in more than one country. The electronic format also complied with the company culture in both companies, where large volumes of information are circulated through emails. By using a web-based questionnaire sent directly to the researcher, users could be assured that the information and knowledge managers would not be involved in the data collection and therefore, they would be able to complete the questionnaire more honestly. In addition, web questionnaires provide more design features, compared to mail questionnaires, such as tools to guide the respondents through the questionnaire or to motivate them to complete the task (Couper et al. 2001, p.250). SurveyMonkey was the survey software selected because it allowed an unlimited number of surveys and questions, designing the questions according to the survey’s needs, and export of the data to spreadsheets for analysis.

3.5.4. Interviews

Face-to-face, semi-structured interviews were conducted with a small number of users in both companies to get more detailed answers to the questions of the study and to explore, in more depth, some of the issues that emerged
Methodology

through the questionnaire. The semi-structured interview was a more suitable method to collect rich data on the users' opinions of the impact of the KMS on managing knowledge and their attitude towards metadata. These interviews were very important because they allowed the users to report and interpret in their own words their attitude and preferences, providing valuable insights into how the system was being used and on self-perceived issues. Another advantage of the interviewing was that the researcher was able to explore causation, in other words to enquire why individuals behave in the way they do (Gorman & Clayton 2005, p.125).

The interview schedules for each case were developed after the preliminary analysis of the questionnaires. The same principles of question wording, as explained in 3.3, were followed and effort was made to avoid leading or hypothetical questions. The interview schedule included mostly open-ended questions on the following topics:

- System use (frequency of use, for which purposes, integration in the daily tasks)
- Metadata scheme (which metadata are significant for the evaluation of a knowledge asset, which metadata are missing from the existing scheme, what is the importance of metadata when searching/evaluating a knowledge asset)
- System administration (user participation in adding/updating the resources)
- User attitude (trust towards the system, retrieval efficiency, user friendly interface, willingness to provide metadata, ease of adding/updating a knowledge asset, impact of the system on knowledge sharing)

Copies of the interview schedules can be found in Appendix D and I.

Furthermore, the managers and the administrators of the KMS were interviewed to gain insight into how the system was developed, why and how well it served the organisation's needs. The interview schedule included questions on the topics:

- System development (strategic goals and objectives, user needs analysis, functions offered, modifications, customisation, personalisation and training)


Methodology

- System administration (responsibility for metadata creation, maintenance and updates)
- System use (statistics of usage and incentives used)
- System evaluation (metrics, evaluation processes, results and pay back period)
- Metadata scheme (rationale, standards and automated creation of metadata)
- KM practices

Copies of the interview schedules can be found in Appendix E and J.

Face-to-face, rather than telephone, interviews were used because they permit asking the most questions and all types of questions with the respondent focused on the interview, compared to telephone interviews. Semi-structured interviews were preferred because they may include open-ended questions and, although they are founded on an interview schedule, the researcher is able to ask additional questions according to the interviewee’s answers. Unstructured interviews were not optimal because they would not allow the comparison between the two cases. Structured interviews were not suitable either for this particular study because structured interviewing exposes all the informants to exactly the same questions with the aim of controlling the questions so that the answers can be reliably compared. In this study, each group of interviewees, i.e. users of the system, administrators and managers, needed to have a different set of questions adapted to their role in terms of the system.

In both cases, it was agreed that the interviews with the users should last approximately 30 minutes and the interview with the system’s manager should last 1 hour and 30 minutes. The information and knowledge managers offered to select and contact the interviewees, choosing employees from all departments and all levels of KMS use (heavy, adequate, and non-users). Therefore, a purposive sample of interviewees was used in both case studies.

All interviewees were guaranteed confidentiality and were assured that their identity, behaviour and comments would not be attributed directly to them. The only piece of personal information that was taken into consideration during the data analysis was the group/department to which they belonged to, in order to evaluate whether the KMS meets the needs of all groups/departments within the two companies.

81
Methodology

The interview schedules for the users were tested on two employees who were not selected for the actual interviews with the aim of checking for ambiguity in the questions and test the amount of time taken. Appropriate modifications were made according to their comments. It was not possible to test the interview schedules for the system's managers.

All interviews were recorded with the permission of the interviewees. The recordings, after their transcription, enabled the researcher to have and to be able to analyse an exact picture of what the interviewees have said, even after some time had lapsed.

3.5.5. Limitations on Data Collection

The case study research method is quite complicated with important implications on the role of the researcher, in terms of objectivity and rigour in both the data collection and data analysis. Working with an outside organisation raises the additional issues of confidentiality, privacy and politics. All these issues are thoroughly analysed in the last chapter in a process of critical reflection.

This section focuses specifically on the data collection process and on the advantages of working with these two organisations, commenting also on a number of minor or major complications on the method followed for the research project. These include issues of time management, sampling possibilities and specific data collection methods.

Data collection may be facilitated by superior asking for employees' participation in the research. This was quite obvious in Case Study A, when the Head of Business Systems and Knowledge Management asked the engineers to complete the questionnaire and most of them completed the questionnaire on the same day. In both case studies, the information and knowledge managers were very helpful in arranging all the interviews.

On the other hand, when collaborating with an outside organisation, in general, a major issue is time management. The researcher had to schedule the activities on dates that were suitable for the company and within various other time limitations. For example, the interview with the users in both case studies
Methodology

had to last only 30 minutes because of their tight schedule and limited availability.

In addition, formal sampling methods were not always possible, thus making the generalisation of the findings more difficult to support. In both case studies, the interviewees were selected by the companies as a matter of convenience. Statistically, this may have an impact on the results of the interviews, as it can be argued that the sample of interviewees chosen was not representative of the entire population. Also, for Case Study B judgement sampling was used to select 400 out of the approximately 10,000 users, on the basis of them using the system during the past month - 300 users had contributed to the library and a different 100 had read documents from the library. In Case Study A no sampling methods were required because the whole user population was manageable and they were all sent the questionnaire.

Lastly, it was the researcher's intention to observe a small number of employees while they were using the system to retrieve knowledge for purposes of data triangulation. Neither a camera nor special software that records the screen and the keyboard strokes could be used for confidentiality purposes. Instead, users were asked to report their thoughts on the efficiency of the system and to criticise the results of their query in terms of accuracy, relevancy and presentation. This task was not undertaken as an experiment, i.e. with predefined queries in a secluded environment. It was more appropriate to observe the participants in the course of their daily tasks in order to get as accurate a picture as possible of their actual interaction with the system and their perception of it. This observation task was not possible because there was not enough time to conduct the interview and the observation task and in some cases the interviews took place in meeting rooms rather than at the users' desks.

3.6. Data Analysis

The data collection stage produced a variety of data, such as field notes, documents, questionnaires and interview transcripts. Each was analysed both separately and in comparison with the others. Data analysis is the process of bringing order, structure and meaning to the mass of collected data (Gorman &
Methodology

Clayton 2005, p.206). Figure 5 outlines the data analysis process followed. The main aim of both data collection and analysis was to maintain consistency in the treatment of the cases, which allowed the findings to be reliable and valid.

The reliability of qualitative data can be secured when, firstly, the researcher records consistently the data and, secondly, validity can be supported when there are numerous pieces of evidence. If both of these conditions are met, then it could be argued that the findings of this study will provide an authentic and valuable account of the cases (Neuman 2003, pp.184-186).

The reliability of the quantitative data was increased by conceptualising the constructs as clearly as possible, by using multiple indicators of a variable and by using pilot tests (Neuman 2003, pp.180-182).

![Data Analysis Diagram]

Figure 5: The data analysis process
Methodology

3.6.1. Analysis of Quantitative Data

The quantitative data collected through the questionnaires were analysed statistically to find the user satisfaction levels with the KMS and the metadata. Before proceeding to the analysis of the data, the internal reliability of the questionnaires was tested using the most common reliability coefficient, Cronbach's alpha. It is based on the average correlation of items within a test if the items are standardised or on the average covariance among the items, if the items are not standardised (Coakes et al. 2006, p.116). A value at the level of 0.70 or higher is generally accepted to indicate a scale of high reliability (Hinton et al. 2004, p 363).

The data collected were measured at the nominal and ordinal level, thus making them categorical data (Elliot & Woodward 2007, p.39). Although in some cases Likert scales are treated as numeric data, in this instance they were treated as categorical data because the assumption that the differences between any two categories were equal could not be made. Data were described and reported as counts, frequencies or percentages of subjects and presented with frequency tables and cross-tabulations.

The description of the results was augmented through some statistical tests to explore whether there were any relationships in the responses given between different groups of respondents. It would be meaningful to explore whether particular groups, or respondents of certain age or qualifications, have different views from others. Also, the length and the frequency of use of the KMS have been identified as variables that can influence the searching skills, attitude towards metadata and KM and the overall level of satisfaction of the respondents.

The nature of the data, i.e. data measured by either nominal or ordinal scales, determined the use of nonparametric (or distribution-free) methods of analysis (Siegel & Castellan 1985, p 32-35). Due to the fairly small number of responses, some of the categories had to be collapsed so that meaningful analysis of the data with statistical tests was possible.

A first set of hypotheses was formulated based on the independent variables of gender, age, qualifications, years worked in the company and location. These were tested to see whether there was any covariation in the data.
Methodology

referring to the information seeking behaviour and search skills, metadata and the respondents' attitudes to the KMS. Younger people are generally more positive towards the use of new technologies, highly educated people are more likely to have used similar systems in the past and tend to have better information searching skills, and people that have been longer in the company may be more resistant to the adoption of new IT systems; all these assumptions needed to be tested in order to be accepted or rejected in the context of the two case studies.

These hypotheses were tested by comparing the observed frequencies of cases for independence or relatedness with Pearson's Chi-square test. This is a statistical significance testing procedure, used to test the hypothesis that there is no relationship between the variables in the population and it tests whether the observed data justify rejecting this null hypothesis (Weisberg et al. 1996, p.277). The significance level selected is the well-accepted 0.05 (Bryman & Cramer 2005, p 210) If a test proves statistically significant, it indicates that overall there is a relationship between the two variables, which is unlikely to be explained by chance factors.

The reliability of the Chi-square test depends on a number of assumptions. The most important of these is that the results may not be reliable if any cell has an expected frequency of less than 1 or if 20% or more cells have an expected frequency of less than 5. Therefore, the minimum expected frequency was reported along with the probability in order to accept or not the reliability of the results. Due to the small number of responses, many of the tests had a very low frequency count, therefore they were not reliable and the hypotheses associated with them could not be rejected, nor accepted. For this reason, it is mostly the significant results that were reported.

A number of correlation tests were also performed to explore possible relationships between the information seeking behaviour of the respondents, their attitude towards metadata and their level of satisfaction with the KMS. Correlation coefficients are the measures of co-relationship between two variables. They give an indication of both the strength and the direction of the relationship between the variables. At the ordinal level, the Kendall correlation coefficient or Kendall's tau is the most frequently used measure of association and it measures covariation (Weisberg et al., 1996 p.274). Values range from -1 to 1. Kendall's tau-b was selected, instead of tau-c, because it takes into account
Methodology

ties. It is also most appropriate when the number of columns and rows is equal, as in this instance (Elliot & Woodward 2007, p.149).

3.6.2. Analysis of Qualitative Data

Field notes, interview transcripts, documentation as well as the open-ended questions of the questionnaires were analysed with the use of the computer-assisted qualitative data analysis software Atlas ti, which facilitated the data storage, coding, retrieval and allowed easy comparisons and linking between the data. This software was selected based on availability and because it provides adequate functionalities to analyse the volume of data. The advantage of using qualitative data analysis software, instead of a matrix, is that it offers flexibility in the coding stage, so that the user can modify the codes and themes if necessary. It also enables the user to run word searches within the data and collate all quotes with similar coding. Using software is, in general, more suitable in exploratory studies, as this one, because a matrix demands the early definition of the themes. Although the use of software greatly facilitates the qualitative analysis, especially the coding, the researcher is still responsible to code the data properly and to identify the common topics and themes.

The analysis of qualitative data may even occur during the data collection stage, as patterns, themes and insights take shape (Patton 2002, p 436). This was particularly true when the preliminary analysis of the open-ended questions of the questionnaire was used to formulate the interview schedules.

The analytical process of the qualitative data can be divided in the following steps:

- Data preparation: transcribing interviews, removing all personal information, and allocating ID codes.
- Data management. developing an analytical structure, identifying broad themes, and refining the code frame.
- Data description: affixing codes to specific quotes, noting reflections and other remarks, and sorting through the data to identify similar phrases, patterns, and themes.
Methodology

- Data explanation and interpretation. Building generalisations that cover the consistencies discerned in the data, seeking for associations, contradictions and exceptions, and confronting the generalisations and relationships with the research literature (Miles and Huberman 1994, p.8-9).

With the exception of the first step, all other steps may be repeated as this process is not strictly linear but requires continuous adjustments as the meaning of the data becomes clearer.

More specifically on coding, it is two simultaneous activities. Mechanical data reduction and analytical categorisation of data into themes. Codes are composed of five parts: the label or name of the code, a definition with a main characteristic, a flag description of how to recognise the code in the data, any exclusions or qualifications and an example (Neuman 2003, p.441-445). In vivo codes, i.e. codes that derive from the interviewees' terms and language, were used in the most part, along with codes constructed for the field notes and the documentation. In vivo codes are preferable, as opposed to constructed codes, i.e. concepts borrowed from the social science literature, because they are closer to the data and allow a bottom-up approach to the derivation of categories from the content of the data (Coffey & Atkinson 1996, p 32).

Theoretical coding was used to develop theories. It included the processes of open, axial and selective coding. Open coding was conducted during the first read of the data. Initial codes are assigned to condense the mass of data into categories. Line-by-line coding, i.e. coding each line of an interview, was used because it helps to refrain from inputting personal motives or issues to the collected data (Charmaz 1995, p 37). A list of codes was then created to facilitate the identification of main themes. Axial coding, i.e. review and examination of the initial codes, was then performed to organise the ideas or themes and identify "the axis of key concepts in analysis" (Neuman 2003, p.444) Axial coding facilitates the connection between evidence and concepts by searching for causes and consequences, conditions and interactions. Last, selective coding, i.e. scanning through the data and previous codes, continued the axial coding at a higher level of abstraction. The aim was to give a short descriptive overview of the data and to identify specific quotes that illustrate the case. These quotes were
Methodology

selected to present and justify the theory (Flick 2002, pp.177-183). An example of the coding is presented in Table 6.

<table>
<thead>
<tr>
<th>Code Label</th>
<th>Definition</th>
<th>Description</th>
<th>Exclusions or Qualifications</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Google - effect</td>
<td>The effect of Google on enterprise search</td>
<td>Users would like a Google-like search engine</td>
<td>Include quotes on any other web search engines</td>
<td>&quot;The search engine should be easy to use like Google.&quot;</td>
</tr>
</tbody>
</table>

Table 6: Coding Example

3.6.3. Cross-case Analysis

Cross-case analysis was used to analyse the data from the two case studies in conjunction to test whether the events or processes of each case were not wholly idiosyncratic. The most important benefit of the multiple case design and subsequent cross-case analysis is that it provides indications for analytic generalisation, i.e. to expand and generalise theories. Data were analysed to identify similarities and differences to draw conclusions that could be applicable to other similar settings. Cross-case analysis also facilitates the deeper understanding and explanation of the cases. Negative cases, which strengthen the theory, may emerge (Miles & Huberman 1994, p.173).

Cross-case analysis enabled the comparison of the two cases against predefined categories, in search of similarities and differences, or by classifying the data according to data sources (i.e. questionnaires and interviews). Cross-case analysis was also selected because it is an effective method to communicate the findings of two projects with similar objectives, such as the application of a KMS. By analysing the context of implementation across projects, it was possible to develop a comparative framework for analysis.

Miles and Huberman (1994, pp.174-177) present two main approaches for cross-case analysis; a variable oriented approach focusing on one variable and applying this across all cases, and the case oriented approach studying one case in depth, then examining successive cases to see if the pattern continues to emerge. The first approach was followed because there were only two case
Methodology

studies and this fact allowed the in-depth analysis and comparison of each variable across both cases.

3.7. Summary

This chapter provided a brief analysis of the research paradigms and provided the rationale for selecting the case study research design as the method for this research. The process of selecting case studies was outlined and the specific methods for data collection and data analysis were presented.

The following two chapters present the two case studies in detail, they provide a thorough description of the KMS used in each company and then the results of the data collection process are analysed. Findings are presented following a thematic approach, in which a typology of themes is used to structure the presentation (Gorman & Clayton 2005, p.235).
This chapter describes the case study undertaken with the collaboration of the motorsport engineering company. The data collection for case study A was conducted in June and July 2006. The highly competitive nature of the business meant that a confidentiality agreement had to be signed between the company, the researcher and her supervisors. The case study intended to investigate how Windows SharePoint Services has been implemented in Company A as a KMS and how metadata are used within SharePoint. Emphasis was put on the users' attitudes towards SharePoint and metadata, as their acceptance of and satisfaction with SharePoint were critical in its adoption and successful implementation.

The specific objectives were:

- To identify the main uses and the frequency of use of SharePoint.
- To measure users' satisfaction with SharePoint.
- To investigate users' attitude towards metadata.
- To explore how SharePoint is managed as a KM tool
- To explore Company A's metadata management strategy.

The chapter provides a short background description of Company A and then the description and analysis of the data collected. It concludes with a number of observations that are further discussed and compared with those from Company B in Chapter 6.

4.1. Company A Presentation

Company A is a motorsport engineering company with a long and successful history. It was a suitable case study because knowledge creation and sharing play a significant role in maintaining its competitiveness. Operating in the highly competitive and technological environment of motorsport, Company A comprises various engineering and administrative departments, ranging from Vehicle Design and Aerodynamics, to Marketing and Paint Shop. Figure 6 presents a simplified organisational chart of Company A, with the Engineering
Case Study A

Department highlighted, as this case study focused primarily on how they use SharePoint. The development of a new racing car every year and the necessary adjustments for each race demand very strict deadlines on research and design. Having all pieces of knowledge available in a timely manner is of crucial importance. Developing a new car each year also means that a wealth of data, information, and knowledge is produced on a daily basis.

![Organisational Chart of Company A](image)

**Figure 6:** Simplified organisational chart of Company A

4.2. Documentation

Documentation related to this case study was collected from a number of sources during the data collection phase. Information on the company and the user manual and other technical documents on SharePoint published by Microsoft on its website were used prior to the field visits to prepare for the first meeting with the Head of Business Systems and Knowledge Management. These were discussed in Sections 2.2.1.1 and 2.5.1. Most significant, though, were the
Case Study A

internal confidential documents provided by the Head of Business Systems and Knowledge Management, referring to the selection process and business case for SharePoint, as well as some system statistics. The preliminary analysis of these documents was also used to prepare the interview schedules.

The rationale for developing a KMS in Company A was to increase the efficiency in accessing and sharing of information and knowledge. The strategic goals were to improve the quality of the information produced, to share it using the appropriate medium and to implement a document management system in order to support it.

SharePoint had been selected after an examination of six software packages because it fulfilled all of the company's requirements (search engine, ease of publishing, ease of entering metadata, version control, low maintenance security, integration with Microsoft Office, customisation and more) Also, it is a widely used, cost effective package that can be upgraded with the addition of more applications.

The Engineering Department is organised into the groups Design, Aerodynamics, Stress Analysis and Materials, Simulation, Labs, Race Engineering and Vehicle Electronics (Figure 6) Each group was responsible for the development of its website with the guidance of the Head of Business Systems and Knowledge Management, and most teams seemed to perform well at this task. Some of the other departments of the company had developed additional sites, such as the supply chain and legal department. According to a storage report produced in the end of July 2006, the Design group site was significantly larger in terms of Megabytes used, followed by the sites of the Simulation, Race Engineering, and Stress Analysis and Materials sites. This may be explained by the larger number of designers as well as the large number of drawings and pictures they store in SharePoint.

The Design site also received the largest number of visits in the first half of the 2006, even more than the home page which was second in number of visits. Next in the rank, the sites most visited were the Race Engineering, Aero and Simulation site.
Case Study A

4.3. Field Notes

A number of site visits were made to become familiar with the company and the KMS, prior to the design of the survey. The preliminary questionnaire used for the identification of the case studies held valuable information for the preparation of these visits. The visits provided a valuable insight into the company and its KM practices.

Windows SharePoint Services was installed in summer 2005 and was used mainly by the Engineering Department of Company A, i.e. 100 – 150 employees and it held 10,000 – 99,999 resources, according to their responses in the preliminary questionnaire. It is used mainly as a document management system to facilitate information and knowledge sharing. Announcements are used to inform users of recent developments. These announcements also create a sense of community. No use is made of the collaboration facilities it offers.

4.3.1. Site Structure and Navigation

The structure was designed based on the organisational structure of groups, with each group having its own site. The main purpose of having a site was to store the group’s documents in a document library. SharePoint presented a folder structure, which resembled closely the shared file system that was used extensively prior to implementing SharePoint. However, some of the folders of SharePoint remained empty, which created a sense of frustration for the users. This structure also led the users to have to use many mouse clicks when browsing for content in order to reach the document of interest. Documents were normally presented on the screen in lists with the metadata: "Type", "Title", "Description", "Author", and "Date". Users could also apply filters to these lists, by selecting, for example, documents submitted by a specific author.
Case Study A

4.3.2. Metadata

The metadata scheme was created by the Head of Business Systems and Knowledge Management in collaboration with the users. The scheme included metadata that were default in SharePoint, of the descriptive type, such as “Title” and “Author”, and metadata specific to the business, such as “Car Marque”.

Users were responsible for creating the metadata for each document they uploaded in a document library. A metadata input form, with mandatory and non-mandatory metadata elements, would appear every time a user uploaded a document. Each site library required different metadata to be input by the user because other metadata elements were more relevant and necessary to particular groups. For example, all metadata elements defining “Event” were important for the Race Engineering group but not as much for the Vehicle Electronics. Metadata elements that are created automatically from SharePoint are mostly of the administrative type “Author”, “Email”, “Checked out to”, “Creation Time”, “Image URL”, “Last Modified Time”, “Last Author”, “Name”, “Picture Height”, “Picture Width”, “Site URL”, “Size”, “Type” and “URL”. Table 7 presents the metadata elements used across all document libraries.

Quite often, the metadata provided for each document did not provide enough information about the document because the user neglected to fill-in all the properties in the metadata form. For example, there were quite a few instances where the title and the description of a document were identical, as the user copied the title in the description field to avoid writing a new and more comprehensive description. Often, photographs were not well described, having a generic title, such as “IMG_0633”.
Case Study A

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</table>

Table 7: Metadata Elements used Across Document Libraries

The list of possible values for the metadata element “Document Category” was quite extensive and particular again for each group, replicating some document types across groups, e.g. “Lab Test Report”, “Report”, “RIG/DYNO Report” and “Technical Report” (Table 8).

<table>
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<th>Document Category Values</th>
<th>Coding Standards</th>
<th>Data</th>
<th>Drawing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fault List</td>
<td>Form</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Harness Topology Diagram</td>
<td>How To</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lab Schedule</td>
<td>Lab Test Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Materials Data</td>
<td>Maintenance Log</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating Manual</td>
<td>Operation Procedure</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Photo</td>
<td>Reference</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Releasing</td>
<td>Report</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Schedule</td>
<td>Specification</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Task list</td>
<td>Technical Note</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Template</td>
<td>Testing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wiring Diagram</td>
<td>Wiring Schedule</td>
<td></td>
<td>Other</td>
</tr>
</tbody>
</table>

Table 8: “Document Category” Values
Case Study A

There was not an extensive use of subject metadata. Different groups used different subject terms, with some being very similar, e.g., "Electrical General" from Vehicle Electronics and "Electrical" by Labs Table 9 presents a list of possible values the metadata element "Subject".

<table>
<thead>
<tr>
<th>Subject Terms</th>
<th>Actuators</th>
<th>Brakes</th>
<th>Camera Cover Heat Shield</th>
<th>Clutch</th>
<th>Development Studies</th>
<th>Engine</th>
<th>Front Suspension</th>
<th>Harnesses</th>
<th>Impact Test</th>
<th>Performance Studies</th>
<th>RCS &amp; Rear Wing</th>
<th>Suspension</th>
<th>Transmission</th>
<th>Wheel/Rim</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bodywork</td>
<td>Calibration</td>
<td>Cockpit</td>
<td>Dampers</td>
<td>Electrical</td>
<td>Exhaust System</td>
<td>Front Wing</td>
<td>Hoses</td>
<td>Monocoque</td>
<td>Personnel</td>
<td>Rear Light</td>
<td>Suspension General</td>
<td>Transmission Software</td>
<td>Wheels</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Crash Damage</td>
<td></td>
<td>Electrical General</td>
<td></td>
<td>Fuel System</td>
<td></td>
<td>Oil System</td>
<td></td>
<td>Rear Suspension</td>
<td>Top Body</td>
<td>Software</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Floor</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 9: Subject Terms across site document libraries

The implication of having different metadata and subject terms used across the site document libraries was that there was no uniformity in the description of documents. This inconsistency may cause confusion to the users when evaluating a document and obstacles in the function of the search engine.

4.3.3. Search Engine

SharePoint offers a search and an advanced search facility. The user can select which source to search: all sources, the network drive, the people directory, or the portal content. Search by type is also available: by any type, area items, areas, document libraries, documents, lists, people, picture libraries, pictures. Search by date is also available and user can search for content created or modified in a given time period. It includes a number of default options based
Case Study A

on metadata, which are really not relevant to the company's needs, such as picture height.

During the site visits, a number of queries were submitted to the search engine, in order to test its efficiency. Creating a simple query and getting relevant results proved to be difficult, especially when phrases were used as queries.

4.3.4. Results Presentation

Each resource is presented with its title, author, date, a short description (5-10 words), URL and size. More details are available such as creation time, last modified time, last author, and document category.

Results are grouped and sorted. The user can group the results by area, author (sorted alphabetically by the first name instead of the surname), date (by year but not exact date in the year), none (it does it by relevance in this case), site (it does it by group e.g. Aero), size (large >1MB, medium>150KB, small>30KB, tiny<30KB)

The user can also sort the results by author (again by the first name), date (last modified date), relevance, size and title. The criteria that create the relevance order are not very clear and frequently the relevance order is different based on the grouping of the results.

4.3.5. Personalisation

Users could personalise SharePoint to some extent according to their needs by setting up alerts for specific content and creating a list of "My links" with documents that are of particular interest to them.

Most importantly, they could personalise the appearance of the document libraries. They could create which metadata would appear with the list of documents and they could select filters, based on metadata, that would define which documents are presented on screen.
Case Study A

4.4. Questionnaire Results

Based on the field notes, a questionnaire was designed and distributed to all engineers, who are the main users of the KMS, as well as to other groups of occasional users, such as employees in the Manufacturing, Supply Chain and Legal departments. The total number of recipients was manageable, approximately 140, so there was no need to select a sample. An electronic format was necessary to allow for quick, cost-effective distribution. It was decided that a web-based questionnaire tool would be more suitable, instead of using SharePoint's facility for surveys, because it would provide the necessary anonymity for the respondents. Additionally, using SharePoint for this questionnaire might have had some impact on the data collected since one of the questions was whether SharePoint is being used or not. The survey took place on the 23 - 27 June 2006. The actual questionnaire can be found in Appendix C.

A total of 85 responses to the questionnaire were received, corresponding approximately to 65% of the total users. The total number of responses in each question fluctuates as none of the questions was mandatory to answer. Most of the respondents provided their demographic details. Sixty-two of the respondents were male and only two were female, as expected because it reflects the gender balance of staff. The largest group of respondents (19, 29.2%) were between 26 and 30 years old, had an undergraduate degree (27, 42.2%) and had been working for the company from 3 to 6 years (32, 49.2%). The largest group of respondents work in the Design or the Simulation Group (17, 26.2%). Table 10 provides the respondents' background information in more detail.

---

* (number of respondents, percentage of respondents)
Case Study A

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Categories</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>62</td>
</tr>
<tr>
<td>Age</td>
<td>Under 20</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20 – 25</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td>26 – 30</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>31 – 35</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>36 – 40</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>41 – 45</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>46 – 50</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>Over 50</td>
<td>4</td>
</tr>
<tr>
<td>Qualifications</td>
<td>NVQ or equivalent</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>Undergraduate</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Master’s</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>PhD</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>12</td>
</tr>
<tr>
<td>Years in Company A</td>
<td>Less than 1</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>1 – 2</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>3 – 6</td>
<td>32</td>
</tr>
<tr>
<td></td>
<td>More than 7</td>
<td>18</td>
</tr>
<tr>
<td>Group</td>
<td>Aero</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>Design</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Labs</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Race Engineering</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Simulation</td>
<td>17</td>
</tr>
<tr>
<td></td>
<td>Stress Analysis &amp; Materials</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Vehicle Electronics</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 10: Demographics of the respondents

Before proceeding to the analysis of the data, the internal reliability of the questionnaire was tested using the most common reliability coefficient, Cronbach's alpha. A value at the level of 0.786, that the questionnaire produced, is generally accepted to indicate a scale of high reliability (as explained in Section 3.6.1). Therefore, the questionnaire was judged as reliable.

4.4.1. Description of Responses

Respondents were asked when they used SharePoint for the first time and how often they use it. The majority indicated that they had used SharePoint for more than six months (48, 56.5%) and that they use it more than once a day (33,
Case Study A

38.8% (Tables 11 and 12). The group that uses SharePoint most frequently is Simulation (11, 64.7% of the group uses it more than once a day), followed by Aero (5, 41.7%) and Design (5, 31.3%).

<table>
<thead>
<tr>
<th></th>
<th>No. of Respondents</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over a month ago</td>
<td>9</td>
<td>10.6</td>
</tr>
<tr>
<td>Over three months ago</td>
<td>7</td>
<td>8.2</td>
</tr>
<tr>
<td>Over six months ago</td>
<td>48</td>
<td>56.5</td>
</tr>
<tr>
<td>Over a year ago</td>
<td>21</td>
<td>24.7</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 11: When did you first use SharePoint?

<table>
<thead>
<tr>
<th></th>
<th>No. of Respondents</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than once a day</td>
<td>33</td>
<td>38.8</td>
</tr>
<tr>
<td>Once a day</td>
<td>11</td>
<td>12.9</td>
</tr>
<tr>
<td>2 - 3 times a week</td>
<td>25</td>
<td>29.4</td>
</tr>
<tr>
<td>Once a week</td>
<td>9</td>
<td>10.6</td>
</tr>
<tr>
<td>Once a month</td>
<td>1</td>
<td>1.2</td>
</tr>
<tr>
<td>Rarely</td>
<td>6</td>
<td>7.1</td>
</tr>
<tr>
<td>Never</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 12: How often do you use SharePoint?

Accessing technical documents that are necessary for their work is the main reason why respondents use SharePoint (69), while contributing documents to SharePoint and using it to search for information or to keep up-to-date with the development of the car also received a significant number of responses (Figure 7).

Figure 7: For which purposes do you use SharePoint?
Case Study A

Other purposes indicated were to access JobShop viewer and the CFD job list, to find people in the company, to browse drawings and read technical magazines and, finally, to use it as a database for current project work and for FIA correspondence.

SharePoint was considered to be important for the daily tasks of 46 (55%) of the respondents. It is more important for the Simulation and the Design group as stated by 12 (70.6%) and 11 (68.8%) respectively of the respondents of these two groups. Among the reasons stated were again the JobShop viewer and the CFD job list, the employee contact details, and the FIA documentation. Quite a few of the comments (20) though referred to SharePoint as an easy way to access technical documents and share information with their colleagues.

The information seeking behaviour and satisfaction of the respondents were measured with a number of statements in Q.6. The larger group of respondents agreed that they are comfortable in searching in SharePoint for the information or knowledge that they need (23, 28%) (Figure 8) and that most of the time, they manage to find the information that they are looking for (33, 41%) (Figure 9). Respondents from the Simulation group were more positive to these two statements, followed by those in the Design and the Aero group.

![Figure 8: I am comfortable in searching for the information or knowledge that I need.](image-url)
Case Study A

Figure 9: Most of the time, I manage to find the information that I am looking for.

Browsing for information is the preferred method for information seeking (somewhat agreed 28, 35%) (Figure 10), whereas the search engine at the top right corner of SharePoint and the advanced search are less favoured (Figures 11 – 13).

Figure 10: I prefer to browse for information.

Figure 11: I prefer to use the search engine.
Case Study A

Figure 12: I prefer to use the advanced search.

The majority of respondents were undecided or disagreed with the remainder of the statements referring to information seeking and search engine satisfaction. Thirty-five of them (45%) were undecided and 34 (43%) somewhat or strongly disagreed with the statement that they find it easy to perform a complicated search. Thirty (38%) were undecided and 29 (36%) somewhat or strongly disagreed with the statement that the search options are easy to use. Twenty-nine (36%) were undecided and 30 (38%) somewhat or strongly disagreed with the statement that they are satisfied with the results they are getting form the search engine. Nevertheless, 36 (45%) of the respondents agreed or somewhat agreed that they are satisfied with the way results are presented, probably because SharePoint gives a number of options for sorting the results of the search engine.

The most significant metadata tags for searching and evaluating a document are “Subject”, “Name”, “Title”, “Description”, “Car Marque” and “Author”, based on the ratings of the three most significant metadata. “Subject” received higher rating than the other metadata (27 out of the 55 respondents have rated it as the most important), but it is interesting to note that “Subject” is not used extensively by all Groups.

The vast majority of the respondents (53, 93%) did not identify any metadata tags that should be added to SharePoint, whereas one suggested that the “Test Week Number” would be useful to add. Others have made general comments on the kind of metadata that should be used so that the search engine would be more efficient:
Case Study A

"Some that the search engine can recognise. At the moment the searching is near impossible...The search engine is very easily fooled into returning barely matching strings in preference to more closely matching ones."

"Tags should be used to replace folders to a large degree - Design especially, is highly cluttered with folders, and given the search facility is so "pants" this makes finding stuff nigh-on impossible. If we changed to using a few tags to describe the document, and then filtered to create 'pseudo folders' that would be much easier."

Another respondent identified the problem that almost every group needs highly specialised metadata along with the descriptive metadata that each group uses, i.e. "Title", "Author", etc:

"This varies dramatically depending on the type of documents being loaded, just as some of the above are irrelevant to a lot of documents, for example. "Car marque", "Event Location" and "Event Type" are of no relevance to a component spec."

The next set of questions referred to uploading documents in SharePoint and adding the appropriate metadata. 35 out of the 67 respondents (52.2%) have uploaded at least one document in SharePoint and the majority of them (14, 40%) uploads documents at least once a week. Out of 47 respondents, 25 (53%) strongly or somewhat agreed that it is easy to fill-in the metadata fields (Figure 13), although 22 (47%) somewhat or strongly agreed that it is time-consuming to do so (Figure 14). Respondents from the Simulation group were the most positive about finding it easy to fill-in the metadata fields, although half of them found it time-consuming, but it is mostly respondents from the Aero group that find it time-consuming to fill-in the metadata fields. Nevertheless, 30 (64%) somewhat or strongly agreed that it is important to fill-in the metadata fields (Figure 15). In accordance with the above, it was the Simulation group that is most convinced about the importance of filling-in the metadata fields.

105
Respondents did not have strong views on the rest of the questions on metadata. The majority were undecided as to whether they would prefer someone else to fill-in the metadata for them (19, 40%) or to edit the metadata they have provided (21, 45%). They were more positive about the automatic creation of metadata by SharePoint, with 25 (43%) somewhat or strongly agreeing that they would prefer it if SharePoint was to fill-in the metadata fields automatically. They did not have very strong views on the subject classification, with 22 (47%) being undecided as to whether they would prefer to add their own subject
Case Study A

category. They were more positive about using the drop down lists to add subject metadata, as 25 (50\%) somewhat or strongly agreed with that statement. The majority again did not have strong views on whether the subjects in the drop down list are satisfactory (22, 47\%) or on whether they would like to add more subjects in the drop down list (18, 41\%).

One of the most positive findings was that the majority agreed that the content found in SharePoint is accurate, up-to-date, reliable and comprehensive (Figure 16).

Figure 16: The documents found on SharePoint are accurate, up-to-date, reliable and comprehensive.

Respondents were asked next about their attitude towards SharePoint as a KMS. Out of the 65 respondents, 39 (61\%) agreed or somewhat agreed that they are satisfied with the overall efficiency of SharePoint (Figure 17), and 39 (60\%) stated that SharePoint is their first port of call when they are looking for documents and/or information (Figure 18). Respondents from the Design Group were the most satisfied with the overall efficiency of SharePoint, even though the older file share system was still in place.
Most of the respondents (33, 51%) strongly or somewhat agreed that SharePoint successfully meets their daily information needs but most importantly 52 (79%) strongly or somewhat agreed that SharePoint has improved access to technical information (Figure 19). This result is in agreement with the comments made in Q.5 as to how important SharePoint is in their daily tasks.
**Case Study A**

As a result, the larger group of respondents somewhat or strongly agreed that by using SharePoint they spend less time looking for documents and information (26, 56%), using SharePoint enables them to accomplish tasks more quickly (31, 47%) and more easily (33, 51%). Learning to use SharePoint was easy for the larger group of respondents (47, 70%), partly because SharePoint’s navigation and site structure is logical and easy to use for 31 respondents (47.7%) and SharePoint libraries’ folder structure is logical and helpful when looking for documents for 26 (40%).

Since each group had a different structure in its site library and the larger group of the respondents preferred to browse for documents, the search for a relationship between the group and their attitude towards navigation and site structure was meaningful. Table 13 provides a cross-tabulation of the groups and their attitude towards the navigation and site structure. Aero and Simulation are more positive to the statement than the Design or the Race Engineering group.

| **SharePoint’s navigation/site structure is logical and easy to use.** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Group** | **1** | **2** | **3** | **4** | **5** | **6** | **7** |
| Aero | Count | 2 | 2 | 4 | 3 | 0 | 0 | 1 |
| % Group | 17 | 17 | 33 | 25 | 0 | 0 | 8 |
| Design | Count | 0 | 1 | 8 | 4 | 1 | 1 | 1 |
| % Group | 0 | 6 | 50 | 25 | 6 | 6 | 6 |
| Race Engineering | Count | 0 | 1 | 2 | 2 | 1 | 1 | 2 |
| % Group | 0 | 11 | 22 | 22 | 11 | 11 | 22 |
| Simulation | Count | 2 | 3 | 2 | 2 | 4 | 3 | 1 |
| % Group | 12 | 18 | 12 | 12 | 24 | 18 | 6 |
| Vehicle Electronics | Count | 0 | 0 | 0 | 3 | 2 | 0 | 0 |
| % Group | 0 | 0 | 0 | 60 | 40 | 0 | 0 |
| Other | Count | 0 | 1 | 2 | 1 | 1 | 0 | 0 |
| % Group | 0 | 20 | 40 | 20 | 20 | 0 | 0 |
| Total | Count | 4 | 8 | 19 | 15 | 9 | 5 | 5 |
| % of Total | 6 | 12 | 29 | 23 | 14 | 8 | 8 |

* Labs and Stress Analysis and Materials are excluded from the table because they did not have any counts.

** 1 = Strongly Agree; 2 = Agree; 3 = Somewhat Agree; 4 = Undecided; 5 = Somewhat Disagree; 6 = Disagree; 7 = Strongly Disagree

Table 13: Cross-tabulation of the groups and their attitude towards the navigation and site structure
Table 14 provides a cross-tabulation of the results to the statement “SharePoint libraries’ folder structures are logical and helpful when looking for documents” for each group. Once again, the Aero and the Simulation group appeared to be more positive than the other groups.

<table>
<thead>
<tr>
<th>SharePoint’s libraries’ folder structures are logical and helpful when looking for documents.</th>
<th>1**</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group</strong></td>
<td>Count</td>
<td>% Group</td>
<td>Count</td>
<td>% Group</td>
<td>Count</td>
<td>% Group</td>
<td>Count</td>
</tr>
<tr>
<td>Aero</td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
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<td>16</td>
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<td>8</td>
<td>16</td>
<td>4</td>
<td>16</td>
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<td></td>
</tr>
<tr>
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<td>2</td>
<td>16</td>
<td>4</td>
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<td>Simulation</td>
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<td></td>
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<td>16</td>
<td>32</td>
<td>16</td>
<td>11</td>
<td>16</td>
</tr>
</tbody>
</table>

* Labs and Stress Analysis and Materials are excluded from the table because they did not have any counts.
** 1 = Strongly Agree; 2 = Agree; 3 = Somewhat Agree; 4 = Undecided; 5 = Somewhat Disagree; 6 = Disagree; 7 = Strongly Disagree

Table 14: Cross-tabulation of the groups and their attitude towards the folders’ structure

It is clear that the majority of the respondents had a positive view on SharePoint as a KMS. Fifty-four (83%) strongly or somewhat agreed that SharePoint is a useful tool for managing their knowledge resources (Figure 20). 62 (95%) strongly or somewhat agreed that they generally trust the content found in SharePoint, which is in agreement with the results on the accuracy, reliability and comprehensiveness of the content in Q.13 (Figure 21). Furthermore, 54 (81%) strongly or somewhat agreed that SharePoint is useful to store knowledge resources that are important for their colleagues.
Case Study A

Figure 20: SharePoint is a useful tool for managing our knowledge resources.

Figure 21: I generally trust the content found in SharePoint.

Respondents were also positive about using SharePoint for exchanging information and sharing knowledge with their colleagues (Figures 22-23). This result is important as SharePoint may work as a solution to the numerous emails circulating reports and other documents. Last, SharePoint was thought of as a useful place to search for existing information before starting a new project (40, 61%). This figure is expected to rise with the years, as more content will be available through SharePoint and it will act as the deposit of the company’s memory.

Figure 22: SharePoint is useful to exchange information with my colleagues.
Case Study A

Figure 23: SharePoint is useful to share knowledge with my colleagues.

At the end of the questionnaire, there was an open-ended question asking for comments on SharePoint and most specifically on areas that could be improved. Twenty-seven respondents took the time to write down their views on SharePoint. The majority of the comments referred to the user interface, structure and navigation in SharePoint (10), the search engine (10), and the speed of accessing documents (9). For example:

"Finding data, either by browsing or searching remains very difficult and somewhat 'hit-and-miss'."

"When navigating rather than searching it is very difficult to guess where things might be hidden and how to get them out."

"I have often found that the search results are far too vague."

"The search facility is not easy to use. For instance, trying to find where photos from the last Grand Prix are held takes me ages compared to the old system."

"Search results need to be more relevant. Given the quality of search engines these days (e.g. Google), SharePoint should be much, much better and finding the top few results on a particular topic."

"Speed: ideally, it needs to be as quick as browsing a folder on my local disk."
Case Study A

"1) main problem is that the search tool is abysmal, which makes metadata somewhat irrelevant. 2) Following from 1) it means I generally have to browse for info, which kind of defies the point of having SharePoint. The other problem is that the directory structure is counter-intuitive, for instance with test reports under design and test outlines under race and test. 3) Browsing is slow (slower than Internet explorer) and not as slick, e.g. often have problems "going back" on the previous page."

"Vastly improve the user interface! It's time consuming, slow and awkward to use."

Other areas for improvement identified included the presentation of search results, the need for more training, the use by more departments, the need for remote access, the inconsistency between the site libraries, a need for a visible hierarchical structure, the need to migrate older documents to SharePoint, granting restricted access to partner companies, and using more blogs and forums.

4.4.2. Statistical Tests

The above description of the results was augmented through statistical tests, exploring whether there were any relationships in the responses given between different groups of respondents. It would be meaningful to explore whether particular groups, or respondents of certain age, qualifications and years worked in the company had different views than others. Also, the length and the frequency of use of SharePoint have been identified as variables that can influence the searching skills, attitude towards metadata and KM and the overall level of satisfaction of the respondents.

Due to the fairly small number of responses, some of the categories provided as possible answers had to be collapsed so that meaningful analysis of the data with statistical tests was possible. In addition, although it was intended to use the independent "Group" as one of the bases of comparison, this was not
Case Study A

...possible, again because of the small number of responses. “Gender” was not used either in the analysis, because there were only two female respondents. The small number of responses had an implication on what hypotheses could be tested.

A first set of hypotheses was formulated based on the independent variables of age, qualifications and years worked in the company. These were tested to see whether there was any correlation in the data referring to the information seeking behaviour and search skills, metadata and the respondents’ attitude to SharePoint as a KMS. Younger people are generally more positive towards the use of new technologies, highly educated people are more likely to have used similar systems in the past and tend to have better information searching skills and people that have been longer in the company may be more resistant to the adoption of new IT systems; all these assumptions needed to be tested in order to be accepted or rejected in the context of Company A.

These hypotheses were tested by comparing the observed frequencies of cases for independence or relatedness with a Chi-square test. The significance level selected was the well-accepted 0.05. Due to the small number of responses, many of the tests had a very low frequency count. Therefore, the hypotheses associated with them could not be tested.

4.4.2.1. Tests with the Variables “Age”, “Qualifications” and “Years worked in Company A”.

Age did not prove to have an impact on the respondents’ frequency of use of SharePoint, but had an impact on whether the user uploaded documents in SharePoint or not. From the variables measuring the information seeking behaviour and search skills, only the satisfaction with the search results could be tested for significance. The test revealed a statistically significant difference on the satisfaction with the results users were getting from the search engine according to their age, $\chi^2 (4, N = 65) = 0.039, (p < 0.05)$. Younger respondents tended to be less satisfied with the results they were getting from the search engine (Table 15).
Case Study A

<table>
<thead>
<tr>
<th>I am satisfied with the results I am getting from the search engine.</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20 – 30</td>
<td>5</td>
<td>5</td>
<td>15</td>
<td>25</td>
</tr>
<tr>
<td>31 – 40</td>
<td>9</td>
<td>8</td>
<td>6</td>
<td>23</td>
</tr>
<tr>
<td>Over 40</td>
<td>2</td>
<td>9</td>
<td>6</td>
<td>17</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>22</td>
<td>27</td>
<td>65</td>
</tr>
</tbody>
</table>

Table 15: Cross-tabulation of age and satisfaction with the search results

There was a reliable statistical result for a relationship between qualifications and satisfaction with the results of the search engine, $\chi^2 (2, N=64) = 0.033, (p < 0.05)$ More highly qualified respondents tend to be less satisfied with the results obtained from the search engine (Table 16). The tests did not find any significant relationship between the qualifications and the respondents’ attitude towards metadata.

<table>
<thead>
<tr>
<th>I am satisfied with the results I am getting from the search engine.</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Qualifications</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undergraduate degree or less</td>
<td>11</td>
<td>18</td>
<td>12</td>
<td>41</td>
</tr>
<tr>
<td>Postgraduate degree</td>
<td>5</td>
<td>4</td>
<td>14</td>
<td>23</td>
</tr>
<tr>
<td>Total</td>
<td>16</td>
<td>22</td>
<td>26</td>
<td>64</td>
</tr>
</tbody>
</table>

Table 16: Cross-tabulation of qualifications and satisfaction with the search results

The number of years worked in Company A was the final variable used to test whether there are any statistically significant differences between the people that are new to the company or not and their attitude towards SharePoint. The only two significant relationships found were those related to uploading documents in SharePoint and spending less time to perform their tasks.

4.4.2.2. Tests with other variables

A number of correlations were also performed to explore possible relationships between the information seeking behaviour of the respondents, their attitude towards metadata and their level of satisfaction with SharePoint. Kendall’s tau was used as a measure of association, as explained in Section 3.6.1.
Case Study A

Referring to how long respondents have been using SharePoint, and therefore being more used to it, there was a significant correlation that the users that have been using it for the most time thought that it was less important to fill-in the metadata fields. This may be due to the inefficiency of the search engine.

There was no significant correlation found between the frequency of use of SharePoint and the respondents’ information seeking attitude, with the exception of the use of the advanced search, with the more frequent users preferring to use the advanced search less (Table 17). There was no significant covariation between the frequency of use and the attitude of the respondents towards metadata or their level of satisfaction with SharePoint either, in other words it is irrelevant how frequently respondents use SharePoint and how satisfied they are with it.

<table>
<thead>
<tr>
<th>Kendall's tau b</th>
<th>Frequency of use</th>
<th>Advanced search</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation Coefficient</td>
<td>-0.188*</td>
</tr>
<tr>
<td>Frequency of use</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>80</td>
<td>78</td>
</tr>
<tr>
<td>Advanced search</td>
<td>Correlation Coefficient</td>
<td>-0.188*</td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>N</td>
<td>78</td>
<td>78</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

Table 17: Correlation of the variables “Frequency of use” and “Advanced search”

Respondents who were positive about finding information and knowledge in SharePoint, (i.e. agreed that they manage to find the documents they need, were satisfied with the search options, the search results and the way they were presented), tended to use the search engine and the advanced search more. They also tended to agree that access to information and knowledge has improved through SharePoint and therefore they tended to use less time to search for documents and they were able to perform their tasks more quickly and more easily (Tables 18-19). They generally had a positive attitude towards SharePoint as a KMS, in the sense that they believed that it was useful for managing the company’s knowledge resources (Table 20).
### Case Study A

<table>
<thead>
<tr>
<th>Kendall's Tau b</th>
<th>Comfortable in searching</th>
<th>Access to information</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable in searching</td>
<td>Correlation Coefficient</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>80</td>
</tr>
<tr>
<td>Access to information</td>
<td>Correlation Coefficient</td>
<td>0.202*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>65</td>
</tr>
<tr>
<td>Less time</td>
<td>Correlation Coefficient</td>
<td>0.399**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>64</td>
</tr>
<tr>
<td>More easily</td>
<td>Correlation Coefficient</td>
<td>0.382**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>65</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.05 level (2-tailed).

**Correlation is significant at the 0.01 level (2-tailed).

Table 18: Correlation of the variables “Comfortable in searching” and “Access to information”

<table>
<thead>
<tr>
<th>Kendall's tau b</th>
<th>Less time</th>
<th>More easily</th>
</tr>
</thead>
<tbody>
<tr>
<td>Comfortable in searching</td>
<td>Correlation Coefficient</td>
<td>0.399*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>64</td>
</tr>
<tr>
<td>Access to information</td>
<td>Correlation Coefficient</td>
<td>0.547*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>64</td>
</tr>
<tr>
<td>Less time</td>
<td>Correlation Coefficient</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>64</td>
</tr>
<tr>
<td>More easily</td>
<td>Correlation Coefficient</td>
<td>0.762*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>64</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.01 level (2-tailed).

Table 19: Correlation of the variables “Less time” and “More easily”
Case Study A

<table>
<thead>
<tr>
<th></th>
<th>Comfortable in searching</th>
<th>Managing knowledge resources</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kendall's tau b</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Comfortable in searching</td>
<td>Correlation Coefficient</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>80</td>
</tr>
<tr>
<td></td>
<td>Correlation Coefficient</td>
<td>0.283*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>65</td>
</tr>
<tr>
<td>Managing knowledge Resources</td>
<td>Correlation Coefficient</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>65</td>
</tr>
</tbody>
</table>

*Correlation is significant at the 0.01 level (2-tailed).

Table 20: Correlation of the variables “Comfortable in searching” and “Useful to managing resources”

It was interesting to find out that those who uploaded documents more frequently, tended to prefer to fill-in the metadata fields themselves, instead of someone else filling-in or editing the metadata for them. They also tended to think that SharePoint was useful to store knowledge resources that were important for their colleagues and that SharePoint was generally a useful tool to facilitate knowledge sharing in Company A.

The respondents who were positive about adding metadata when uploading a document in SharePoint, i.e. they found it easy to fill-in the metadata fields and they believed that it is important to do so, were also positive about the use of SharePoint for knowledge sharing. They tended to believe that SharePoint was their first port of call when they were searching for documents and that it was useful to search in SharePoint for existing information before starting a new project.

Those that found that it is time-consuming to fill-in the metadata fields, would prefer, as expected, someone else to fill-in or edit the metadata for them. For some of them it was not easy to learn how to use SharePoint, and that may be a reason for their reluctance to provide metadata for the documents they were uploading. They would also prefer to add their own subjects and believed that more subjects were necessary in the drop down list, since this was not very satisfactory.
Case Study A

4.5. Analysis of Interviews

Twelve face-to-face, semi-structured interviews were conducted to get more detailed answers and to explore, in more depth, some of the issues that came across through the questionnaire. The semi-structured interview was a more suitable method to collect rich data on the users’ opinions of the impact of SharePoint on managing knowledge and their attitude towards metadata. The interview schedule was developed after the preliminary analysis of the questionnaires. These interviews covered the topics mentioned in Section 3.5.4 and were conducted according to the interview schedule found in Appendix D. Another interview schedule was developed for the Head of Business Systems and Knowledge Management as the person responsible for the implementation and continuing development of SharePoint. Her interview was conducted according to the interview schedule found in Appendix E.

The thirteen interviews were analysed and the main themes that came from the users’ interviews were their satisfaction with SharePoint and for which purposes they use it, the site structure, the efficiency of the search engine, metadata, whether SharePoint has facilitated KM and training needs. The interview with the information and knowledge manager covered the topics of SharePoint’s development, administration and evaluation.

4.5.1. Attitude towards SharePoint

The majority of the interviewees (9)* were positive about the use of SharePoint as a KMS. They generally agreed that SharePoint has improved the access to technical documentation, information and knowledge.

“It is generally an improvement on what we had before.”

“I think we can find things more quickly now.”

* Numbers in brackets correspond to the number of interviewees.
Case Study A

“I can see the potential benefits of using it instead of Windows Explorer.”

“The main benefit is that we are able to search for documentation.”

Three interviewees positively commented the concept of using SharePoint as a KMS but suggested that the implementation of it in Company A needs improvement.

“The concept is good but the implementation is not great.”

“It is a great idea, but it fails to deliver.”

There were some complaints (7) about the system being slow in comparison to the older shared file system. They mentioned that it can be slow when navigating the folders, when opening large documents or when users need to switch between two screens.

4.5.2. Use of SharePoint

Most of the interviewees agreed that SharePoint is important to their daily tasks and use it daily (9). Some of them used SharePoint to access documents necessary for their work (6), whereas others used SharePoint only to upload documents that were useful for their group (4).

“The main use is mainly to store and retrieve our internal documentation within the team.”

Three interviewees mentioned that they use SharePoint to read only documents of their group

“99% of my usage is just looking at our own page.”
Case Study A

“I get lots of emails with links to SharePoint for results from races and tests and things like that. None of those are relevant to me. I would be wasting my time if I went through all those links and read them because they don’t have anything to do with my work really.”

It was mentioned that the designers do not use SharePoint very often because they are still accessing the design library through the older spreadsheet with hyperlinks to the documents, mainly due to familiarity and because they do not know whether the documents in SharePoint are up-to-date and who maintains them. They use it more to access documents from other groups, such as the Race Engineering. They would use SharePoint more if it replaced the older spreadsheet.

Other shared files are also used by some groups of engineers, such as groups of designers or the Stress Analysis and Materials group. One of the reasons mentioned was that, in the older shared files, they can access historical data that are not available through SharePoint. Another group mentioned that they prefer to keep the old file system for large data files because accessing them through SharePoint is a bit slow. In addition, files like executables cannot be stored in SharePoint, so they need to be kept in a shared file system. Links can be made to SharePoint and it is indexed, so the search will also give results from the file share if required.

4.5.3. Site Structure and Navigation

Most of the site libraries were created by the Head of Business Systems and Knowledge Management with the collaboration of the leaders of each group. Almost all of the engineering groups asked for a folder type structure very similar to the one of the previous file system, so that the transition to the new environment would be easier.

Most of the interviewees (6) agreed that it has a relatively good user friendly interface.
Case Study A

“It is intuitive, it is, to me it is just like a folder system, so I can find my way around, it’s alright.”

There were some comments (4) on the large numbers of folders that a user may need to navigate in order to reach the one he is looking for.

“I like the folder structure but it is a bit clunky the way they expand it.”

“The directory structure is dreadful.”

Another thing that may be problematic at times is that there is great inconsistency in the structure of the different libraries. This may be confusing to the users when they are searching for documents in libraries other from their own

“If anybody else wants to look at our stuff I think that the fact that it is not consistent between teams is a bit of a problem.”

“I normally don’t need to look at other stuff, but on occasions that I have, it is all going to be quite confusing because it is all new; if you look at a different page and is unfamiliar, it is not really obvious how to browse and find stuff that you are interested in.”

4.5.4. Searching and Browsing

Most of the interviewees (8) commented on the inefficiency of the search engine. The main problems identified are the fact that it is not clear, as expected for a commercial tool, how it works, and the irrelevance of the results most of the time.

“The big complaint that you will probably hear from most people is the fact that the search isn’t particularly good. So, it is unclear what it is searching and also the results that you are getting at the
Case Study A

end, the result that you are looking for isn’t always the thing that comes up on top.”

“I sometimes find myself quite frustrated with the search itself, because it often throws out a lot of things that are not relevant to the search.”

“If there is one thing that could be improved it could a much better search.”

“I think I would use it more if it was a better search facility”

Quite a few users (4) used the filter buttons within folders to find specific documents. It was suggested that users tended to browse more than using the search engine because they were used to browsing in the older file system. The quality of browsing depends on how well users file the documents.

“Some of them maybe, shouldn’t be in there, but it is basically where people choose to file them away.”

4.5.5. Metadata

Some interviewees mentioned “Title” and “Name” being the most significant metadata (7). “Author” (4) and “Document Category” (3) and “Car Marque” (3) were also mentioned. The “Last Modified Time” was used heavily by certain users that used SharePoint mostly for version control of documents they worked on as a team.

Most said that they felt it was important to fill-in the metadata fields (6), while others said that they normally filled-in one or two fields and ignored the rest of them (3)

“I fill in the form the titles, because the title comes up with the document when you look through SharePoint.”
Case Study A

While "Subject" was the most significant metadata tag, according to the results of the questionnaire, the interviewees did not share the same point of view (6).

"Most of our documents cover the same area, so probably I haven’t paid as much attention to that as I should do."

"The subject is very design office oriented."

"Description" was one of the fields that interviewees usually paid more attention to (6).

"In my mind, description and summary should cover everything you need to cover."

"I try to fill that in with a reasonably good description, so it is easy to see the content of the document."

None of the interviewees identified any metadata that would be useful to be added. The metadata tag that most interviewees (3) found redundant was the "Approved/draft" one.

For some (3) metadata was so important that they had very strong views as to how to create metadata and asked for a set guidelines for all in terms of adding names or part numbers consistently.

"I am not sure that the same standard (in filling-in the description) is actually used across the board. So, I think that can influence the search. Maybe, rather than just dumping a document very quickly, we could spend some time in filling-in as much information as possible, and that would help the search, so it is a bit down to education as well."
Case Study A

The importance of metadata in the search process has raised some controversy. Some (4) thought that if metadata were used more that would facilitate the search engine.

“Because we started using properties properly, it helps us to find stuff.”

“Basically we use it as a complete replacement for folder structure, so we have to use properties otherwise we’ve got no way to find documents at all.”

“The search facility is problematic because metadata doesn’t get used.”

“To then put metadata to back it up so that people can find it in the future, it is as important as writing the conclusion of that report. There is no excuse.”

Others (2) said that they did not spend much time filling-in the metadata fields because the search engine did not work satisfactorily and therefore they were not convinced of the importance of metadata.

One of the issues regarding metadata was that each library could use different metadata because some of them were not relevant at all to the needs of the specific users (4).

“For our particular usage we cut down on, I think, there was a default set of properties, and a lot of those were not relevant to us, so we got rid of those and we got our own defined properties”

In general, though, metadata was regarded as a positive step because it provides information about a document to the user.
Case Study A

"Comparing SharePoint to the older system, the older system was very poor in the sense that it stored reports on a serial number with no reference to the author or the content."

4.5.6. Knowledge Management and Collaboration

Most of the interviewees agreed (10) that SharePoint had improved knowledge sharing and collaboration because it was the most efficient way to disseminate, even very large, documents.

"Even though I am a very small user of it, I recognise that it is quite a powerful way for sharing information."

"It is a good way of passing information."

"It has improved collaboration within the company."

"It encourages people to share documents"

"It does facilitate communication."

It helped to collect all documents in one central document library and has replaced most of the shared network files, so that users know where to look for documents (3).

"The best part is forcing us the discipline to put documents in one place."

"It is best for knowledge sharing for the fact that there is a single platform across the company."

"It is one area where we can find all the information that people loaded up without having to search through different directories."
Case Study A

Because SharePoint was available to all, documents and knowledge flew freely between the various groups. In that way, it increased visibility between groups and made the work of each group known to the others (4).

"Sharing data across groups has been much improved."

"It has improved the visibility of our documentation and made other departments more aware of what we are doing."

In contrast to the general comment that SharePoint has improved the visibility in the company of what each group does, one group has mentioned that it was not always useful to have all the data accessible to all the company.

It was very helpful that SharePoint was accessible remotely and engineers have access to the team's documents, information and knowledge while they were away from the facilities for testing or races (2).

The use of SharePoint motivated some groups to write down more of their procedures (2) but a concern was raised (4), that there was still a lot of information and knowledge circulated and stored in emails.

"There is a lot of knowledge stored in people's Outlook that is not stored in the main system."

Because it was intended to be a central repository of the team's documents, information and knowledge, it would be a very helpful resource for the new employees joining the team (3) and probably would help to retain knowledge from people leaving the team (1).

It would help innovation and perhaps the reduction of mistakes because it provided a constant library of the company's documents in the sense that users were able to identify which areas have been investigated in the past, with what results and which areas can be further investigated (1).

Although SharePoint has discussion tools that can be used for knowledge sharing and collaboration, most users still preferred to go and talk to the person
Case Study A

that they needed to (5) or send an email, because the company was still a relatively small organisation.

"If I have a question I'd rather get up and walk to the person, I usually know, or at least I know which direction to hit in, and then when I get the right person I can ask him directly."

Last in terms of collaboration and KM, Company A collaborates with a number of partners and suppliers. In the questionnaire it was suggested that these partners should be granted limited access to SharePoint because that would significantly help collaboration within the partnership. Most of the interviewees (7) agreed with this suggestion provided that content was very carefully managed due to the sensitive and confidential nature of the information.

4.5.7. Training

A 45 minute presentation/introduction was offered to users when they first started to use SharePoint. In the presentation, users were asked to fill in the metadata fields and were shown an example. No further details on metadata were given.

Most of the interviewees (7) said that they would benefit from more training on SharePoint either because there were minor things that they were not comfortable doing or they feel that were not aware of the full capabilities of SharePoint.

"I think that perhaps I am not really aware of the full scope of SharePoint and what it can actually do, so there are probably lots of things that I am missing. Perhaps if I have the training I would think oh yeah, I should be doing that as well."

"I haven't had any proper training for SharePoint; I don't see the relevance of some of the metadata fields. Maybe if I had a bigger
Case Study A

picture of it, I’ll think: “I have to fill that in because in the future I could do some more with it.”

“To gain the true benefit of SharePoint, I think, we need to have some training, to understand how to use the search functionality.”

One of the main aims of training, according to one of the interviewees, should be to make engineers more aware of the benefits of using SharePoint, so that they would start using it more frequently and more effectively.

Most of the interviewees (5) would also find beneficial an online Help File where they could refer to, possibly in the form of FAQs and “how to guides”.

4.5.8. System Development

The vision and the strategic goals that SharePoint was meant to meet, according to the Head of Business Systems and Knowledge Management, were:

- Transmit information and knowledge more efficiently,
- Improve access to information,
- Target information to the right audience,
- Capture important information and knowledge to avoid ‘re-inventing’,
- Integrate knowledge management into the core business, to become part of ‘how we do things’.

The primary user needs for implementing SharePoint, as they came up in a user survey conducted in December 2004, were:

- Central repository for documents and up-to-date information (know where to look for it)
- A search facility to help find documents and thus reduce time spent looking for information
Case Study A

- Reduce the number of bulk emails with file attachments.

For its development a consulting company was initially used to simply install the software, customise the look and feel according to the company’s style, and to write a couple of web parts to help navigation. All other specifications and implementation were done by the Head of Business Systems and Knowledge Management. Users were introduced to SharePoint gradually by group.

The main rationale for developing the metadata scheme was to have some basic descriptive metadata that every group would find useful, such as “Author”, “Title”, and “Description”. More metadata were added that were specific to the motorsport environment, such as “Event Type”, “Event Location”, and “Event Week”. It was then left to the groups to decide which metadata would be relevant to their needs.

4.5.9. System Administration

Some metadata were produced automatically by SharePoint, such as “Author”, which was defaulted to the current user. Both models for uploading information and adding metadata to them have been implemented in the company: the first is when the actual author/creator of a document uploads it and adds the metadata for it. This is the case for most of the site libraries of SharePoint. Some users (4) commented that they prefer to add the metadata themselves, because they feel they are most knowledgeable and capable of assigning the most appropriate metadata. “It is a necessary evil” or “Part of the job” as some have called it. The automatic production of metadata through scripts was also suggested.

The second model is when one person has the responsibility to (edit and approve in some other organisations), upload and add metadata to the documents that the users are preparing. This model is followed at the Design group site library with the Design Support Officer having the responsibility of administering the whole of the site library. The migration to SharePoint has created more work for the Design Support Officer in the sense that she needed to
add more metadata to each of the numerous documents she uploaded on the system. The implication of that is that there was some level of consistency as to where similar documents are placed within SharePoint and in the quality of metadata. On the other hand, users are not encouraged to contribute to the system as much as they would do with the other model.

SharePoint offers customisation in appearance to a great extent, so that it is customised to the company's colours, company style and needs. There were comments (2) though on the limitations and difficulty of changing and updating the appearance of the individual site branches and the linking of files. In general, it does not offer great flexibility in its administration.

4.5.10. System Evaluation

Prior to this project, there had been no evaluation exercise of SharePoint. The Head of Business Systems and Knowledge Management had informal feedback from the users which allowed her to be positive about the business value of this implementation. Most of the objectives have been met, which were:

"To improve the visibility of the reports; the quality of reports is good, the way we search and therefore increased access information isn't great, it is better than not having anything, so there is an improvement, but there is a lot to be done on that."

"I think that the pay back period would be for us two years, simply on time that we don't lose looking for documents. It is very difficult. You plug it in and you think that you save everybody 5 minutes over... every week... It is difficult to be tangible about it, but I doubt that we will regret having done it."
Case Study A

4.6. Conclusions

Based on the analysis of the questionnaires, interview transcripts, and documents, a number of conclusions can be made in the following topics: the use and user attitude towards SharePoint, the content, the metadata used, and whether it has facilitated knowledge sharing. Following these conclusions, a number of recommendations at the strategic and operational level were made to Company A. They can be found in Appendix F.

4.6.1. Use of and User Attitude towards SharePoint

Windows SharePoint Services was introduced in Company A in summer 2005 and is used mainly by the Engineering Department. It was considered to be important to the daily tasks of 46 (55%) of the respondents. It was more important for the engineers of the Simulation (70.6%) and the Design group (68.8%). The largest site, in terms of number of documents and volume, was that of the design office, including documents that could be useful to all engineers, such as trade magazines and FIA information.

The main use of SharePoint was to access documents necessary for their task (81.2%), to upload documents that were useful for their group or the team (47.1%), to search for information that it was relevant to their job (48.2%), to inform themselves on the current developments of the car (36.5%) and other purposes (10.6%).

The majority of the participants agreed that SharePoint was very useful and they were satisfied with the overall efficiency of it (60%). It had significantly improved access to the team’s documents (78%) and, as a result, users spend less time searching for documents and were able to perform their tasks more quickly and more easily. Over half of the respondents (52.2%) had uploaded at least one document in SharePoint and the majority of them uploaded documents at least once a week. It was generally considered a useful tool for managing their knowledge resources (83%). No significant differences were found in the users’ attitude towards SharePoint based on their age, qualifications, and years worked for the team.
Case Study A

The complaints were mostly about the site design and structure, the search engine, and the fact that it could be a slow system.

4.6.2. Content

One of the critical factors for the success or failure of a KMS is the quality of content. It is very positive for Company A that the majority of the respondents in the questionnaire agreed that content was accurate, up-to-date, reliable and comprehensive and therefore, they trusted it (95%). Some interviewees thought that the content in SharePoint was better than in the previous system because they were generally reluctant to upload a document, unless the content and structure of it was of the quality they felt was appropriate to circulate in the whole Engineering Department. This is very positive because this was one of the targets set for the KMS in the beginning of its implementation.

“Somehow SharePoint does seem to be better ordered and it’s easier to find stuff there and you only put stuff there that’s relevant, whereas using just the file system previously you dumped all your rubbish there and the important stuff got lost in all the files.”

The negative effect of this attitude was that, occasionally, engineers did not have the time to write the full report of something they had been investigating and because of that they would not put their notes on SharePoint, because they did not want to put something of inferior quality. A possible outcome could be that this specific information will remain inaccessible for most of the engineers although useful.

“I may draft a simple spreadsheet and email it to my colleagues and then it will sit on their hard drive, my hard drive and nowhere. To be honest, it should appear on the system. But, for me to actually issue it as a technical note is not a very good return...
Case Study A

of my time, because it will take me too long to put it together and make it look tidy."

Blogs could be used to address this issue because they would help to capture and search very valuable nuggets of information and knowledge that never reach the status of a technical note or a technical report and were send mainly through emails and resided in engineers' Outlook.

The content in SharePoint was very up-to-date because only the most recent documents were uploaded on it. One of the characteristics of knowledge, especially in the motorsport industry, is that it has a use-by date. Therefore, a retention schedule would have to be drafted to ensure that documents that were not useful would be archived. Users would also need to be encouraged to check and update their documents, especially the procedures, as appropriate.

4.6.3. Browsing and Searching

The structure of SharePoint was based on the organisational structure of groups, with each group having its own site library. Most of the groups had selected a folder structure, which closely resembled the older shared file system.

Most of the respondents in the questionnaire agreed that they were comfortable in searching for the documents they need (60%) and most of the times they succeeded in finding those (73%). Browsing in SharePoint was the preferred method for information seeking (76%), whereas the search engine (32%) and the advanced search (19%) were less favourable. Most of them said that they became familiar as to where specific documents were and therefore they preferred to browse the system in order to access them.

Nevertheless, SharePoint's structure was criticised by many users, mainly because it had numerous folders, many of them being empty, and not always in a clear arrangement. In some cases, SharePoint had great depth in navigation, without the appropriate navigation aids. Most studies concluded that breadth is better than depth for the organisation of content on internet based applications (Larson & Czerwinski 1998, p 25). A balance should be kept between the number of links on each page and the number of layers that are required to access.
Case Study A

documents. A broad, shallow menu architecture should provide users the most efficient and learnable access to resources on an intranet (Straub & Weinschenk 2003).

Having a search engine through SharePoint to search for documents was commented on positively but the majority of users were not satisfied with the results they were getting from the search engine, even for relatively simple queries. Many of them said that they browsed for information because the search engine did not work satisfactorily, although they would prefer to search rather than browse. They also mentioned that they would use SharePoint more, if the search engine worked better. The quality of metadata that the search engine had to work with was not optimum, but the real issue was that it was not known how SharePoint's search engine used metadata to execute a query.

4.6.4. Metadata

The most significant metadata tags for searching and evaluating a document were “Subject”, “Name”, “Title”, “Description”, “Car Marque” and “Author”, based on the ratings of the three most significant metadata. “Subject” received higher rating than the other metadata (27 out of the 55 respondents (49%) rated it as the most important), but it is interesting to note that “Subject” was not used extensively by all Groups or named in the interviews. The use of “Name” and “Title” is also confusing because SharePoint creates automatically as “Name” the file name that the user uploads, which may not always be appropriate, and as “Title” the title that the user assigns to the document.

Besides these basic descriptive metadata, each group needed highly specialised metadata to describe its documents, such as “Stress Number”, and “Part number”. An advantage of SharePoint is that it is very easy for the users to create, update and delete documents and create and modify their metadata, so that each library can have the appropriate metadata.

The use of a thesaurus or taxonomy would be beneficial both for navigation and searching purposes. It would enable users to select correct and consistent terminology when describing documents. It could be used as a
Case Study A

navigation aid in the form of a taxonomy and it would improve the results of subject-based queries.

In general, and partly because the search engine was not efficient, not all users were convinced of the importance of filling-in the metadata fields consistently and comprehensively. As a result, the majority of the documents in SharePoint were not described properly. This behaviour may not be significant at the moment because the number of documents is fairly small and the majority of users preferred to browse. In the future, though, when the number of documents in SharePoint has increased significantly and browsing will not be efficient, this could be an obstacle in the efficiency of SharePoint.

4.6.5. Knowledge Management

Knowledge management, as a systematic effort, in Company A was still on its first steps. The use of SharePoint had been a significant step towards knowledge organisation and sharing. It had become the central library of the team's documentation and subsequently the repository of the team's knowledge and memory. More effort is required towards knowledge capture, mainly in the form of processes. Besides processes, effort is needed in changing the organisational culture and explaining the possible benefits of the KM programme.

SharePoint has greatly facilitated knowledge sharing and made the work and the documentation of the different groups more visible to each other and the company. This helped the users to identify their core competencies and expertise; collaborate better; and the team to perform a knowledge audit and identify and address possible gaps. Visibility in the design process of the car may lead to better understanding of the team's processes and functions, creates the "big picture" for the individuals and promotes the team spirit.

The design of SharePoint was based on organisational structure, with each group having its own site library and very often members of each group were browsing or searching only for documents in their own group. As a result, there were some groups that were quite isolated from the others and knowledge did not flow sufficiently. The identification and cultivation of groups of people
Case Study A

with similar work areas beyond the formal groups (communities of practice) could be used to address this issue and help in knowledge sharing. Working with problem-solving communities of practice is common in many teams in motorsport (Reay 2000, p.20) This, of course, demands "integration across the different disciplines of design and specification, production engineering, testing and race action." SharePoint could be used to facilitate these communities of practice by providing a common space for document storing in the form of site libraries and collaboration tools.

4.7. Summary

This chapter presented the analysis of the data collected in Case Study A with the collaboration of the motorsport engineering company. This case study served the aims and objectives of this research because it provided data that:

- Identified and documented the metadata elements currently used for the description of content created in the process of KM;
- Provided indications of metadata element types that may be useful for the description of knowledge;
- Provided insights into the perceived usefulness of metadata, in terms of retrieval efficiency and trust towards the system; and
- Presented the metadata management strategy of Company A.

The next chapter presents the data collected in Case Study B with the collaboration of the pharmaceutical company. Both case studies are further discussed, analysed and compared in Chapter 6.
Case Study B

Chapter 5. Case Study B

This chapter describes the case study undertaken with the collaboration of the pharmaceutical company. The data collection for case study B was conducted from April to June 2007. The highly competitive nature of the business meant that a confidentiality agreement had to be signed between the company, the researcher and her supervisors. The case study had the aim to investigate how Company B is using the ABC\textsuperscript{2} library as a KM tool and how metadata are used within it. Emphasis was put on the users' attitudes towards the ABC and metadata, as their acceptance of and satisfaction with the ABC were critical in its successful implementation.

The specific objectives were:

- To identify the main uses and the frequency of use of the ABC.
- To measure users' satisfaction with the ABC.
- To investigate users' attitude towards metadata
- To explore how the ABC is managed as a KMS.
- To explore Company B's metadata management strategy

The chapter provides a short background description of Company B and then the description and analysis of the data collected. It concludes with a number of observations that will be further discussed and compared with those from Company A in Chapter 6.

5.1. Company B Presentation

The pharmaceutical industry is dominated by a small number of very large companies engaged in the development and manufacturing of medicines. Competition is fierce between these companies, each of them aiming to develop new medicines and to reduce the time required to develop them. A key factor to this industry, related to KM, is the very strong legal requirements for data and

\textsuperscript{2} ABC and DEF are mock names that the researcher gave to the KMS to protect the anonymity of the company B
Case Study B

information management during the R&D phase, so that the company can apply for licences for its medicines.

Company B was a suitable case study because it is one of the leading global pharmaceutical companies, strongly engaged in the research, development, manufacture and marketing of medicines. It is a multinational company and its broad range of products is available across the world. The numerous R&D staff located in different countries required a robust KMS that could accommodate the vast amounts of data, information and knowledge produced on a daily basis. This content should then be accessible to the manufacturing and marketing departments of the company in order to compete and excel in sales. Figure 24 presents a simplified organisational chart of Company B.

Figure 24: Simplified organisational chart of Company B

139
Case Study B

5.2. Documentation

Documentation about this case study was collected from a number of sources during the data collection phase. Information on the company was used to prepare for the meeting with the information and knowledge manager and the field visits. Other research articles referring to KM in Company B were also consulted to get a holistic picture of the KM activities within the company. Most of these are discussed in Section 2.5.2. References to others studies cannot be provided for reasons of confidentiality. The preliminary analysis of all these documents was used to prepare the interview schedules.

Internal documentation was provided by the ABC team referring to the metadata naming guidelines that the company has in place. The Naming Guidelines included detailed instructions and examples as to how to fill-in the “Title” and “Description” properties and how to name new sub folders in the ABC library. Users were asked to keep in mind when setting titles and document descriptions “all possible end-users” and that these metadata were intended for display not only in the ABC library where the folder structure was visible, but also in the portal where the only means of navigation and searching was the metadata. The main aim was to facilitate the browsing of and retrieval of documents from both the portal and the ABC.

5.3. Field Notes

A number of site visits were made, according to the research design, to become familiar with the company and the KMS, prior to the design of the survey. The preliminary questionnaire used for the identification of the case studies held valuable information for the preparation of these visits. The visits provided a valuable insight into the company and its KM practices.

The ABC library is a knowledge base that was developed in 2000 to support the sales and marketing departments with information related to the products. It was based on Documentum software using Oracle and has been customised heavily according to Company B’s needs. Recently, its scope was expanded and it is being used heavily by R&D as the central document
management system for the company. It is part of a 3-fold information sharing practice (Figure 25):

- **EMC Documentum eRooms** has been used since 2005 by project teams as web-based collaborative workspaces. Users are encouraged to promote documents from the eRooms to the ABC library in order to share them with the rest of the company. Currently, there is a large number of eRooms, where the users are responsible for their updating and maintenance.

- **The ABC library** is one of the main document libraries used across the company. It is being used by over 10,000 users around the world. The content of the ABC is in the form of documents (mainly Microsoft Office and PDF documents) and includes information/knowledge about the products of Company B and the process of creating them, and competitive intelligence about the products of their major competitors.

- **The company portal** was developed in 2005. It is the result of an effort to consolidate a large number of intranets that existed in the past. Besides company information, the portal presents the “R&D Infospaces” and “Brand Infospaces” which, to an extent, provide access to documents of the ABC library. They are portlets created and maintained automatically based on the classification of the documents as they are added to the ABC library. Users are strongly encouraged to search and access documents through the portal and are asked to go directly to the ABC only to upload or create a document, because the interface of the ABC is not very attractive.

To aid the functioning of these tools, an Oracle database is used to hold the content and an Autonomy search engine is used to retrieve it. To facilitate the indexing of the documents, WordMap taxonomy management software is used with the database. eRooms, the ABC and the portal are used for the unregulated documents. The regulated documents, i.e. the documents that are submitted in regulatory agencies to support the drug approval applications, are stored in DEF. It is required that these documents are kept in databases, where access restrictions are in place and the version history of documents is closely monitored. The focus of this research is on the unregulated documents; therefore, the use of DEF will not be discussed in detail.
Case Study B

This strategy and the relevant tools were fairly recent to Company B, at the time of the data collection. Different parts of the company had adopted the portal and the ABC at different times and some countries’ offices still use local intranets. The fact that there was the ABC team, a strong information management team, behind all these tools that worked to constantly improve them was a very positive feature.

5.3.1 Site Structure and Navigation

The ABC’s folder structure was based on the organisational structure of teams and projects, with each project and product having its own folder. The interface is organised in 3 sections. On the left is displayed the folder structure of the ABC, either in full or “My ABC”. The users can navigate the folders to find the appropriate documents or select the appropriate folder to upload/create a
document. A number of folders appeared empty because they were created automatically based on topics or processes within the parent folder. It was at the users' discretion then to populate these folders. Nevertheless, when navigating the ABC and browsing the folders, it was quite frustrating to hit an empty folder. The option to view only selected folders of the ABC using “My ABC” is very useful because the whole folder structure is quite extensive.

On the top-right section is displayed the list of documents with the metadata that the user has selected By default the “Document type”, “Title”, “Description”, “Editors”, “Status”, and “Classification” are displayed. The full metadata of a document can be seen when the user selects the appropriate document.

The bottom-right section includes a number of options for changing the document status, editing the metadata properties, linking the document with others, moving and copying the document, viewing and deleting the document.

5.3.2. Metadata

The metadata scheme was created by the ABC team and includes basic descriptive metadata, such as “Title” and “Description”, and metadata specific to the business, such as “Diseases”.

The users were asked to fill in the metadata form when they were creating or uploading a document in a specific ABC folder. Thus, they selected the location of the document in the ABC folder structure. Apart from the basic metadata, i.e. “Title”, “Description”, “Editors”, “Owners”, “Classification” and “Dates”, the metadata form is tailored to specific folders and includes metadata specific to the functions of Company B, such as “Diseases”, and “Products”. Table 21 presents the metadata elements used across the folders of ABC.

The metadata provided for each document were, in most cases, of good quality with users making the effort to select appropriate attributes for the properties. It was mainly the “Description” that was being neglected, with users copying the “Title” in the “Description” field.
Case Study B

### Table 21: Metadata Elements Used Across the Folders of ABC

<table>
<thead>
<tr>
<th>Metadata Elements</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Access Level</td>
<td>Checked out by</td>
<td>Checked out Date</td>
</tr>
<tr>
<td>Classification</td>
<td>Classification Type</td>
<td>Compound</td>
</tr>
<tr>
<td>Contributed by</td>
<td>Creation date</td>
<td>Description</td>
</tr>
<tr>
<td>Diseases</td>
<td>Ed Date</td>
<td>Editor</td>
</tr>
<tr>
<td>File type</td>
<td>Infospaces</td>
<td>Intended Audience</td>
</tr>
<tr>
<td>Intended for</td>
<td>Intended for Use</td>
<td>Is Parent Binder</td>
</tr>
<tr>
<td>Location</td>
<td>Meeting Start Date</td>
<td>Modified by</td>
</tr>
<tr>
<td>Modify Date</td>
<td>Organisation</td>
<td>Owner</td>
</tr>
<tr>
<td>Primary location folder</td>
<td>Products</td>
<td>Purpose Material</td>
</tr>
<tr>
<td>Re-approval Date</td>
<td>Release to MC</td>
<td>Relevant files</td>
</tr>
<tr>
<td>Status</td>
<td>Title</td>
<td>Valid from</td>
</tr>
<tr>
<td>Version</td>
<td>Withdraw Date</td>
<td></td>
</tr>
</tbody>
</table>

5.3.3. Search Engine

The default search box of ABC searches for keywords in the title. Additional search boxes search for keywords in the description or people’s names in the “Contributed by”, “Editors”, and “Item owner”. Users can select the “Classification” or the “Disease” from a drop-down list and the document status (draft, in review, valid, withdrawn). They can specify the dates that the document is valid from and select the primary folder location in the ABC.

The advanced search button reveals more search boxes, most of which produce drop-down lists for the user to choose the desired values. The user can form a very specific query by specifying the company’s properties. These properties refer to specific functions (e.g. regulatory affairs, business enablement, management & planning, chemistry, manufacturing and control), geographic regions, drug project operating model core processes, research sites, therapeutic areas, subjects, topics, activities and disciplines. Competitor information can be searched by company or by product, and promotional and educational material can be searched by classification, purpose material intended for, intended audience, country and project manager.

The ABC search engine searches only the metadata, contrary to the portal search engine, and it may be quite slow to produce results. In general, the search interface is heavily structured with many search boxes and drop-down lists for
names and classifications. Results include all documents, with those inaccessible to the user due to access rights being inactive, so the user can see all relevant documents but may not be in a position to access them.

5.3.4. Personalisation

Besides the “My ABC” option for viewing and browsing only selected folders of the ABC, users can personalise the ABC according to their preferences. They can specify how many items are presented per page, whether or not to see the withdrawn documents and which column headings, e.g. metadata, are displayed. “Title”, “Editors”, “Status”, “Infospace”, “Valid from”, “Withdraw Date”, “Edt Date”, “Modify Date”, “Version”, “Classification”, “Classification Type”, “Diseases”, “Meeting Start Date”, “Description”, “Location”, “Is Parent Binder”, “Intended for Use in the Following Countries”, “Intended Audience”, “Purpose Material Intended for”, “Release to MC”, “Reapproval Date”, “Contributed By”, “Checked Out By”, “Checked Out Date”.

5.3.5. User Support

The ABC library is not a very intuitive system but users benefit from extensive support provided by the ABC team. First of all, users need to register to use the ABC library. They can read documents from the portal without registering, but in order to be able to upload documents to the library, they need to register and have training on it.

Company B employs trainers that deliver courses on the Infospaces, eRooms and the ABC. They offer a short course lasting one hour and a half covering the topics of Infospaces, the news sections, the index of topics, key links and new documents of the ABC and mostly searching the portal to find relevant information. A longer course lasts two hours and covers all the above plus logging into ABC and adding documents on it. During this course, users are trained on filling-in the metadata form following the Naming Guidelines. These
training sessions are offered when a new user is registered to use ABC. Refresher training is offered upon request to project teams and groups.

These training sessions are available mostly to the UK users. Worldwide users do not get training, so they have to rely on the other training material available. This includes the Help guide, a number of training movies covering the use of Infospaces, eRooms and the ABC, leaflets, awareness sessions on new services/functions and the “Office hours” every week, when the trainer logs into a web conference environment and the users can ask specific questions.

The Help guide is quite extensive but simple to use. It explains the 3-fold strategy to information management and includes help on the use of eRooms, the portal with the Infospaces and the ABC library. It provides guidance on using the portal search engine, handy hints, good practice information for selected documents and business processes and case studies.

5.4. Questionnaire Results

A questionnaire was designed and distributed to a sample of users of the ABC library. Judgement sampling was used to select 400 out of the approximately 10,000 users of the ABC, on the basis of using the system during the past month - 300 users had contributed to the ABC library and a different 100 had read documents from the library. An electronic format was necessary to allow for quick, cost-effective distribution and therefore a web-based questionnaire tool was used. The design of the questions was based on the field notes collected during two site visits. The questions were organised in topics and each topic was addressed in a different web page. The operational definition of the appropriate variables was validated by the ABC team in order to make sense to the users and the questionnaire was pilot tested on 3 users. The questionnaire can be found in Appendix H.

The survey took place from 21 March to 12 April 2007 and a total of 190 responses were collected, out of which 175 were usable, corresponding to 43.7% of the sample. The total number of responses in each question fluctuates as none of the questions was mandatory to answer. Most of the respondents provided their demographic details. Thirty-seven of the respondents were male and 117
Case Study B

were female. The dominant group of respondents (38, 24.2%) were over 50 years old, had an undergraduate degree or no formal qualifications (85, 58.6%) and are located in the UK (62, 39.2%). The majority of the respondents work in the Global Drug Development team (109, 69.4%) and had been working for Company B for more than 7 years (95, 60.1%). Table 22 provides the respondents' background information in more detail.

<table>
<thead>
<tr>
<th>Demographics</th>
<th>Categories</th>
<th>No. of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>Female</td>
<td>117</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>37</td>
</tr>
<tr>
<td>Age</td>
<td>Under 20</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>20 - 25</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>26 - 30</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>31 - 35</td>
<td>19</td>
</tr>
<tr>
<td></td>
<td>36 - 40</td>
<td>36</td>
</tr>
<tr>
<td></td>
<td>41 - 45</td>
<td>37</td>
</tr>
<tr>
<td></td>
<td>46 - 50</td>
<td>15</td>
</tr>
<tr>
<td></td>
<td>Over 50</td>
<td>38</td>
</tr>
<tr>
<td>Qualifications</td>
<td>Undergradnate</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Master's</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>PhD</td>
<td>16</td>
</tr>
<tr>
<td>Years in Company B</td>
<td>Less than 1</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>1 - 2</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>3 - 6</td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>More than 7</td>
<td>95</td>
</tr>
<tr>
<td>Team</td>
<td>Global Drug Development</td>
<td>109</td>
</tr>
<tr>
<td></td>
<td>Discovery</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>Global Marketing</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>US Business</td>
<td>3</td>
</tr>
<tr>
<td></td>
<td>ISMO</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>7</td>
</tr>
<tr>
<td>Country</td>
<td>UK</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>Sweden</td>
<td>57</td>
</tr>
<tr>
<td></td>
<td>USA</td>
<td>33</td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td>6</td>
</tr>
</tbody>
</table>

Table 22: Demographics of the respondents

Before proceeding to the analysis of the data, the internal reliability of the questionnaire was tested using the most common reliability coefficient, Cronbach's alpha. A value at the level of 0.885, that the questionnaire produced,
Case Study B

is generally accepted to indicate a scale of high reliability (as explained in Section 3.6.1). Therefore the questionnaire was judged as reliable.

It should be also noted that, with the sampling process being judgement sampling and most of the respondents located in the UK and Sweden, the results should be treated as indications of trends only for the global users of the ABC.

5.4.1. Description of Responses

Respondents were asked when they first used the ABC and how often they use it in order to find out their familiarity with the system and the frequency of use. The larger group of respondents indicated that they first used the ABC over a year ago (128, 73.1%) and that they use it more than once a day (64, 36.6%) (Tables 23 and 24) The team that used the ABC more frequently is the Global Drug Development (45, 41.3% of the group used it more than once a day) followed by Global Marketing (5, 24%).

<table>
<thead>
<tr>
<th>Over a month ago</th>
<th>9</th>
<th>5.3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Over three months ago</td>
<td>13</td>
<td>7.4</td>
</tr>
<tr>
<td>Over six months ago</td>
<td>25</td>
<td>14.3</td>
</tr>
<tr>
<td>Over a year ago</td>
<td>128</td>
<td>73.1</td>
</tr>
<tr>
<td>Total</td>
<td>175</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 23: When did you first use the ABC?

<table>
<thead>
<tr>
<th>More than once a day</th>
<th>64</th>
<th>36.6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Once a day</td>
<td>26</td>
<td>14.9</td>
</tr>
<tr>
<td>2 – 3 times a week</td>
<td>46</td>
<td>26.3</td>
</tr>
<tr>
<td>Once a week</td>
<td>27</td>
<td>15.4</td>
</tr>
<tr>
<td>Once a month</td>
<td>5</td>
<td>2.9</td>
</tr>
<tr>
<td>Rarely</td>
<td>7</td>
<td>4.0</td>
</tr>
<tr>
<td>Total</td>
<td>175</td>
<td>100</td>
</tr>
</tbody>
</table>

Table 24: How often do you use the ABC?
Case Study B

Creating or uploading documents was the main reason why respondents use the ABC (158), while accessing documents that were necessary for their work also received a significant number of responses (Figure 26).

No of Respondents

<table>
<thead>
<tr>
<th>Purpose</th>
<th>No of Respondents</th>
</tr>
</thead>
<tbody>
<tr>
<td>To access documents</td>
<td>141</td>
</tr>
<tr>
<td>To create/upload documents</td>
<td>158</td>
</tr>
<tr>
<td>To search for information</td>
<td>51</td>
</tr>
<tr>
<td>To inform myself about current developments</td>
<td>41</td>
</tr>
<tr>
<td>Other</td>
<td>39</td>
</tr>
</tbody>
</table>

Figure 26: For which purposes do you use the ABC?

The other main purpose for using the ABC was to publish documents that should appear on the portal, which was similar in scope to the option “To create/upload documents that may be useful to my colleagues” In addition, there were 11 references to the review process as a useful feature of the ABC.

The ABC library was considered to be important for the daily tasks of 143 (81.7%) of the respondents. It was more important for the Global Drug Development team, as stated by 92 (70.8%) of the respondents of that team. Among the reasons stated were again the review process, e_approval, and version control, accessing agendas, presentations, and meetings minutes, as well as accessing forms, templates and guidelines. Most of the comments, though, referred to the ABC library as a structured, controlled, secure area to file and access documents and share information with their colleagues, especially across teams and marketing companies and with the whole organisation.

The users were also asked what their preferred option for information seeking was. Most of them (85, 49.7%) strongly agreed or agreed that they preferred to navigate the folders of the ABC library when they were seeking for information. Other preferred options were to browse the Infospaces (52, 30.4%)
Case Study B

and to use the ABC basic search (47, 28%). The least preferred option was to use a local search (81, 47.9% disagreed with its use) and the Brand Infospace advanced search (80, 47.1% disagreed with its use). Figure 27 and Table 25 presents the results in more detail.

![Figure 27: Preferred option for information seeking](image)

<table>
<thead>
<tr>
<th>Options for information seeking</th>
<th>1*</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I prefer to browse for information in infospaces.</td>
<td>29</td>
<td>23</td>
<td>42</td>
<td>22</td>
<td>16</td>
<td>29</td>
<td>10</td>
</tr>
<tr>
<td>I prefer to use the basic search in the Your portal.</td>
<td>12</td>
<td>21</td>
<td>25</td>
<td>27</td>
<td>20</td>
<td>31</td>
<td>31</td>
</tr>
<tr>
<td>I prefer to use the advanced search in the Your portal.</td>
<td>11</td>
<td>18</td>
<td>26</td>
<td>36</td>
<td>16</td>
<td>34</td>
<td>31</td>
</tr>
<tr>
<td>I prefer to use the Brand Infospace basic search.</td>
<td>9</td>
<td>16</td>
<td>19</td>
<td>36</td>
<td>13</td>
<td>35</td>
<td>42</td>
</tr>
<tr>
<td>I prefer to use the Brand Infospace advanced search.</td>
<td>11</td>
<td>11</td>
<td>20</td>
<td>33</td>
<td>15</td>
<td>37</td>
<td>43</td>
</tr>
<tr>
<td>I prefer to navigate the folders of the of the ABC library.</td>
<td>37</td>
<td>48</td>
<td>24</td>
<td>18</td>
<td>10</td>
<td>19</td>
<td>15</td>
</tr>
<tr>
<td>I prefer to use the basic search of the ABC library.</td>
<td>18</td>
<td>30</td>
<td>33</td>
<td>28</td>
<td>18</td>
<td>25</td>
<td>17</td>
</tr>
<tr>
<td>I prefer to use the advanced search of the ABC library.</td>
<td>12</td>
<td>22</td>
<td>29</td>
<td>31</td>
<td>16</td>
<td>37</td>
<td>22</td>
</tr>
<tr>
<td>I prefer to use a different local search facility.</td>
<td>11</td>
<td>6</td>
<td>12</td>
<td>44</td>
<td>15</td>
<td>32</td>
<td>49</td>
</tr>
</tbody>
</table>

* 1 = Strongly Agree; 2 = Agree; 3 = Somewhat Agree; 4 = Undecided; 5 = Somewhat Disagree; 6 = Disagree; 7 = Strongly Disagree

Table 25: Preferred option for information seeking
Case Study B

In addition, the majority agreed or strongly agreed that they are comfortable in searching for the information or knowledge that they need (101, 57.8%) (Figure 28) and that most of the time, they manage to find the information that they are looking for (92, 52.6%) (Figure 29).

Figure 28: I am comfortable in searching for the information or knowledge that I need.

A significant percentage of the respondents found it quite easy to perform a complex search (69, 39.4% agreed or somewhat agreed). They also found that the search options are very easy to use (70, 41.2% agreed or somewhat agreed). Most of the respondents were undecided whether it is important to search in the full text of the documents (Figure 30) probably because this option was a fairly recent introduction and only available with the search engine on the Infospaces.
Case Study B

Figure 30: It is important for me to search in the full text of the documents.

Respondents were undecided about the results they were getting from the search engines (Figure 31). A number of cross-tabulations were performed to examine whether users of a particular search engine were more satisfied with the results than others. It was found that users of the ABC basic search and the ABC advanced search were more satisfied with the results they were getting from the search engine (61.9% and 50.8% respectively). The basic and advanced search engine in the portal were next with 47% and 44.6% and the basic and advanced search engines in the Brand Infospaces were after them with 40% and 35.4% respectively. Local search engines received the lowest score, with only 15.6% of the users that prefer to use them being satisfied with the results they are getting from them. Respondents, in general, were positive about the presentation of the results (83, 48.2% agreed or somewhat agreed that they are satisfied with the way the results are presented).

Figure 31: I am satisfied with the results I am getting from my preferred search engine.
Case Study B

The most significant metadata tags for searching for a document were "Title", "Description", "Primary Location Folder", "Owner" and "Classification", based on the ratings of the most significant metadata. "Title" received a remarkably higher rating than the other metadata (101 out of the 158 respondents to the specific question have rated it as the most important), which reflects the organisation's practice to focus on this tag through the training sessions and the Naming Guidelines.

The vast majority of the respondents (130, 82.3%) did not identify any metadata tags that should be added to the ABC, whereas a few asked for the addition of keywords, abstracts and ratings (metadata that would indicate the relevance and usefulness of the documents and user annotations). Other metadata proposed were: compound, owner's contact information, department, brand, original application of the documents, country or region specific, Global Study Master File Index and ISS/NIS/Phase IV Studies. Users also suggested the addition of an indication whether the document is published on the portal and if so, in which Infospace(s) and recommended the use of a broader range of classifications.

Others have made general comments on the kind of metadata that should be used:

"Being user friendly"

"Origination (one or more values for each document; could be project identifier, site identifier, research area, or other trans-person entity that allows functional grouping of documents and ... most importantly ... transcends the lifetime of a person's association with the business and the document. Relying on folder structure for this axis is not sufficient)."

Comments were also made on the quality of metadata:

"What is important is that when adding a document into ABC all these data are filled in properly, especially classification."
Case Study B

"Consistent use of a subject taxonomy by all functions using ABC."

The next set of questions referred to uploading documents in the ABC and adding the appropriate metadata. 155 of the respondents (95.1%) have uploaded at least one document in the ABC but this was expected as, out of the 400 recipients of the questionnaire, 300 of them had added at least one document in the ABC. The majority of the respondents (75, 49.7%) uploaded documents at least once a week. They agreed or strongly agreed that it is easy to fill-in the metadata fields (86, 55.9%) (Figure 32), although they agreed or strongly agreed that it is time-consuming to fill-in the metadata form (83, 53.9%) (Figure 33). Nevertheless, 141 (92%) agreed that it is important to fill-in the metadata (Figure 34).

Figure 32: I find it easy to fill-in the document properties.

Figure 33: I find it time-consuming to fill-in the document properties.
Regarding the creation of metadata, the majority of the respondents were quite negative to someone else filling-in the metadata for them (77, 50.3% somewhat disagreed, disagreed or strongly disagreed) or to someone else editing the metadata they have provided (83, 57.7% somewhat disagreed, disagreed or strongly disagreed). They were more positive about the automatic creation of metadata by the ABC, with 113 (74.8%) somewhat or strongly agreeing that they would prefer it if the ABC was to fill-in the metadata fields automatically.

The respondents did not have very strong views on the subject classification; 68 (44.5%) agreed that they would prefer to have the choice to add their own classification, 38 (24.7%) agreed that the classification values were satisfactory and 37 (24.2%) were undecided as to whether they would like to add more classification values or not.

One of the most positive findings is that the majority agreed that the content found in the ABC was accurate, reliable, up-to-date and comprehensive (Figure 35). It has to be noted though that respondents thought that the content was not as up-to-date as it was accurate or reliable, with 32 (19.7%) somewhat or strongly disagreeing with the statement.
Respondents were asked next about their attitude towards the ABC as a KMS. Out of the 175 respondents, 107 (67.3%) strongly or somewhat agreed that they are satisfied with the overall efficiency of the ABC (Figure 36), and 81 (51.3%) that the ABC was their first port of call when they were looking for documents and/or information (Figure 37), although there were other information systems in use, such as the portal and the eRooms.

Figure 35: The documents found on the ABC are accurate, reliable, up-to-date and comprehensive.

Figure 36: I am satisfied with the overall efficiency of the ABC.
Even though ABC has improved access to information, according to 108 (68.8%) who strongly or somewhat agreed with the statement (Figure 38), respondents did not think strongly that by using the ABC they spend less time looking for documents and information (76, 48.1% strongly or somewhat agreed), or that by using the ABC they were able to accomplish their tasks more quickly (64, 40% strongly or somewhat agreed) and more easily (73, 45.9% strongly or somewhat agreed). Nevertheless, respondents felt that learning to use the ABC was easy (128, 80% strongly or somewhat agreed), partly because the ABC’s navigation and structure were logical and easy to use (100, 62.5% strongly or somewhat agreed).

It is clear that the majority of the respondents had a positive view of the ABC as a KMS. One hundred and thirty of the respondents (82.3%) strongly or somewhat agreed that the ABC was a useful tool for managing their knowledge resources (Figure 39). One hundred and thirty-four (83.8%) strongly or somewhat agreed that they generally trusted the content found in the ABC, which
Case Study B

was in agreement with the results on the accuracy, reliability and comprehensiveness of the content, as shown in Figure 35.

![Figure 39: ABC is a useful tool for managing our knowledge resources.](image)

Furthermore, 141 (88.7%) strongly or somewhat agreed that the ABC was useful to store knowledge resources that were important for their colleagues (Figure 40). They were also positive about using ABC for exchanging information (128, 80.5%) and sharing knowledge with their colleagues (131, 81.9%) (Figures 41-42). Last, ABC was thought of as a useful place to search for existing information before starting a new project (97, 61% strongly or somewhat agreed).

![Figure 40: ABC is useful to store knowledge resources that important for my colleagues.](image)
Case Study B

Figure 41: ABC is useful to exchange information with my colleagues.

Figure 42: ABC is useful to share knowledge with my colleagues.

At the end of the questionnaire, there was an open-ended question asking for comments on the ABC and most specifically on areas that could be improved. One hundred and fourteen respondents took the time to write down their views on the ABC. A great number of comments referred to the speed of the system (47 out of 114), as it seems to have a slow response time when searching or browsing the library, the folder structure (16), with users asking for more flexibility in creating/naming subfolders, and the creation of metadata (14), with users asking for a more simple and automated process for adding metadata when creating/uploading a document. There were also a number of comments referring to the system as not being very user friendly (12). Users recommended improvements for the search engine (9), asking for a more Google-like experience, and asked for an improved classification list (7), as this is one may be quite limited. The 3-fold information path strategy was not very clear to all and some asked for more guidance on selecting which documents should be imported to the ABC, DEF or the Infospaces (7). The need for more training was
Case Study B

also mentioned (8) as a means to help explain the 3-fold information path and the use of the ABC in more detail. Some of the comments were:

“Speed - it should take less time to browse folders and access documents.”

“It would be helpful if we could come up with a better, organized structure that is consistent.”

“The search engine should be easy to use like Google. More metadata, like key words, for the search engine to give decent results, sorted into order of important/relevance. Structure is cumbersome with too many layers.”

“Better training in how best to import and categorise documentation.”

5.4.2. Statistical Tests

The above description of the results was augmented through some statistical tests to explore whether there were any relationships in the responses given between different groups of respondents. It would be meaningful to explore whether particular groups, or respondents of certain gender, age, qualifications, years worked in the company and country had different views than others. Also, the length and the frequency of use of the ABC have been identified as variables that can influence the searching skills, attitude towards metadata and KM and the overall level of satisfaction of the respondents.

Due to the fairly small number of responses, some of the categories provided as possible answers had to be collapsed so that meaningful analysis of the data with statistical tests was possible. In addition, although it was intended to use the independent variable “Team” as one of the bases of comparison, this was not possible, again because of the small number of responses.
A first set of hypotheses was formulated based on the independent variables of gender, age, qualifications, years worked in the company and country. These were tested to see whether there was any covariation in the data referring to the information seeking behaviour and search skills, metadata and the respondents' attitude to the ABC as a KMS. Younger people are generally more positive towards the use of new technologies, highly qualified people are more likely to have used similar systems in the past and tend to have better information searching skills and people that have been longer in the company may be more resistant to the adoption of new IT systems; all these assumptions need to be tested in order to be accepted or rejected in the context of Company B.

These hypotheses were tested by comparing the observed frequencies of cases for independence or relatedness with a Chi-square test. The significance level selected was the well-accepted 0.05. Due to the small number of responses, many of the tests had a very low frequency count. Therefore, the hypotheses associated with them could not be tested.

5.4.2.1. Tests with the variables “Gender”, “Age”, “Qualifications”, “Years worked in Company B” and “Location”

Gender did not prove to have an impact on the respondents' frequency of use of the ABC and their preferred method for information seeking, but had an impact on the creation of metadata. The test revealed a statistically significant difference on the ease of filling-in the document properties according to their gender, $\chi^2 (2, N = 146) = 0.004, (p < 0.05)$. Women in Company B seemed to find it easier to create metadata than men (Table 26).

<table>
<thead>
<tr>
<th></th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>91</td>
<td>6</td>
<td>14</td>
<td>111</td>
</tr>
<tr>
<td>Male</td>
<td>20</td>
<td>2</td>
<td>13</td>
<td>35</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>111</td>
<td>8</td>
<td>27</td>
<td>146</td>
</tr>
</tbody>
</table>

Table 26: Cross-tabulation of gender and ease in filling-in the document properties.
Case Study B

There were no significant relationships regarding the age of respondents, however, more highly qualified users preferred someone else to add and edit the metadata for them. The test revealed a statistically significant difference on their preference for someone else to add/edit the metadata for them according to their qualifications, $\chi^2 (2, N=136) = 0.003, (p < 0.05)$ (Table 27). This may be due to the fact that some senior knowledge workers may ask their administrator to upload the knowledge objects on the KMS and create the metadata.

<table>
<thead>
<tr>
<th>Qualifications</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undergraduate degree or less</td>
<td>23</td>
<td>10</td>
<td>49</td>
<td>82</td>
</tr>
<tr>
<td>Postgraduate degree</td>
<td>25</td>
<td>13</td>
<td>16</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>48</td>
<td>23</td>
<td>65</td>
<td>136</td>
</tr>
</tbody>
</table>

Table 27: Cross-tabulation of qualifications and preference for someone else filling-in the document properties

In terms of how many years a user has been working for the company, employees longer in the company tended to perform their tasks more easily and more quickly by using the KMS, probably because they are more experienced in using it (Tables 28-29). The test revealed a statistically significant difference on performing tasks more quickly, $\chi^2 (4, N=158) = 0.023, (p < 0.05)$ and more easily, $\chi^2 (4, N=157) = 0.001, (p < 0.05)$.

<table>
<thead>
<tr>
<th>Years in Company B</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 years</td>
<td>5</td>
<td>4</td>
<td>6</td>
<td>15</td>
</tr>
<tr>
<td>3 - 6 years</td>
<td>27</td>
<td>2</td>
<td>19</td>
<td>48</td>
</tr>
<tr>
<td>More than 7 years</td>
<td>32</td>
<td>21</td>
<td>42</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>64</td>
<td>27</td>
<td>67</td>
<td>158</td>
</tr>
</tbody>
</table>

Table 28: Cross-tabulation of years worked in Company B and accomplishing tasks more quickly
Case Study B

Table 29: Cross-tabulation of years worked in Company B and accomplishing tasks more easily.

<table>
<thead>
<tr>
<th>Years in Company B</th>
<th>Agree</th>
<th>Undecided</th>
<th>Disagree</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 2 years</td>
<td>5</td>
<td>5</td>
<td>5</td>
<td>15</td>
</tr>
<tr>
<td>3 - 6 years</td>
<td>33</td>
<td>1</td>
<td>13</td>
<td>47</td>
</tr>
<tr>
<td>More than 7 years</td>
<td>35</td>
<td>22</td>
<td>38</td>
<td>95</td>
</tr>
<tr>
<td>Total</td>
<td>73</td>
<td>28</td>
<td>56</td>
<td>157</td>
</tr>
</tbody>
</table>

The tests for the impact of the team that the respondents work for or their location did not provide any reliable results. Therefore no suggestions can be made on differences in the attitude of the respondents based on the team they are working for or the country they are located.

5.4.2.2. Tests with Other Variables

A number of correlations were also performed to explore possible relationships between the information seeking behaviour of the respondents, their attitude towards metadata and their level of satisfaction with SharePoint. Kendall’s tau was used as a measure of association, as explained in Section 3 6.1.

These tests did not provide more insight into the preferred search options of the users. There were a number of significant correlations between the users that were comfortable in searching for the information they need or were satisfied with the search results and those that stated that they prefer to browse the Infospaces or ABC or search using the basic or advanced search engine of the Infospaces and the ABC (Tables 30-31).
### Table 30: Correlation of the variables “Comfortable in searching” and “Browse Infospaces”, “Navigate ABC” and “ABC Advanced Search”

<table>
<thead>
<tr>
<th>Kendall's tau_b</th>
<th>Browse Infospaces</th>
<th>Navigate ABC</th>
<th>ABC Advanced</th>
<th>Comfortable searching</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>-.160**</td>
<td>-.102</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>171</td>
<td>168</td>
<td>166</td>
</tr>
<tr>
<td>Navigate ABC</td>
<td>Correlation Coefficient</td>
<td>-.160**</td>
<td>1.000</td>
<td>.318**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>168</td>
<td>171</td>
<td>168</td>
</tr>
<tr>
<td>ABC Advanced</td>
<td>Correlation Coefficient</td>
<td>-.102</td>
<td>.318**</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>166</td>
<td>168</td>
<td>169</td>
</tr>
<tr>
<td>Comfortable searching</td>
<td>Correlation Coefficient</td>
<td>.139*</td>
<td>.249**</td>
<td>.193**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>171</td>
<td>171</td>
<td>169</td>
</tr>
</tbody>
</table>

**. Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).

### Table 31: Correlation of the variables “Satisfied with Results” and “Navigate ABC”, “ABC Basic Search”, “Basic Search” and “Brand Basic Search”

<table>
<thead>
<tr>
<th>Kendall's tau_b</th>
<th>Satisfied with results</th>
<th>Navigate ABC</th>
<th>ABC Basic</th>
<th>Basic</th>
<th>Brand Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Correlation Coefficient</td>
<td>1.000</td>
<td>.218**</td>
<td>.203**</td>
<td>.233**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>174</td>
<td>170</td>
<td>167</td>
<td>166</td>
</tr>
<tr>
<td>Navigate ABC</td>
<td>Correlation Coefficient</td>
<td>.218**</td>
<td>1.000</td>
<td>.383**</td>
<td>-.150*</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>170</td>
<td>171</td>
<td>167</td>
<td>165</td>
</tr>
<tr>
<td>ABC Basic</td>
<td>Correlation Coefficient</td>
<td>.203**</td>
<td>.383**</td>
<td>1.000</td>
<td>.100</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>167</td>
<td>167</td>
<td>168</td>
<td>162</td>
</tr>
<tr>
<td>Basic</td>
<td>Correlation Coefficient</td>
<td>.233**</td>
<td>-.150*</td>
<td>.100</td>
<td>1.000</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>165</td>
<td>165</td>
<td>162</td>
<td>167</td>
</tr>
<tr>
<td>Brand Basic</td>
<td>Correlation Coefficient</td>
<td>.297**</td>
<td>.047</td>
<td>.161**</td>
<td>.282**</td>
</tr>
<tr>
<td></td>
<td>N</td>
<td>168</td>
<td>167</td>
<td>164</td>
<td>164</td>
</tr>
</tbody>
</table>

** Correlation is significant at the 0.01 level (2-tailed).
*. Correlation is significant at the 0.05 level (2-tailed).
Case Study B

Regarding the use and importance of metadata, the users that agreed that it is easy and important to create metadata, preferred to use ABC rather than Infospaces. ABC uses faceted search to retrieve the knowledge documents and it becomes more evident to its users how important it is to create metadata. Also, the respondents who were positive about adding metadata when uploading a document in ABC, i.e., they found it easy to fill in the metadata fields and they believed that it is important to do so, were also positive about the use of ABC for knowledge sharing, i.e., they agreed that ABC is a useful tool to exchange information and share knowledge and they trusted the content found on ABC.

5.5. Analysis of Interviews

Another method used for data collection was semi-structured interviews. Thirteen interviews were conducted to get more detailed answers and to explore, in more depth, some of the issues that emerged through the questionnaire. The semi-structured interview was a more suitable method to collect rich data on the users' opinions of the impact of the ABC on managing knowledge and their attitude towards metadata. The interview schedule was developed after the preliminary analysis of the questionnaires. These interviews covered the topics mentioned in Section 3.5.4 and were conducted along the lines of the interview schedule found in Appendix I. A separate interview schedule was developed for the Information Architect, as the person responsible for the architecture of the library. His interview was conducted along the lines of the interview schedule found in Appendix J. Another interview was conducted with one of the Business Partners in order to explore the aspects of the KM work that the business partners do. Last, informal talks with a Principal Information Architect and a Trainer were useful to better understand the training provided to the users, the culture of the company, as well as the implications that the large size of the company has on the information and KM initiatives undertaken.

The fifteen interviews were analysed and the main themes that emerged from the users' interviews were their satisfaction of the ABC and for which purposes they use it, the site structure, comments on the search engine, metadata, whether the ABC facilitates KM and training needs.
Case Study B

5.5.1. Attitude towards the ABC Library

The majority of the interviewees were positive about the use of the ABC as a KMS in Company B (12). They generally agreed that the ABC has improved the access to documentation, information and knowledge.

“...It is very good to have a single place to store documents for the future...”

“...it is the one-stop primary source of information sharing...”

“...the single best thing is that you can trust the information that is on there...”

“I find it useful when you are looking for additional information on a particular product. It is a good starting point.”

“It is very good in making sure that you have the latest version of a document.”

There were some complaints (4) about the system being slow when navigating the folders, searching or when opening the documents.

5.5.2. Use of the ABC

Most of the interviewees agreed that the ABC was important to their daily tasks and used it, if not daily, a few times every week (10). Some of them used the ABC to access documents that were necessary for their work (7), whereas others used it only to upload documents that were useful for their group (4).

“Star-users” (3) were used to promote ABC and cascade information regarding new features or changes to their colleagues. They were very

*Numbers in brackets correspond to the number of interviewees.
Case Study B

enthusiastic about the ABC and agreed to keep up-to-date with the developments through training. Sometimes they did take on the role of the "ABC administrator" for their team/department, i.e. they agreed to upload all documents in ABC and search for relevant information in the ABC for the group, which obviously was helpful and time-saving for their colleagues. The negative aspect of it was that people relied on them for using the ABC and they did not learn how to use it themselves.

5.5.3. Site Structure and Navigation

Although most of the users were positive regarding the system, the site structure of the ABC library received some criticism (7).

"It looks quite complicated. There is so much wording on there."

"I don't find the homepage very friendly."

"You have to know where to look in order to find what you are looking for or you have to call somebody and ask where they put the information."

Some comments were made regarding the consistency of the file structure and the content found in ABC (4). Given that the file structure was fairly consistent and most folders had the same subfolders, interviewees asked for more consistency in which documents were being uploaded in the ABC and in which folders.

"The real challenge for ABC is consistency across the file structure."

"There needs to be a consistency in what the teams do and how much information they put in the ABC."
Case Study B

"I don't think that everybody is consistent in where they file documents."

5.5.4. Searching and Browsing

Most of the interviewees (10) tended to navigate the folders of the ABC in order to find the documents they were looking for, which was in agreement with the results of the questionnaire. The main theme that came out of the interviews and the questionnaire was that using the search engine of the ABC "is not like Googleing". They seemed generally satisfied with the search engine (7), with a few negative comments.

"The search is not too bad."

"When you can refine the search, for example by disease, by classification, that helps. It makes it more specific."

"It didn't bring everything up that I wanted."

"I find it a bit difficult when I am trying to search by a search title; it keeps asking you to reformat your wording when I am trying to search for particular things."

"I think the search criteria need to be more specific by text fields."

"Unless you are very lucky, you don't get what you want."

Some interviewees commented on the large number of results that they tended to get from the search engine (4).
Case Study B

"Because the search is not very specific, it is difficult to find exactly what you are looking for. I find that it takes a while to go through a list with a thousand documents."

It was also mentioned that the quality of browsing depended on how well users filed the documents (3).

"Some of them maybe shouldn’t be in there, but it is basically where people choose to file them away."

5.5.5. Metadata

Both of the models for uploading documents and adding metadata to them have been implemented in Company B: the first is when the actual author/creator of a document uploads it and adds the metadata for it. This is the case for most users. Some users (4) have commented that they did prefer to add the metadata themselves, because they felt they were most knowledgeable and capable of assigning the most appropriate metadata “It is a necessary evil” or “Part of the job” as some have called it. The automatic production of metadata was also suggested.

“No, I wouldn’t prefer someone else to fill-in the properties for me, because I think I am closer to the documentation, I am closer to the information, it doesn’t take very long to do it, it would take longer to explain to somebody else and then go back and do it if it is not done correctly.”

The second model is when one person has the responsibility to upload and add metadata to the documents that the users are preparing. This model is followed with administrators and some “star users” having the responsibility of uploading most of the documents in ABC. The implication of that is that there was some level of consistency as to where similar documents were placed within the ABC and in the quality of metadata. On the other hand, users were not
Case Study B

encouraged to contribute to the system as much as they would do with the other model.

In general, most said that they felt it was important to fill-in the metadata fields (8), while some others said that they normally filled-in the "Title" and then copied it in the "Description" (4), because they did not recognise the usefulness of the "Description" and they felt that it took quite a long time to add the metadata

"No one is interested in metadata which is why you may find metadata that mean something to the editor and no one else"

Some interviewees mentioned "Title" and "Date" being the most significant metadata (6). "Classification" should be extended to meet the needs of more departments within the company.

Also, some of the users commented that they found it hard to decide in which folder/subfolder to upload their documents (3).

A few interviewees identified "Abstract", "Project", and "Ratings" as metadata that would be useful to be added.

"It doesn't give you an abstract, so you don't know what it is about, so you have to open every document and it is quite difficult to find what you are looking for."

5.5.6. Knowledge Management and Collaboration

Most of the interviewees agreed (10) that the ABC has improved knowledge sharing and collaboration because it is the most efficient way to disseminate, even very large, documents.

"It certainly assists dissemination of information"

"Definitely (the ABC has a role to play in knowledge management in Company B), because it is the global solution Not
Case Study B

all functions use it yet and the functions that do use it may don’t put all their information there. But it is one of the very few global systems that can be accessed by any marketing company around the world."

“The good thing about it is that everyone has access to it and therefore, you can use it for knowledge sharing and you can access things that have been done in the past in other projects or other similar activities.”

“Access to information is definitely improved through that.”

Some have also mentioned that it has improved access to information at the company level and that users had access to information produced by other projects teams or departments, especially between the global company and the marketing companies (5).

“It is very good for communication between the global company and the marketing companies.”

It was stressed though that the ABC was a one-way means for communication, i.e. from the global company to the marketing companies and not the other way around. The means for communicating information from the marketing companies to the global company was mainly email and telephone.

5.5.7. Training

Most of the interviewees (12) were satisfied with the training they received regarding the use of the ABC. Some though identified the need for more training, especially on uploading documents on the ABC and filling-in the document properties form (4).
Case Study B

“I don’t think there is enough awareness of ABC. A lot of people don’t know how to access it, what they can use it for or they don’t know which search engines are available.”

“You do need to have training in order to use the ABC effectively; it is not a particularly intuitive system, especially if you have to add information.”

The other training material, such as the videos, and the help desk support were also well-received (4).

5.5.8. System Development

The ABC environment was developed in 2000 and at the time of data collection held over 70,000 documents, which could be research articles, minutes of meetings, presentations, video files etc. It was built to consolidate the product information that existed in a number of different databases within the company and to provide a holistic view of the drug cycle pipeline from discovery through to marketing. The aim was to close down all the different databases and have an area for product information, not the actual data but the supporting information, like the plans for the next stages of development, that it could be standardised and make it available in different ways, very much like the deal: “store once, use many times”.

“The idea of the library is to be a sharing mechanism and we have always advocated that if you are putting something in the library you are doing it for the purpose of making it more widely available. It is a place for corporate information assets.”

Emphasis was put on the long term storage of the key information, i.e. any information across the drug development life cycle.
Case Study B

"The time line for a drug to be developed and marketed is between 10 to 12 years. That’s a long time. People come and go in that time, so if you don’t know where this information is, you might start to lose it. So the idea is that you store it in one central place and you make it available and you can manage it over time with the owners and through version control and access control."

The ABC library is composed of several software components: a library, which is Documentum based and has been tailored over the years, an Autonomy search, which allows the searching and grouping of the library records, and a portal from Vignette, called the “Infospaces”, which is the publishing mechanism. Comparing the ABC library with the portal, in the portal the owner of a document can display in context the information that they were trying to push out to the general users. The portal wraps the information in context, unlike the library which acts more as a repository.

The metadata scheme has evolved over the years of use. Initially, the metadata scheme had 15 elements that were out-of-the-box from Documentum. The only automated field was the name of the person contributing to ABC. Gradually and after users’ feedback, the metadata elements came down to 6 mandatory metadata elements for all documents in ABC. Most of them were pre-filled so that it would take the shortest time possible for the users to create the metadata. The main metadata that the users needed to contribute was the title, which was taken for the file name they gave their file, a short free-text description of the content, owner and classification, both taken from a drop down list. They also mapped their scheme to DCMI (2.3.5.1) and renamed some of their metadata to correspond to DCMI elements in an effort to produce a standard core metadata scheme to be used across the company. This would facilitate integration with new information systems and the general management of metadata in Company B. A standardised taxonomy was recently implemented to populate the “Subject” field. All metadata related to version control, i.e. “Modified by” and “Modified Date” were created automatically from ABC.

After the initial customisation of the system to the company’s needs, the ABC library was continuously improved, based on the users’ comments and
requests. The ABC team examined and fine tuned the functionality of the system on a monthly basis.

5.5.9. System Administration

Regarding the search engine of both the library and the portal, a lot of users would like the search to work like Google works. This was acknowledged by the ABC team and they were trying to improve the search functionality.

“The reasons [for the fair search efficiency] are that there aren’t the resources to fine tune it, keep it very relevant and there are so many different repositories to search.”

“There is quite a lot to do in search I think.”

It was noted though that the search efficiency was heavily dependent on the quality of the metadata that the users create.

“In reality it is only as good as the data you are looking for and if you can fine tune it. So if the stuff you are storing does not have standard metadata, is in different format, is all in different places and the engine does not know where it is to begin with, you are really going to struggle. Rubbish in, rubbish out.”

There was not a formal retention schedule for the content of ABC and users tended to regard it as a permanent storage place for documents. The IKM team was working with records management professionals towards a global retention and disposal schedule for the whole company. The main difficulty was that every country that they operated in may have different legislation regarding electronic records retention. In the mean time, it was highlighted that ABC was an operational knowledge document library rather than a permanent archive. Users were encouraged to withdraw from it documents that were out-of-date or
of no value to the company. Withdrawing documents would remove them from
the search results and the navigation but they would be accessible if required.

5.5.10. System Evaluation

The ABC team constantly monitors the use of the ABC library with a
variety of tools.

"We have some good tools to look at statistics; we use business
objects, we have some home grown tools, we have user
authorisation tools... we look, for example, at how many
classifications have been used in this particular area in the last six
months or how many authors have contributed a particular type of
documents... using SQL to built queries for Oracle we can find out
everything we need to know."

The team was generally satisfied with the efficiency and the use of the
ABC library, although there was room for improvement, especially regarding the
speed of the system

"It does what it is supposed to do"

"I think that it could be used better, e.g. the rigour of the
information and the quality of what goes in, that's from the
information management side."

"Speed has always been an issue but that's the architecture, how it
sits on the network, and we might have to re-evaluate it."

From a financial point of view, the payback period has finished and the
financial targets have been met a long time ago.
Case Study B

“We are well into business as usual; we are in the maintenance period if you like.”

The ABC team did try to monitor the metadata quality a few years ago but it required a lot of resources. When users were presented with the reports of metadata quality, they wanted the ABC team to fix the metadata for them. But they were going to start checking again the metadata quality and to put more emphasis on training to resolve this problem.

5.6. Conclusions

Based on the analysis of the questionnaires and interview transcripts, a number of conclusions can be made on the following topics: the use of and user attitude towards the ABC, the content, the metadata used, and whether it has facilitated knowledge sharing. It should be noted that there were a number of occasions when the data from the questionnaire and the interviews provided conflicting results.

5.6.1. Use of and User Attitudes towards the ABC

The ABC library was developed in Company B over five years ago for the purpose of disseminating marketing information. Its scope was expanded to be used by most departments in Company B as one of the main KMS. The ABC was used on a daily basis by most of the respondents of this study and was considered to be important to the daily tasks of 143 (81.7%), in particular in the Global Drug Development team.

The main use of the ABC was to upload or create documents, some of which were being published in the Infospaces, and to access documents necessary for the daily tasks of the users.

The majority of the participants agreed that the ABC was very useful and they were satisfied with the overall efficiency of it (67.3%). It has improved
access to the company’s documents (68.8%) and, as a result, users spend less
time searching for documents.

Almost half of the respondents (49.7%) indicated that they
uploaded/created documents in the ABC at least once a week. It was generally
considered a useful tool for managing their knowledge resources (82.3%). No
significant differences were found in the users’ attitude towards ABC based on
their gender, age, qualifications, or location. Users that have been working for
more years in Company B tended to believe that by using the ABC they were
able to perform their tasks for easily and more quickly.

Version control and the review process were two characteristics of the
system that users found most important. The criticism referred mostly to the site
structure, the process of uploading documents, and the fact that it could be a slow
system.

5.6.2. Content

One of the critical factors for the success or failure of a KMS is the
quality of content. In many organisations, users tend to abandon KMS because
content may be out-of-date, incomplete and misleading. The results of this
project were completely the opposite; the majority of the respondents in the
questionnaire agreed that content was accurate, up-to-date, reliable and
comprehensive and therefore, they trusted it (83.8%).

Just a few interviewees commented on the content not being as up-to-date
as needed. The “Valid from” and “Valid by” dates that were in use should help
users identify which document were reliable in terms of time. In addition, a
retention schedule could ensure that documents that are no longer useful are
archived. Users will also need to be encouraged to check and update their
documents, especially the procedures, as appropriate.

Another comment that was made related to the content of the ABC was
that users were not yet certain about the 3-fold path. They were not always
certain as to which documents should be promoted from the eRooms to the ABC
and claimed that a lot of useful documents remained in the eRooms and thus
were inaccessible for most of the users. In addition, users were not very clear as
Case Study B

to which documents were published in the Infospaces and therefore, usually searched both the ABC and the Infospaces when they were looking for information.

5.6.3. Browsing and Searching

Participants in the study were asked to indicate their preferred method/tool for information seeking. Browsing was the preferred method for searching for documents and in particular, navigating the ABC library folder structure (63.7%). Most of them have said that they had become familiar as to where specific documents were and therefore they preferred to browse the system in order to access them.

Most of the participants agreed that they were comfortable in searching for the documents they needed (71.4%) and most of the times they succeed in finding them (76.6%). The ABC basic search and the advanced search were the most popular search engines with 47.6% and 37.3% of the respondents indicating them as their preferred tool. Participants were undecided about the quality of the results they were getting from the search engine, but the ABC basic search and the advanced search results were judged more satisfactorily than the other search engines, probably because the extensive search options allowed for very specific queries.

5.6.4. Metadata

The quality of metadata in the ABC was quite high, with most of the documents having a “Title” according to the Naming Guidelines, a number of “Owners” or editors and dates of creation and modification. Users could select most of the metadata from drop-down lists, which simplified the process enormously and facilitates consistency. The good quality of the metadata facilitated the retrieval of more accurate results through the ABC basic and advanced search.
Case Study B

The most significant metadata tags for searching and evaluating a document were “Title”, “Description”, “Primary Location Folder”, “Owner”, and tags indicating the creation or modification date of a document. It is interesting that “Description” was rated so high, although it was quite common that users overlooked this tag when creating the metadata and just copied the “Title” for it.

Nevertheless, the majority of the participants recognised that it was important to fill-in the metadata tags (92%). Most of them preferred to create the metadata themselves or to have as many metadata as possible automatically created by the system. Highly qualified users though would prefer it if someone else was creating or editing the metadata for them. It is, therefore, very positive that both of the metadata creation models were present in Company B catering for the needs and preferences of all users. Those that preferred to create the metadata themselves may do so and administrators or “star users” may create the metadata for those who would like to do so.

It was very interesting to see that women tended to find it easier to create the metadata need for a document, than men. Unfortunately, there are no other similar studies with which to compare these results.

5.6.5. Knowledge Management

The ABC library was regarded by its users as an efficient KMS system (82.3%). They did think of it as a useful source to search for existing information before starting a new project (61%) and as a useful system to store knowledge resources (88.7%) and to exchange information (80.5%). It is very important that, by using it, users were able to share information across the company and the work and documentation of different teams was more visible to each other and the company. This helped the users to identify their core competencies and expertise and collaborate better. The team can also perform a knowledge audit and identify and address possible gaps.

The metadata used in the ABC helped the users to identify the ownership of a document, both in terms of an author and the project team through the “Owner”, “Editor” and “Primary Location Folder” tags. In addition, the use of various tags for the creation or the modification date provided the users with the
**Case Study B**

appropriate time frame that they required in order to evaluate the timeliness of a document. These two factors, i.e. ownership and timeliness, are important to enhance the trust of users to the content found in the ABC. User ratings and annotations could be also used to provide added value to the content. Contextual information about the creation and appropriateness of documents is being given by some metadata tags, such as “Geographic Region”, or “Specific Function”, but more could be added that would specify the research area or provide project identifiers, as some users have requested.

5.7. Summary

This chapter presented the analysis of the data collected in Case Study B with the collaboration of the pharmaceutical company. This case study served the aims and objectives of this research because it provided data that:

- Identified and documented the metadata elements currently used for the description of content created in the process of KM;
- Provided indications of metadata element types that may be useful for the description of knowledge;
- Provided insights into the perceived usefulness of metadata, in terms of retrieval efficiency and trust towards the system; and
- Presented the metadata management strategy of Company B.

The next chapter analyses and compares the data from the two cases studies and presents the proposed metadata framework and metadata management strategy.
Chapter 6. Cross-case Analysis

This chapter compares and synthesises the findings from the two case studies. The discussion is focused first on the organisations, exploring the characteristics that shaped their KM programme and their metadata management strategy. Data for this part are drawn from the documentation, field visits and the information and knowledge managers’ interviews. Then, the focus shifts to the individuals, examining their attitude towards the KMS and metadata. Data are drawn from the questionnaires and the interviews with the users. Variables are examined and compared one by one for the two cases.

Based on the discussion of the metadata schemes used in the two case studies, a metadata framework is presented in the later sections of this chapter, followed by guidelines on the metadata management strategy.

6.1. The Two Cases, Similarities and Differences

The criteria for selecting organisations as case studies in this research were that they should be UK-based, knowledge-intensive organisations with a knowledge management system for managing their knowledge. As a result, the case studies have some common characteristics: they involve two highly knowledge-intensive companies, which use a main KMS to store their knowledge documents. At the same time, there are differences between the two companies, which make the cross-case analysis of the results particularly interesting (Table 32).

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Knowledge intensive</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Competition</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Innovation</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Quick Staff Turnaround</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Quick Production Cycle</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Legal Requirements</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Large Size and Resources</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Geographically Dispersed</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 32: Similarities and Differences between the Two Case Studies
Cross-case Analysis

This emphasis on organisational characteristics is justified because KM is successful only when it is aligned with the organisational strategy, culture and business needs. The following paragraphs explore how these characteristics influence the KM needs of each company.

Both companies operate in highly knowledge-intensive industries, as presented in Sections 2.5.1 and 2.5.2. The motorsport engineering industry comprises a wide range of high technology performance engineering, advanced materials, electronics, and research companies. Very large amounts of data, information and knowledge are produced with the development of each car and success is only possible when knowledge from previous years and designs is transferred and used in new designs. The pharmaceutical industry is heavily engaged in R&D with the aim to develop new drugs, utilising the latest piece of research Knowledge from previous endeavours allows the use of current research in quick and successful design of new products.

Competition is fierce for both companies. The motorsport engineering company has to demonstrate its superiority in engineering in order to win the championship from their competitors. Similarly, pharmaceutical companies compete with one another in developing ground-breaking, well-tolerated and cost-effective medicines for diseases that may affect large parts of the population. Competition drives both companies to innovative solutions. Through innovative product designs they can get a competitive edge from their competitors. They both rely on a large number of designers and researchers to come with creative ideas and develop unique designs. Innovative thinking will allow the motorsport engineering company to produce the most technologically advanced car to win the races. Innovative use of existing or new compounds will allow the pharmaceutical company to develop new drugs and gain greater market share.

Another characteristic of the motorsport engineering industry is the, relative to other industries, quick staff turnover, with companies losing a considerable amount of their employees every few years. If their knowledge is not captured in some way, it will be lost. Staff turnover is not as great an issue in the pharmaceutical industry; nevertheless, the long lead time of 10 to 12 years to put a medicine in the market requires, again, some way of knowledge capturing, as staff may leave the company in the meantime.
Cross-case Analysis

In terms of product life cycle, Company A has by far a quicker product life cycle than Company B. Company A develops a new car every year, whereas it can take over ten years for Company B to bring a new drug to the market. This difference in time requirements has significant implications for the information and knowledge needs of the two companies and, consequently, to their information and knowledge management practices. Company A needs to have instant access to information and knowledge. Their strict deadlines on research and development and the large amounts of data, information, and knowledge that are produced on a daily basis require strong information and knowledge management to facilitate the decision-making process. At the same time, this quick production cycle means that usually they do not have sufficient time to document their knowledge. On the other hand, time pressure is not as great in Company B. It is the very strong legal requirements of the pharmaceutical industry that demand strong data, information and knowledge management, especially during the R&D phase of a medicine, so that Company B can apply for licence for a medicine. There are no such regulations in the motorsport engineering industry that could influence the KM needs of Company A.

In terms of size and resources, Company B is significantly larger than Company A and therefore, has a larger number of KMS users and is able to invest greater financial, technical and people resources. It is also geographically spread, having a large number of R&D facilities and marketing companies across the globe. The numerous R&D staff located in different countries and time zones required a robust KMS that could accommodate the vast amounts of data, information and knowledge produced on a daily basis. This content should then be accessible to the manufacturing and marketing departments of the company in order to excel in sales. On the other hand, Company A has a limited number of resources invested in KM because it has a significantly smaller number of KMS users which in their majority are located in the same facilities. Information and knowledge sharing is possible even with face to face communication. Davenport and Prusak's studies (2000, pp.17-18) found the same result; in small, localised companies, people most probably know who has experience in a particular aspect of the business and can talk to them face to face. The maximum size of an organisation in which “people know one another well enough to reliable grasp of collective organisational knowledge” is estimated to two to three hundred people.
Cross-case Analysis

6.2 Knowledge Management in the Two Cases

Knowledge management, as a systematic effort, in Company A was still in its first steps. It was very much technology-driven from the need to develop a KMS where the company could store and find its documentation to improve quality of information and to avoid "re-inventing". The use of SharePoint had been a significant step towards knowledge organisation and sharing. It had become the central library of the company’s documentation and subsequently the repository of the company’s knowledge and memory.

Company A’s commitment to KM was not as strong as required. The number of IKM staff was limited and users were not encouraged to use the KMS through any incentives. Knowledge sharing happened ad hoc. There was not a systematic process for knowledge capture or much time invested in documenting processes. More effort was required for changing the organisational culture and explaining the possible benefits of the KM programme to the whole of the company.

Company B’s commitment to KM was much stronger than Company A. KM has been part of company B’s way of working for the past 7 years. The IKM team was numerous, including Information Architects developing the KMS, Trainers and Business Partners. Business Partners, in particular, worked with the users to facilitate the knowledge sharing and capture process in a more coordinated way. They helped them identify best practices and share them with their colleagues in other project teams or departments of the company.

6.3 Knowledge Management Systems Used by the Two Companies

Both companies have employed a KMS to support their KM programme. Company A selected SharePoint in 2005 as its KMS and Company B created ABC, a KMS based on Documentum 5 years ago as the central document management system across the company. In other words, Company B’s KMS has been developed in-house according to the company’s needs and has been used for longer than Company A, which used an almost off the shelf solution.
Cross-case Analysis

The KMS in Company A, being a recent development, has greatly facilitated knowledge sharing and made the work and the documentation of the different groups more visible to each other and the company. No formal evaluation process of the KMS was in place, but informal positive feedback from the users provided the IKM team with evidence of the business value of the implementation. The KMS in Company B was well-established. In the past, they used incentives to promote its use; at the time of the data collection, no incentives were used because it was integrated with the users’ day-to-day tasks. It was viewed as the global KMS which provided a holistic view of the drug cycle pipeline from discovery through to marketing. The efficiency of the KMS was being monitored constantly to identify areas for improvement.

Summarising the key points of this and the previous section, Table 33 examines whether the critical success factors for KMS, as they were presented in Table 1, are present in the two companies.

<table>
<thead>
<tr>
<th>Critical success factors</th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commitment and support of top management, including allocation of resources and leadership</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>User acceptance and expectations from KM initiatives</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>A knowledge strategy that identifies users, sources, processes, storage strategy, knowledge and links to knowledge for the KMS</td>
<td>Weak</td>
<td>Strong</td>
</tr>
<tr>
<td>An organisational culture that supports learning and the sharing and use of knowledge</td>
<td>Average</td>
<td>Strong</td>
</tr>
<tr>
<td>Information systems, including content, capabilities, user interfaces, level of difficulty and how they fit with the work environment</td>
<td>Strong</td>
<td>Strong</td>
</tr>
<tr>
<td>Measures to assess the impact of the KMS and the use of knowledge</td>
<td>Weak</td>
<td>Strong</td>
</tr>
</tbody>
</table>

Table 33: KMS critical success factors in Company A and B

The following sections provide more information on the KMS development and ongoing management.
Cross-case Analysis

6.3.1. KMS Development and Administration

As mentioned before, the KMS in Company A, SharePoint, was implemented largely as an off the shelf solution. Although that allowed for quick installation, it was not used to its full potential. ABC, the KMS in Company B, being a more mature system, had been customised heavily to accommodate the company’s needs. Company B had the resources available to continue improving the functionality of its KMS. The IKM staff systematically collected feedback from the users and amended the system according to their requests. Company A lacked the resources to continue customising and improving the KMS according to the users’ requirements.

In terms of measuring impact on the business and its effectiveness, both companies were not systematically using measurements of financial basis. The impact on the users’ ability to retrieve relevant information and knowledge documents and to collaborate was far more important for both companies. The KMS in Company B had already met the payback period and it was “business as usual”. The KMS in Company A was still in the middle of its payback period, as estimated by the IKM team. KM and the use of KMS have intangible impact on the business, as presented in Sections 2.1.2 and 2.2.2. Therefore, it was very positive that the two companies were not putting much emphasis on financial measurements. Nevertheless, monitoring and evaluating the KM programme and the use of KMS with a number of techniques is important because it allows the IKM team to identify which processes or tools are not meeting users’ expectations or needs. Techniques that can be used to collect meaningful feedback on the effectiveness of the KM programme are both qualitative and quantitative in nature, such as users’ stories, interviews, surveys and system usage data.

Both of the KMS were designed based on the organisational structure of the two companies and did not allow many opportunities for cross-team collaboration. In Company A, cross-team collaboration was neither encouraged nor nurtured in any explicit way. The design of SharePoint was based on organisational structure, with each group having its own site library and very often members of each group were browsing or searching only for documents in their own group. As a result, there were some groups that were quite isolated.
Cross-case Analysis

from the others and knowledge did not flow sufficiently. The identification and cultivation of groups of people with similar work areas beyond the formal groups (communities of practice) could be used to address this issue and help in knowledge sharing. In Company B, the use of eRooms allowed for cross-team collaboration. eRooms were not studied extensively during this case study but were used heavily by different project teams as a means to communicate project-related information and knowledge. Company's B information path dictated that knowledge documents, created in eRooms, should be promoted in the ABC library, if they were of use to the whole company.

Both systems allowed for limited personalisation from the users, which was very positive as this can create a sense of ownership for the users. In addition, both systems had a variety of navigation aids and search functionalities to allow users to access the knowledge documents they needed. Navigation aids and search engines are equally important because navigation provides to an extent the context of knowledge documents and promotes relevant content. The factor of serendipity is also important. Search, on the other hand, allows for quicker access.

6.3.2. User Support, Training and Coaching

Training is needed not only to educate users in how to use a KMS, but to show them how the KMS can help them to perform their tasks. KMS are becoming more user-friendly and their use more intuitive to the users. Users are increasingly familiar with web applications, databases and communication and collaboration applications. The training will make them aware of the available tools and how the information and knowledge documents relate to their job. Training will put the KMS in context. It can provide for example usage scenarios, i.e. "I need to develop a new design > I can use this tool to find a similar design and to communicate with my colleague to ask for clarifications and advice". A training or awareness session is required to show users the organisational culture, policies and procedures, and to set the company's expectations from them in terms of knowledge management.
Cross-case Analysis

In Company A, users were not adequately trained to use the KMS or the metadata to help them find the necessary pieces of knowledge. Therefore, the system and metadata was not used to its full potential. On the other hand, in Company B, the expected information and knowledge management practices to support the 3-fold information path (Figure 25) were clearly communicated and users were systematically trained to use the KMS to contribute and find relevant information and knowledge. Web conferencing tools could be used, as Company B does, as a cost effective approach to train users located in different countries.

6.4. Metadata Management Strategy in the Two Companies

The two companies followed different approaches to metadata, which had an impact on the quality of metadata in the KMS and the efficiency of the search engine. Metadata quality can be defined differently in different settings and for different purposes. "Economic, political and technical constraints are a part of every decision affecting quality and perception of quality" (Bruce & Hillmann 2004). In the context of an organisational KMS and for the purposes of KM, metadata quality is defined by a fine balance between richness and comprehensiveness for the one part and efficiency and functionality from the other. Metadata is expected to provide adequate information regarding the content, context and value of the knowledge documents and to comply with the syntax and rules set in the metadata scheme. On the other hand, the metadata creation should not be complicated or time-consuming.

Company B followed a systematic approach to metadata, which resulted in metadata of good quality (Figure 43). The metadata creation process is simplified as much as possible with few mandatory metadata, drop down boxes of controlled values and some metadata being created by the KMS. The Metadata Naming Guidelines, linked on the metadata creation form, reminded users how they should create their metadata and the mandatory training for the users that will be creating metadata taught them how metadata is being used and why it is important to create metadata of good quality. The outcome of this strategy was that users knew how to create good metadata and were willing to do so because they understood the effects of having good metadata while searching and...
Cross-case Analysis

browsing for knowledge documents. The IKM team managed the metadata scheme, updated it according to the company’s needs and aimed to standardise it, using DCMI as a baseline, to better integrate different information systems. They tried to automate the metadata creation process as much as possible so that users would not spend too much time. In addition, they would do an audit of the metadata of a part of the KMS from time to time, to ensure that knowledge documents are described with good quality metadata.

<table>
<thead>
<tr>
<th>Metadata in Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Few mandatory metadata</td>
</tr>
<tr>
<td>Drop-down boxes of controlled values</td>
</tr>
<tr>
<td>Some metadata are created automatically</td>
</tr>
<tr>
<td>Mandatory training on metadata creation</td>
</tr>
<tr>
<td>Metadata Naming Guidelines</td>
</tr>
<tr>
<td>Metadata are easily created</td>
</tr>
<tr>
<td>Users are willing to create metadata</td>
</tr>
<tr>
<td>Good Quality Metadata</td>
</tr>
<tr>
<td>Importance of metadata is highlighted</td>
</tr>
<tr>
<td>Users know how to create metadata</td>
</tr>
</tbody>
</table>

Figure 43: Metadata management in Company B

On the other hand, Company A did not really have a clear policy or strategy regarding metadata in the KMS (Figure 44). Users were taught only briefly why and how to create metadata. There was no ongoing support in the form of guidelines or further training. There were no controlled fields for users to select metadata and even less metadata were mandatory. As a result, the metadata found in Company B’s ABC were of significantly better quality than the metadata found in Company A’s SharePoint.
Cross-case Analysis

Metadata in Company A

- Few mandatory metadata
- Drop-down boxes of controlled values
- Some metadata are created automatically
- Once-off training on KMS
- Metadata Naming Guidelines

Users are not willing to create metadata
Users know how to create metadata

Importance of metadata is highlighted

Poor Quality Metadata

Items in grey are those missing in comparison to Fig.43
Items in red are those different from Fig.43

Figure 44: Metadata management in Company A

6.4.1. Metadata Creation

It was interesting to note that both companies followed a mixed approach to metadata creation. They both held users responsible for the creation of metadata for the knowledge documents they contributed to the KMS. In both instances though, there were super-users or star-users of the KMS who might upload documents and create metadata for their teams or their managers. The use of super-users presents two important advantages, compared to the IKM or the users creating the metadata:

1. They are close enough to the creator of the knowledge document to have a better understanding of what metadata should be attached to the document, in contrast to the IKM team, which needs to keep an overview of the KMS and all knowledge documents.
2. They have the time and commitment to be trained and create metadata of good quality, contrary to the users who may not commit the time to do either.
Cross-case Analysis

The main disadvantage of using super-users is that users do not become as engaged with the KMS or the knowledge documents as they should be.

In neither company, were the IKM teams responsible for creating metadata, as was the case in business libraries of the past, where librarians were the custodian of both knowledge documents and the relevant metadata. This approach is no longer sustainable for organisations, where a very large number of knowledge documents are produced on a daily basis. Although business librarians or the IKM team may be most qualified and keen to create metadata for the KMS, it is a very expensive approach that does not engage the users in using and taking ownership of the knowledge documents and the KMS. Hahn and Subramani (2000, p.308) also pointed that librarians, since they are not the individuals who actually create the knowledge documents, may not have an “accurate, first-hand understanding” of the content. Hence, the metadata appended by a librarian may be inappropriate and, as a result, subsequent queries searching for a knowledge document may not retrieve the right resource. In CWA 15247 (2005, p.10) it is reported that in 43% of the organisations studied, after users create metadata for the knowledge documents they upload, the IKM team “cleans up and/or adds metadata so that it meets the corporate standard. All organisations that value and use metadata require a high level of completeness and consistency, and typically have metadata staff to provide quality assurance.”

CWA 15247 (2005, p.10) also reported that about half of the organisations surveyed (43%) used tools to automatically generate metadata using business rules or statistical algorithms. Most of the organisations (71%) used web-based forms for the users to input the metadata. Not all metadata can be created automatically by the KMS. Company B tried to automate the creation of “Description” with limited success because it was very difficult to decide which part of the document the system would understand as “Description”, since the majority of knowledge documents in the KMS are unstructured. Nevertheless, it is important to automatically create as many elements as possible to allow more time to the users to create meaningful bibliographic metadata, such as “Summary” and “Keywords” or business-specific metadata. A fine balance between quality and ease of creation should be kept.

The cost-effectiveness of the application of metadata, both human- and machine-generated in the two case studies could not be formally established.
Cross-case Analysis

Neither of the companies had measured or quantified the cost of creating metadata or what were the direct gains of creating it. In Company A, the investment in metadata was very limited in terms of resources spent on training and the time users spent on creating metadata. In Company B, the investment was significantly higher, with resources spent on training, developing the metadata scheme, naming guidelines and taxonomy and monitoring the quality of metadata. The return of this investment was evident in the system’s search efficiency and users’ feedback.

6.4.2. Metadata Types

Regarding the types of metadata used, both companies used mainly common descriptive metadata, such as “Title”, “Author” and “Description”. They both used administrative metadata, such as “Creation date” or “File type”. Company B used structural metadata, in the sense that users could create links between relevant knowledge documents or between different versions of the same documents. Use metadata were used for version control purposes only, users proposed the use of metadata that could indicate how useful an object is by how many times it had been accessed or by user rating and annotations. Technical metadata, such as the format of the knowledge documents, were used in both instances. In addition, technical metadata, not visible to the users, were used to control access levels. Both companies used business specific metadata, such as “Event location” (Company A) or “Disease” (Company B). These provided, to a great extent, the context of the knowledge object. In addition to the above, both companies used metadata related to version control, such as “Last Modified” and Modified by”. Table 34 summamises the types of metadata used in each case.

<table>
<thead>
<tr>
<th>Type</th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Descriptive</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Administrative</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Structural</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Use</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Technical</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Business</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 34: Types of metadata used in the two cases

192
Cross-case Analysis

Regarding subject-based metadata, which is part of the descriptive metadata, in Company A subject headings were used but there was not a controlled list of them (Table 8), whereas in Company B there was a classification list, offered as a drop down menu, including subject headings and document types.

Company A users suggested the addition of more business specific metadata, such as "Test week number". Company B users suggested the addition of "Keywords", "Abstract" and more business specific metadata indicating the origination of the knowledge documents, such as "Research area" and "Original application".

6.4.3. Crosswalk Analysis of the Metadata Schemes

The metadata schemes used in the two companies were developed in-house based on the out-of-the-box metadata of their KMS. They included, for the most part, common descriptive and administrative metadata. To find out how similar they were, the two schemes were mapped semantically on the Dublin Core Metadata Element Set (DCMI) (2.3.5.1). This mapping could be used to explore whether a common metadata framework could be used from companies in different industries. DCMI was selected as the basis of the mapping because it has become the de facto standard for the description of digital objects and its use has been promoted for the purposes of knowledge management. CWA 15247 (2005, p 15) reported that DCMI is widely used in private companies and Company B has also mapped and aligned to an extent their metadata scheme to DCMI. Table 35 presents the metadata mapping matrix.
Cross-case Analysis

<table>
<thead>
<tr>
<th>DCMI</th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Content</td>
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</tr>
<tr>
<td>Title</td>
<td>Title</td>
<td>Title</td>
</tr>
<tr>
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<td></td>
<td></td>
</tr>
<tr>
<td>Code</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Title – Alternative</td>
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</tr>
<tr>
<td>Subject</td>
<td>Subject</td>
<td>Classification</td>
</tr>
<tr>
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<td>Image keywords</td>
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</tr>
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<td>Description</td>
<td>Description</td>
<td>Description</td>
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<td>Summary</td>
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<td>Description - Contents</td>
<td>Contents</td>
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<td>Source</td>
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<tr>
<td>Language</td>
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<tr>
<td>Relation</td>
<td></td>
<td>Relevant Files</td>
</tr>
<tr>
<td>Coverage - Temporal</td>
<td>Event Year</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Event Week</td>
<td></td>
</tr>
<tr>
<td>Coverage - Spatial</td>
<td>Event Location</td>
<td>Location</td>
</tr>
<tr>
<td>B. Intellectual Property</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Creator</td>
<td>Author</td>
<td>Owner</td>
</tr>
<tr>
<td></td>
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</tr>
<tr>
<td>Publisher</td>
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</tr>
<tr>
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</tr>
<tr>
<td>Rights Management</td>
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</tr>
<tr>
<td>C. Instantiation</td>
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</tr>
<tr>
<td>Date</td>
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<tr>
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<tr>
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<tr>
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</tr>
<tr>
<td>Date – Modified</td>
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</tr>
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<td></td>
<td>Picture Width</td>
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<td>URL</td>
<td>Primary Location Folder</td>
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<td></td>
<td>Site URL</td>
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</tr>
<tr>
<td>D. Other Metadata</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Email of Author(s)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Contact Name</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Group</td>
<td>Organisation</td>
</tr>
</tbody>
</table>

194
Cross-case Analysis

<table>
<thead>
<tr>
<th>DCMI</th>
<th>Company A</th>
<th>Company B</th>
</tr>
</thead>
<tbody>
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<td></td>
<td>Project</td>
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</tr>
<tr>
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<td>Project File Number</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Manufacturer</td>
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</tr>
<tr>
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<td>Supplier</td>
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</tr>
<tr>
<td></td>
<td>Status</td>
<td>Status</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td>Version</td>
<td>Intended Audience</td>
</tr>
<tr>
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</tr>
<tr>
<td></td>
<td></td>
<td>Intended Country</td>
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<td>Diseases</td>
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<tr>
<td></td>
<td></td>
<td>Compounds</td>
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</tbody>
</table>

Table 35: Metadata mapping matrix of schemes used in Company A and B

From the mapping, it can be seen that the two companies used quite similar metadata schemes. Most of the DCMI elements were used in the two companies, making it a good base line for designing metadata schemes. There were some elements that were not used in these two companies, but could be used in others, such as “Language”. There were, also, some elements that the two companies used, such as “Status”, that do not exist in DCMI, or others that do not match exactly the metadata definitions of DCMI, such as “Coverage”, “Event Location” and “Event Year”.

The metadata schemes collected from the companies that replied to the preliminary questionnaire (Section 3.4), which were all consultancy firms, include similar metadata tags to the schemes used in Company A and B (Table 36).
Cross-case Analysis

<table>
<thead>
<tr>
<th></th>
<th>Respondent 4 Consultancy</th>
<th>Respondent 5 Consultancy</th>
<th>Respondent 6 Consultancy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Content</td>
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<td></td>
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<td>Subject</td>
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<tr>
<td>Keywords</td>
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<td>Project Phase</td>
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<tr>
<td>B. Intellectual Property</td>
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<tr>
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<td>C. Instantiation</td>
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Table 36: Metadata mapping matrix of schemes used by Respondents 4, 5 and 6

The metadata schemes collected from the literature include similar metadata tags to the schemes used in Company A and B, too (Table 37). The schemes from the preliminary questionnaire respondents and the literature may not be complete and the definition of each element and how it is used in context is not known. Nevertheless, the second and third matrices provide an indication of generalisability of the findings of the first matrix.
Cross-case Analysis

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Table 37: Metadata schemes from the literature
Cross-case Analysis

Comparable results to the above were presented by Obershaw in his study of ten metadata schemes of large multinational corporations (2002, pp.27-42). The schemes included a combined total of forty distinct metadata elements. All of the fifteen DCMI elements were included in at least two of these schemes, with “Description”, “Title”, “Creator”, “Subject”, “Publisher” and “Date” being included in at least eight schemes. All elements, apart from “Publisher”, were used in the case study companies. “Publisher” was not used in any of the other respondents or the schemes collected from the literature. How this element can be used for content produced internally is not obvious. It could be mainly used for content acquired from external resources.

The metadata elements not covered by DCMI were related to products, such as “Product Name”, “Product Category” and “Customer Solution”. Product-related metadata elements are business specific metadata and were used in both case studies. In Company B, the element “Product” was in use and in Company A, some groups were using elements to describe documents referring to products from their suppliers, such as “Stock Code” and “Manufacturer”. DCMI being primarily a descriptive metadata scheme, it also lacked elements such as “Status”, “Audience” and “Rating”. “Status” was used in both case studies and it is an important element because it denotes the currency and thus the value of a knowledge document. Metadata indicating the intended audience and use of a knowledge document were not used in Company A, but were used in Company B as “Intended Audience”, “Intended for” and “Intended for Use”. None of the companies used “Rating” but users in Company B asked this to be added.

As a summary of the above, the following three tables present the mapping of DCMI to the extended metadata schemes of the two case studies, the schemes collected for the preliminary questionnaire and the schemes reported in the literature (Table 38) and the metadata elements that are not listed in DCMI but could be useful across industries (Table 39) and the business-specific metadata (Table 40). The numbers in parenthesis in the Obershaw column denote the number of schemes where the particular metadata element can be found.
## Cross-case Analysis

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### Table 38: Metadata mapping of all collected schemes

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Cross-case Analysis
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### Cross-case Analysis

**Table 39: Non DCMI Elements potentially applicable across industries**

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<td>Car Marque</td>
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<tr>
<td>Diseases</td>
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<td>Compounds</td>
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<tr>
<td></td>
<td></td>
<td>Sector</td>
<td>Industry Area</td>
<td>Legislation and Cases</td>
<td></td>
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</tr>
</tbody>
</table>

Table 40: Business-specific Metadata
6.4.4. Interaction of the Data Management Model and the Bibliographic Control Model

In Section 2.3.2, the two main schools of thought on metadata were presented in order to present and explain the current status of metadata. The bibliographic control approach, focused on developing information systems to organise and provide access to large collections of information-bearers, was criticised as expensive and too elaborate. The data management approach, concerned mainly with the technical aspects of metadata, such as data security, data sharing and data integrity, seemed to neglect the meta-information about information sources that would allow users to establish if the information source was of value to them. It was also mentioned that these two approaches are moving closer to one another.

In the context of KMS, the amalgamation of the two approaches becomes more evident, especially as KMS technology is evolving. The metadata schemes from the two case studies included bibliographic (or descriptive) metadata, administrative, technical and use metadata in order to indicate to the users the content, context and value of knowledge documents. As technology evolves and systems are better integrated, metadata that in the past were created manually and managed by the IKM team, such as the access rights to a document or the contact details of its creator, are now managed automatically by the KMS. Contact information for the creator of a knowledge document, such as “Contact email” or “Address”, does not need to be recorded with the knowledge document but can be stored centrally and linked through technologies, such as the Active Directory (Windows Server 2003 Active Directory). “Security”, an element found in 5 schemes by Obershaw (2002, p.35), is no longer necessary to record with knowledge documents because access rights are managed centrally in security levels. Users usually can only browse, search and access content that they have clearance for.

As the technology and the capabilities of information systems evolve, the tendency will be to use more automatically created metadata elements. Administrative metadata, such as “Date of Publication” or “Format” are created by the KMS at the time the knowledge document is uploaded into the system. Many systems, such as SharePoint, can also use the name of the file uploaded as
Cross-case Analysis

the “Title” of the document. Users are then responsible for giving a meaningful name to their file, following, for example, the Naming Guidelines of Company B. Version metadata used in workflows, such as “Version”, “Last Modified by” and “Modified”, are created by the KMS at the time of the modification.

6.5. Users’ Attitude towards the KMS and Metadata

The previous sections presented the organisational context and the companies’ effort to manage knowledge through KMS and the relevant metadata. This section presents users’ attitudes towards the KMS and metadata and whether these are useful tools for their job.

For KMS to work and serve their purpose, i.e. to facilitate knowledge sharing within an organisation, users need to become involved and take ownership of the KMS. The IKM team is there only to provide support; the KMS needs to be a users’ tool rather than an information system that the company has imposed. Meeting users’ needs and thus getting users’ acceptance is one of the critical success factors for KMS (Table 1). To achieve that, the IKM team needs to identify who the main user groups are, what organisational groups do they function within and what knowledge they need. They also need to know how they currently find what they need and what are the shortcomings of this method/tool. Last, they need to investigate the factors that may hinder knowledge sharing.

6.5.1. Attitude towards the KMS

The results of the surveys and the interviews in both companies revealed that the majority of the KMS users had a positive attitude towards the KMS. In both cases, more users were using the KMS more than once a day to access and upload knowledge documents and search for information relevant to their jobs. In Company B, the KMS was much more important to the daily tasks of users probably because it had been used longer and was better integrated to the day-to-day tasks. It was interesting to note that users from both case studies identified
Cross-case Analysis

the same two main issues: search efficiency and speed of the KMS. More details on the search efficiency will be provided in the next section.

In both case studies, users in their majority were satisfied with the overall efficiency of the KMS and equally agreed that the KMS was useful to share knowledge. The main gain of the use of the KMS in both companies was improved access to documentation, information and knowledge. Less information was circulated via emails and more was made more easily available. Particularly in Company A, where the KMS was fairly new, the effect of its recent implementation was felt more intensively. Users were satisfied with the fact that they could access other colleagues’ work and felt that it had increased visibility of all teams’ work in the design process of the car, which led to a better understanding of the team’s processes and functions. They also felt that the KMS increased the visibility of their own work, which was a strong motivation to use the KMS. They thought that the use of the KMS helped them to identify their core competencies and expertise and to collaborate better. The KMS created the “bigger picture” for the individuals and promoted the team spirit. Nevertheless, with the majority of engineers in Company A located in the same facilities, a lot of users mentioned that they preferred to “walk across the room” and discuss with their colleagues, instead of using the KMS.

In Company B, the KMS has a crucial role as it enables the dissemination of knowledge documents across research centres and to all marketing companies. Face-to-face communication is not as easy as in Company A, since Company B has facilities around the globe. Users thought of it as the first port of call when they were looking for documents more than users in Company A did, because the KMS in company B is more established and has much more content. In both cases, users agreed that they spent less time searching for documents, although they felt that the search capability was not optimum, as discussed in the previous section.

In both case studies, users were positive in the role of their KMS for KM. They both agreed that the KMS were useful tools to manage their knowledge resources and to store knowledge resources useful for their colleagues. In Company A, the respondents trusted the content slightly more than in Company B, probably because the KMS had been installed recently, content was still up-to-date and more effort was made to put valuable content in the KMS. It was
expected that users in Company B would agree more that the KMS was useful to search for existing information before starting a new project because there was more content in their KMS; a slightly higher percentage of users in Company A agreed that that was the case.

6.5.2. Searching and Browsing

Search efficiency remains problematic for a lot of KMS. Always improving users' search experience helps in gaining users' acceptance of the KMS. Users spend a lot of time searching for content; the aim is to reduce that time and increase productivity. The KMS should be a one-stop shop; users should be able to access internal and external knowledge, find colleagues and collaborate, and keep up-to-date with news. A federated search across these sources will enable users to access knowledge seamlessly and quickly. Search can and should be customised to different users and their needs, through indexing, categorising and configuring the search algorithm to particular user groups.

Users in both case studies were comfortable in information seeking and most of the time they managed to find what they were looking for. Users in Company B had more options to search for knowledge documents; they could use the simple or advanced search of the ABC library, the portal or the Infospaces, with the simple search in the ABC library being the most popular. They agreed that they could easily perform a complex search and that the search options were easy to use. Users in Company A could use the simple or advanced search options of SharePoint but they were undecided regarding the execution of complex searches and the search options. In Company B, the search interface was adjusted to the metadata used to describe the knowledge documents, whereas such customisation was not fully done in Company A. Both were not particularly satisfied with the search results of the search engines. They complained about the large number of results and the irrelevancy of many results. They asked for the ability to execute more precise queries but they did not use the advanced search options; this may be a training issue. Therefore, both preferred to browse for information rather than search. Most users said that, most of the time, they used
the KMS to access known knowledge documents and therefore browsing for them was more convenient. It was not very often that they would need to do a general search on a topic, when the use of the search engine would be most appropriate.

In both case studies, users asked for a search experience similar to Google, i.e. simple, fast and efficient. Search engine Google with its simple interface and effective page ranking has become the global baseline for search facilities. It has dominated the market of internet search engines during the past ten years, holding an average of 78% of the market share over the past year (Search engine market share 2008). Enterprise search though is quite different from internet search and companies do not have the resources to fine tune their search engines as much as Google does.

There were a few differences based on demographic characteristics in the KMS users in Company A. Younger and more highly qualified users were less satisfied with the search results, probably because they were more experienced users of information systems and search engines and therefore had higher expectations. There were no similar results in case study B; nevertheless, these findings were expected as younger people, even named as the “Google generation”, are experienced users of Web search engines and their level of efficiency.

6.5.3. Attitude towards Metadata

Users need to take ownership of metadata, as they should for knowledge documents. When they understand the notion and usefulness of the metadata they assign to the knowledge documents they contribute, they can ensure the quality of metadata. Nevertheless, motivating users to contribute to KMS and assign appropriate metadata is a difficult task. “Motivation is problematic since extra effort and time required for structuring contributions need to be allocated in addition to their regular job tasks” (Hahn & Subramani 2000, p.307).

In Company A, users did not have strong views on the creation of metadata and its importance. Some interviewees had a very positive attitude towards metadata and asked for more training and guidelines, whereas others
thought that it was not worth creating metadata because the search engine was not using it to provide good results. In Company B on the other hand, there was a clear consensus that it was easy and important to create metadata for the knowledge documents. This difference in attitudes is most likely down to the mandatory training that users in Company B receive on metadata and KMS. Although they thought that it was time-consuming to create metadata, they preferred to create their own metadata rather than someone else because they felt that they were more knowledgeable about the knowledge documents.

"Description" was an interesting element in Company B, as some admitted that they did not feel that it was an important element and that they simply copied the title instead of providing a description, whereas others asked for the addition of “Abstract”, which is a qualified element of description, according to DCMI, in order to evaluate a knowledge document without having to open it. In both case studies, as users preferred to browse rather than search, they complained about the filing process. They felt that sometimes it was difficult to decide where to file a knowledge document and that documents were misfiled and therefore, difficult to find.

In Company B there were differences in users' attitudes towards creating metadata based on their demographic characteristics. It was very interesting to find that women found it easier to create metadata. This variable could not be tested in case study A and no other similar studies were found to compare the results. The reason for this difference is not obvious and therefore, it is an aspect that more research could explore. It is also something that should be taken into account when developing training sessions on metadata. In addition, more highly qualified users preferred someone else to add and/or edit metadata for them. This may be due to the fact that some senior knowledge workers might ask their assistant to upload the knowledge documents on the KMS and create the metadata.

Users were also asked to rate the metadata elements in terms of importance, when they were searching for knowledge documents. Responses from the two companies were almost identical. In Company A, the most significant metadata were “Subject”, “Title”, “Description”, “Car Marque” and “Author”. In Company B, the most significant metadata were “Title”, “Description”, “Primary Location Folder”, “Owner” and “Classification".
6.6. Metadata Framework

Section 2.3 presented the current state of metadata and a common typology of functions served by metadata. In addition, it provided arguments for the development and use of metadata standards in the corporate sector (2.3.5) despite the fact that each organisation and industry may differ significantly. The metadata mapping in Section 6.4.2 demonstrated that, although the two case study companies were active in very different industries and had different characteristics, they used very similar metadata in their KMS. This finding was supported by the mapping of the other schemes too.

Company A did not have a metadata scheme in place; users were allowed to modify the metadata elements of different libraries according to their needs. Although this practice has obvious benefits, it allows the co-existence of similar metadata elements that have not been clearly defined. As a result, the search efficiency was compromised. Having a core metadata scheme in place would allow users to select metadata elements for their document libraries from a predefined list. Thus, the IKM team would be able to monitor the mapping of metadata and their quality. Users would have to comply with the core elements, which should be mandatory. The search options could be then linked to these elements. Users could still create their own metadata elements for these attributes that are particular to their own group of information.

6.6.1. Rationale and Objectives

A metadata scheme defines the attributes that can be assigned to information or knowledge documents, the scope of these attributes and the values that these attributes can take. It also defines which of the attributes are mandatory.

Having a scheme in place, facilitates the assignment of appropriate attributes to knowledge documents, the consistency among different sets of metadata and the quality control of metadata. From the user perspective, the scheme allows them to provide metadata for the knowledge they contribute in the most efficient way.
Cross-case Analysis

6.6.2. Metadata Framework

The main purpose of storing knowledge documents in a KMS is two-fold. Firstly, to be able to access a knowledge document without having to rely on getting it from their creator; secondly, to be able to find information and knowledge relevant to what the users are currently working on, so that they can benefit from the knowledge and experiences of others and avoid trying an approach or a solution that was unsuccessful before. Content should not be copied or used without prior critical analysis and evaluation. To evaluate the knowledge documents, users are in need of three main categories of metadata: content, context, value. They need to have an indication of the content of the knowledge document; they need to know the context where this knowledge object was created and the context where it can be used, and last, they need to have an indication of the value of the content. Table 41 provides a set of questions that users of KMS should be asking before using knowledge documents and what kind of information can metadata provide to that effect.

<table>
<thead>
<tr>
<th>Question</th>
<th>Metadata</th>
</tr>
</thead>
<tbody>
<tr>
<td>Who wrote it? What expertise does the author have?</td>
<td>Value</td>
</tr>
<tr>
<td>Who is the intended audience?</td>
<td>Context</td>
</tr>
<tr>
<td>When was this produced? Is it still valid and relevant?</td>
<td>Value</td>
</tr>
<tr>
<td>What evidence is used? What argument is being made? Is it relevant to the task at hand?</td>
<td>Content</td>
</tr>
<tr>
<td>How confidential is this information? Does the company have the right to distribute this internally and/or externally?</td>
<td>Context</td>
</tr>
</tbody>
</table>

Table 41: Metadata for the evaluation of knowledge documents

Both case study companies used in their metadata scheme, as seen in Section 6.4.2, different types of metadata to provide information and access to their knowledge documents. It became evident that, in the context of business organisations, almost all types of metadata, as defined in the metadata typology (Section 2), are needed. Thus, a comprehensive metadata scheme for a KMS should include.
Cross-case Analysis

- Descriptive metadata, which describes the content (with the description and keywords for example) and, to an extent, the context of a knowledge document (who wrote it), for the purposes of discovery and identification.
  - Subject-based metadata, which enables users to find content when they are not familiar with a specific knowledge area and do not know what search terms to use.
- Administrative metadata, which provides more information on the context of a knowledge document (what is the intended audience) and the value (when it was created and reviewed)
- Structural metadata, which can help users to find relevant knowledge documents
- Use metadata, which provides the value of a document (how relevant is the document, what do other users think about it). Use metadata can help to build trust on the content with quality ratings.
- Technical metadata, which facilitates the management of knowledge documents by controlling access to them. Users can share knowledge more freely when they are assured that only authorised users can access confidential documents.
- Business metadata, which provides the context of a knowledge document. It provides information on the specific business process or method or tool that the particular document refers to

Based on the metadata mapping, Table 42 presents a list of metadata elements that should be included in a comprehensive metadata scheme. This table is intended to be used as a framework for future development of metadata schemes in KMS. The framework indicates good practice but needs to be customised to the particular needs and business context of each organisation with business-specific metadata to maximise its effect. Most, but not all, of the DCMI elements are used according to the Dublin Core Metadata Initiative Usage Guide (Hillmann 2007). Additional elements are proposed within the three DCMI metadata categories.
### A. Content

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Format</th>
<th>Scope Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title</td>
<td>Free text</td>
<td>Provides the document name and an indication of the content. As many KMS use the file name as title, Naming Guidelines should be established to help the users construct meaningful titles. The practice of inputting meaningful titles significantly facilitates both search and navigation, as the title is usually used as hyperlink to the knowledge document. When the title is hyperlinked to the document, there is no need to use the element &quot;Identifier&quot;.</td>
</tr>
<tr>
<td>Subject</td>
<td>Controlled vocabulary</td>
<td>Provides in the form of keywords an indication of the content. The use of a controlled vocabulary or formal classification scheme is highly recommended as users can search by particular terms and relevant knowledge documents can be grouped together in navigation.</td>
</tr>
</tbody>
</table>
| Description     | Free text               | It is the most difficult elements for the users to create as it requires more time and thought. Guidelines should be given on what to include:  
- contents  
- description of the context that lead to the knowledge document  
- summary of key or unexpected findings  
If subject is noted with controlled terms, description is the only elements where users can include keywords, not available in the controlled vocabulary. |
| Language        | Controlled list         | For multinational organisations, it is very useful to be able to retrieve content in only one language.                                    |
| Relation        | Hyperlinks to other knowledge documents | It is very useful to link knowledge documents with the same content in different versions (e.g. executive summary and presentation) or in different languages. |
| Coverage        | Controlled list         | Temporal and spatial coverage provide to an extent the context of the knowledge document.                                              |
| Project         | Controlled list of projects | It provides indication of the content and the context of the knowledge document and can be used to group together all documents created for a project. Project phase may be an attribute that a company may consider to use for better tracking of the documents related to a project. |

### B. Intellectual Property

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Format</th>
<th>Scope Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creator and contact details</td>
<td>User’s name</td>
<td>Indicates the person responsible for the content of the knowledge document. Many KMS use as creator the person who uploads the document in the KMS. When this is not the case, creator should be used for the person who had the intellectual input and can be contacted when further information about the content is needed. Knowledge documents can help identify</td>
</tr>
</tbody>
</table>
Cross-case Analysis

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Format</th>
<th>Scope Notes</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>experts and &quot;go to&quot; people and to create links between users that work in similar projects or practices. The person who just uploads the document on behalf of the creator should be marked differently. Related to the creator, is the user who last modified the document. KMS captures this metadata automatically but users should be able to see who the original creator was. Contact details for the creator and the user that last modified the document should be easily accessible. They should not be captured as metadata and stored with the knowledge document because their maintenance is particular difficult. A hyperlink to the company's people directory (or yellow pages) provides the necessary details. A hyperlink to the user's profile, if this is an available option, provides more information on the creator's experience and expertise and that can help users trust the content.</td>
</tr>
<tr>
<td>Business Unit</td>
<td>Controlled List</td>
<td>It refers to the specific department, group or project team that is responsible for the content, as more often a knowledge document is the outcome of the work of a group of users. In addition, this element is useful when the creator of the knowledge document has left the company or changed business unit, as the users can contact their colleagues for additional information.</td>
</tr>
<tr>
<td>Rights</td>
<td>Controlled List</td>
<td>Confidentiality of business information is something that users need to keep in mind when they are consulting a knowledge document. Not all content can be used or referenced externally and complicated confidentiality agreements are used to make sure that clients' information is not published. At the same time, some information needs to be used for business development and marketing purposes. Being able to easily identify what can be used externally and what not is very important.</td>
</tr>
<tr>
<td>Date</td>
<td>Automatically input by the KMS</td>
<td>Date is a very important element because it indicates the value of a knowledge document. Date of creation and date of last update are important as users should be able to search for content that was created or updated in the last month, week etc. Expiration or next revision date is equally important to facilitate the quality control of content. To avoid the KMS turning into a storage space for out-of-date content, effort is required to regularly check and update content.</td>
</tr>
</tbody>
</table>
| Type            | Controlled List   | It is an important element because it allows the identification and retrieval of documents created for

215
Cross-case Analysis

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Format</th>
<th>Scope Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audience</td>
<td>Controlled list</td>
<td>It can be used with the type to indicate the intended audience of a knowledge document, e.g. if it is a training material for a specific group of users or a marketing material to be used in specific countries.</td>
</tr>
<tr>
<td>Format</td>
<td>Automatically input by the KMS</td>
<td>It is an element that the KMS creates to facilitate the management of documents and allows the users to select the appropriate software.</td>
</tr>
<tr>
<td>Status</td>
<td>Controlled list</td>
<td>It indicates whether the knowledge document is in draft or approved, so that users know whether they can use it or not.</td>
</tr>
<tr>
<td>Version</td>
<td>Automatically input by the KMS</td>
<td>It is very useful to keep track of changes in the content of knowledge documents. It facilitates the tracking of responsibility too.</td>
</tr>
<tr>
<td>Rating</td>
<td>Can be relevancy ratings, user annotations or number of downloads</td>
<td>It is an element that was asked for by users. Relevancy ratings can help the retrieval process. User annotations provide other users' opinion on the content and number of downloads allows users to see if their knowledge documents are used by their colleagues. All these can help them trust the content of the knowledge document and motivate them to share knowledge.</td>
</tr>
<tr>
<td>Practice Area</td>
<td>Controlled list</td>
<td>It can be used to indicate the main practice, process, method or tool used in the project.</td>
</tr>
<tr>
<td>Client</td>
<td>Controlled list of clients</td>
<td>It provides indication of the content and context and allows users to retrieve knowledge documents by specific clients.</td>
</tr>
<tr>
<td>Industry</td>
<td>Controlled list</td>
<td>It can be used to categorise documents by industries or sectors.</td>
</tr>
<tr>
<td>Product or Service</td>
<td>Controlled list of products or services</td>
<td>It can be used to retrieve and group together all knowledge documents by a specific product, service or customer solution. More elements can be used to provide more detailed information, if required, such as product family or product category.</td>
</tr>
</tbody>
</table>

Table 42: Metadata Framework

6.7. Development of a Metadata Management Strategy

From the comparison of the two case studies, it became clear that metadata need to be addressed from each organisation in a systematic way to
Cross-case Analysis

ensure that it is used in its full potential and to facilitate KM. A metadata management strategy describes the systematic way that an organisation decides to use metadata.

The literature does not offer much information on this specific aspect of using metadata for the purposes of knowledge management, as discussed in Chapter 2. Most studies only mention the use of metadata, but do not offer much information on what metadata and how they are used in KMS. Only a few organisations have published their metadata scheme (Section 2.4). Not many studies have been published on metadata management strategy either. The following sections aim to offer some guidance on what the strategy should cover.

6.7.1. Rationale and Objectives

A well-defined metadata management strategy will allow an organisation to use metadata in the most effective and successful way. For the organisation and the IKM team, the benefits are multiple: it will enable the quality control of the existing metadata in the KMS; the development of new metadata tags to address future needs; it may also enable the development and interoperability with new KMS or information systems in general. For the individual users, it will allow them to create and use metadata of high quality. It will also facilitate the delivery of the training they need to create and use metadata.

As mentioned before, each organisation is different and has different metadata needs. The factors that need to be taken into account when deciding on a metadata management strategy, as they have been identified through the two case studies, are.

- **Size and resources:** the size of an organisation is proportional, to an extent, to the number of KMS users, the number and type of KMS, the number of knowledge resources, the size of the information and knowledge management team, and the budget to be spent on information and knowledge management.
- **Industry:** each industry has specific characteristics and trends that dictate the information and knowledge management needs and practices of the organisations that do business in it.
Cross-case Analysis

- Knowledge dependency: the industry sector defines how important is information and knowledge for each organisation. The protection of intellectual capital and innovation are two subjects closely related to knowledge-intensive organisations.
- Product or service life cycle. the time required to develop a new product or service determines the importance of having all the pieces of information and knowledge accessible at any time. The processes required to develop a new product or service impact on the amount of documentation produced for it.
- Legal requirements: in many industry sectors, regulatory bodies set standards that the organisations need to meet in order to produce acceptable products or services. Some standards dictate the sort of information and metadata each organisation should produce in order to comply with the standards.

6.7.2. Metadata Management Strategy

The metadata management strategy should address all issues related with metadata. Therefore, it should include the following components:

A. Planning

- Definition of roles and responsibilities for executing the metadata management strategy, establishing standards, procedures and policies.
- Allocation of resources (staff, time, budget requirements) to implement the metadata management strategy.
- Identification of and collaboration with key stakeholders to develop the metadata management programme.
- Decision of how metadata will be used in the organisation in which KMS, for which purposes, in order to align metadata management with business objectives.
- Decision on the use of metadata for internal only, or internal and external resources.
Cross-case Analysis

- Decision of who will use which metadata and why: is metadata to be used only for technical functionality or it will be used by the users of the KMS as well?
- Identification of KMS user groups and their metadata needs. Some metadata elements will be appropriate only for a group or groups of users
- Development of the metadata scheme with definition of elements, possible values and scope of use. As discussed in the previous sections, the scheme should address business needs and accommodate for business data.
- Development or implementation of corporate taxonomy.
- Definition of metadata processes:
  - Responsibility for creating metadata.
  - Decision if metadata will be examined/edited for quality and by whom.
  - Development of workflows for metadata, so that there is a clear identification of ownership, approval status, date of operation etc.
- Definition of expected metadata quality.
- Alignment of search capabilities and navigation aids of the KMS with the metadata scheme.
- Identification of sources of metadata (existing databases and files) and their quality. Will metadata used in legacy systems be directly migrated to the new KMS.
- Development of methods to consolidate metadata from multiple sources: how metadata will be harvested by other sources and how the KMS and different information systems will interoperate.
- Identification of training requirements: how and when should be users trained to use and create metadata. Training should be aligned with user group requirements.
- Decision on the appointment of metadata super-users and identification of selection criteria and their training requirements.

B. Ongoing Maintenance

- Responsibility for updating and maintaining the metadata scheme.
Cross-case Analysis

- Design of communication plan for ongoing communication and cooperation with key stakeholders, involving them in the quality assurance and scheme maintenance in order to assure that metadata deployment will add value for them
- Development of time plan for metadata scheme and corporate taxonomy review and updating
- Development of methods for measurement of the use and effectiveness of the metadata

6.8. Summary

This chapter compared the results of the two case studies. It provided the similarities between the case studies that made them comparable and discussed the organisational characteristics that define the KM needs of the organisations. KM in Company A was still in its first steps and a lot of effort is further required to make the implementation of the KMS a success. Users were enthusiastic about the KMS and thought that it was a very useful tool for KM. The negative comments focused on the search engine and the speed of the system. Company B has a more mature KM programme and the KMS is well integrated in the day-to-day tasks of the users. Users had positive views for both the KMS and the metadata used. The criticism referred mostly to the site structure, the process of uploading documents, and the fact that it could be a slow system.

From both case studies, there are useful lessons to be learnt. This research focused on the metadata used and the metadata management strategy followed by the two companies. A metadata framework was developed based on a mapping of the metadata schemes used in the two companies. Guidelines for the development of a metadata management strategy were also developed based on what was thought as good practice from the strategies that the companies were following.

The next chapter presents the conclusions of this research and examines how the aims and objectives, set in Chapter 1, have been met.
Conclusions

Chapter 7. Conclusions

This chapter presents the outcomes of this research at a higher level and examines how the aims and objectives set in Chapter 1 have been met. It summarises the findings and explains the contributions of this research to the KM theory and practice. It provides the researcher's reflections and lessons learnt in regards to the methodology and the overall research process. Last, it presents areas that this research has identified as opportunities for further research.

7.1. Summary of Findings

Many have argued that knowledge cannot be managed, as it primarily resides in people's heads. Nevertheless, the processes of creating and sharing knowledge can be facilitated by KM and KMS. Knowledge is valuable when it is shared; codified knowledge can be shared when it is retrievable in some way, it can be easily retrieved if it is organised in a KMS and described with metadata. KMS should be viewed as a number of systems that work together to provide a knowledge management capability. This research followed the pragmatic paradigm and was driven by the lack of a metadata standard for KM and relevant guidance on how to develop and manage metadata in a KMS. It adopted the user perspective with the overall aim to offer practical advice on the use of metadata in KMS. In terms of theory, it explored how metadata is evolving and what information science has to offer to KM practice. This research had three aims.

The first aim was to examine the role of metadata in the organisation of knowledge for the purposes of KM. The specific objectives to support this aim were the identification of currently used metadata, their perceived usefulness, analysis of metadata management strategies and the study of their cost-effectiveness. The two case studies provided useful data to pursue these objectives. Users' attitude towards metadata and KMS was generally positive. Well-designed and managed metadata was an important component of KMS and
Conclusions

impacted on the ability of the users to retrieve, reuse and share knowledge documents. Metadata and KMS are necessary stepping stones for KM, facilitating their users to collaborate, create new knowledge and innovate. The interviews with the IKM team of both companies provided valuable insight to their metadata management practices. The two companies followed different approaches to metadata, with Company’s B approach providing better results for the users. In both cases, users needed to take ownership of the content, its update and the related metadata, since they are the most knowledgeable about the content and can describe it best. They can decide when content and metadata need updating. Creating metadata should be as quick and easy as possible for the users. The use of taxonomies, in the form of drop down menus, for metadata elements that can have predefined values, such as subjects, regions, and clients, significantly facilitate the creation and enhance the quality of metadata. None of the two companies measured the cost of creating metadata or quantified the benefits of its use. It became apparent that the use of metadata did not need to be financially justified; the benefits, although not formally measured, justified the investment. Studying the metadata schemes of the case studies also showed that the two models are moving closer together, especially in the context of KMS. Technical metadata, from the data management approach, are necessary to run and govern the KMS. Bibliographic metadata are necessary to describe and retrieve knowledge documents.

Building on the findings of the first aim, the second aim was to propose a framework or guidelines for the creation of a comprehensive scheme, which would be composed of the necessary elements that would effectively describe knowledge in the context of an organisation’s memory. The specific objectives to support this aim were to identify the elements that may be specific for the description of knowledge and to map semantically the elements identified for the first objective to DCMI. DCMI was used as the baseline for the mapping as it is the de facto standard for digital content. Both schemes had a lot of common elements, making it a good starting point. However, current metadata standards, such as DCMI, focus on the description of the content of a knowledge document. KMS users also need to know the context and value of a knowledge document. Metadata should be thought of as part of the three-tier approach of KM, as it
Conclusions

provides benefits to all three levels (organisation, community, individuals). More specifically, metadata:

- fulfils the organisational needs and business objectives related to KMS efficiency, facilitates the management of the content of the KMS and establishes ownership and preservation needs,
- helps connect users by identifying the community that contributed to the creation of a knowledge document, or is interested in the knowledge area that the document is relevant to, monitors version control of documents that are co-authored and monitors knowledge documents’ value by status (approved, to be reviewed etc),
- allows the individual user to easily retrieve relevant knowledge documents, evaluate the content of a knowledge document, understand the context that led to the creation of the knowledge document and connect with its owner.

The understanding that each industry may have different requirements led to the proposal of a metadata framework, instead of a metadata scheme. The framework can provide sufficient guidance on the creation of metadata schemes, according to the needs of each organisation or industry. The comparison and cross-walk analysis of metadata schemes used in different sectors and industries showed which elements should be always present. User and business needs, as well as demographic factors need to be taken into consideration when designing and implementing a KMS and its metadata scheme. DCMI can be used as a basis for the creation of a metadata scheme, but more metadata, giving information of the use and business background of knowledge documents, are needed to provide the business context and trust to the knowledge documents.

The third aim was to propose a set of guidelines for efficient metadata management strategy. The proposed set of guidelines aims to cover all stages of metadata management. Users’ needs and attitudes need to be taken into account in every KM programme and KMS. Demographic characteristics of the user population can be used in the design of the metadata management strategy and the training provided. The role of training became apparent in these two case studies. Users need to understand how metadata works and why it is important to provide good metadata. The training should not be limited to how to create metadata but should include scenarios of how quality metadata allowed a user to
Conclusions

find the information they were looking for or to connect with other users. In addition, individuality and personalisation is important. KMS customisable to the individual and from the individual create the sense of personal space, ownership and sense of community with region- or community-specific content. Context is driving the content; users need content that will suit their context.

7.2. Contributions of the Research

The method followed in this research, case study research, has been used for a number of studies in different disciplines and it is well-suited for exploratory studies. An interesting point of this method is that there are not clearly defined and designed steps but each researcher has to design his/her research plan according to their research questions, subject and environment. On this occasion, the research plan was based on a set of topics, related to metadata and KMS. The same topics were used consistently while applying a number of data collection methods to frame the investigation and the presentation of findings. This practice allowed the researcher to develop consistent data collection tools and collect comparable data.

Research literature on metadata, KM and KMS provided the basis and the theoretical framework of this research but there was not enough information on how metadata is being used for the purposes of KM. This research offered a detailed exploration of KM practices related to metadata in two organisations. It documented the metadata schemes that the two companies use and their metadata management strategy and demonstrated the importance of metadata in knowledge organisation. It also offered an in-depth description of KM practices applied in two knowledge-intensive industries. Both industries present specific characteristics that have an impact on the KM needs of the two companies. These characteristics have been identified and their impact on KM practices has been explained. The KM literature on the pharmaceutical industry was more extensive, offering studies on various aspects of KM practice and theory, but not the use of metadata. The KM literature on the motorsport engineering industry was very limited.
Conclusions

A significant aspect of this research, compared to other studies on KMS evaluation, is that it provided the users' perspective and attitudes. It has been mentioned earlier that users are the most important stakeholders of a KMS. To have a successful KMS and KM programme, users have to use the KMS and create high quality metadata. The case studies provided indications as to which metadata users find important, whether they are inclined to create metadata and who they think should create metadata and whether training is important to improve the metadata quality.

The metadata framework and the metadata management strategy proposed in Chapter 6 are the main contributions to the KM practice, as they provide good practice on how to create a metadata scheme to be used in a KMS and what steps should be included in a metadata management strategy. The metadata framework includes all necessary metadata to provide the content, context and value of a knowledge document. The metadata management strategy outlines the necessary steps for the planning and ongoing maintenance of an investment on quality metadata. They are both intended to be used as a checklist when creating or improving a KM programme and KMS. Organisations should be able to take these two tools and adjust them to their own system, environment, culture, and needs.

At a higher level, the main contribution to information science and KM is that this research offered a link between the two areas of study. KM is said to draw its theories and practices from various disciplines. The contribution of information science was not as evident as other sciences, such as management or computer science. This research demonstrated how cataloguing, i.e. a well-established practice in information science, and the theory behind it are necessary for knowledge organisation and KM. Information science has long developed cataloguing rules and metadata schemes, such as the DCMI, that can be applied in KMS.

7.3. Reflections and Lessons Learnt

As mentioned in Section 3.5.5, the case study research is quite complicated with implications for the role of the researcher, terms of objectivity.
Conclusions

and rigour. Working with outside organisations raised additional issues of time management, confidentiality, privacy and politics.

The main issue with working with outside organisations was to find organisations that were willing to participate in the case studies. The process of finding organisations that fulfilled the criteria for the case studies and securing their collaboration was long and complicated. The original scope of research in terms of industry sectors, i.e. management consultancies, had to be broadened to other industries which proved equally interesting, in terms of KM practices and context. This research asked companies to devote substantial time, demonstrate their KMS and share proprietary information and knowledge documents to people outside their confidential boundaries. To agree to that, the research had to provide some value to them as well. Both of the companies that participated thought that this was a good opportunity to evaluate their KMS and get users' feedback from an impartial source.

Time constraints are always an issue when working with other organisations, as the researcher needs to adhere to their time schedules. The time spent with each of the two companies, evaluating and testing the KMS, speaking with the users and the IKM team, was sufficient to collect the necessary data and get a feeling for the organisational culture. In an ideal research scenario, more time spent interviewing and observing users would be useful. The protection of confidentiality for all users and their companies was of primary interest. Data were only presented when they did not allow the identification of the companies. Users' privacy was assured through the anonymity of their responses and interviews. Nevertheless, it became apparent that some users, especially in Company A where the number of employees is relatively small, were reluctant to answer the questionnaire or did not want to provide their demographic characteristics, possibly because they were afraid that this would lead to their identification within the team.

In case studies following the qualitative paradigm, such as this one, the role of the researcher is very important. While conducting qualitative, semi-structure interviews, the researcher needs to stay focused, avoid personal views and leading questions and take every opportunity is given from the interviewee to explore particular aspects of the topic in more detail. At the same time, the researcher needs to control the process and guide the interview, not allowing the
Conclusions

Interviewee to wander into irrelevant topics. Experience in conducting interviews helps the researcher in collecting useful data. Objectivity is required not only in data collection, but in data analysis, too. The exploratory nature of the cases, the absence of similar studies and relevant literature made the interpretation of findings even more difficult. The rigorous analysis of the interviews and the qualitative answers of the questionnaires with codes and the use of Atlas significantly facilitated the grouping of similar data and the presentation of all users' views and attitudes. Data triangulation is a means for the researcher to check if their personal opinion or the view of a stakeholder has influenced the collection and analysis of a set of data. If data collected through one method contradict data collected with another method, then the researcher needs to take a step back and review their analysis to find out why data do not corroborate the findings.

7.4. Areas for Further Research

The findings of this research are based on two case studies and the literature. Although steps were taken to ensure the generalisability of the findings of the case studies to the greatest extent possible (multiple-case study design, triangulation of data), case studies can only offer analytic generalisation, i.e., the expansion and generalisation of theories, and not statistical generalisation. This research provided the initial exploration of the topic. Further research would be useful to collect and analyse more users' attitudes, metadata management strategies and metadata schemes used in KMS from different companies in various industries.

A survey could be done with more companies across more industries to collect more metadata schemes in order to validate the metadata framework. The framework showed that the same core metadata are used in companies in different industries. Studying more industries would confirm the applicability of the framework independently of industry sectors. The framework could also be put to test in a limited number of cases; measuring users' attitudes after the initial stage of implementation would demonstrate whether the framework is comprehensive and meets users' needs. A series of in-depth qualitative
Conclusions

Interviews with the IKM team leaders of a greater number of companies would allow the testing and further development of the proposed metadata management strategy with more data on methodologies and possible timelines.

This research provided some interesting findings based on the demographic information of users, such as the gender differences in attitude towards metadata in Case Study B. The demographics of Case Study A did not allow the examination of this variable with the users' attitude towards metadata. There was not much information on users' attitudes towards KMS or metadata in the literature to allow the comparison of the findings. Further studies should be conducted to validate the findings around users' attitudes towards metadata and KMS. Users' positive attitude towards KMS is one of the critical success factors of KMS and their needs, likes and dislikes should be taken into account when designing the KM infrastructure.

Finally, one of the objectives of this research was to explore the financial benefits of using a KMS and metadata for the organisation of knowledge documents. The two case studies showed that the specific organisations were not too much concerned with the financial aspect of the use of a KMS. Nevertheless, the use of KMS and the development of a KM programme, even in its simpler form, require financial, time and labour resources and the IKM team needs to make the business case for them. Therefore, the financial value of using of a KMS and investing on quality metadata should be explored through a detailed cost-benefit analysis.


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Appendices
Appendices

Appendix A: Preliminary Questionnaire
Invitation to participate in a research project

Dear Sir/Madam,

I would like to invite you to participate in a research project that is investigating how knowledge is most efficiently described, distributed and stored within UK-based management consultancy companies. More specifically, the project is concerned with the use of metadata for the description of knowledge assets.

Your company has been selected on the basis of its main activities and services with reference to knowledge management. An important criterion was also the importance that knowledge creation and sharing has within your company.

This questionnaire is the first phase of the project running from March to May 2006 and aims to collect preliminary data about companies' knowledge management activities. The second phase of the research involves further investigation conducted through interviews and another questionnaire. I would also like to extend an invitation to you to help in these follow-up activities.

I would like to assure you that all data that you provide for the purposes of this research will be kept anonymous, and no opinions or results will be attributed to you or to your organisation.

Should you have any questions or require more details about this research, please do not hesitate to contact me.

Thanking you in anticipation,

Christina Apostolou, PhD Researcher

Christina Apostolou
C Apostolou@lboro.ac.uk
http://km.lboro.ac.uk/
Appendices

Background Information

1. Name of company_________________________________________________________
2. Please state your position in the company___________________________________
3. How many employees does your company have?
   0 – 49  □  50 – 99  □  100 – 499  □  500 – 999  □  1000 + □

Knowledge Management

4. Does your company actively manage and support knowledge?  Yes □ No □
5. Do you have an Information Manager or Knowledge Manager? Yes □ No □
6. If “Yes”, what are their exact job title and responsibilities?
   ________________________________________________________________
   ________________________________________________________________

7. Does your company have systematic processes for capturing knowledge? Yes □ No □

Knowledge Management System

8. Does your company use any kind of knowledge management system? Yes □ No □
   (If “No”, please go to question 18.)
9. If “Yes”, please specify the kind:
   • General knowledge management system □
   • Content management system □
   • Collaboration software □
   • Other □ (please specify)_________________________________________

10. If possible, please give an estimate of the number of resources on your knowledge management system:
    0 – 999 □ 1,000 – 9,999 □ 10,000 – 99,999 □ 100,000 + □ I don’t know □
Appendices

11. How has your system been developed?:
   • Has it been developed in-house? □
   • Is it off-the-shelf commercial software? □
   • Has it been customised to your needs? □
   • Other □ (please specify) ________________

12. Who is primarily responsible for its updating and continuing development?

13. Who decides which new resources will be added to the system?
   • The author/creator □
   • An editor □
   • Other □ (please specify) ________________

14. What is the process of adding new resources to the system, in terms of activities, such as creation, editing, and organising?

15. Do you regularly monitor and evaluate the usage of the system? Yes □ No □

16. How well does the knowledge management system support the business objectives of your company?
   Very well □ Satisfactory □ Not very well □ I don't know □

17. How well does the knowledge management system meet the daily information and knowledge needs of your employees?
   Very well □ Satisfactory □ Not very well □ I don't know □

(Please ignore Question 18, if you have answered "Yes" in Question 8.)

18. Could you state the reasons why your company is not using a knowledge management system?
   • It is not necessary □
   • Other information systems are sufficient □
   • The commercial software solutions are too expensive □
   • Other □ (Please specify) ________________
Appendices

Metadata:
Tags used to describe attributes of information and knowledge resources, e.g. author, keywords, date and abstract, frequently input as fields in databases, information systems and knowledge management systems.

19. What kind of tags does your information/knowledge management system use in order to describe and organise the resources available?

20. Are the resources in your system described and organised automatically by the system? 
   Yes □ No □ Some □

21. Is any member of staff involved in the evaluation or refinement of this process? (such as the information manager or an editor) 
   Yes □ No □

22. Are the tags developed according to a specific scheme or standard? Yes □ No □
22a. If "Yes", which? ____________________________

22b. If "No", is it a metadata scheme developed by your company? Yes □ No □

23. Who is/was responsible for the selection of the specific tags?

24. If none of the above situations accurately describes your approach to metadata, could you please provide some details about your practice? (e.g. who is responsible for its creation, development and application?)

Your further contribution will be most valued in this research. If your company is willing to participate in more in-depth research on the topic, please provide contact details.

If you decide not to participate in the follow-up research, it would be very helpful to know the reasons why.

Thank you very much for taking the time to complete this questionnaire. Please return it in the envelope provided at your earliest convenience.
Appendix B: Preliminary Questionnaire Design, Administration and Results

1. Preliminary Questionnaire Design and Administration

The design principles presented in Section 3.3 were put into practice when designing the preliminary questionnaire. It was designed keeping in mind all known factors that influence the response rate of a survey. The questions that were developed aimed to collect preliminary data about the management consulting companies. Questions referring to sensitive information, such as cost or efficiency of the KMS, were kept to a minimum. These issues would be better addressed through interviews, where the respondent can feel more comfortable and formulate the answer more effectively.

The questionnaire included open- and closed-ended questions, as appropriate. Closed-ended questions were used to ask factual information and attitudes. Choices for middle and non-attitudes were included so that respondents would not be forced to make a choice. Open-ended questions were used in the instances where more information was necessary, for example to describe the process of adding new knowledge assets to their system or to describe their metadata approach. In order to provide response categories within respondents’ capabilities, the response “I don’t know” was used in a few questions. Overall, questions were tested for ambiguity and vagueness to reduce inconsistency in responses.

The questionnaire was produced in a booklet format that would appear professional and appeal to very busy senior managerial staff. The covering letter, explaining the purpose and importance of the research, information about the researcher, and the anonymity of the responses, was included in the first page of the booklet. The mailing of the questionnaire was selected as a delivery method, instead of an email or a web-based questionnaire, because postal questionnaires tend to have slightly higher response rates (Kaplowitz et al. 2004, p.98).

The companies were selected from two lists: the members of the Management Consultancies Association (MCA) and the list of the Top 75 Management Consultancies 2005 (Management Consultancy 2005, p.8-9). The
Management Consultancies Association was formed in 1956 to represent the consultancy industry to clients, the public, and government. It is estimated that nine out of the top ten UK consulting firms are MCA members, measured by UK consulting fee income. MCA members must comply with industry criteria as well as professional and ethical standards. The list of the Top 75 Management Consultancies is formulated according to the 2004 fee income that the companies report. Out of these two lists, 55 companies were selected according to simple systematic sampling procedures (Dillman 2002, p.92; Tashakkori & Teddlie 1998, p.73-77) No formal framing sample or framing techniques were used to select the sample of companies that would receive the questionnaire because the main purpose of this questionnaire was to collect some preliminary data and primarily to solicit participation in the next step of the research.

In order to increase the response rate the majority of the questionnaires were sent to a specific person, namely the information manager or IT manager (Neuman 2003, p.289). All the companies were contacted by phone and the name and contact details of the appropriate manager were asked. Initially, “Information Manager” as a title was used to ask for contact details but, since many companies were replying that there was no information manager on site, the details of the IT manager were asked for instead. This was felt appropriate because it is very possible that the person responsible for the KMS would be the IT manager. In almost half of the companies contacted, there was a “no name” policy on the switchboard. In those instances, they encouraged the researcher to address the questionnaire to “The IT Manager”. A postage-paid, addressed return envelope was also included to facilitate the return of the questionnaires.

The questionnaire was finally sent to 55 UK-based management consulting companies at the beginning of March 2006. A reminder letter was sent in April 2006.

3. Preliminary Questionnaire Results

Although the design of the questionnaire attempted to address all possible reasons for non-response, the response rate of this questionnaire was
Appendices

approximately 11% (6). It was known from the beginning that the target group would be difficult to persuade to participate in an unsolicited research.

Out of the six questionnaires, one was returned empty because it was not Respondent 1’s policy to participate in surveys. This might be a common policy with other companies and one of the reasons for the lack of participation. Another questionnaire was only half-completed by the intranet manager of Respondent 2. She indicated that, at the moment, they do not use metadata extensively but they are considering it for the future.

There were four questionnaires fully completed. Respondent 3 replied that they were using a content management system that had been developed in-house, various professional community leaders are responsible for updating and editing the content, and that IT and HR were responsible for the selection of metadata tags. They also indicated that they would be willing to participate in the second stage of the research. When they had been contacted, though, at the email address provided, they replied that someone else had filled-in the questionnaire and that they would not be interested. Respondent 4 replied that they were using a general KMS, content management system, collaboration software along with other function-specific systems that either have been bought off-the-shelf or have been developed in house. The metadata tags used are the “Author”, “Subject”, “Date”, “Keywords”, “Taxonomy ISIC”, and “Company registration number”. They indicated that they could not participate further in the research due to lack of time. Respondent 5 replied that they were using commercial collaboration software that has been customised to their needs. Responsible for this system are the ICT manager and the KM content manager. The metadata tags used are the “Document name”, “Sector”, “Service”, “Knowledge area”, Method”, “Tool”, “Client name”, “Project name”, “Keywords”, “Abstract”, “Rating” and “Owner”. They indicated that they would be willing to participate but when they have been contacted by email, they mentioned that, currently, it is not an appropriate time for this research as they were considering buying a different KMS. Last, Respondent 6 indicated that they are using Microsoft SharePoint Services and collaboration software. Both of them have been customised to the company’s needs. The knowledge manager is responsible for the updating and development of the system and the metadata. Among others they use the following tags: “Business process”, “Industry Area”, “Project phase”, “Owner”, “Review date”,

253
Appendices

“Modified by” and “Modified date.” Although Respondent 6 decided to participate in the research as a case study and incorporated the research in an intranet consolidation project they were running, after the field visits and the development of the questionnaire, they withdrew from the research without notice.
Appendices

Appendix C: Questionnaire for the Users of Case Study A

The questionnaire is a part of a research project that is investigating the role of metadata for managing knowledge. More specifically, it explores how metadata can be implemented most efficiently to support knowledge sharing, creation and organisation in order to leverage a company’s performance. The term “metadata” refers to tags used to describe attributes of information and knowledge resources, e.g. author, keywords, date and abstract, frequently input as fields in database, information systems and knowledge management systems.

The questionnaire is focused on the use of SharePoint and most importantly on the user’s acceptance, perceived usefulness and ease of use with the aim to improve its functionality. It includes 6 sections and should not take more than 15 minutes to complete.

The data collected will be kept anonymous by the researcher and no opinions will be attributed to individuals.

---

Questionnaire for the users of SharePoint

1. When did you first use SharePoint?
   - Over a month ago
   - Over three months ago
   - Over six months ago
   - Over a year ago

2. How often do you use SharePoint?
   - More than once a day
   - Once a day.
   - 2 - 3 times a week
   - Once a week
   - Once a month
   - Rarely
   - Never

3. For which purposes do you generally use the system? (please tick all that apply)
   - To access technical documents necessary for my work
   - To access documents that may be useful to my colleagues
   - To search for information relevant to my job
   - To inform myself about the current developments of the car
   - Other (please specify):

4. Do you consider SharePoint to be important to any of your daily tasks?
   - Yes
   - No

5. If "Yes", please specify:

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255
Appendices

Questionnaire for the users of SharePoint

<table>
<thead>
<tr>
<th>b. Please rate how strongly you agree or disagree with each of the following statements. (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>When I am using SharePoint:</td>
<td></td>
</tr>
<tr>
<td>Most of the time, I manage to find the information that I am looking for</td>
<td></td>
</tr>
<tr>
<td>I prefer to use the search engine at the top right corner of SharePoint</td>
<td></td>
</tr>
<tr>
<td>I find it easy to perform a complicated search</td>
<td></td>
</tr>
<tr>
<td>I am satisfied with the results that I am getting from the search engine</td>
<td></td>
</tr>
</tbody>
</table>
Appendices

Questionnaire for the users of SharePoint

7. Which metadata tag is significant for you when you are searching and evaluating an information or knowledge resource? Please rate the following from 1 – 13, starting with 1 being the most important:

Subject
Group
Home
Last modified time
Car marque
Event location
Document category
Description
Event type
Title
Author
Other (please specify)

8. Are there any metadata tags that you believe would be helpful to add to any of the site libraries?
[ ] Yes
[ ] No

9. If "yes", please specify:

10. Have you ever uploaded a document to SharePoint?
[ ] Yes
[ ] No

11. If "yes", how often do you generally upload documents to the system?
[ ] Once a day
[ ] Once a week
[ ] Once a month
[ ] Occasionally

12. Please rate how strongly you agree or disagree with each of the following statements:

1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree

When I am uploading documents in SharePoint:

[ ] I find it time-consuming to fill in the metadata fields
[ ] I would prefer someone else to fill in the metadata for me
[ ] I would prefer it if SharePoint would fill in the metadata automatically
[ ] I prefer to use the subjects provided from the drop down list
[ ] I would like to add more subjects in the drop down list

[ ] All Present [ ] Half of the Present
### Questionnaire for the users of SharePoint

13. Please rate how strongly you agree or disagree with each of the following statements:

1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree

<table>
<thead>
<tr>
<th>The documents found on SharePoint are:</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>up-to-date</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>comprehensive</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

14. Please rate how strongly you agree or disagree with each of the following statements:

1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree

<table>
<thead>
<tr>
<th>SharePoint is the first port of call when I am looking for documents and/or information.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>SharePoint has improved access to technical information.</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>using SharePoint enables me to accomplish tasks more quickly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning to use SharePoint was easy for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SharePoint library folder structures are logical and helpful when looking for documents</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

15. Please rate how strongly you agree or disagree with each of the following statements:

1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree

<table>
<thead>
<tr>
<th>I generally trust the content found in SharePoint</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>SharePoint is useful to exchange information with my colleagues.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SharePoint is useful to search for existing information before starting a new project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. Finally, could you identify any areas that SharePoint could be improved? Do you have any comments to add?

[Blank space for comments]
Appendices

Questionnaire for the users of SharePoint

Please provide the following details to assist in the data analysis:

17. What is your gender?
   - Female
   - Male

18. What is your age?
   - Under 20
   - 20 - 25
   - 26 - 30
   - 31 - 35
   - 36 - 40
   - 41 - 45
   - 46 - 50
   - Over 50

19. What is the highest level of education you have completed?
   - HVO or equivalent
   - Undergraduate degree
   - Master's
   - PhD
   - Other (please specify)

20. How long have you been working for the company?
   - Less than 1 year
   - 1 - 2 years
   - 3 - 5 years
   - More than 7 years

21. In which group do you work?
   - Aero
   - Design
   - Labs
   - Race Engineering
   - Simulation
   - Stress Analysis and Materials
   - Vehicle Electronics
   - Other (please specify)

Questionnaire for the users of SharePoint

Thank you very much for your time and collaboration.
Appendices

Appendix D: Interview Schedule for the Users in Case Study A

I. Introduction

- Thank you for agreeing to have an interview with me about SharePoint.
- (Personal introduction and affiliation of the interviewer)
- (Purpose) The purpose of this interview is to examine more in-depth some of the issues that came across through the questionnaire on SharePoint. It will focus on the same topics with the questionnaire: namely the use of SharePoint and metadata, i.e. data that describes data, information and knowledge.
- (Motivation) This interview will help to design SharePoint better and hopefully maximize its use and efficiency.
- (Recording) Would you object if this interview is recorded?
- (Time Line) The interview should not last more than 30 minutes.
- Is there anything you would like to ask me before we start?

II. Main Part

(Topic A) General comments on SharePoint

1. Do you use SharePoint at all?
   - Could you identify the main reasons for not using it more often?
     (content, inefficiency, irrelevant to job responsibilities)
2. Could you tell me for which tasks you use it most?
3. Have you been involved in the design or structure of any of the libraries of SharePoint?
   (For the Design Office Administrator: could you tell me more on your responsibilities concerning SharePoint?)
   - (No) Have you uploaded any documents on it?

260
Appendices

- (Yes) Could you describe what your contribution was?
- What was the rationale or main aims of designing the libraries as such?
- How did you select the specific metadata for library?

4 Could you tell me what do you think overall of SharePoint?
- Do you think it is useful to your daily tasks?
- Has it improved the way that you are searching and finding the documents that you need for your job?
- Could you compare it with the older system? In terms of content, ease of access etc.

5. What would you say are the best parts of it?
6. What would you say are its weak parts?

(Topic B) Training

7. Have you had any training on the use of SharePoint?
- Did it include any training on metadata? E.g. how you should fill-in the forms and what kind of values to assign.
- Were you satisfied with it?

8. Would you like to have further training on SharePoint?
- Are there any particular topics that this session should cover?

9. Would you like to have an online help guide?
- Are there any particular topics that this guide should include?

(Topic C) Metadata

10. Do you think that metadata are important in SharePoint?
11. Do you think that metadata is used properly in SharePoint? (consistently, comprehensively, efficiently)
12. Do you think that you should be using more or less metadata tags?
- If more, which?
- If less, which are redundant?

13. Do you think that better use of metadata would improve the search engine?
Appendices

14. Do you think that browsing could be improved by using better metadata?
15. Do you find it difficult or time-consuming to fill-in the metadata tags?
   - If yes, would you prefer someone else to fill-in the metadata for you?
   - Would you prefer SharePoint to produce metadata automatically?
16. Which metadata are more important to you when you are searching for a document?
17. How important is for you to retrieve documents by their subject?
   - How often do you search for a document on a given subject? E.g. tyre wear.

(Topic D) Knowledge Management and collaboration

18. What kind of information or knowledge do you choose to add to SharePoint?
19. What are the criteria for adding a document in SharePoint or not?
20. Do you have a systematic process for knowledge capture?
   - Could you please describe it to me?
   - Do you feel encouraged to document what you feel is important?
   - Do you feel encouraged to contribute this knowledge to SharePoint?
21. Would you say that SharePoint has improved access to the knowledge produced by you and your colleagues?
22. Do you think SharePoint is useful for storing that knowledge effectively?
23. Do you think that better metadata would improve the storage and access to knowledge?
24. Has SharePoint facilitated at all the collaboration among the members of your group?
   - Among your colleagues in general?
25. Do you think that SharePoint helps you to locate who is the best person to talk about a specific project?
26. Would you like to use the forums that SharePoint has for online communication with your colleagues?
Appendices

27. SharePoint is currently used mainly by the Design and Engineering office. Do you think it would improve collaboration within the company if other departments, such as supply chain and manufacturing, were using it more extensively?

(Topic E) Remote Access

28. Would it be useful for you to have remote access to SharePoint?
   - In which occasions, do you think that would be useful?
   - How often would you say that this would be useful to you?

29. Do you think that there is good communication and collaboration with your colleagues working on the track?
   - Do you think that SharePoint has had / could have a role in that?

30. Some have stated that it would be useful for your partners to have limited access to the content of SharePoint. Do you agree with that?
   - If yes, which content do you think they should be able to access?
   - If not, do you think that other means of collaboration, such as blogs or forums, should be used instead?

III. Closing

- I appreciate the time you took for this interview.
- Is there anything else you would like to add?
Appendices

Appendix E: Interview Schedule for the Information and Knowledge Managers in Case Study A

I. Introduction

- Thank you for agreeing to have an interview with me about SharePoint.
- (Recording) Would you object if this interview is recorded?
- (Time Limit) The interview should not last more than 1 hour and 30 minutes.
- Is there anything you would like to ask me before we start?

II. Main Part

(Topic A) General comments on SharePoint

1. Could you tell me what do you think of SharePoint overall?
2. Are you satisfied with the system’s use and efficiency so far?
   - Do you think it has integrated well with the users’ daily tasks?
   - Has it improved the way that you are searching and finding information?
3. Could you compare it with the older system? (content, ease of access).
4. What would you say are the best parts of it?
5. What would you say are its weak parts?

(Topic B) System Development

6. How long have you been using SharePoint?
7. Could you explain the strategic goals that SharePoint was meant to meet?
8. Were there specific objectives to be met? (in terms of number of users, use)
9. What were the primary user needs for this system?
   - Have you done any user needs analysis?
Appendices

10. Which are the main functions of SharePoint currently used in the company?
11. Has SharePoint been customised for the company’s needs?
12. Who was responsible for the design and structure of SharePoint in the company?
   - What was the rationale and principles of the design?
13. From the day of the first implementation, have you made any significant modifications to it?
14. Which groups/departments of the company currently use SharePoint?
   - Do you think it would be beneficial for the company and improve collaboration if other departments, such as supply chain and manufacturing, were using it more extensively?
15. How many users are there in total?
16. How was SharePoint introduced to the different groups?
17. Have they received any training?
   - Did it include any training on metadata? E.g., how they should fill-in the forms and what kind of values to assign.
   - Do you have any plans for further training?

(Topic C) Metadata

18. Do you think that metadata are important in SharePoint?
19. What kind of metadata does the company currently use?
20. What was the rationale of selecting the specific metadata?
21. Do you think that metadata is used properly in SharePoint by your colleagues? (consistently, comprehensively and efficiently)
22. Do you think that you should be using more or fewer metadata tags?
   - If more, which?
   - If fewer, which are redundant?
23. Do you think that better use of metadata would improve the search engine?
24. Do you think that browsing could be improved by using better metadata?
25. Do you find it difficult or time-consuming to fill-in the metadata tags?
26. Which metadata are produced automatically by the system?
Appendices

27 Do you use any kind of thesaurus / taxonomy?

(Topic D) System Administration

28 Could you comment on the ease of administering SharePoint?
29 Which are your responsibilities?
30. How easy is it to maintain?
31. Do you have any plans for major modifications / updating of the system?
32. What is the process of adding new content on SharePoint?
33 Is there a review / quality control process in terms of content? In terms of the metadata that users are producing?
   • If no, do you see a need for one?
34. Is there a retention process for out-of-date documents?
35. In terms of content, has SharePoint benefited the quality of information?

(Topic E) System Use and Evaluation

36. Are you satisfied with the volume of use of SharePoint?
37. Are there any incentives for the users to use it?
38 Have you predicted a payback period?
   • Has it been met?
39. Is there a specific evaluation process for SharePoint?
   • Do you regularly monitor its use?
   • Do you regularly monitor its efficiency?
   • Do you follow specific metrics or set targets?
   • Do you use any financial measures? (such as ROI)

(Topic F) Knowledge Management and Collaboration

40. Do you think that SharePoint could help you to manage your company's knowledge?
41 To reduce repetition of mistakes?
42. To facilitate innovation?
43. Do you have a systematic process for knowledge capture?
Appendices

• What are the criteria for adding a document in SharePoint or not?
• Do you encourage users to document what they feel is important and to contribute it to SharePoint?

44. Would you say that SharePoint has improved access to the knowledge produced in the company?
45. Do you think SharePoint is useful for storing that knowledge effectively?
46. Do you think that better metadata would improve the storage and access to knowledge?
47. Has SharePoint facilitated the collaboration among the employees of the company?
48. Do you think that SharePoint helps the users to locate who is the best person to talk about a specific project?
49. Would you like to use the forums that SharePoint has for online communication?

III. Closing

• I appreciate the time you took for this interview.
• Is there anything else you would like to add?
Appendices

Appendix F: Recommendations Made for Company A

A number of recommendations was made to Company A referring to the site structure and navigation, the use of metadata, some training required, and further steps for KM.

1. Site Structure and Navigation

- Audit of the content of the folders.
- Design of a consistent folder structure and reorganisation
- Balance between the breadth and the depth of the site libraries.
- Removal of the empty folders.
- Creation of a common space (most likely in the form of a site library) for documents and information that is relevant to all engineers (race and track information, templates, magazines etc).
- Reorganisation of the design site library and transfer of the FIA documentation to the FIA site library.
- Creation of a visible hierarchy of the folder structure.
- Creation of more visual aids for navigation.
- Users should be encouraged to maintain the site libraries according to their needs.

2. Metadata

- Users should be encouraged to adapt metadata to their needs.
- Definition of mandatory fields for each site library. “Author”, “Title”, “Subject”, and “Description” should be included.
- Consistency should be maintained, to the possible extent, across libraries
- A set of guidelines can be used to train users on how to fill-in the metadata fields. (E.g. “Description” should not just duplicate the “Title”).
Appendices

- Dropdown lists should be used as much as possible in the metadata forms, because they make the process of adding metadata quicker, easier and more consistent.
- Addition of more subject terms to reflect the needs of more groups.
- Use of a thesaurus. In Appendix G a mini thesaurus can be found that can be used as a basis
- In the long term, development of an effective metadata management strategy because it enables a company to make better use of the data, information and knowledge assets it has. The components of a metadata management strategy could include.
  1) Decision of how metadata will be used in the organisation,
  2) Decision of who will use which metadata and why,
  3) Training requirements,
  4) Sources of metadata (existing databases and files),
  5) Quality of the metadata sources (absolute, relative, historical, etc.),
  6) Methods to consolidate metadata from multiple sources,
  7) Responsibility for capturing, establishing standards and procedures, maintaining and securing the metadata, proper use, quality control and metadata update procedures,
  8) Definition of metadata standards and procedures,
  9) Naming standards (abbreviations, class words, code values, etc.),
  10) Measurement of the use and effectiveness of the metadata.

3. Training

Delivering more training sessions to SharePoint was a suggestion from the users. Some of them missed the initial introduction and most of them have very specific questions as to how they can do or not do certain tasks. Most importantly, the majority of them are not aware of the full scope of SharePoint or of the scope of metadata.

- Organisation of a small number of introductory sessions for those that feel intimidated or who do not use it much
Appendices

- Organisation of sessions for intermediate and advanced users with the topics/functions that they need to cover. Topics that came up in the interviews were the linking of documents within SharePoint, the efficient use of the advanced search, the alerts, and the customisation/designing of the appearance and structure.
- Thorough presentation of SharePoint's philosophy and functions.
- In each of these sessions, presentation of the scope and use of metadata in SharePoint and explanation of the principles or guidelines for filling-in the metadata fields.
- Organisation of presentations when new features are added to SharePoint or when the company adopts new practices regarding SharePoint.
- Refresher training on regular basis (perhaps once a year) for those that do not use it very often
- Introduction to SharePoint in the induction of the new employees.

4. Knowledge Management

- The use of SharePoint in the company can be seen and advertised as the signpost to an organisational culture change, where knowledge creation, capturing and sharing are embedded into processes and drive innovation and competitiveness.
- Creation of collaboration space (possibly in the form of site libraries or sub-libraries) for groups that are currently using shared files, such as the front suspension group.
- Gradual migration of all content of the shared files (with the exception of the executable files) to SharePoint.
- Users should be encouraged to contribute more to knowledge capture in the form of reports, procedures.
- Users should be encouraged to personalise SharePoint to the extent possible by creating alerts and personal collections of links to documents frequently used.
Appendices

- Blogs can be used for posting of information and knowledge that users feel is important but they are not willing to put into the form of a technical note or a report.
- Identification and cultivation of possible communities of practice.
- Use of the knowledge gained through competitive intelligence.
- In the longer term, involvement of all the team, from the drivers and the management to the manufacturing and HR, in actively managing knowledge in the company.
## Appendices

### Appendix G: Thesaurus Developed for Company A

The following thesaurus has been developed based on the subjects used in SharePoint (Table 8). The SAE Thesaurus and the Automotive Engineering Terms* have been used also as a base for comparison.

<table>
<thead>
<tr>
<th>Actuators</th>
<th>Dampers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aerodynamics</td>
<td>Dampers</td>
</tr>
<tr>
<td>NT Aerodynamic Drag</td>
<td>NT Suspension Dampers</td>
</tr>
<tr>
<td>Aerodynamic Lift</td>
<td></td>
</tr>
<tr>
<td>RT Wind Tunnel</td>
<td></td>
</tr>
<tr>
<td>Alloys</td>
<td></td>
</tr>
<tr>
<td>Bodywork</td>
<td></td>
</tr>
<tr>
<td>Brake system</td>
<td></td>
</tr>
<tr>
<td>NT Brake Discs</td>
<td></td>
</tr>
<tr>
<td>Brake Drums</td>
<td></td>
</tr>
<tr>
<td>Brake Pedals</td>
<td></td>
</tr>
<tr>
<td>Calibration</td>
<td></td>
</tr>
<tr>
<td>RT Measuring Techniques</td>
<td></td>
</tr>
<tr>
<td>Car General</td>
<td></td>
</tr>
<tr>
<td>Chassis</td>
<td></td>
</tr>
<tr>
<td>Clutches</td>
<td></td>
</tr>
<tr>
<td>Cockpit</td>
<td></td>
</tr>
<tr>
<td>Collisions</td>
<td></td>
</tr>
<tr>
<td>NT Collisions, Head-On</td>
<td></td>
</tr>
<tr>
<td>Collisions, Rear-End</td>
<td></td>
</tr>
<tr>
<td>Collisions, Side-Impact</td>
<td></td>
</tr>
<tr>
<td>Composite Materials</td>
<td></td>
</tr>
<tr>
<td>NT Bimetals</td>
<td></td>
</tr>
<tr>
<td>Fibreglass-reinforced</td>
<td></td>
</tr>
<tr>
<td>Connecting Rods</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Appendices

<table>
<thead>
<tr>
<th>Materials</th>
<th>Suspension Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monocoque</td>
<td>NT Front Suspension</td>
</tr>
<tr>
<td>Oil System Painting</td>
<td>Rear Suspension</td>
</tr>
<tr>
<td>RT Paints</td>
<td>Suspension Dampers</td>
</tr>
<tr>
<td>Plastics</td>
<td>Test Tracks</td>
</tr>
<tr>
<td>NT Laminated Plastics</td>
<td>Torque</td>
</tr>
<tr>
<td>RT Reinforced Materials</td>
<td>Transmission Systems</td>
</tr>
<tr>
<td>Reinforced Plastics</td>
<td>NT Clutches</td>
</tr>
<tr>
<td>Pumps</td>
<td>Gearboxes</td>
</tr>
<tr>
<td>Push Rods</td>
<td>Tyres</td>
</tr>
<tr>
<td>RCS &amp; Rear Wing</td>
<td>NT Tyre testing</td>
</tr>
<tr>
<td>Sensors</td>
<td>Vibration</td>
</tr>
<tr>
<td>Simulation Software</td>
<td>Water System</td>
</tr>
<tr>
<td>Steering Gear</td>
<td>Weather</td>
</tr>
<tr>
<td>NT Steering Rack &amp; Column</td>
<td>NT Fog</td>
</tr>
<tr>
<td>Stress Analysis</td>
<td>Ice</td>
</tr>
<tr>
<td>NT Photoelasticity</td>
<td>Rain</td>
</tr>
<tr>
<td>Studies</td>
<td>Sunlight</td>
</tr>
<tr>
<td>NT Development Studies</td>
<td>Wind</td>
</tr>
<tr>
<td>Performance Studies</td>
<td>Weight Control</td>
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<td>Wings</td>
<td>NT Front Wing</td>
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<td>NT Rear Wing</td>
<td></td>
</tr>
</tbody>
</table>
Appendices

Appendix H: Questionnaire for the Users of the Case Study B

Questionnaire for the users of the ABC library

This questionnaire is part of a project that is investigating the role of document properties for managing knowledge. More specifically, it explores how properties can be implemented most efficiently to support knowledge sharing, creation and organisation in order to leverage the company's performance.

Document properties are the attributes assigned to a document including title, description, author, etc. These attributes enable ABC to file a document in the library and enable a user to retrieve the document when navigating or searching.

The questionnaire is focused on the use of the ABC Library and most importantly on the users' acceptance, perceived usefulness and ease of use with the aim to improve its functionality. It includes 24 questions in 3 sections and should not take more than 15 minutes to complete.

Your contribution will be greatly appreciated. Please answer as many questions as possible, as full analysis can only be undertaken if all questions are answered.

Your contribution is anonymous and no opinions or results will be attributed to individuals.

1. When did you first use the ABC library?
   - Over a month ago
   - Over three months ago
   - Over six months ago
   - Over a year ago

2. How often do you use the ABC Library?
   - More than once a day
   - Once a day
   - 2 - 3 times a week
   - Once a week
   - Once a month
   - Rarely

3. For which purposes do you generally use the ABC library? (please tick all that apply)
   - To access documents necessary for my work
   - To create/suggest documents that may be useful to my colleagues
   - To search for general information relevant to my job
   - To inform myself about the current developments of a project or product.
   - Other (please specify)

4. Do you consider the ABC Library to be important to any of your daily tasks?
   - Yes
   - No
Appendices

**Questionnaire for the users of the ABC library**

1. Please explain in what way is the ABC library important to your daily tasks.

   ![Response option](image1)

   ![Response option](image2)

2. Please rate how strongly you agree or disagree with each of the following statements.
   
   (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)

   **When I am looking for documents.**

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q1</td>
<td><img src="image3" alt="Rating option" /></td>
<td><img src="image4" alt="Rating option" /></td>
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<td><img src="image15" alt="Rating option" /></td>
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<tr>
<td>Q3</td>
<td><img src="image17" alt="Rating option" /></td>
<td><img src="image18" alt="Rating option" /></td>
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<tr>
<td>Q4</td>
<td><img src="image24" alt="Rating option" /></td>
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<td><img src="image29" alt="Rating option" /></td>
<td><img src="image30" alt="Rating option" /></td>
</tr>
</tbody>
</table>

   **Picture 1. The portal basic search.**

   ![Picture](image31)

   **Picture 2. The portal advanced search.**

   ![Picture](image32)

   **Picture 3. Brand Infospace basic search.**

   ![Picture](image33)

   **Picture 4. Brand Infospace advanced search.**

   ![Picture](image34)

   **Picture 5. The ABC library basic search.**

   ![Picture](image35)

   **Picture 6. The ABC library advanced search.**

   ![Picture](image36)

275
Appendices

A. Please rate how strongly you agree or disagree with each of the following statements:
(1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)

When I am looking for documents:

1 2 3 4 5 6 7

Most of the time, I manage to find the information that I am looking for

1 2 3 4 5 6 7

I find the search option very easy to use.

1 2 3 4 5 6 7

I am satisfied with the results that I am getting from the search engine

1 2 3 4 5 6 7

---

Questionnaire for the users of the ABC library

8. Which document properties are significant for you when you are searching for a document? Please rate the following from 1 - 10, starting with 1 being the most important:

- Title
- Author
- Keywords
- Classification
- Dates

9. Are there any document properties that you believe would be helpful to add to the ABC Library?

- Yes
- No

---

Questionnaire for the users of the ABC library

10. Please name which document properties it would be helpful to add to the ABC Library

---

Questionnaire for the users of the ABC library

11. Have you ever created or imported a document in the ABC Library?

- Yes
- No

---
Questionnaire for the users of the ABC library

13. How often do you generally create or import documents to the ABC library?
   - Once a day
   - Once a week
   - Once a month
   - Occasionally

14. Please rate how strongly you agree or disagree with each of the following statements:
   (1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)
   when I am creating or importing documents in the ABC library:

   | I find it time-consuming to fill-in the document properties | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | I would prefer someone else to fill-in the document properties for me | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | I would prefer it if the document properties were created automatically | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | I find the classification values satisfactory | 1 | 2 | 3 | 4 | 5 | 6 | 7 |

The documents found in the ABC library are:

   | Up-to-date | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
   | Comprehensive | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
Appendices

Questionnaire for the users of the ABC library

15. Please rate how strongly you agree or disagree with each of the following statements:
(1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC is the first port of call when I am looking for documents and/or information.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC has improved access to information.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using ABC enables me to accomplish tasks more quickly</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning to use ABC was easy for me</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

16. Please rate how strongly you agree or disagree with each of the following statements:
(1 = strongly agree, 2 = agree, 3 = somewhat agree, 4 = undecided, 5 = somewhat disagree, 6 = disagree, 7 = strongly disagree)

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>I generally trust the content found in ABC</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC is useful to exchange information with my colleagues</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABC is a useful source to search for existing information before starting a new project</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

17. Could you describe any key improvements you would like to see in the ABC library? Do you have any comments to add?

18. Please leave your name if you want the information and knowledge managers to follow up your suggestions. Your other responses will still be anonymous.

278
Appendices

Questionnaire for the users of the ABC library

Please answer the following questions to assist in data analysis, i.e. to formulate and test hypotheses.
A list of options can only be understood if all questions are answered.
These details are asked solely for the purposes of academic research.
Your contribution is anonymous and no opinions or results will be attributed to individuals.

19. What is your gender?
   - Female
   - Male

20. What is your age?
   - Under 20
   - 20 - 25
   - 26 - 30
   - 31 - 35
   - 36 - 40
   - 41 - 45
   - 46 - 50
   - Over 50

21. What is the highest level of education you have completed?
   - Undergraduate degree
   - Master's
   - PhD
   - Other (please specify)

22. How long have you been with the company?
   - Less than 1 year
   - 1 - 3 years
   - 3 - 4 years
   - More than 7 years

23. In which team do you work?
   - Global Drug Development
   - Discovery
   - Global Medical
   - US Business
   - BiMD
   - Other (please specify)

24. Please provide your location/country

Thank you very much for your time and cooperation.

End of survey.
Appendices

Appendix I: Interview Schedule for the Users in Case Study B

I. Introduction

- Thank you for agreeing to have an interview with me about the ABC.
- (Personal introduction and affiliation of the interviewer)
- (Purpose) The purpose of this interview is to examine more in-depth some of the issues that came across through the questionnaire on the ABC. It will focus on the same topics with the questionnaire: namely the use of the ABC and document properties, i.e. data that describes data, information and knowledge.
- (Motivation) This interview will help to improve the ABC and hopefully maximize its use and efficiency
- (Recording) Would you object if this interview is recorded?
- (Time Line) The interview should not last more than 30 minutes.
- Is there anything you would like to ask me before we start?

II. Main Part

(Topic A) General comments on the ABC

1. Do you use the ABC at all?
   - Could you identify the main reasons for not using it more often?
     (content, inefficiency, irrelevant to job responsibilities)

2. Could you tell me for which tasks you use it most?
   - Have you uploaded any documents on it?

3. Could you tell me what do you think overall of the ABC?
   - Do you think it is useful to your daily tasks?
   - Has it improved the way that you are searching and finding the documents that you need for your job?
   - Could you compare it with another system?

4. What would you say are the best parts of it?
Appendices

5. What would you say are its weak parts? (speed, interface, classification)
6. How do you normally search for a document? ABC, Infospaces, eRooms?
7. Do you browse the folders to find it or do you use the search engine?
8. Do you use the advanced search at all?
   - Could you tell me more about the search options? Are you satisfied with them?
9. Are you satisfied with the results that you are getting from the search engine and how these are presented?

(Topic B) Training

10. Have you had any training on the use of the ABC?
   - Did it include any training on the properties? E.g. how you should fill-in the forms and what kind of values to assign
   - Were you satisfied with it?
11. Would you like to have further training on the ABC?
   - Are there any particular topics that this session should cover?
12. How do you find the online help guide, the helpdesk or any other training material on the ABC?

(Topic C) Metadata

13. Do you think that properties are important in the ABC?
14. Do you think that properties are used properly? (consistently, comprehensively and efficiently)
15. Do you think that you should be using more or less properties?
   - If more, which?
   - If less, which are redundant?
16. Do you think that better use of properties would improve the search engine?
17. Do you think that browsing could be improved by using better properties?
18. Do you find it difficult or time-consuming to fill-in the properties?
   - If yes, would you prefer someone else to fill-in the properties for you?
Appendices

- Would you prefer it if properties were assigned automatically?

19. Which properties are more important to you when you are searching for a document?

20. How important is for you to retrieve documents by their classification?
   - How often do you search for a document on a given subject?

(Topic D) Knowledge Management and collaboration

21. What kind of information or knowledge do you choose to add to the ABC?

22. What are the criteria for adding a document in the ABC or not?

23. Do you have a systematic process for knowledge capture?
   - Could you please describe it to me?
   - Do you feel encouraged to document what you feel is important?
   - Do you feel encouraged to contribute this knowledge to the ABC?

24. Would you say that the ABC has improved access to the knowledge produced by you and your colleagues?

25. Do you think the ABC is useful for storing that knowledge effectively?

26. Do you think that better use of the properties would improve the storage and access to knowledge?

27. Has the ABC facilitated all the collaboration among the members of your group?
   - Among your colleagues in general?

28. Do you think that the ABC helps you to locate who is the best person to talk about a specific project?

III. Closing

- I appreciate the time you took for this interview
- Is there anything else you would like to add?
Appendices

Appendix J: Interview Schedule for the Information and Knowledge Managers in Case Study B

I. Introduction

- Thank you for agreeing to have an interview with me about the ABC library.
- (Recording) Would you object if this interview is recorded?
- (Time Line) The interview should not last more than 1 hour and 30 minutes.
- Is there anything you would like to ask me before we start?

II. Main Part

(Topic A) General comments on the ABC

1. Could you tell me what do you think of the ABC overall?
2. Are you satisfied with the system's use and efficiency so far?
   - Do you think it has integrated well with the users' daily tasks?
   - Has it improved the way that you are searching and finding information?
3. Could you compare it with an older system? (shared files) (content, ease of access).
4. What would you say are the best parts of it?
5. What would you say are its weak parts?

(Topic B) System Development

6. When the ABC was first developed?
7. Could you explain the strategic goals that the ABC was meant to meet?
8. Were there specific objectives to be met? (in terms of number of users, use)
9. What were the primary user needs for this system?
Appendices

- Have you done any user needs analysis?
10. Which are the main functions of the ABC?
11. Who was responsible for the design and structure of the ABC?
   - What was the rationale and principles of the design?
12. From the day of the first implementation, have you made any significant modifications to it?
13. Which groups/departments of the company currently use the ABC?
   - Do you think it would be beneficial if more departments were using it more extensively?
14. How many users are there in total?

(Topic C) Metadata

15. Do you think that metadata are important in the ABC?
16. What kind of metadata does the company currently use?
17. What was the rationale of selecting the specific metadata?
18. Do you think that metadata is used properly in the ABC by your colleagues? (consistently, comprehensively and efficiently)
19. Do you think that you should be using more or fewer metadata tags?
   - If more, which?
   - If fewer, which are redundant?
20. Which metadata are produced automatically by the system?
21. Do you use any kind of thesaurus / taxonomy?

(Topic D) System Administration

22. Could you comment on the ease of administering the ABC?
23. Which are your responsibilities?
24. How easy is it to maintain?
25. Do you have any plans for major modifications / updating of the system?
26. What is the process of adding new content on the ABC?
27. Is there a review / quality control process in terms of content? In terms of the metadata that users are producing?
   - If no, do you see a need for one?
Appendices

28. Is there a retention process for out-of-date documents?
29. In terms of content, has the ABC benefited the quality of information disseminated within the company?

(Topic E) System Use and Evaluation

30. Are you satisfied with the volume of use of the ABC?
31. Are there any incentives for the users to use it?
32. Have you predicted a payback period?
   - Has it been met?
33. Is there a specific evaluation process for the ABC?
   - Do you regularly monitor its use?
   - Do you regularly monitor its efficiency?
   - Do you follow specific metrics or set targets?
   - Do you use any financial measures? (such as ROI)

(Topic F) Knowledge Management and Collaboration

34. Do you think that the ABC helps you to manage your company’s knowledge?
35. To reduce repetition of mistakes?
36. To facilitate innovation?
37. Do you have a systematic process for knowledge capture?
   - What are the criteria for adding a document in the ABC or not?
   - Do you encourage users to document what they feel is important and to contribute it to the ABC?
38. Would you say that the ABC has improved access to the knowledge produced in the company?
39. Do you think the ABC is useful for storing that knowledge effectively?
40. Has the ABC facilitated the collaboration among the employees of your company?
41. Do you think that the ABC helps you to locate who is the best person to talk about a specific project?
Appendices

III. Closing

- I appreciate the time you took for this interview.
- Is there anything else you would like to add?
Appendices

Appendix K: Recommendations Made for Company B

The ABC library is an efficient system for the purposes of information and knowledge sharing and therefore only a small number of recommendations was included referring to the site structure and navigation, the use of metadata, some training required, and further steps for KM.

1. Structure and Navigation

Although a number of users have asked for more flexibility in the lower folder structure by giving them the ability to create subfolders, the design and management of the folder structure should remain in the responsibility of the information and knowledge managers for the purposes of consistency and quality control.

The large number of empty folders should be discarded as it may be frustrating for the users to navigate through them.

In the longer term, the interface could be improved and modernised to be made more similar to other web-based applications, such as the eRooms that users are familiar with.

2. Metadata

It is very positive that both metadata creation models are present, according to the users' preferences. Attention should be drawn though to the instances when metadata are created by "star users" and administrators.

Specific metadata, such as the "Description" or the classification of the documents, require in-depth knowledge of the content and they should be supplied by or verified with the creator of the document in order to be refined enough.
Appendices

Drop-down lists should be used as much as possible in the metadata forms, since they make the process of adding metadata quicker, easier and more consistent.

The “Description” should be better defined in the Naming Guidelines. Users should be encouraged to include an abstract and keywords of a document rather than copy the “Title”. For certain categories of documents, the description could include the findings or conclusions of the specific document.

The classification list should be updated, refined and extended to include appropriate terms for all teams that use the ABC.

Access statistics, relevance and user ratings or annotation should be included to provide the users with information about the usefulness of a specific document.

In the long term, development of an effective metadata management strategy because it enables a company to make better use of the data, information and knowledge assets it has. The components of a metadata management strategy could include.

1) Decision of how metadata will be used in the organisation,
2) Decision of who will use which metadata and why,
3) Training requirements,
4) Sources of metadata (existing databases and files),
5) Quality of the metadata sources (absolute, relative, historical, etc.),
6) Methods to consolidate metadata from multiple sources,
7) Responsibility for capturing, establishing standards and procedures, maintaining and securing the metadata, proper use, quality control and metadata update procedures,
8) Definition of metadata standards and procedures,
9) Naming standards (abbreviations, class words, code values, etc.),
10) Measurement of the use and effectiveness of the metadata.
Appendices

3. Training

The ABC is not a very user friendly system and in order to be able to use it to its full extent, training is necessary. The training provided on the ABC was well received by all participants in the study.

A few pointed out that it would be useful to have received this training at an earlier date and that it should be made mandatory for all newcomers to the company.

The advanced search options of the ABC search engine should be promoted more because they allow for the execution of very precise queries.

The personalisation options that are available should be also covered in these training sessions, to allow users to create their own version of the system, according to their preferences and needs.

Training should be extended to the users located in all countries, through the information and knowledge managers and online training material.

The 3-fold path should be explained in more detail to the users. Guidance as to which documents should remain in the eRooms, which should be migrated to the ABC or DEF and which should be published in the Infospaces, should be provided to all and in particular to the administrators of eRooms.

4. Knowledge Management

Managing knowledge in such a large company is a very difficult task that should be addressed at three levels: the company, the project groups or teams and the individual knowledge workers.

At the company level, positive steps for managing knowledge have already been made: robust KMS, such as the ABC, the Infospaces and eRooms, have been designed and implemented to facilitate knowledge creation, organisation, sharing and reuse. These systems help preserve the corporate memory and facilitate collaboration and possibly innovation. Improvements can always be made to these systems taking into the account technology changes and users' increasing needs and preferences. In addition, the introduction of the
systems to all teams involved in the drug production and marketing process and will help the communication across the company and will encourage users from all teams to share in a very efficient way important information and knowledge.

At the project group or team level, the work of the knowledge managers helps groups of knowledge workers to identify good practice and lessons learnt. This work can be augmented through the adoption of the 'communities of practice' theory. Supporting the development of informal groups of employees that share common goals or interests, beyond the boundaries of the formal projects teams, will help the free flow of ideas and the teamwork.

Last, at the individual level, training helps the knowledge workers to use the KMS in the most efficient way. Through training, it is also possible to introduce recommended practices for information management and the notion of knowledge sharing, with the long-term aim to change the company’s culture and to continue its development as a knowledge sharing and learning organisation.