University of Nottingham

Improving Document Management and Information Flow in a Railway Signalling Projects Operation

Paul O. Erubami, CFM

MSc Industrial Engineering and Operations Management

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By

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2010

A Dissertation Presented in Part Consideration for the Award of
"Industrial Engineering and Operations Management MSc Degree".

ABSTRACT

The availability and application of quality information plays a pivotal role in the success of engineering, design and project management operations in hi-tech and knowledge-based industries, such as those involved in providing engineering solutions for signalling to the railway industry. This research Project has as its stated purpose to evaluate the capabilities and extents of deployment of current document management systems, assess the document management needs of Signalling Solutions Ltd, and make recommendations based on gap analysis between needs, available systems and business requirements. The objective is to produce a workable program for the planning, selection and implementation of an enterprise content management system for the management of information assets by Signalling Solutions Ltd, a UK provider of engineering solutions for railways signalling.

The study presents first an understanding of the current situation of the business, a vision of the ideal situation with regards to document and information management and then proceeds to chart a possible path to improve on the people, processes and technology required to achieve the future state. The methodology adopted include the use of literature review of relevant articles published in reputable journals and books to describe precedent, current and future trends in the industry. Surveys are combined with interviews for primary data collection, after which mixed-methods evaluation techniques are then employed to analyse and present the case study research findings.

This study shows that the large volumes and types of data, strict regulatory and contractual obligations and the need for high level information security in the rail industry calls for investment in an effective document management system. However, the selection of a particular vendor or supplier's electronic document or enterprise information management system based on functionality, though very significant, comes secondary to the user and organisational issues involved in the effective implementation of such systems for overall success.

TABLE OF CONTENTS

TABLE OF FIGURES

ACKNOWLEDGEMENTS

I am indebted to my Heavenly Father whose grace and mercies have attended me throughout this last one year. And also grateful to the following people who allowed themselves to be instruments in God's hands towards the successful completion of this research effort;

- Dr. Jane Guinery, my very resourceful and articulate MSc Dissertation Project Supervisor, and all the Nottingham University Business School Faculty and Staff for their instructions and support.

- Engr. Tony Davis, Mike Stevens, Alan Wiggins (Company Project Supervisors and Support), the Management Team and the very warm and cooperative employees of Signalling Solutions Ltd, with special mention going to Leanne Hill and Paul Hickman for their valuable time spent with me on this project.

- My wonderful Family, especially my Wife Grace and our two Sons, Efe (5 years old) and Ese (3 weeks old) to whom I dedicate this work, for creating the conducive environment and providing calm reassuring words when the going seemed tough as I worked very hard to complete this MSc program in flying colours.

1.0   CHAPTER ONE- INTRODUCTION

This chapter sets the tone for the report and introduces most of the concepts involved, the methods employed in this research and also lays out the outline for the presentation of the entire report.

1.1   Purpose of the Research

Information Systems have over the years changed from the traditional role of back office support and automation to that of more strategic positioning for most businesses, especially knowledge-based organisations, with the introduction of new strategic applications such as Materials Requirements Planning (MRP), Enterprise Resource Planning (ERP), Electronic Document Management Systems (EDMS) and Enterprise Content Management Systems (ECMS) amongst others. Galvin Lorraine (2009) argues that the turn of events in the IS application industry has led to much investments and many notorious failures which along with the lack of understanding in measuring strategic benefits combined with the rate of technological change have portrayed IS as a high-risk investment. In order for organisations to sustain competitive advantage in whatever industry they operate in, there is a need to invest in information systems and to control these investments in order to decrease the uncertainties associated with project failures. The purpose of this research is to devise a strategy for the planning, selection and implementation of an electronic information and content management system as part of the overall IS portfolio in a specialised engineering projects-oriented organisation.

The case is a medium sized UK-based company providing end-to-end signalling solutions for the railway networks on a country-wide basis. Signalling Solutions Ltd came to existence on the 1st of October 2007 as a joint venture between ALSTOM Transport Signalling (UK) and Balfour Beatty Rail Signalling (UK). The new company was created by formally bringing together the two businesses of ALSTOM UK Transport Information Solutions and Balfour Beatty Rail Signalling, providing a unique opportunity to offer 'individual' or 'complete solutions' to any customer requiring design, installation, testing, commissioning and product support for signalling, power and telecommunication applications (http://www.signallingsolutions.com/about-us).

The need for this type of research is borne out of several factors such as a lack of integration in information management systems deployed in the case organisation as well as poor user understanding and interest in the use of available systems, resulting in operational inefficiencies such as loss of information, poor information sharing and difficulty in accessing business-critical documents as and at when required. The need to meet strict legal, contractual, legislative and regulatory provisions and obligations and the need to improve employee productivity and loyalty, while at the same time securing the organisation's information assets are all very important additional business drivers for this project. The overall goal of this research is to understand and present information management related problems in this engineering organisation and map a pathway for the successful identification of needs, selection and implementation of a suitable solution which synergistically combines the available technology in the form of systems or packages, the orientation of the individual users and their organisation with effective processes.

1.2   Scope and Research Boundaries

In this research, strategies for planning and implementing the selection and deployment of electronic information management systems are investigated from three perspectives thus; the people who are the end-users of the information management system, the documents which together with organisational processes form the work performed and the available information technology tools which aid the performance of productive business activities by the end-users. The research will concentrate on the operational and management issues involved in the development of an information management strategy with specific attention paid to the area of document and content management systems.

This research does not however extend to the detailed technical aspects of computing, such as hard and soft ware architecture and design, including those technological issues described in the International Organisation for Standardization's technical report ISO/TR 10255:2009 such as optical storage devices, file structures, optical disk standards and the likes. Also excluded in this research is a market survey of comparable products that may support document and content management, with the exception of the currently deployed systems in Signalling Solutions Ltd. Besides the fact that such a survey is not required by the company, the extensive range of commercially available products and their rapidly changing functionality and integration capabilities will make any such effort quickly out-dated. The case study organisation also already has investments in some systems whose providers are

very active, continually improving and adapting their systems and software products to meet customer requirements.

The needs of the end users are a central theme in this report. This is because the entire efforts to implement or improve information management systems in the organisation is geared towards making it easier for the employee to find the right information tools to enable him deliver on projects. This in turn will directly translate into cost, time and resources savings which impacts the bottom-line of the business. This also has the additional benefit of increasing the knowledge-worker's job satisfaction and loyalty which leads to a high rate of skilled manpower retention.

1.3   Research Methodology and Questions

The descriptive and exploratory single, representative, or typical case study research methodology is employed to present a mixed-method evaluation of the relevant subject matters covered in the report. According to Yin (2009), "the case study method allows investigators to retain the holistic and meaningful characteristics of real-life events- such as life cycles, small group behaviour, organisational and managerial processes, neighbourhood change, school performance, international relations, and the maturation of industries". The purpose of a descriptive strategy is to present an intervention and the real-life context in which it occurs. It is exploratory to the extent that the situation in which the intervention is taking place may have no defined single set of outcomes (Yin, 2009).

The research questions of this study are the following;

1. How can user and organisational needs be evaluated in a document management systems implementation?

2. Why is the current state of document management perceived to be ineffective by end-users in the organisation?

3. What ideal or future state do we need to envision?

4. How can the organisation be led from the current state to the ideal future state of information management?

Two questionnaires were also administered to a wider section of the employees to cover those not included in the initial interviews, and also to validate the results gathered from the

unstructured interviews using triangulation techniques. Content analysis is employed as a tool for categorising the collected data which are then reported statistically through simple, generally understood and accepted procedures (Wolcott, 2001, p.33).

1.4   A Brief Introduction of the Research Subject Area

An Enterprise Content Management strategy aims at reducing the costs of creating, managing, and distributing content as well as ensuring that content effectively supports organizational needs both tactically and strategically. An ECM strategy is a method to identify the requirements for creating consistently high quality content for reuse, managing that content in a definitive source as an asset, and assembling content on demand to meet organizational and customers' needs. The ECM strategy development process starts by analysing existing user and organisational needs and how these are being met by current information management systems, processes and resources. It goes further to envision an ideal state and then charts a course for delivering the ideal state of information management efficiency (O'Callaghan & Smits 2005). This Enterprise Content Management implementation problem is here studied from the viewpoint of integrating the individual users and their productivity requirements, organisational and operational processes, and available document and content management technologies, in the development of a strategy for the selection and implementation of an information management system.

Many collaboration and communication strategies are primarily initiated to reap the benefits of infrastructure consolidation, such as reductions in operational costs, and to improve levels of service quality. However, although these are useful goals, the real value afforded by unified communications and collaboration solutions ultimately arises from improvements to business processes, enhancement of stakeholder interactions, optimisation of workflow, and eventually driving innovation in the business (Butler Group, 2008). There is an opportunity for organisations, with the deployment of integrated communication services and collaboration tools, to significantly improve employee productivity, augment business processes and foster innovation. Very few firms have yet developed the capability to aggregate, analyze, and use content to make informed decisions that will lead to action and generate business value. The implementation of an integrated document management system provides such an opportunity for Signalling Solutions Ltd.

In the words of Smith & Mckeen (2003); "In the rush to use computers for all transactions, most organizations have neglected the most important step" which in light of this report is careful and purposeful planning, which involves asking all the 'why's and 'how's, not just the 'what's kinds of questions. In an effort to develop a framework for ECM strategy, O'Callaghan and Smits (2005) identified the main components of such a strategy to include aspects such as a content management (CM) system, reusable content and collaborative CM processes. Tyrvainen P. et al (2006) further postulated that research about the subject of enterprise content management can be viewed from the perspectives of content, technology, enterprise and processes as illustrated in the diagram below;
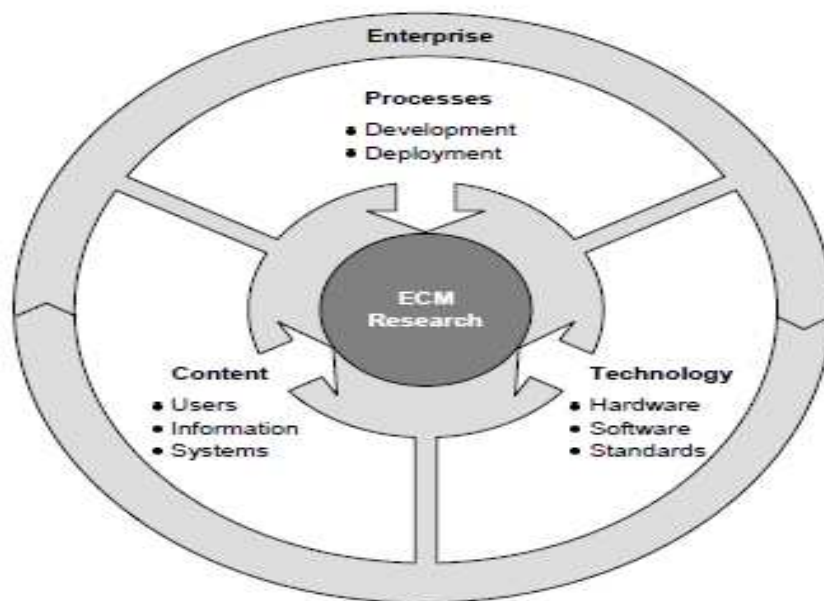
Figure 1.1- A Framework for ECM Research (Tyrvainen P. et al

The research questions of content perspective concern identification of content items, their semantics, structuring, and organisation as well as the creation and use of content both by human users and information systems. Research in this area involves looking into content management with the view of information on how the content is represented and made available to others, the relationship between content and users, and the system view which looks at the interoperation of various systems in which the content resides and is made available to others.

The technology perspective concerns the development of hardware, software, and standards for content management in an organisational context. The focus on the base technology has a

rich body of literature (Tyrvainen P. et al 2006) and although this is without doubt significant as an enabler of enterprise content management, the major focus should be on systems because a number of technologies are integrated in a system together with other elements.

The enterprise perspective provides the contexts where the content of various information assets should be managed, and considers organisational, social, business and legal issues of content management. Much of the research on enterprise content management from the enterprise perspective has focussed on its role in the communication processes of the enterprise. As shown in the illustration above, the enterprise perspective is also tightly intertwined with the process perspective. Research in this area has been rather limited (Tyrvainen P. et al 2006), consisting mostly of early conceptual and theoretical recommendations and a limited set of empirical studies

Research from the process perspective considers the development and deployment of new content management solutions in enterprises. This perspective distinguishes between two major process categories related to information systems which are the development of processes for the implementation, maintenance and change management of enterprise content management systems, as well as the deployment process including the implementation of content life cycle activities (Paivarinta &Munkvold, 2005).

With the above frameworks in mind and the research questions outlined above, it becomes obvious that this research deliberately attempts to approach this subject within the perspectives of enterprise and processes which in themselves are intertwined. A balanced approach of this nature is also helpful in reducing the over-concentration on electronic systems, software and IT as the primary source of efficiency (the technology perspective) which is all too rampant in the industry today. This research will show that a system is only as good as the level of its acceptance, understanding and use by the people responsible for various business activities, irrespective of the level of its technological sophistication.

1.5   Structure of the Report

This chapter which is the introduction to the report presents the summary of the underlying issues of the research as well as the main problems to be resolved by the research. The introduction chapter also touches on the main research questions as well as the methodology to be employed in their resolution.

Chapter 2 presents the main issues and concepts, which covers the relevant bodies of knowledge involved in a research of this nature. The main concepts include definitions and strategies for information, data, documents, enterprise contents, enterprise knowledge, workflow processes, etc. and their management. Reference is made to established authors in reputable information systems, business processes and operations management journals, discussing these issues together with specific strategies for successful implementation in organisations.

Chapter 3 discusses the methodology used in carrying out the research in greater detail, which is a mixed method approach using a qualitative case study together with simple surveys. The process of data acquisition using interviews, document reviews, focus groups and questionnaire surveys is defended and illustrated.

Chapter 4 is dedicated to data collection and analysis, describing the Signalling Solutions case environment and drawing mainly from materials gathered from the company during focus group meetings, observations, results of interviews and questionnaires as well as company records. This chapter also puts forward a detailed comparison of the current situation in the company with respect to existing document management practices and systems, their level of implementation and effective use and compares this to end-user requirements.

Chapter 5 is devoted to discussion and the researcher's recommendations on what changes are required to be made in transiting from the current state to a future or near-ideal state that represents the satisfaction of majority of the users and the organisational requirements for effective operations. Recommendations for areas where quick gains can be made and a possible path to the implementation of a fully functional document management system are provided.

Chapter 6 draws conclusions based on implications from the study both for the case organisation and for further research. With a summary of the entire research proceedings along with a summary of answers to the research questions, this chapter rounds up the report.

2.0 CHAPTER TWO- LITERATURE REVIEW

"Where **is the wisdom that we have lost in knowledge, and where is the knowledge that we have lost in** *information"*- **TS Elliot**

2.1 Introduction and Framework

With an introduction of the main parts of this report presented in the previous chapter in mind, this chapter details the first major effort aimed at understanding the underlying issues of this study, which is the review of relevant literature. It looks into Enterprise Information Management and systems deployment subject areas to get a 'feel' of the academics' and the systems suppliers' points of view in the delivery of systems for effective information management. In addition to the above, the review also explores management literature for materials relevant to user orientation and organisational change management, especially those prompted by mandated IT-related strategies.

It should be noted that due to the fact that this is an evolving field (Nordheim & Paivarinta, 2006) and research in this domain is still not very sophisticated, resulting in confusion of terms (Paivarinta and Munkvold, 2005), there is need to include some concept definitions to aid proper understanding of this research piece and to adopt specific definitions for some of the various terms used in this report. The main concepts that require such definition include data and metadata, information and its management, knowledge and its management, enterprise content and its management, document and its management, record and its management, as well as workflow and Business Process Reengineering (BPR) amongst others.

The diagram below depicts a simplified model designed as a framework for piecing together the various concepts covered in this literature review. It shows Enterprise Content Management as a conversion process for transforming knowledge into productive activities in a business enterprise. Knowledge, both tacit and explicit is used as the major input in the achievement of effective production as it goes through the processes of being recorded and consulted by the knowledge worker.
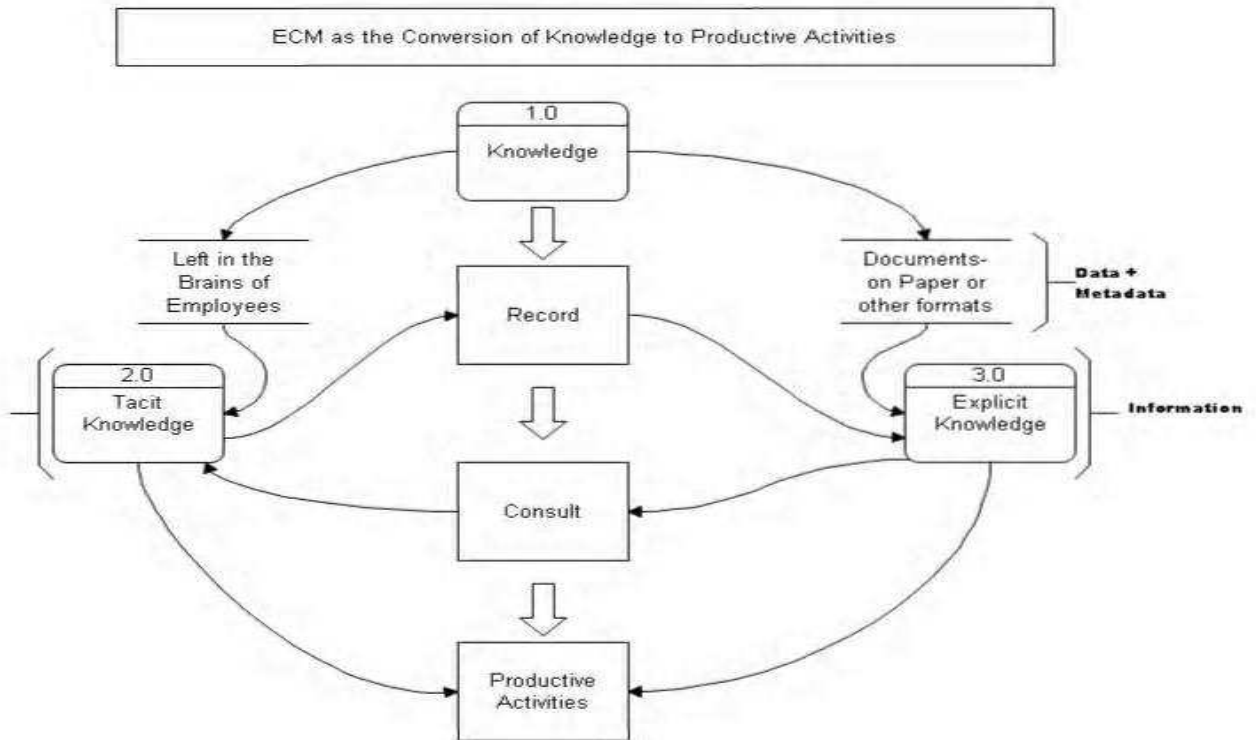
Figure 2.1- ECM as the Conversion of Knowledge to Productive Activities.

2.2   Data and Metadata

There is a difference between the primary information 'within' a document which is the 'data', and the secondary information 'about' the document which is the 'metadata'. Whereas data refers to packets of information or information-objects contained in a document, metadata is the descriptive, structural and administrative information about a document or any object resource within it, which allows users to locate and evaluate data or information in the document. It is this secondary information about the document that is called metadata and its function is to enable humans or document management systems to search for, retrieve and open documents and possibly search within the contained data (Bjork, 2003). The British Standard, BS EN 82045-1:2001 identifies it as 'management data', which is defined as data about the content of a document necessary to manage it in an Electronic Document Management System (EDMS) or a Product Data Management System (PDMS) or any other relevant system. Metadata supports the viewing and reproduction process of documents, identification of documents, workflow and version management of documents, as well as relations between documents and associated products.

While enterprise content or document management systems serve to collect and integrate data and turn it into information that is accessible for query and analysis for decision making by end-users within the organisation, many of these end-users may not be technically oriented and would require considerable support to use a data ware house effectively (Foshay N. et al, 2007). The incorporation of effective and easy to use, user-oriented metadata-sets in an electronic system for managing documents ensures that knowledge workers fully understand and trust the data they are being provided, and as such guarantees that the system will be used extensively (Bjork 2003). The British Standards Institution specifies the criteria for identification and classification of technical documentation forming part of a document management system as; administrative which provides the means of control, and technical criteria which describes and defines the product concerned in its finished state (BS EN ISO 11442-4:1996). A major goal of integrating document content management with engineering/product data management according to William Hall et al, (2002) is to provide hard links between configurations related information in the documents and master data held in engineering tools.

2.3   Information and Information Management

Numbers, words and images are the basic units of data that are processed into meaningful patterns to produce information. Information in turn can be codified into computer data bases, characterised as factual structured data, which can be analysed using arithmetic and logical deductions. Documentary information is the alternative form of information held on paper, film or digital formats on digital media. This is the type of information that requires management, which results in the need for information and document management systems and processes.

The timely flow of appropriate information is the fluid through which business processes and indeed the entire operation of an organisation depends. Most of the waste encountered in business organisations can be related to the deficiency of the information management systems and processes. When information cannot flow because it has not been generated, a process is broken or a critical process is unavailable. When information is unable to flow because it cannot be identified and flow-activated or, shared processes are incompatible, the same effect is felt by the process. When excessive information is generated and maintained or excessive information flows and as a consequence, the most appropriate information cannot

be easily identified or, inaccurate information flows, inappropriate downstream activities are performed (Hicks, 2007).

It is no secret that organizations have become overwhelmed by physical and virtual information artefacts. The number of paper documents, data, reports, web pages, and digital assets has literally grown exponentially in recent years causing considerable information 'overload'. Information and systems for its management are critical elements for the efficient and effective operation of business organisations. The objective of information management is to ensure that valuable information is acquired and exploited to its full extent through such activities as creation, representation, organisation, maintenance, visualisation, reuse, sharing, communication and disposal of information (Hicks, 2007). The ability to manage explicit information is a key knowledge-management capability (Dilnutt, 2006), and this capability is increasingly an area of need in most enterprises, especially those in the hi-tech and creative business sectors.

This situation is further fuelled by the need to improve productivity and also, mitigate both anticipated and unanticipated risks in an increasingly competitive environment. These risks are mitigated by the control and security of information, managed as a valuable asset, which is made available as a resource in the pursuit of the underlying organisational goals. Information security is defined as confidentiality, integrity and availability. Confidentiality is the protection of sensitive information from unauthorised disclosure or interception. Integrity is safeguarding the accuracy and completeness of the information. Availability refers to ensuring that information and vital services are available to users when required (Wiggins 2000).

2.4   Knowledge and Knowledge Management

Knowledge is the information that is held in the brains of humans, which when recorded in any format whether paper, electronic or digital, becomes a document. Knowledge is described as a blend of experiences, values, contexts, insights and grounded information (Davenport & Prusak, 1998 cited in Dilnutt, 2006). Knowledge is a critical property that organizations use to gain and maintain competitive advantages. In the constantly changing business environment, organizations have to exploit effective and efficient approaches to help knowledge workers find task-relevant knowledge, as well as to preserve, share and reuse such knowledge (Lai & Liu, 2010).

With this view of knowledge in the background, knowledge management should be seen as a system that is beyond the management of information captured in documents. To this end, knowledge management can be described as concerning providing people with the current and accurate information within the context of their roles to perform activities at various stages of business processes. It is easy to observe too that enterprise content management systems or any other technology for that matter is only able to provide management for explicit knowledge which is the knowledge that is documented, and has a limited ability to address the need to manage tacit knowledge which is information retained in the brains of employees. However, the emergence of enterprise content management as an integrated approach to building organisational capability, enabling the management of explicit, documented information is an important infrastructure supporting knowledge management practice (Dinutt, 2006).

Since a major problem in many business enterprises today is how to create share and exchange knowledge and work effectively in collaborative knowledge-activities across locations while still being business-process aware (Dustdar, 2005), it is imperative that any system implemented for managing content, which is a carrier of this knowledge must consider knowledge management issues as part of its requirements. Functionalities of information management systems that aim to support knowledge management according to Dustdar (2005) include; gathering or capturing of knowledge from sources such as files from servers, intranet and web pages, emails, etc; contribution of information to the knowledge base, including who can, and under what controls create content; organization or categorising and linking of information; facilitation, distribution or delivering information to users; collaborative capabilities such as routing, bulletin boards, discussion databases, etc.; and refining and analysis of a knowledge base, such as data mining, custom reports etc.

2.5   Records and Records Management

A record is a document created, received and maintained as part of business actions, acting as a medium for saving, and providing evidence relating to all kinds of activities for reference at a future time as may be required. The major emphasis here is on administrative control, filing and storage and meeting regulatory requirements. To decide whether any document is a record, it must be created in the course of business or received for action, may document organisational activities or actions, may be mandated by statute or regulation or legislation, support contractual obligations or legal claims and may communicate organisational

requirements etc. The document repository which is a central component of virtually all electronic document management systems, is an electronic records management system which exists to serve the purpose of turning documents into records for future use at the end of the current use of such documents in the daily transactions and workflows of the enterprise.

The International Organisation for Standardization (ISO) provides several insights into records management in ISO 10255:2009(E) concerning records retention, archival and migration. Data retention is defined as the shortest period of time that a record should be retained before it becomes eligible for destruction. The organisation should hold a retention schedule which sets minimum and maximum retention periods for various record types within an organisation, with the objective of ensuring access to the record as long as necessary and no longer. Archival refers to the preservation of recorded information and their indices, for periods that extend beyond generational change. It involves protecting each media used to drive them from any damage, ensuring accurate long-term access to information. It is an established practice due to regulation that information must be retained for extended periods in the railway industry. Migration plans must be developed from the beginning of electronic document management system adoption. The objective is to ensure long term retention for record keeping purposes as well the exigency of backup in disaster recovery.

Due to the high sensitivity to risk in railways signalling projects mainly due to public safety and environmental issues, original wet signed copies of critical documents are required by legislation and industry regulation to be kept in retention for as many as 10 or more years and to be produced as evidence if required. This is particularly noteworthy in this research because even though the document management industry tends to be moving towards completely paperless operation environments, players in the railway industry trying to adopt electronic document management systems may still be bugged with the additional costs of maintaining hard copies of critical documents as acceptable evidence for reference purposes.

2.6   Documents and Documents Management

Asprey and Middleton (2003) defines documents as recorded communication with recognizable structure, on any medium which are intelligible without any further need for processing except for on the screen or on printed page. This is closely related to the definition given by the international standard BS EN 82045-1:2001 which defines a document as a fixed

and structured amount of information that can be managed and interchanged as a unit between users, and systems. In technical terms, a document is an instrument that carries information in some format that it could be shared, disseminated, stored and acted upon. A set of metadata, which is the ownership authorisation, history, status, procedures, links, data description, and the contained data itself which is the attributes associated in the document (Eloranta, 2001). A simpler and more straightforward definition for the layman is provided by Harris et al (1997) who defines a document as being a collection of information assembled for the purpose of communicating something to someone.

The activities along the life cycle of a document are outlined according to BS EN 82045 to include the initiation phase where the document gets it identification, the preparation phase where its content is developed, checked and approved, and then the establishment phase when the document is released or made available for use in its intended purpose. The document then progresses through the revision phase where the content may be changed as needed, and finally the withdrawal phase when the document is no longer of use. The elimination or deletion phase is usually after the satisfaction of contractual and legal obligations to retain documents, which are however withdrawn from the system and may be held on for a good number of years in the records management component of the system.

Business performance must necessarily rely on documents, and performance enhancements such as information systems development, quality systems implementation, business process reengineering and organisational reorientation all must depend on effective communication through documents. Documents play several roles in the business context of Signalling Solutions Ltd, which includes; recording contracts and agreements; recording company standards, policies and procedures; representing a view of reality at a point in time in projects with plans, schedules and programs; creating an image or impression, with reports; and can also generate revenue as a product of its own as in the case with design drawings. Documents also acts as a mechanism for communication and interactions among people, through letters, minutes, presentations, etc.; provide a discipline for the capture of ideas and concepts through drawings, etc.; as well as acting as a vehicle for organisational processes, such as invoices and orders. The exponential increase of information however has affected the manner in which it is accessed, disseminated and delivered. Emphasis has gradually shifted from the mere need to view information in documents, to efficient storage, retrieval and monitoring of selective changes to the information contained in documents. This shift has been

demonstrated in the evolution of document management systems over the last couple of decades.

Document management is a subset of information and knowledge management and also of the process of reengineering the business process. It is the integration of relevant technology, people and processes to support the production cycle from concept to delivery in any business environment. Document management is the process that governs information flows in distributed business processes, performing this role in three aspects according to Eloranta (2001) including; 'document flow' as the intended way each activity is to be performed, as stated in flow diagrams; 'document life-cycle' as the chain of statuses through which each and every document passes compulsorily once created; and 'document implementation' as how the document is transferred, manipulated and controlled, comprising the tools and information networks.

Document management is the process that governs information flows in distributed business processes, performing this role in three aspects according to Eloranta (2001) including; 'document flow' as the intended way each activity is to be performed, stated in flow diagrams, defining the organisational routines to be performed in order to run the operations and development processes in the enterprise; 'document life-cycle' as the chain of statuses through which each and every document passes compulsorily once created, that along with their revisions and different versions, follow the predefined sequence; and 'document implementation' as how the document is transferred, manipulated and controlled, comprising the tools and information networks..

The goals of an effective document management system should include, to satisfy the user's requirements, be easy to use and to operate, be easy to maintain and be easy to enhance or modify. The business-drivers for a document management strategy includes the need to get close to the customer, focus on critical competencies, be flexible and respond quickly to change, integrate the whole business and focus attention on people issues. According to Megill & Schantz (1999), typical objectives of a document management system may include; improve speed of business processes by enabling workflow management; reduce the cost of managing business processes by saving on time and other resources that are results of waste due to, waiting for, unnecessary handling of, loss of, and corruption of business critical information; communicate more effectively through document currency, validity and integrity; improve the relevance of documents disseminated by making it timely, especially

for time-sensitive information requirements; reduce cost of obtaining required documents both for reacquiring lost or recreating defective ones; increase business and individual productivity as the most important tool of the knowledge worker; replace labour intensive operational system with lower cost, capital intensive but more productive operational system; conserve business physical facilities space; reduce overheads required to effect work processes and supervision; shorten communication time for both upstream (suppliers-ward) and downstream (customers-ward); and also achieve a leaner, more professional, more stable and skilled labour force.

Raynes (2002) describes electronic document management system as a computerised system that facilitates the creation, capture, organisation, storage, retrieval, manipulation, and controlled circulation of documents in electronic format. It consists of a storage facility where electronic documents are kept, a method or number of methods for adding documents to the storage area and a method for identifying and retrieving the documents from the storage area. An electronic document management system includes all the technology functions related to the scanning, indexing, modifying, processing, storing, and retrieval of all forms of documents whether electronic, graphical, compound or virtual that are required to meet the needs of business customers (Megill & Schantz, 1999). Electronic document management systems supports business processes by making it easier to vet and approve processes, control versions, control distribution, comply with quality requirements amongst other functionalities.

2.7   Content and Enterprise Content Management

White (2002) defines Content Management software as a system that provides a platform for managing the creation, review, filing, updating, distributing and storage of structured and unstructured content, and Munkvold et al (2006) defines Enterprise Content Management (ECM) as "the strategies, tools, processes and skills an organization needs to manage all its information assets (regardless of type) over their lifecycles". There seem to be also some confusion in the existing literature about the relationship between Document Management and Enterprise Content Management. "If there's one thing that all the experts agree on, it is that no one really knows exactly what Enterprise Content Management (ECM) really is. In fact, there is considerable confusion around everything about it – what content it includes, what organizational functions are responsible for it, what activities it involves and how to accomplish it. In short, ECM is an emergent concept that managers, academics, and vendors are all trying to understand and define" (Han, 2004).
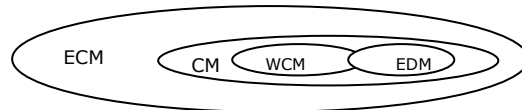
Fig. 2.2- The Relationships between EDM, CM, WCM and ECM (Raynes, 2002)

While some authors do not see any substantial difference and choose to regard them as one and the same, others mostly from more recent literature support the view that Document Management is a subset of Enterprise Content Management, noting that ECM systems commonly contain Document Management as a sub-component, along with some accepted sub-components of Document Management as independent components, such as records management, search and retrieval, etc. (Dilnutt, 2006). The term Enterprise Content Management is however being increasingly used by technology vendors to describe their software products, with claims of being able to manage unstructured information in the form of documents, web pages, drawings etc. (Dilnutt, 2005, Asprey & Middleton, 2003). Furthermore, Raynes (2002) notes the following as the distinction between document management and enterprise content management systems: "While Document Management (DM) manage documents by providing operational efficiencies through improved document storage and retrieval, Enterprise Content Management (ECM) manages the information or knowledge contained within the documents, thereby making an impact on the performance of the individuals using the information in those documents." As noted by Anderson (2007), excitement for vendor-based solutions is rampant and the ECM market is actually booming.

Liu et al (2007) shows the distinction between Electronic Document Management Systems (EDMS) and Enterprise Content Management Systems (ECMS) as the product of their evolutionary process. While EDMS can manage documents as single files, ECMS are more sophisticated, and can manage complex documents made up of components or a range of content objects (also Smith & Mckeen 2003, cited in Munkvold et al 2006). However, enterprise content management is not limited to technological aspects only as it captures strategies, approaches and methods ensuring a suitable enterprise wide platform for information management, providing means to enhance content quality and consistency, potential to raise an organisation's business process efficiency, helping to address compliance issues while at the same time reducing overall costs of doing business (Jan et al, 2007). Enterprise Content Management systems for very large organisations with wide presence has further evolved into the world wide web space as Web Content Management (WCM), while

medium to small organisations now seek the application of enterprise content management using software to manage general document content at numerous levels.

In describing the much functionality that these systems perform, Raynes (2002) noted that they appropriately refer to what the systems or software might do, as they do not in themselves manage documents. The management aspect is what brings together the software, the appropriate business processes and the people who will make it work. Further stressing that people are particularly important as the providers of the need, the operators of the systems, while the ways in which they work determines whether the system is likely to be effective or not. Document management can have an influence on the culture of the organisation and it can sometimes simply reflect the existing culture. Such effects are critical to be taken into account when selecting and implementing a system

In this research study however, the stand adopted in the International Organisation for Standardisation's ISO 10244:2010(E) which identifies both Electronic Document Management Systems (EDMS) and the Enterprise Content Management Systems (ECMS) as terms that can be used interchangeably serves the current discussion. This is because while an attempt to see EDMS as a subset of ECMS is very valid and tenable, user needs assessments as well as off-the-shelf systems providers have continually included features of ECMS into EDMS, making them hard to differentiate from the market's point of view. In addition, ISO 12651 considers Enterprise Content Management to be a set of tools and methods that allow an organisation to obtain, organise, store and deliver information crucial to its operation, which is also the common definition for the Electronic Document Management System.

Fig. 2.3- Components of Enterprise Content Management (Dilnutt, 2006)

Information integration is the key benefits of an enterprise content management system as it replaces functionally-oriented and poorly connected legacy software and results in savings in infrastructure support costs. This also affects the entire organisation, with positive impacts on the firm's performance and sophistication in planning capabilities, better customer relationships management and operational integration amongst others (Hendricks et al, 2007).

Smith & Mckeen (2003) suggests that the current interest in ECM is due to a number of reasons including the following four reasons: First, research shows that the average knowledge worker now spends about a quarter of his or her day looking for information either internally or externally. Anything that can reduce this effort or improve the quality of the information acquired will get corporate attention. Second, there is simply more content out there these days. In addition to traditional documents and data, corporate internet and intranet sites are becoming central to how enterprises do business. Extranets and external sources of information often add further layers of complexity and cost to the information overload that enterprises find themselves in. Third, organizations are realizing that they could (and should) be doing much more with the content that they have. Although most are still unable to leverage their data and turn it into knowledge and results, this goal remains a strong vision for them (Davenport et al, 2001). Fourth, the technology available to manage different types of content is improving and converging. Traditionally, different software was used to manage documents, web pages, and digital assets. Today however, the lines of demarcation between these tools are blurring. Software, while by no means perfect, is therefore opening the door to the possibility of new organizational capabilities in Enterprise Content Management.

For all these reasons, many companies feel that it is time to address ECM. As a result, it is a big business. Many senior managers now recognize that enterprise content is central to their business' strategy (e.g., integrating processes, a single point of customer contact, e-business, competitive information). ECM truly touches virtually every aspect of an organization. In short, how organizations define and implement their ECM strategy could easily turn out to be the biggest challenge of the next decade.

2.8 Problems and opportunities in Engineering Companies

Engineers involved in design have been found to spend as much as thirty percent of their time searching for, and accessing design information, such as specifications and standards (Lowe,

2002 cited in Liu, 2007). This can be viewed as an indication of the importance of providing better information systems to allow engineers to more easily search and retrieve information. In addition, engineers often in the quest for the right pieces of information are prone to sifting through long engineering documents which is very tiring and a wasteful use of the engineering designers' skills. Retrieval of document fragments has a great potential for application in engineering information management because engineers frequently have neither the time nor the inclination to sift through long documents for small pieces of useful information and when they do, it constitutes an expensive waste of resource. However, it is frequently in the form of one or more long or complex documents that the information that they seek is presented. It therefore follows that supporting the delivery of the right information, in the right format and in the right quantity is a goal that should be considered during the process of selecting and implementing a document management system for use by engineers (Lui et al, 2006).

Engineering processes are long running tasks compared to ordinary business processes, and because of the mixture of creative work, collaborative tasks and repetitive activities, engineering processes have to cope with uncertainty (Steiert, 2005). The technical requirements of the engineering environment means that a large volume of documents is generated during the project life-cycle such as specifications, engineering models and drawings, project schedules, etc. In the same vein, quality assurance requirements demand the existence of procedures, process measurements, and the generation of quality-related records. In addition to these, business requirements demand formal quotations, contracts, purchase orders, invoices and financial management accounts. Legislative requirements demand traceability of materials and decision processes for project liability purposes, safety policies and accident reports. Some common document management related challenges of this environment include finding the right version of the right document at the right time from the lot. Using inconsistent documents, not distinguishing the master from the copy due to configuration management problem, and not delivering documents in a readable form may result in complications when multiple and incompatible document creation systems are used by different departments.

2.9   Challenges in Project Management

A project can be defined as a one-time goal-oriented activity where some form of input is transformed into an output, under the particular set of circumstances or constraints and

usually centred on time and resources (Maylor 1999 cited in Mesihovic et al, 2004). Project management is seen as an information conversion process as it carries out planning or deciding what is to be done, organising resources through the activities such as procurement and recruitment, directing the activities towards the project goal, as well as integrating all aspects of the project, controlling the activities concerning project constraints and motivating the people to accomplish the project objectives. Railway signalling projects are often large, with many work-packages and hundreds of tasks. This puts severe requirements on information management, including for planning and project control, information structuring as well as distribution and search.

Project management organisations such as Signalling Solutions are typically involved in series of projects running concurrently. While most of the projects will be customer-oriented or a deliverable based on a contractual obligation to the main client which is Network Rail, there are also those which focus on the organisation itself, with a view to improving its efficiency and capacity to deliver to the requirements of the customer. After surveying about 8000 projects with various aims, Eloranta et al (2001) reported that only 16% achieved the initially stated goals concerning time, budget and quality. Some of the more obvious problems encountered in relation to project management oriented business processes have been shown to be largely managerial issues in different stages of project lifecycles, such as no clearly defined processes, lack of disciplined execution, poor time-based management of delivery and supply operations as well as misjudgement of available competence amongst others. The common denominator in virtually all project management failures is the lack of quality information to the extent that people make decisions or perform activities without up-to-date and coherent information.

A major challenge of project management is the tangled accumulation and use of knowledge, necessitating the need for a rigorous knowledge management system for project organisations. According to Kasvi et al (2003), knowledge management in a project is considered to consist of knowledge creation, knowledge administration, knowledge dissemination and knowledge utilisation. Moreover, notwithstanding the strength of currently deployed project management information systems such as primavera in the business, there are some areas where improvements are needed to better support the project, and one such area is the need for a collaborative environment (Mesihovic et al, 2004), where all project team members can work

together in the same system environment. Jaafari & Manivong (1998) identified following five requirements for a system to manage information on a project for successful execution as;

1. The system should support systematic modelling, recording, storing, validating, retrieval and general management of information and data related to the life-cycle management of a project.

2. Integrating information across the entire project life cycle, from feasibility through to execution and finalisation.

3. Processing and reporting, or alerting capabilities in order to highlight the status of a given project at any point in its life.

4. Pro-activity facilitation such as monitoring cost and schedule set targets and the capability for continuous assessment and reassessment of the project decisions to see if value addition is being achieved and if changes made to the project can be objectively justified

5. Interoperability and compatibility with other systems used in projects delivery such as ability to link with and import data from the CAD and planning systems commonly used in projects.

2.10   Workflow and Business Process Management

The adoption of enterprise content management and business process management systems is often spurred by regulatory and compliance concerns, but it can occur also not as emergent change but as planned change, driven by business catalysts (Allen, 2007) such as management seeking to render more value in terms of greater revenues or develop stronger loyalty both from within and outside of the enterprise. Today's business enterprises must deal with global competition, reduce the cost of doing business and rapidly develop new services and products to meet the needs of customers and clients. To address these requirements, enterprises must constantly reconsider and optimise the way they do business and change their information management systems and applications to support evolving business processes.

Workflow technologies facilitates this by providing methodologies and software to support business process modelling, to capture business processes as workflow specifications,

business process reengineering to optimize specified processes, and workflow automation to generate workflow implementations from workflow specifications (Georgakopoulos et al, 1993). Workflow is a process whether manual or automated by which documents can be moved around a multiuser document management system during its life cycle on an as-need basis. Workflow emphasises the process, which acts as the container for information.

The definition of a business process is simply 'how work is done' not necessarily 'what work is done'. Providing information and guiding the pattern for how to perform specific tasks is what workflow is concerned with. Mahon (1997) notes that adopting a work flow management system whether as a stand-alone system or as a component part of an enterprise information management system necessitates a cultural change in the way an organisation does its business, requiring a group consensus and extensive retraining.

Business processes must be documented as a pre-specified pattern on which day-to-day activities of the organisation are to be run, in order to minimise the undesired variations in the outcomes of the processes. The huge amount of content in today's work environments brings up a new set of challenges for business process management. The right content has to be provided at the right time, of the right quality and at the right cost, preferably the lowest cost. Eloranta et al (2001) identifies the two levels at which business process management is exercised as, management of the day-to-day business processes across internal and external stake holders, and the meta-management of the lifecycle of the business processes from process creation to obsolete business process ramp-down.

While enterprise content management is based on a number of technologies that promise to allow organisations to capture, manage, store and provide contents and documents to their employees, customers and key stake holders, business process management focuses more on active and complex business processes than on managing specific elements of content, while often relying on the same content components as ECM (Bill, 2007). The fundamental difference can be seen in the fact that ECM solutions focuses on managing repositories of information, BPM solutions focus first on the business processes involved, and makes use of content management tools within the context of those business processes (Allen, 2007).

This is a major justification for the selection of a system that offers both content management, as well as workflow and have the capability to lead predefined processes and potentially prevent the commitment of errors in process steps implementation. The workflow of an

organisation changes upon the implementation of a functional electronic document management system, in two ways. First, it reduces the amount of direct labour required to run the business, including supervision and control functions. And secondly, it results in fewer process steps, resulting in a faster, cheaper and better way of running the business.

2.11   IT-Business Alignment

Companies have realised that all enterprise information management systems be it a dashboard, planning, budgeting, or forecasting system needs to deliver trustworthy, integrated and timely information that supports key performance indicators and serves as a foundation for business decisions. As a result, every organisation in seeking out a system for managing its information assets must make every effort to formulate information strategies that align to their business strategies because they are inextricably linked (Kichuk & Wooledge, 2006).

Henderson and Venkatraman (1999) proposed a model to describe the mutual alignment that must exist between the business enterprise and its information technology, and concludes that a company's business strategy determines its organisation and in the same vein influences the efficiency of its information systems. The model shows that business and IT have to align on an internal as well as external level (Jan et al 2008) both on the vertical or strategic fit and the horizontal or functional integration. Strategic fit characterises the alignment between operative and the strategic layer, while functional integration refers to the alignment of business and IT. The implementation of enterprise content management requires a methodical approach according to the IT-business-alignment theory which is mainly based on business process analysis.
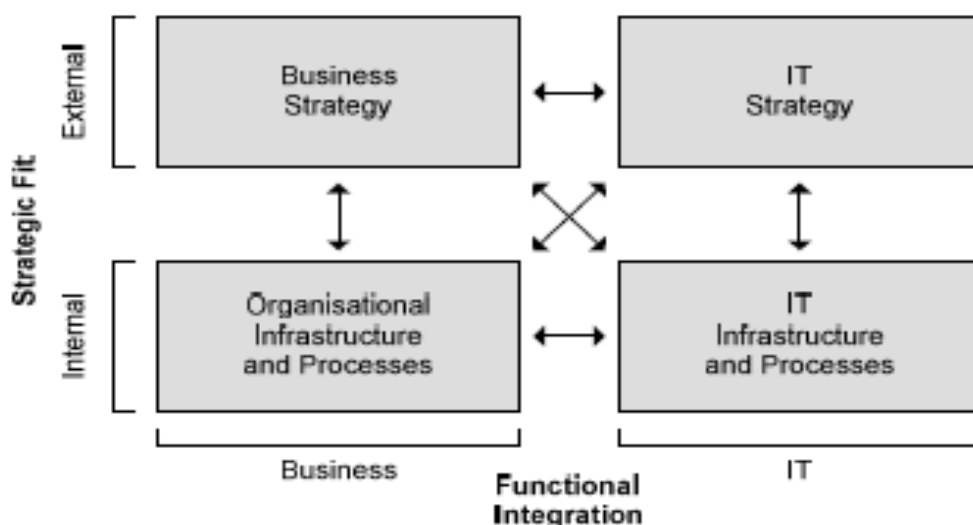
Fig. 2.4- IT-Business Strategic   Alignment Model (Henderson & Venkatraman, 1993)

A structured approach to developing a document management strategy as suggested by Harris S.B (1997) includes the following steps;

1. Analyse requirements, which includes understanding the many different roles that documents play, understanding and prioritizing the document management problems as they affect the business strategy, understanding the generic document management processes, understanding each user requirements within each element of the process, developing a conceptual data model to support the process, understanding the relevant technologies and standards and their change patterns, and developing a functional specification for each element of the process

2. Choice of direction which includes decisions on the document management issues, on formats, on the make/buy question, on the system scope, and cost/benefit analysis.

3. Implement the system by selecting, carrying out pilot implementation, re-evaluate previous assumptions and decisions, roll out to entire organisation and then rewrite the document control procedures.

The above steps though actionable as a sequence of steps require substantial iterations in real life implementation.

2.12   People, Processes and Technology

Human resources are viewed as more critical to organizational success, and as such, many organizations have realized that it is the people in an organization that can provide a competitive advantage, using the processes and the technology. These days, the enterprise environment, which is built on information technology, is also increasing the range and investment of information technology's application in the enterprise process, and considers information technology to be one of the most important elements for improving competitiveness of organizations.

Many viewpoints have been presented as being the most critical factor for information systems' success, such as alignment to strategy, IT investments that take into consideration work process quality, superiority of information system technology to innovate processes, and the organization's culture that can maintain a foundation for information systems implementation. But most importantly, in today's end user computer environment, the bottom line is not how good information systems are, but rather how well they are used. And how

well these systems are used is a function of end-user skills, which empower individuals to utilize IT and perform a variety of functions in the organizational context. The members of enterprises are the subjects who produce products and services of real value, using the processes and information technology for the creation of value. In the end, it is the well-trained members of an organization who can produce great products and services that can affect the outcome of the enterprise (Yu E.J. et al, 2005).

2.13   Cost/benefit Analysis

Most companies are taking a bottom-up approach to ECM strategy at present (i.e., one that focuses on delivering immediate benefits) because cost reduction is a top priority. While the long-term vision for ECM includes improved decision-making, better utilization of information, and the collection of competitive intelligence, these goals do not appear to be the primary drivers of most ECM initiatives in organizations today. "It's very difficult to get hard numbers for these types of uses",(Smith H.A. & Mckeen J.D. 2003).

This research besides making a case for investment in a system to provide enterprise content and document management using the process improvement concept is silent on the actual cost/benefit of any such investments. The reason for this is partly because the case organisation is already familiar with the costing arrangements with the existing systems suppliers and therefore only requires analysing the systems to select the one that best fits organisational and user requirements.

In order to evaluate cost factors however, Allen Doug (2007) identified the following information that should be included in any comparison to make it a defensible cost/benefit analysis in terms of real financial gains

1. Key Corporate Data which is an understanding of the case organisation's key statistical information including the benefit rate that can be applied to employee salaries in order to determine how attractive an investment might be. Other key corporate data that would be required include tax rate, investment interest rate, as well as the specific method of calculating the organisations rate of return on an investment.

2. Employee costs including full documentation for job roles, fully burdened hourly costs and the determination of the number of the total employees involved in documents lifecycle management activities. This will also help determine projected

productivity savings as well as costs associated with the implemented system support and administration on an ongoing basis.

3. Process time statistics regarding the current time required to process, issue, or implement process activities that are now to be supported by the installed system and compared to the organisation's ability to do more with the same number of employees.

4. File and storage space saving due to the implementation of the electronic document management system. This would not be significant in an environment where there is substantial reliance on paper document and wet signatures for evidential purposes as in the case of the UK railway industry.

5. Increased revenue projections as a result of increased operational efficiencies even though this may prove a daunting task as it will be difficult to determine what proportion of increased revenue is due to the implemented document management system compared to improvements due to other management decisions during the period under consideration.

6. Project costs for new hardware and new software acquired due to the new system implementation. Other project costs include costs of training, cost of annual maintenance, user licences, predictable upgrades costs, costs of migration and other identifiable start up costs.

7. Other savings include copy costs savings, supply savings, multiple repository savings, communication costs savings, handling equipment savings as well as other financial costs associated with the management of documents in the organisation.

Gathering information in these domains did not form part of the scope of this research, as such a detailed and realistic cost benefit cannot be attempted. However there are numerous qualitative benefits that the new system would provide that cannot be lightly passed over by any thriving business in a competitive environment. However, the value and cost assessment for developing the content portfolio can be done on a relative basis by taking into account the current situation, which is influenced by the existing IT tools, methods, and infrastructures (O'Callaghan R. and Smits M., 2005).

2.14   Conclusion

This chapter has been used to set the theoretical base for this research. The framework developed to relate the major concepts involved in this research have been carefully modelled to show that the theories exposited are very relevant in day to day business practices. Being a research based on the needs of a particular organisation, this report will now proceed to show how research methods where applied to resolve the questions raised by the research.

3.0   CHAPTER THREE- METHODOLOGY

3.1   Introduction and Framework

With a theoretical background already established in the previous chapter, the present chapter takes a closer look at the methods employed in the process of understanding the problem of this research and how these were resolved with specific prescriptions. The research has been conducted using the case study research method as the primary methodology. In this chapter, a discussion of this methodology is presented first before going into the specifics of its use in data gathering and analysis.

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                     ┌──────────────────────────────────┐
                     │        Research Process          │
                     └──────────────────────────────────┘

┌─────────────────────┐   ──      ┌──────────────────────────────┐
│ Understand Current  │           │  Interviews, Focus Groups &  │
│     Situation       │   ──      │     Comapny Documents        │
└─────────────────────┘           └──────────────────────────────┘
          │
          ▼
┌─────────────────────┐   ──      ┌──────────────────────────────┐
│    Define User      │           │ Literature Review, Technical &│
│   Requirements      │   ──      │      Awareness Surveys       │
└─────────────────────┘           └──────────────────────────────┘
          │
          ▼
┌─────────────────────┐   ──      ┌──────────────────────────────┐
│ Select Technology   │           │     Compare Existing         │
│     Solution        │   ──      │   Systems & Selection        │
└─────────────────────┘           └──────────────────────────────┘
          │
          ▼
┌─────────────────────┐   ──      ┌──────────────────────────────┐
│    Implement        │           │    Literature Review &       │
│    Solution         │   ──      │    Research  Findings        │
└─────────────────────┘           └──────────────────────────────┘
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Figure 3.1- The Research Process.
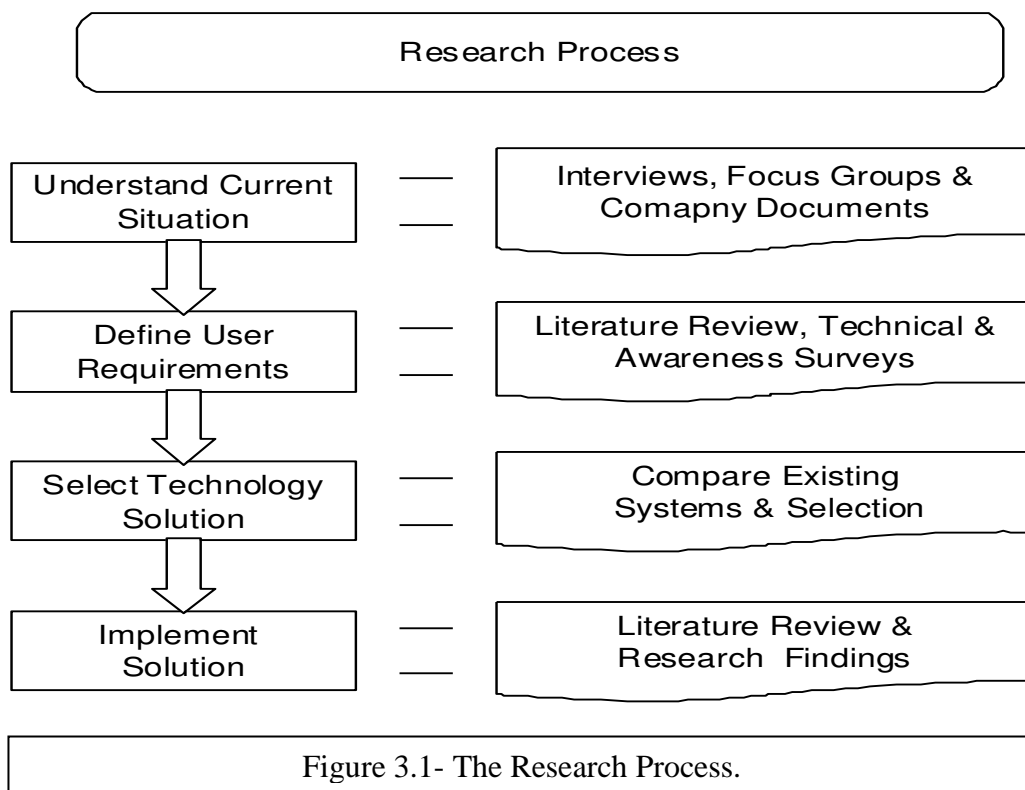
The process followed in conducting this research is presented in the above diagram. As a relevant research, the first step is to understand the current situation and circumstances which necessitated the intervention. The needs of the organisation and the individual system users are then analysed so that the gap between requirements and current capability can then be evaluated and a suitable solution prescribed.

3.2   Research Activities

The following activities were performed during the 15 weeks period of this research project (See appendix 2 for Gantt chart of research activities) ;

1. Meet with Company and Get Briefing   -Week   1

2. Introduction to Stakeholders and Business   -Weeks   1&2

3. Informal Interviews and Pilot Study   -Weeks   1-3

4. In-depth Interviews with Key Employees   -Weeks   2-4

5. Literature Review and Technical Survey   -Weeks   3-8

6. Vendors' Presentations/ Focus Groups   -Weeks   4&6

7. Final Awareness Survey   -Weeks   9-11

8. Investigate System Use in Balfour Beatty Rail   -Weeks   7&8

9. Report Writing   -Weeks   10-15

10. Presentation to Company Management   -Week   14

These activities were carefully planned to implement the defined research process. They needed to be performed in this order to take advantage of the organisation's resources who are actively involved in the daily performance of live-projects deliverables. The research progressed with the least possible disruption to ongoing business activities. Discussions on the objectives and the results of specific research activities are presented in this chapter.

3.3   Statement of Methods

This research effort first aims at relevance by putting forth implementable prescriptions in a manner that they could be used in practice to exploit an opportunity, or to resolve a problem in a real-life context (Benbasat & Zmud, (1999). As a descriptive study, the objective is to amass data addressing the research themes, leading to the formulation of research propositions for intervention. Real world context was essential to the research, thus a field study was required to show that useful research on organizational effectiveness required in-depth understanding of existing processes. This notion, together with the descriptive nature of

the research, suggests a case-study approach with the primary unit of analysis being the concept of document management, as a strategy in an organisational context.

Data, both quantitative and qualitative were collected and analyzed on a pooled basis. Data were collected at each site from several sources and by several methods including interviews, observation, focus groups and questionnaires, and analyzed using mixed methods triangulation to identify convergent findings about the concept. This concept of concurrent triangulation, where quantitative and qualitative data are collected and analysed at the same time with equal priority given to both forms of data (Boeijie H, 2010) is intended to help validate the outcomes of the qualitative data. The difficulty here though is mainly how to present or interpret evidences from both methods (Erzberger & Kelle, 2003 cited in Boeijie, 2010). Triangulation according to Bryman (2008) is the process of examining the phenomenon under study by using more than one method or source of data. Case study as the primary approach in this project examined the problem in its natural setting and employed multiple methods of data collection to gather information from several entities in the organization. This process is supported by Yin (2009), and Pare (2004).

According to Sheila Stark and Harry Torrance (2008), Case study assumes that social reality is created through social interaction, albeit situated in particular contexts and histories, and seeks to identify and describe before trying to theorize. Further, the strength of case study is that it can take an example of activity that is an instance in action, and use multiple methods and data sources to explore and interrogate it. Thus it can achieve a rich description of a phenomenon in order to represent it from the participants' perspective. The limitation is that it is not possible to generalize from one case or a small group of cases to the population as a whole in many situations.

Benbasat, Goldstein & Mead (1987) identifies the characteristics of a case study research to include; the fact that the phenomenon is examined in a natural setting, data are collected by multiple means, one or few entities (person, group, or organization) are examined, the complexity of the unit is studied intensively, it is suitable for exploration, classification and hypothesis development stages of the knowledge building process, and no experimental controls or manipulation are involved. Others are; the investigator may not specify the set of independent and dependent variables in advance, the results derived depend heavily on the integrative powers of the investigator, and changes in site selection and data collection methods could take place as the investigator develops new hypotheses. Also, case research is

useful in the study of "why" and "how" questions which deal with operational links to be traced over time rather than with frequency of incidences, while the focus are majorly on contemporary events (also Boeijie, 2010). In a study investigating the research approaches for examining technology adoption issues, Choudrie & Dwivedi (2005) found out that case study method was the most widely used methodology when examining adoption issues at the organisational level.

There has however been questions raised as to how rigorous or methodical this approach to research provides (Yin, 2009, Eisenhardt 1989) but these same authors have also provided a lot of guidance on specific ways to conduct and present case study research to overcome the apparent relative lack of empirical evidence, which is often casted upon this method. Dube & Pare (2003) adds that one of the keys is to include better documentation particularly regarding issues relating to the data collection and analysis processes. In general, case research strategy allows for a great deal of flexibility and individual variation and can be used with any philosophical perspective due to its versatility (Dube & Pare, 2003).

This research also to some extents adopts the systems analysis approach, which generally consists of preliminary investigation, problem identification, requirements analysis, decision analysis, system implementation and finally operation and support, due to its prescriptive nature (Whitten, 2001, p.85 cited in Han Y. 2004). It however does not take the direction of several alternative approaches to system analysis due to the particular circumstances of the researcher's relationship to the case organisation. This is not an application description, which are mainly carried out by practitioners and often details the author's experiences in implementing a particular application. The author does not conduct a research study; instead, the objective is to successfully implement a specific system for a given assignment. This study also excludes action research methodology, which are studies in which the author, usually a researcher, is a participant in the implementation of a system, but simultaneously wants to evaluate a certain intervention technique.

The goal of reliability of research findings has been rigorously pursued in this research. The general way this was achieved was to conduct the case research so that another investigator could repeat the procedures and arrive at the same conclusions. And the way this has been complied within this research is the documentation of the procedures followed in the research, as well as including a collection of raw materials in the appendix. Other bulky items that could not be included in the appendix due to size restrictions are compiled separately and

made available (Benbasat I., Goldstein D.K., and Mead M., 1987). Yin K.R. (2009) supports this approach, hinting that there are two ways to achieve this procedure, one is the use of case protocol which implies spelling out the rules to be followed in the use of interviews and questionnaires prior to data collection phase and the other is the development of a case study data base which involves making a collection of raw materials used in data collection including interview transcripts, field notes, documents collected during research, minutes of meetings as well as answered and returned questionnaires.

3.4   Research Design

The diagram below shows the process followed in the collection and analysis of primary data as well as the data sources. The four major techniques employed for data collection are interviews, focus groups, surveys and company documents and process study while data analysis was carried out using three main methods which are the Munkvold et al (2006) framework, comparison tables and information flow charts, as shown in the data collection and analysis framework below. Munkvold et al (2006) was used as the framework for analysing the results of the interviews. This framework groups the various aspects of a complete Enterprise Content Management System into three broad areas which are; management of content, management of infrastructure and change management. Using this framework which was first applied in the analysis of ECM in Statoil, a Norwegian company by the authors helped a great deal in representing the results of the interviews conducted at Signalling Solutions Ltd.
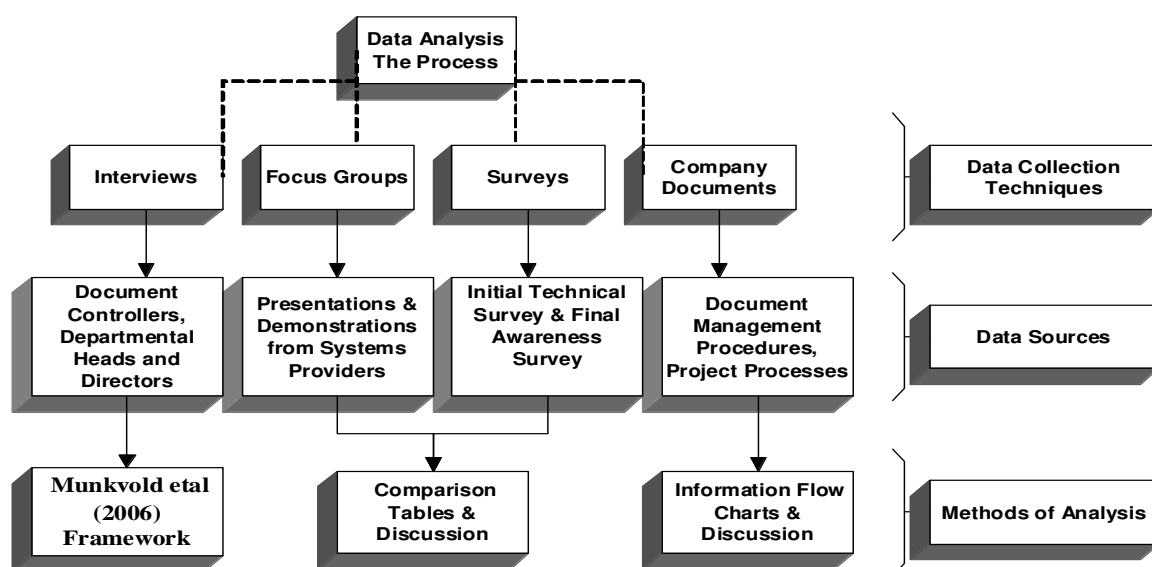
Figure 3.2- Data Collection and Analysis

3.4.1   Type of Research

This research is mainly descriptive with some exploratory research questions. It is not composed explicitly with a theoretical base, not entirely a comparison with extant literature and neither is it explanation-building. It does not involve theory testing, predictions and rival-discussion, nor is it a time-series analysis (Yin, 2009).

3.4.2   Clear Research Questions

Clear research questions expresses the essence of an inquiry, allows one to easily link a study to its practical and theoretical contributions and is the backbone of a solid research design (Dube & Pare, 2003). The research questions of this study has followed a pattern of step reviews as the research progressed until the arrival at a final definitive set of questions as prescribed in Boeijie (2010). The following are the four research questions of this study;

1. How can user and organisational needs be evaluated in a document management systems strategy implementation?

2. Why is the current state of document management perceived to be ineffective by end-users in the organisation?

3. What ideal or future state do we need to envision?

4. How can the organisation be led from the current state to the ideal future state of information management?

The research questions of this study can be identified as questions describing processes (Questions 1 and 4) and questions describing states (Questions 2 and 3). In the first case, the aim is to describe how something develops or changes (causes, processes, consequences, strategies). In the second case, it describes how a certain given state (which type, how often) has come about (causes, strategies) and how this state is maintained (Flick, 2002).

3.4.3   Case Selection

As a relevant case study research, the researcher's individual interest regarding the issue is not the sole basis for initiating the research. While interest and ability to conduct the research occurred as necessary requirements for this project, the outputs and potential value to stake holders in the case organisation are the most important determinants for selecting this case study research topic. It is anticipated that based on these research findings, new concepts will

be supplied that can potentially alter the perceptions and mental models that IS and management in the organisation apply in their work and decisions (Benbasat & Zmud, 1999). Even though most case study research efforts require multiple cases, Yin (2009) explains that single case studies are useful in specific instances such as their substantive significance, on the basis that it is critical, extreme or unique or revelatory. However, in the case of this research, while it may be debatable that it qualifies based on all or some of the above situations, the most important criteria have been the availability of the case organisation for an intervention of this nature.

3.4.4 Unit of Analysis

According to Dube & Pare (2003), only 8% of published IS research clearly specifies the unit of analysis, which illustrates another fundamental problem of doing case research. The specification of unit of analysis, be it a specific technology, a systems development approach or methodology, or a particular type of organisation, is critical to understanding how the case study relates to a broader body of knowledge. The specification of the unit of analysis is however not critical for a descriptive case study such as this, as much as it is for exploratory and explanatory case studies research. It is however explicitly stated as 'the concept of document management, as a strategy in an organisational context' to keep in focus the various discussions.

3.4.5 Context of the Case Study

A detailed description of the research context is necessary to assess the credibility of the research results and also to determine their generalization ability (Yin K.R., 2009). This research was conducted during a 15 weeks period from June to September 2010, during which time four rounds of data collection were conducted. The investigation proceeded through several company sites at Derby, Borehamwood and Birmingham as well as parent-company sites at Derby and Liverpool. In all these cases, employees were able to spare considerable time out of their busy schedules to make inputs into the questions being asked by the researcher. Efforts were however made to restrict questions to only issues relevant to the study as well as deliberately making each interview or group sessions as brief as possible in order to limit the level of distraction from the main duties of the employees.

3.4.6   Data Collection Techniques and Activities

The study is based on a mixture of qualitative and quantitative data which aims to describe the current situation within the target organisation in a holistic way. A major strength of case study data collection is the opportunity to use many different sources of evidence to provide a richer picture of the events and issues than would any single method (Yin K.R. 2009). Data collection in this research involved four methods, and took place in four phases during the investigation as follows:

The first was the unstructured interviews of key IT and management personnel including the following;

1. Operations Director

2. HR Director

3. BPI Director

4. Engineering Director

5. A Project Director

6. Document Controllers at Borehamwood, Birmingham and Derby

7. Planning Manager

8. Head of Commercial

9. Designer

The aim of these in-depth interviews was to get an overview of each individual and group's perception of the current document management systems and processes and to evaluate how much they understood current capabilities as well as how much they were being put to use with such questions as;

1. What processes are currently being observed in document management?

2. What systems are currently available for document management?

3. What document management roles were being performed by document controllers?

4. What document management roles were being performed by frontline employees?

5. What document management problems are being encountered in the various departments?

The next round of data collection involved extraction of relevant documents from the company's archives including document control and management procedures, available process maps and documentation. A study of the project management processes of the business was also undertaken to understand the steps adopted and the various stages of project delivery from initiation to commissioning and maintenance. The aim of this exercise was to see what the available processes were for managing information flow within the business and also to get a feel of how defined organisational processes were, and how much compliance there was to these processes.

The third round of data collection involved the setting up of focus group meetings during which document management system suppliers for the three existing systems in the business were invited to make presentations. There were three of these sessions involving the providers of Enterprise Bridge (eB), which is the currently deployed central system for document control, Cabinet which is currently used by or about to be deployed by the Human Resource department and Igrafx which is a process modelling software implemented by the BPI department for parts of the engineering and operations functions of the business. Invited to these focus groups were representatives of each department as well as most of the senior management who had responsibility for IT policy direction. These sessions helped to gauge the general impressions about these systems as well as provide an opportunity for system vendors to demonstrate the functionalities of their systems. They also offered an opportunity to meet the teams behind the off-the-shelf systems currently run in the company as well as provide an opportunity for decision makers within the company to get a firsthand exposure to these systems.

In line with the main research questions of the research, a couple of structured questionnaires were administered in a survey involving almost all employees who have access to computing facilities and who will have need for any form of document management system in the course of their work. The questions were aimed at providing evidence for any conclusions regarding the current state of document management systems implementation in the business as well as collecting information on user requirements from the users themselves.

3.4.7 Questionnaire Design

Yu et al (2007) describes three types of survey questions as, 'answer-driven' questions for which an absolute answer exists, 'understanding-oriented' questions which ask the survey taker to select the items closer to their thought answers, and 'personality-fit' questions which allows the survey taker to express his or her individual thoughts according to the Likert scale. All three types of questions were adopted in multi-dimensional survey questionnaires that were administered on a cross-section of employees whose roles involved the use of information management systems in the organisation.

Administered to document controllers and relevant departmental heads was an initial questionnaire made up of two worksheets to evaluate the existing document management systems as well as carry out technical needs assessment. It was mainly composed of answer-driven questions which asked respondents to compare the existing document management system by ticking against a list of functionalities under the subheadings of 'capture', 'storage', 'indexing', 'search and retrieval', 'distribution', 'security', 'workflow', 'document management' and 'records management'. Each of these component features of a document management system had several functionalities listed under them. Respondents also had the opportunity of spelling out what their perception of a functional system should be capable of offering using some understanding-oriented questions. Responses were returned from the two groups of document controllers as well as from the offices of five departmental heads. These worksheets were also used as part of the interview process and many of them were filled out with the researcher present.

The second survey conducted represented a wider cross section of the workforce as it was not only administered on heads of departments but also on a majority of the employees whose work revolved around the use of an electronic information management system. It was defined to determine document types and the roles of employees in their life-cycle management such as generating, processing, transmitting, applying, storage and disposal of the documents. The systems currently employed in the lifecycle management of the various documents were identified to include eB, CABiNET, iGrafx, O:Drive, H:Drive, Local Server, Local PC Hard Drive, the E-mail system as well as hard copy or prints and other media or applications. This survey which was conducted after the systems suppliers' seminars also sought to compare some of the employees' perceptions of the existing and proposed systems based on new information emanating from the seminars and focus groups to which they were

present. Respondents were also asked to identify desirable features of their ideal system by ticking from a list of ideal general features of an enterprise content management system identified through the literature review and the systems suppliers' seminars. A copy of this questionnaire is included in this report as appendix 5.

3.4.8 Data Analysis

It is important to note here that a major challenge in this research has been the huge amount of data that was encountered and this was all the more daunting because the research problem is open ended and the timeframe extremely restrictive. In this research, the use of narrative description and tabular displays are employed to present a summary report of the collected data which is supported by Pare (2004), Deluca (2007) and Eisenhardt (1989). A review of mixed methods research methodology literature shows that there is no standard format for such analysis, as there are probably as many approaches as there are researchers. Suggested options however include tabular displays and graphs, sequence analysis to organise longitudinal data, narrative descriptions etc. However out of the three techniques presented by Yin (2009), data triangulation, which is the process of combining multiple data sources, was employed to present the findings from the multiple sources. The most important advantage of using multiple sources of evidence is the development of converging lines of enquiry. Cue for this approach was taken from an excellent example of this technique by Zack (1993).

3.4.9 Literature Review

A thorough and critical review of the literature on document management and information systems was conducted to identify common trends of concepts definition, as the industry has continually seen multiple use of the same terms to mean different things in recent times. Other areas of discussion from the literature review involved are human and organisational issues that must be addressed for a successful implementation, as well as established standards for document management systems adoption from the International Organisation for Standardization (ISO) and AIIM, the information management association as well as the British Institution for Standardisation. In addition, a review of articles was undertaken, selecting from those published within peer-reviewed and highly rated journals such as MIS quarterly, European Journal of Information Systems, Information Systems journal, Information Systems Research Journal, Process Management Journal, Industrial Engineering and Operations management Journals as well as industry-linked publications and text books.

3.4.10 <u>Interviews</u>

Pranee & Douglas (2006) opines that focused or in-depth interviews may also be described as unstructured interviews, non-directive interviews, open-ended interviews, active interviews, semi-structured interviews depending on the writer and the point of emphasis. The advantages of this type of interviews includes the fact that it allows social processes and interactions to be studied better, helps in discovering the subjective meanings and interpretations that people give to their experiences, allows new understandings and theories to be developed during the research process. Responses are less influenced by the direct presence of their peers and people generally find the experience rewarding. The limitations are the amount of time and resources it requires and the complexities involved in the interpersonal interaction, while also standing the chance of missing out on valuable cues that could come from others in a focus group. It is generally involved in the collection and description of substantial in-depth information about an event or a small number of dependent events (Yin K.R, 2009 and Eisenhardt K.M, 1989). The interviews conducted during this project were rather brief and informal but very focussed on the issues under investigation.

3.5   Conclusion

The rather expansive discussion on research methods and research design embarked upon in this chapter has been necessitated by the need to show how much rigor was applied in this research effort as well as the empirical reasoning used to justify the several approaches employed, in order to ensure a thorough understanding of the subject matter of this research report. The next step in this report will be the linking of these methods with the data collected as well as interpreting the actual findings.

4.0 CHAPTER FOUR- DATA COLLECTION AND ANALYSIS

4.1 Introduction

This chapter is designed to show how the methodology discussed in the previous chapter was implemented in the collection and analysis of primary data. It is a presentation of the case organisation, showing the current situation of document management systems and processes as well as the end-users' requirements. A comparative analysis of the currently deployed document management systems in the company is then explored with a view to identifying the gaps between each, and with the end-users' perceived requirements with regards to the current and required functionalities.

4.2 Background information on Signalling Solutions Ltd

The setting for this research is Signalling Solutions Ltd, a medium-sized engineering projects-based organisation which delivers tailored design and installation of railway signalling systems for the UK's Network Rail organisation and other such clients, covering sites across the country. The company, being a partnership spin-off of two of the major players in the railway signalling industry in the UK, inherited the potential to remain the market leader in this specific aspect of railway engineering. Railway signalling projects are often large, with many work-packages and thousands of tasks. This puts severe requirements on information management, including for planning and project control, information structuring as well as distribution and search.

Signalling Solutions Ltd has an IT infrastructure that has evolved into a portfolio of technologies with partly overlapping functionalities and applications. As a result, the company's information management system was made up of infrastructure scattered over a number of different storage media and applications. This created major challenges related to information retrieval, version control and information quality across the enterprise which resulted in content management challenges such as the following;

1. Important information were stored in private folders, multiple copies of documents and hard to distinguish original from copy.

2. The existence of unsynchronised multiple repositories.

3. Poor content quality assessment.

4. Information anarchy and overflow.

5. Difficult information search and retrieval functions.

6. Lack of management attention and commitment mainly demonstrated as lack of incentives or deterrent to ensure employees adhere to document management policies and procedures which were rather clearly stated in configuration control documents as well as unclear information governance roles and responsibilities.

7. Lack of compliance to policies and best practices for collaboration and digital content management by frontline employees mainly due to insufficient training on document management.

8. Lack of simplicity and streamlined processes leaving users with too many choices and possibilities, and

9. Poor integration of tools and functions.

The following can be said regarding its current situation. It should however be noted that the business context scenarios described here are common issues present in most young enterprises which are yet to achieve the benefits of a well articulated information management system (Asprey & Middleton 2004) and may not be peculiar to this case organisation;

1. The volume of documents and the complexity of much of the data including drawings, schedules, process plans, commercial and administrative data structures which the business have to manage is staggering. Added to this is the mix of paper-based, films and multiple, often incompatible electronic systems.

2. There are many interrelated and lengthy technical and management processes including co-operative working in multi-disciplinary project teams, suppliers and subcontractors which is further extended by ongoing relationships with, and reliance on its parent-companies in some areas.

3. There are multiple geographically separated sites spread across the vast UK rail networks. A centrally located management team at Borehamwood have the responsibility to coordinate activities of employees in four major sites, which are Borehamwood, Birmingham, Derby & York as well as several other smaller outposts

and client project sites including Basingstoke, Sittingbourne, Herne Bay, Hitchin and Chesterford

4. Documents are used to support almost every business process in the company and are prone to mismanagement due to the volumes of documents being processed and the diversity of document types and formats, resulting in negative impacts on its capability to implement and sustain quality management processes.

5. Documents mismanagement negatively affects business processes and may impair the organisation's capabilities to deliver in a timely fashion on contractual obligations, comply with mandatory legislative regulations etc, exposing the organisation to risks including litigation, loss of business or threat to continuity and damage to corporate image. There is the potential difficulty in attempting to improve productivity through business process redesign, due to reliance on documents that may not be well managed.

6. Increasing volume of emails with virtually no control on business interactions with customers, business partners and internal staff members resulting in poor workflow management. The processes for external communication are duplicated such that even though there is a transmittal mechanism instituted using eB, emails to external organisations could easily compromise its effectiveness.

7. The organisation is faced with the challenge of implementing privacy and confidentiality legislations but has not yet a foolproof control on compliance with policies, practices and systems to meet those requirements. And this is, despite the presence of implementation strategies for adequate risk management regarding the security of important business documents.

8. Customer driven quality requirements, legislative requirements and industry regulations with regards to project liability, health and safety as well as environmental standards all demand strict compliance which can only be evidenced by proper documentation management.

9. Management efforts to solve the document management problem by buying off-the-shelf software did not yield success according to end-users perceptions from surveys conducted, resulting in the need for a holistic strategic management framework for its

adoption, adaptation and utilisation. The dominant available off-the-shelf solution as presently constituted only addresses a part of the company's document and content management life-cycle problem. Integration between products that might make up a holistic solution together can be complex from the perspectives of usability, redundant functionality and lack of transparency to the end-user.

10. There is the tendency for the organisation to expect rigorous justifications for presumably expensive investments in software and licences due to lack of appreciation for the systems, necessitating the need to re-align the requirements and solution options with business planning imperatives. There is an urgent need to develop completely adequate specifications for document or content management solutions to include costs and time frame for implementation within budget estimates.

11. The organisation has implemented individual document management systems, process mapping system, email management system, drawing management system, HR management system, quality management system, planning systems etc, as point solutions to a specific management problem for specific departments with varying degrees of effectiveness.

12. The technology solutions have in the past been implemented without adequate consideration being given to elements of organisational culture and behaviour such as work-group dynamics and adequate change management process.

4.3   Results of the Interviews

The implementation of an ECM strategy should address issues such as: interoperability of information and document repositories with applications, consistency across processes to facilitate access and sharing of information, and modification of a company's information systems architecture to accommodate ECM (O'Callaghan & Smits, 2005). To realise this, Munkvold et al (2006) has formulated a model which suggests three critical groups of issues to be resolved as; management of content, involving life cycle and metadata; management of infrastructure, which has to do with technological and administrative issues, and; change management. This model will now be used as a framework to analyse the results of the primary data acquired mostly through interviews, as it relates to the various issues which represent the problems with the current state of document management in the Signalling Solutions Ltd.

4.3.1   Management of Content

This is about the most apparent group of issues and it is also the areas that worried functional managers the most. The capture and storage of contents into a shared system lacked absolute control, regardless of whether the content was generated in-house or received from external sources. There was also the general use of emails systems to store a vast amount of information in the form of messages and attachments. While some employees made the effort to download most of their received attachments into their personal drives, this process was not defined, neither was it required, and in any case could not be shared with others. This problem is further compounded by the fact that in some cases, people distributed document copies as email attachment files, instead of simply informing others about new shared content via referenced links. This last bit was however not a significant problem in the cases studied.

There is a requirement that content related to the various projects be uploaded to the structured filing system set up in the shared drive, which has levels of subfolders for filing several categories of documents, including deliverables. But the capability of this system to control how various files are named, indexed and stored for easy retrieval is greatly limited to the extent of what the generic Microsoft windows system could permit. Document naming, versioning and control were generally left to the individual team members who had access to the specific folders, thereby creating confusion and anarchy anytime a document is to be retrieved by other members of the team. To overcome this search difficulty, important documents were sometimes also saved plainly on personal file folders after their production and first-hand-delivery, which is primarily through emails.

The commercial manager during an interview had this to say;

"When we monitored projects with paper documents and paper files, things were so much easier and it was possible to track and manage program changes because all relevant documents were placed on the appropriate files after having been initialled by the staff concerned at the end of each day. All we needed to do to get at any information for audits and for billing and justification of changes was simply to pick up the relevant files, but now *with computerised systems, it seems almost impossible to track anything."*

Even though the business had an Enterprise Bridge (eB) Document Management system in place together with clearly defined processes for configuration control, the existing scenario provided the premise for most business critical documents not to get into the controlled

system. The biggest complaint in this regard though not voiced emphatically during the interviews concerned the fact that only a handful of document controllers in the engineering department of the business had the access and the know-how to store and retrieve documents from this system. Yet these document controllers did not have sufficient powers to ensure that critical documents were brought in for configuration and control. In fact one document controller stated emphatically during the interviews;

"We only control what we are given by the design and project teams and act on instructions using procedures already in place by the engineering department, we cannot make them *bring a document for control when they do not want to".*

Everyone simply has a myriad of options as to where to store any type of document that he or she generates, or come across during the course of day-to-day business activities. It could be left as an email attachment, it could be stored in a personal drive (H: drive) on the individual's computer, it could be dropped inside O: drive in an appropriate file supposedly, but with flexible naming conventions, or it could be sent for configuration and control to the document controllers. There is need for each process to be modelled so that for each type of document generated or received in the course of work, there is a specified and definite pattern of action in terms of sharing, storage or dissemination. A document management system under consideration must incorporate workflow to model this process. It must also have version management facilities, especially with regards to compound documents and their parts from multiple authors.

Signalling Solutions also needs to comply with relevant legislative requirements, industry regulations as well as main client contractual requirements such as those regarding the traceability of engineering and commercial transactions documents. The commercial management team also commented that tracking and justifying changes and escalations in current projects was almost impossible. The current information systems did not provided the means to track the causes of the changes or to analyse their impacts on the business. The only available solution to find out the effects of these changes was to go through drawings and minutes of meetings, as well as hoards of email exchanges both within the business and between various points in the business and the client.

Search, retrieval and reuse of content also appear to be problematic due to the heterogeneity of contents formats and databases. There is no integrated search facility that covered all the

shared databases and repositories such as the ones in O: drive, eB and iGrafx. This made information retrieval across business departments to be regarded as problematic because the different systems mentioned are in use in different business departments with different taxonomical and physical structures for their information resources.

4.3.2   Management of Infrastructure

The infrastructure for content management in Signalling Solutions included a good number of heterogeneous and parallel applications providing several alternatives for producing and storing information. For example, the design teams could work with Microstation or AutoCAD, the design team had document controllers that operate with Microsoft access, the project planners did their programs on Primavera, the project management and operations group worked from O: drive and sometimes pass some items for configuration in eB, process improvement adopted Igrafx for modelling and an embedded repository, with engineering department and a couple of others including the document controllers basing primarily on managing eB. One document controller attached to the design group actually stressed that they were very comfortable working the way their system is set up, as there has only been problems before, when attempts were made to change their system, even to the latest version of the same software. Here is one symptom that must be checked in order to manage change effectively; employees preferring to remain in their comfort zones and showing apathy to change.

In general, the lack of application integration represents a problem throughout the content life cycle. The system for managing documents such as eB was either poorly integrated or not integrated at all with the several production packages, such as micro station and primavera. While the document copies could reside in different systems, changes and updates were only typically registered in one of these. Much of this problem can be traced to two factors. The first is the fact that the dominant client of the company which is Network Rail often demands or at least expects the company to work in certain projects using specified systems or specified document configuration and structure or even specific file formats for presentation of deliverables. Other times it might be that the access to certain 'source' documents which are critical inputs for the project execution are stored in repositories that require a different set of rules to access. The second factor is the fact that the company being a spin-off from two very successful players in the railways industry inherited substantial amount of operating and IT systems which have remained in the business, more due to the convenience of

benefiting from parental cover and support than their effectiveness or suitability. This is also going to be a factor to be considered in choosing a system for the integration of all operations' workflow because the experience and support of one or the other parent organisations cannot be completely discarded, given the age and corporate experience of the case company. The integration of standardized applications and tools throughout the content life cycle remains the major technological challenge in the implementation of a comprehensive enterprise content management system.

Administrative infrastructure consists of policies, routines and procedures for content management as well as the organisational roles required for them. Several of these routines had been defined at the corporate level, but they are followed inconsistently at the level of the various departments. Besides, are they not particularly enforced. This is the reason almost every employee had several options each time a document was generated or received. The issue of information security naturally falls under the domain of information management infrastructure. Each document under configuration control has an owner who also is responsible for the process that that document or information applies to. The document owner also specifies the groups or individuals who are granted access. This process is currently being implemented by the document controllers who act as exclusive administrators of the eB system but the system as currently constituted is hardly used when it matters most.

4.3.3   Change Management

There are at least two instances of enterprise content management related change processes that have occurred at Signalling Solutions Ltd. First was the adoption of the eB system which was an inheritance from one of the parent companies and the second was the adoption of the modelling software which also had an included repository. It is obvious from the interviews and the survey responses that these change processes did not go down well into the business and could be described as 'failed' change management attempts. This is an important factor, as many of the respondents either indicated that they did not know anything about these systems, never used one or more of these systems or never had any formal training in the use of one or more of these systems.

It is hard from the above to conclude whether there was or would have been an opposition to tool and content standardization or whether there was or would have been a reluctance to adopt a new technology. The lack of user training is the primary suspect as a major cause of

under utilization of enterprise content management system in Signalling Solution Ltd leading some employees to comment that "rather than implement new technologies, improved exploitation of the existing ones should be prioritized", during the interviews.

4.4 Results of the Surveys

Responses to the surveys were based on level of awareness of the features or functionality of the various available systems, compared to the total number of identified features of an ideal system from literature review and systems suppliers' presentations. Respondents rated each system based on a total of 124 features distributed amongst the various components of an ideal document management system which are capture (26), storage (9), search and retrieval (12), indexing (10), distribution (10), security (20), workflow (5), document management (18) and records management (14). The results show that a majority of the cross-section of employees surveyed perceived the best of the existing systems as having well below average (30%) number of features, compared to an ideal system. But it also points to the fact that employee perceptions based on their levels of awareness, were adversely affected by the fact that these systems have not been properly taught to them and as such, could not determine what exactly where the features of the existing systems. This is important to note because a score of zero features was assigned to 'I don't know' responses. A table summary of this result is included at the end of this report as appendix 3.

In addition, the perceptions presented by the various departments are indicative of which systems have been predominantly used in each department. The only system that showed a complete general lack of awareness is the Cabinet system, and that is because this system has not been implemented at any level in any of the departments besides only being considered for use in the HR department. While the O: Drive Windows network system appears to be the most widely used across the business, its major weakness turns out to be in the area of workflow management (3.4%). This was a rather surprising outcome because on the surface, it looked as though the issue of security (33.35%) should have been the biggest weakness of this system, as implied from the interviews. The eB system which is the main system deployed for central repository management did not get the level of patronage anticipated, either due to lack of awareness, or access or both by the employees. Out of 119 employees surveyed in the final survey (see appendix 5 for questionnaire), responses were returned by 41 within the stipulated period, representing almost 40%. (See appendix 6 for table of responses received).

4.5   Systems Suppliers' Presentations

The following Providers of Document Management Systems were invited to present and demonstrate their products to a cross section of Departmental Heads and Management;

1. Bentley Systems, providers of eB (Enterprise Bridge)

2. TSA Advet, providers of Cabinet software

3. iGrafx, division of Corel Inc.

These presentations achieved two objectives;

1. They offered an opportunity to meet the teams behind the off-the-shelf systems currently run in the company.

2. They also offered an opportunity for decision makers within the company to get a firsthand exposure to these systems.

4.6   Comparisons of the Three Systems and the End-Users' Requirements

Each of the Systems compared which are iGrafx, eB and Cabinet all have repositories for document management, configuration and control. iGrafx is special for its ability to model processes and link process steps with user-required information sources, and can be integrated to the cabinet system as an ideal. eB is special for its ability to control business-critical records and handle transmittals of project deliverables. Cabinet is special for its ability to handle workflows and collaboration but it can as well handle all the other functionalities of the eB system making it the most robust of the three systems.

The table below shows a comparison between the three systems and the end-users' required functionalities in the order of priority. This ranking priority was established using the number of employees who ticked the features as their requirement. The first few items on this ranked list were pin-pointed as required functionality by most of the respondents while those at the bottom of the list were picked by fewer employees as their functional requirements. A table summarizing the frequencies is included in the appendix of this report (See Appendix 4).

Features (Presented in Order of Frequency in End-Users' Requirements Lists)	Ranking	iGrafx	eB	Cabinet
Information availability and accessibility from all locations.	1	X	X	X
Prevent information duplication.	2			X
Ensure information currency. (E.g. versions, revisions, changes, etc.)	3	X	X	X
Ability to exchange information between systems. (E.g. MRP and CAD, emails and projects, etc.)	4	X		X
Use of single standard for classifying and organising information resources.	5	X	X	X
Information access controls.	6	X	X	X
Validation of information completeness and accuracy at all times.	7			X
Integrated and centralised system management.	7	X		X
Evaluative and computational capabilities. (E.g. automatic up-to-date reports, status alerts, etc)	8			X
Support for collaboration across multi-disciplinary teams.	8			X
Traceability of information or communication exchanges.	8			X
Ability to monitor and control time, costs, etc. with visibility.	9			X
Facilitate effective and quick change-management implementation.	10		X	X
Completely paperless processes, master records, etc.	11			X
Fully automated data entry systems.	12			X
Interface with client document systems and requirements.	12		X	

Figure 4.1- Systems Features Comparison Table

4.6.1 <u>Cabinet</u>

Cabinet is Enterprise Information Management System software developed by TSA Advet, UK based company established in 1983. They also carry out the resale of CAD products from other companies such as Intergraph, Bentley, Autodesk and Falcon and they have quite a substantial clientele amongst the most notable engineering and projects management organisations in the UK including Balfour Beatty Rail, one of the two parent companies of Signalling Solutions Ltd as well as Westinghouse Rail Systems Ltd and Atkins Rail Ltd which are its major competitors.

The cabinet software solution consist of five core modules which are; the 'explorer' which provides the desktop access to the document stores, the 'workflow publisher' which processes workflows for any document type, the 'browser' which enable access to the document stores through intranet and internet protocols, the 'transmittals' which generates transmittals of document packs for paper.CD/DVD copies and the 'SMTP server' which is used for managing emails within the system.

The features of this system as demonstrated by the TSA Advet representatives during their product presentation include;

1. Ability to work from dispersed locations to the same project standards using standard project templates.

2. Data Security and access control

3. Document creation using standard master templates

4. Automatic Document numbering systems

5. Prevents duplication of master document

6. Revision history with past versions saved with automatic issue updating

7. Workflows to follow business processes

8. Provides for audit trails

9. Ease of Use as it is set up to follow organisation's business processes

10. Automates repetitive tasks

11. Accurate reporting on current progress

12. Automatic PDF creation

13. E-mail notification

14. Address book for contacts

15. Automatic transmittals and publications

The pros of adopting this system include the following;

1. Ease of use- the system display screens is organised using the same format as the familiar Microsoft Windows Explorer systems, thereby requiring minimum training.

2. Open architecture- Not locked in by proprietary data formats and non-encrypted folders, files and database.

3. Not tied to any applications- Can interact with most legacy systems and applications and can be adapted to any customers requirements

4. Ease of deployment- Same version for all users, no customisation of versions to particular users but can be configured to specific customer needs.

5. Promised high levels of service and support by the system supplier

6. Proven in the Signalling engineering environment given the number of such companies as current clients which includes Balfour Beatty Rail where additional support and experience sharing can be gained.

The cons for adopting this system may include the following;

1. New system- never been used by anyone within the business and as such there will be no internal experience about its functionality

2. Cost of migrating documents from the current eB system as well as those related to replacing the old system with this new one.

3. Non-visual process mapping- may require the continuous use of the process mapping software, which could however be integrated to mitigate this disadvantage.

4.6.2   Enterprise Bridge (eB)

The eB system is provided by Bentley Systems Incorporated. The system offers enterprise information management solutions that ensure access to accurate information of documents, people, assets, processes and organisational elements at the time and in the context that it is needed for decision making at all levels of the enterprise.

The features of this system include the following;

1. Identify, classify and define relationships between documents in the repository

2. Manage change through control and impact analysis

3. Auditing to prove compliance and for internal reporting

4. Manage records in the repository

The pros of adopting this system include the following;

1. Incumbency factor- it is the current system in use in the business and there are document controllers who are quite familiar with its features.

2. Very effective for managing change, transmittals and security control for established records.

The cons of this system include;

1. Does not support collaboration and workflow processes, requires project-wise, an extra system to be able to do this.

2. Only required for managing records and does not support live operations

3. Difficult to integrate with other project and operations applications

4. Additional software tools are required to allow a URL link to understand which application needs to be launched to open up a stored document

5. Trying to provide a link to a document from, say, the intranet is difficult without additional software due to the proprietary format in which the files are stored.

4.6.3 iGrafx

iGrafx is a recognized leader of comprehensive Business Process Analysis (BPA) solutions. Our solutions help organizations large and small document, analyze, improve, manage, and align processes and technologies integral to their business operations. iGrafx solutions enable companies to achieve process excellence in a controlled, centralized and collaborative manner across functional boundaries, geographies, and levels of maturity. (http://www.igrafx.com/index.html).

iGrafx as an application software for process modelling which is only being considered as a document management system because of its Process Central add-on component which serves as a repository with three components called the 'database', a Microsoft SQL or Oracle server, 'web central' for content viewing using any standard browser, and 'mail central' for approvals via email notifications.

It can handle the following features;

1. Document check-in, check-out

2. Version control/ audit history

3. Search and retrieval

4. Security access rights

5. Email Notification

6. Audit trail of document changes and history

7. Supports digital signatures

8. Bookmark enabled

9. Can store documents of any format and will launch the appropriate application when the document is selected.

The consideration for having this system should mainly be to integrate it as a process modelling application with a fully functional document management system because it has no capability for handling transmittals; neither can it be used to handle process workflows and collaboration.

4.7 Company Documents & Site Visits

The review of company documents and project management processes was setup to understand the current document management system in a live project context. This produced the project information flow process charts which show the major document types and their media for transfer within a typical project. The Bletchley remodelling project which was a live project was selected for analysis. This activity involved the researcher sitting in with the Project Manager and the Planner for two days to review the process activities. This produced the two figures shown below, depicting the major document types, documents and information transfer and sharing activities and the media of information flow, from the initiation to execution stages of this project.
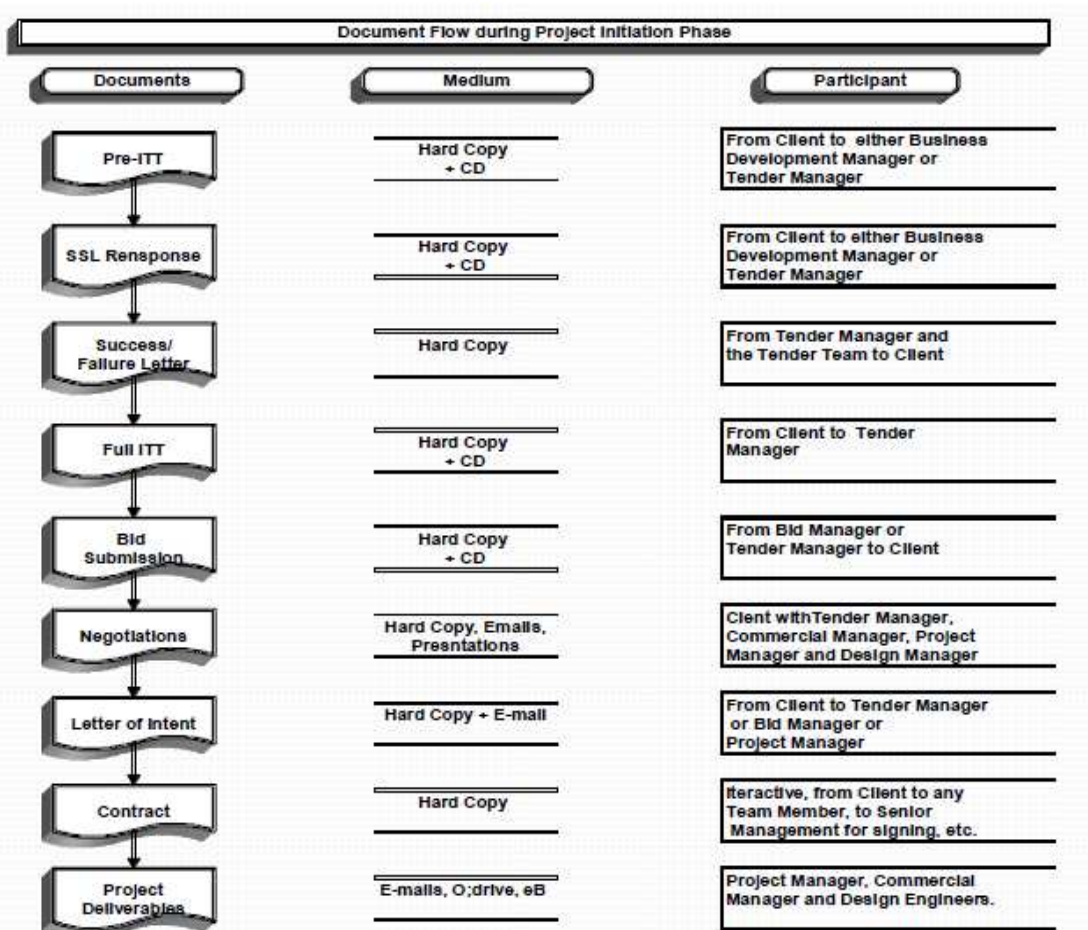
Figure 4.2- Document Flow during Project Initiation Phase

From the document flow during project initiation phase diagram above, the main observation is that documents between the main client and the company are mainly exchanged as hard copy and digital copies on compact disks. These are then downloaded into the many options

of media currently available from personal drives to O;drive folders and eB system. The process that drives this correspondence activity is also loosely structured, such that several points of contacts exist within the company and the main client organisation.

The project information flow survey shown below as information flow in a typical project reveals that documents are either emailed, hard copy mailed or discussed in meetings with minutes published and distributed through the email service. The myriad of business-critical document types handled in the course of a typical project is also noteworthy. The existence of a platform where all documents can be generated in standardized templates and processed through a workflow mechanism for approval and availability will completely remove the need to handle any documents outside, let alone needing to email it around. Access to such a system will be granted to every one who is concerned and can read, initiate and manage change, etc. within the system.
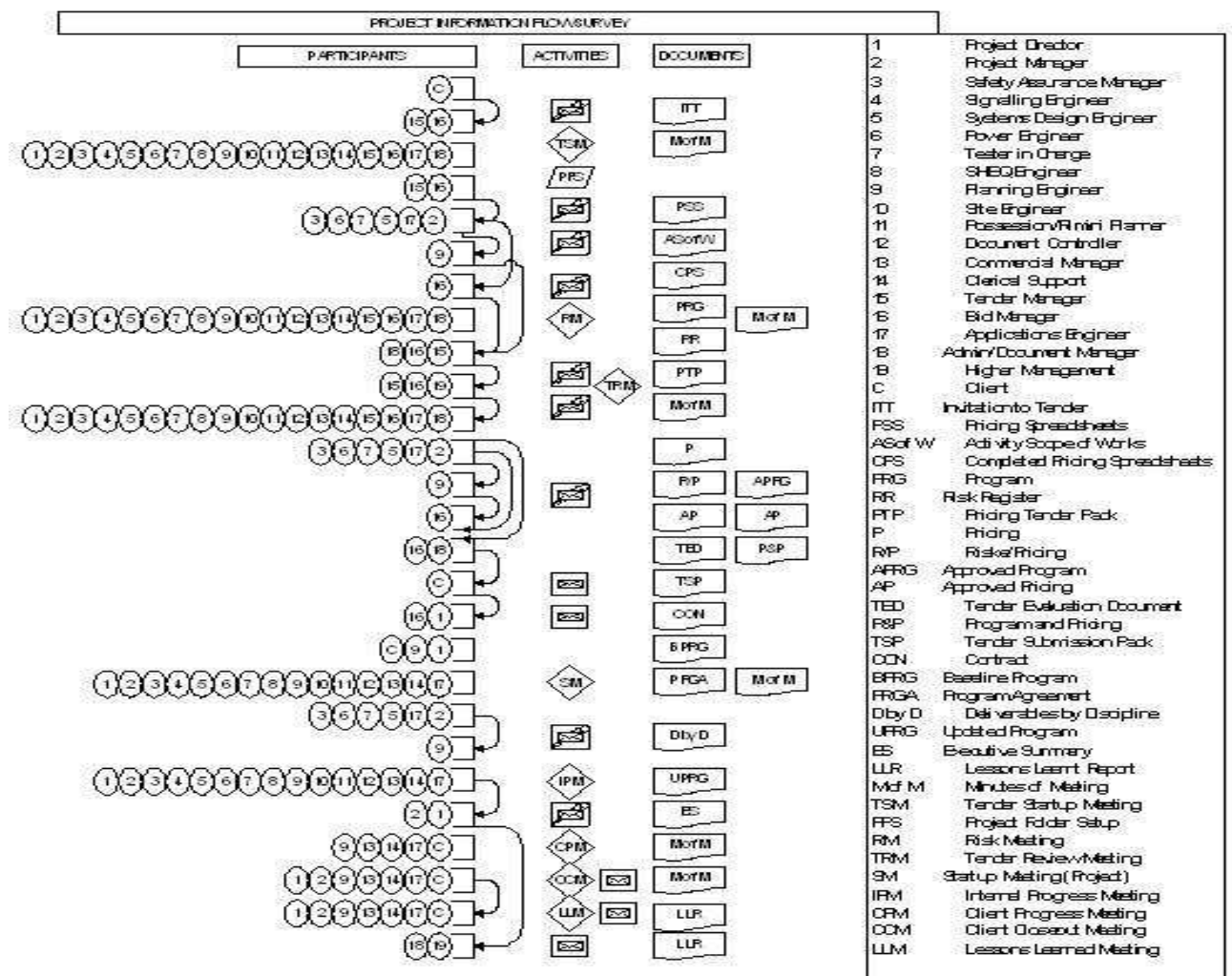
Figure 4.3- Information Flow in a Typical Project

The site visits to Balfour Beatty Rail sites to further explore the use of Cabinet was to experience from a related company, their use of one of the systems under investigation, and learn some lessons about successful implementation. It revealed that the deployment was carried out in phases, based on functions such as purchasing and HR, as well as projects such as electrification. It also opened the eyes of the team to the fact that processes have to be clearly defined by developing work flow diagrams before any rollout can be effective in order to be able to make use of its workflow capability. This process definition, for a typical department or project took up to several weeks before the system could go live.

4.8   Cause and Effect Diagram

As a tool to compress and summarise the entire data collected from multiple sources, the fishbone diagram, one of the many management tools created by Dr. Kaoru Ishikawa is shown below. It is presented as part of this report as a simple visual method to identify, explore, and graphically display, in some detail, all of the possible causes related to the problem of document management at Signalling Solutions Ltd.
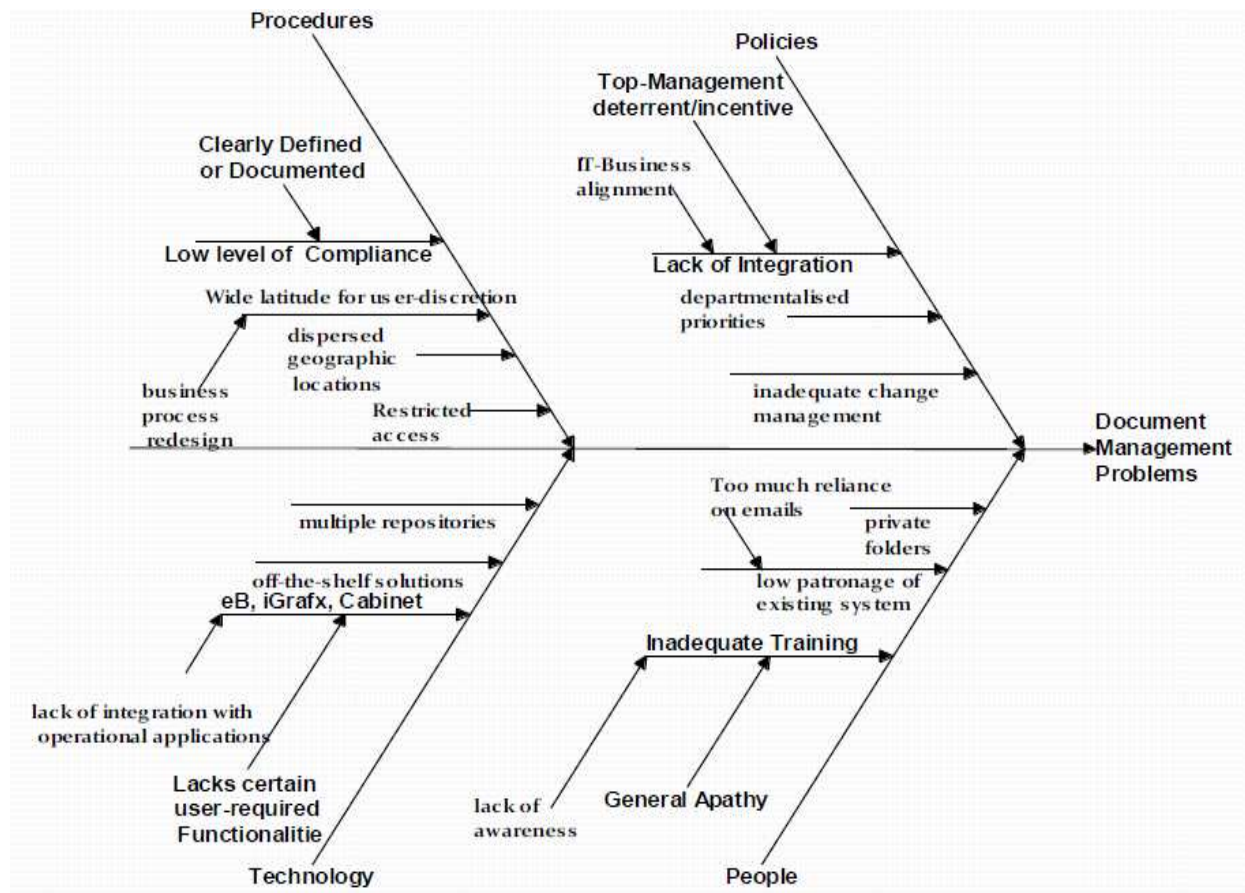
Figure 4.4- Cause and Effect Diagram

4.9   Force Field Analysis

An effort to present the various human-factor issues that should be considered during the implementation of this project, a force field analysis is hereby included in this report. It is a method used to get a whole view of all the forces for or against a plan so that a decision can be made which takes into account all interests. As a specialized method of weighing pros and cons, it allows the decision maker to look at all the forces for or against the plan and thereby to adjust the plan to reduce the impact of the opposing forces while strengthening and reinforcing the supporting forces. The force-field diagram below does not include weightings to the various issues as it is only used here as a simple way to visualise the factors involved.

Figure 4.5- Force Field Analysis
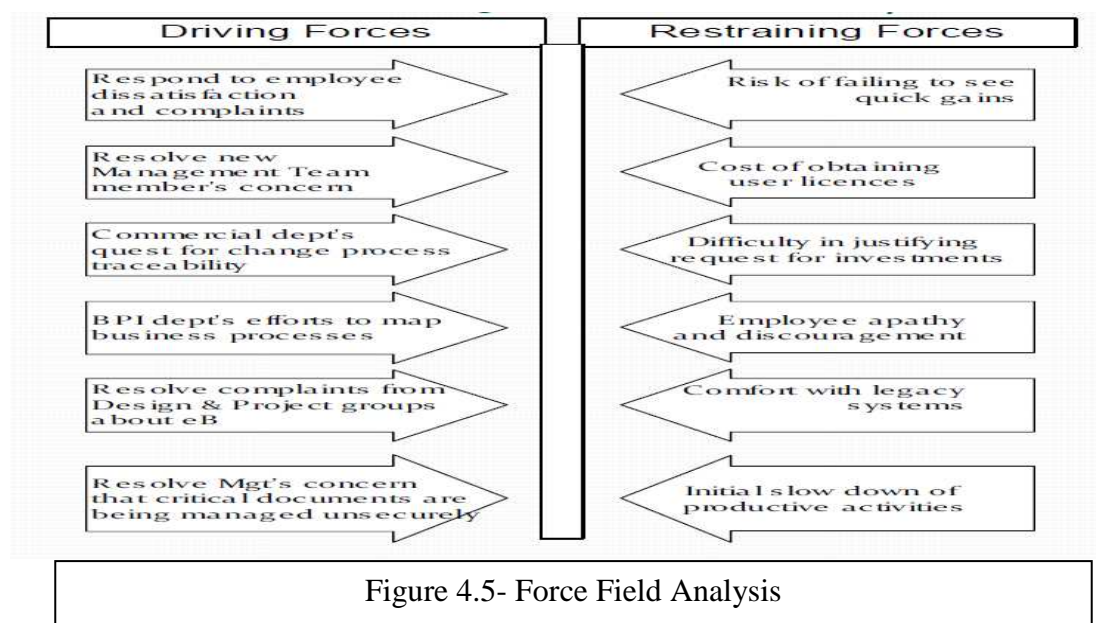
4.10   Conclusion

In order to get validation for the findings reported in this chapter, two senior members of staff of Signalling Solutions Ltd including the Director for Business Process Improvement were engaged to read through and point out possible areas of missed information or inaccurate representation of the various facts touched upon. The consensus feedback was very positive, which indicates that the content of this chapter closely matches the true current situation in the company. The presentation to the management team (see appendix 1), which was mostly based on the contents of the analysis presented here also received very positive response, resulting in an immediate management decision to carry out the recommendations proposed. These recommendations will now form the main content of the next chapter.

5.0 CHAPTER FIVE- DISCUSSION AND RECOMMENDATIONS

"There is no absolute point of view from which real and ideal can be finally separated and labelled."

-TS Elliot

5.1 Introduction

This chapter outlines some specific recommendations for the possible path of selection and implementation of a document management system as part of an information management strategy for Signalling Solutions Ltd based on the findings in the previous chapter. There are also some generally applicable suggestions for the same activity that could be adapted by other organisations based on literature review. This research presents suggestions on strategies for aligning business and technology solutions with enterprise planning imperatives, adaptation and application of relevant information management principles, standards and best practices, as well as change management strategies and communication plans to assist with managing required cultural changes.

Signalling Solutions Ltd in embarking on this study of process for the implementation of an information management strategy, has as its aims, to establish a corporate knowledge reservoir that provides global access to, and the management of a common pool of digital assets used to collaborate, support work processes and share information between the company and their customers, employees and business partners. The implementation of this content management system will provide the following advantages;

1. Improved information accuracy. The quality of information will be improved as a centralised system provides accurate and up-to-date documents because its central repository will be controlled within the system.

2. Increased Flexibility. The system will enable access by authorised personnel from far-flung locations without having to get into the office locations and also at times when office support staff may be unavailable

3. Enhanced system management. This implementation is designed to reduce network management and system security issues thereby only requiring the commitment and confidence of individual users and system administrators to maintain integrity of the system during use.

4. Reduced maintenance and cost. The elimination of current supporting systems and functional modification to the organisation's document control staff and other groups involved in configuration control.

5.2 Outline Recommendations

The main recommendations of this research can be summarised as follows;

1. The Cabinet System more closely meets the end-*users' requirements*, of the three systems evaluated.

✓ There is a major justification for the selection of a system that offers both content management, as well as workflow and have the capability to lead predefined processes and potentially prevent the commitment of errors in process steps implementation. This system will not function merely as a repository or just for configuration management.

✓ As it has the potential for high level adaptation, the Organizations' needs will continually be met through developments.

✓ The iGrafx software if integrated with Cabinet can provide high level process visibility which is a critical need.

2. The Management of Signalling Solutions Ltd should make a deliberate effort to document *and communicate the Company's business strategy to the employees, in* order to establish an IT-Business Alignment.

3. Business Process Management- There is need for clearly defined processes to be mapped for every type of business activity, departmental functions and projects.

4. Disciplined execution of procedures will require greater direct management support through motivation, incentives and deterrents.

5. A carefully executed implementation plan should involve the following;

✓ Design a clear implementation plan to include selection of an interdepartmental project team, assign specific roles to team members, establish reporting structure, develop project work plan, milestones and task breakdowns, develop communication plans and meetings, develop support plan detailing access to required resources, etc.

- ✓ Select the system vendor and product, to include developing specification documents with rules on scope change management.

- ✓ Start with a pilot project or department before general rollout, to include comprehensive testing in a clone system outside the main network.

- ✓ Train the administrators and then the users, mostly onsite and hands-on with a test system and with real data

- ✓ Rollout to the entire organisation, to include resolution of all communication issues about changes and potential issues

- ✓ Use support of system vendor and possibly a consultant system integrator.

- ✓ Set up and follow through with procedures for problem escalation and plan maintenance processes.

- ✓ Publish project audit to include project goals, issues faced and final outcomes of implementation.

- ✓ Evaluate the system by surveying the users again to identify if the project goals including scope, users, activities, document types, metadata etc have been included in the set up

5.3 People Issues

Users will only use the system or make the above technical considerations effective if they understand the system, are adequately trained and want to use the system. The people involved must want to share the information they have. There may be some incentives to make sure the culture changes along with the system. The success of the project also rely on senior management support, an effective technical decision making based on the above requirements, and disciplined implementation within a supportive culture. The range of products is now wider, and more stable. The technology is less of an issue, but the key is to understand the possibilities and the need, and then to match these appropriately. Certainly for a well managed project, there is less risk now in implementing an EDM system that will fail to deliver on its promise. (Raynes M. 2002)

Junco N. et al (2005) noted that it is important to tackle the challenge of managing expectations of line staff and management about the potential and the limitations of the content management system. The factors that can derail a content management system project are many, and a number of them have nothing to do with technology but rather they relate to the human side of the project. Having a powerful ECM system and/or IT infrastructure is useless if the content is inaccurate, outdated, or irrelevant for improving users' ability to perform. Organizations need to be disciplined about the publishing process and the management of taxonomies.

5.3.1 Organisational Culture and Structure

Critical organisational issues that needs looking into are; user motivation, user familiarity with the required process activities or tasks and the system's support features, user job satisfaction and quality of life, or work environment, user involvement in the deployment process, organisational hierarchy and channels of communication, organisational distribution of power, as well as organisational culture. In this particular case however, the system is not being designed from scratch, there is already a background of system use within the organisation and the need for such a system is obvious to most users in the current state. Senior management support could involve making task performance within the system mandatory, modifying procedures to include only one path for performance of certain tasks which would be in the system as well as banning the use of other forms of document exchange etc. (Stewart R.A., 2006).

5.3.2 Change Management

To be a better agent of change, the person responsible for the implementation of an integrated information management system should see his role not simply as one of implementing a new technology but as one who is an organisational change agent. Organisational change necessitated by implementation of a new information management strategy must foster new management practices that are conducive to the achievement of the strategic objectives of the new system. This could involve new job designs to reflect the changes in processes that are required to bring about the improvements anticipated in the system implementation. It also involves an interconnection between people and organisational processes and the rules and principles which constitute culture that govern how people do their work (Appelbaum et al, 1998).

There must also be in place an internal communication strategy which aims at communicating to all involved the expected changes and the effects of the changes on their roles. This information mechanism should seek to carry every stake holder along from the person on the shop floor to the CEO, from the owners of contents to the users, etc There is also the closely related issue of training which must be contemplated in two areas as training about the newly implemented document management system and training on the changes that this new system bring to existing processes (White 2002, Mathieson & Ryan 1994).

5.3.3 Informal Networks

A useful tool in the process of reaching out to employees in a bid to get complete buy-in during the implementation of an information management strategy is the use of 'informal networks' developed by Krackhardt & Hanson (2000). The theory behind this concept is that behind the formal organisational structure depicted in seniority or authority charts, there are often a series of informal networks that can be harnessed to produce strong positive improvements in organisational performance and change management. This involves carrying out a survey to map employees' relationships in three areas which are the advice network, the trust network and the communication network. Mapping the advice networks can uncover the source of political conflicts and failure to achieve strategic objectives while the trust network will reveal the causes of non-routine problems such as poor performance by temporary teams or interdepartmental teams. The communication network can help identify gaps in information flow, the inefficient use of resources and the failure to generate new ideas.

The three simple steps formulated for mapping informal networks are, first a survey using questionnaires to solicit responses about who talks to whom about work, who trusts whom and who advises whom on technical matters, asking questions such as whom do you talk to every day, whom do you go for advice, whom would you trust to keep in confidence your concerns, etc. The next step is to crosscheck the answers for correlation, ambiguity and withdrawal symptoms. The final step is to process the information into maps which management can use to devise an implementation plan that plays on the strengths of the informal organisation (Krackhardt & Hanson, 2000).

5.4 Constraints and Assumptions to be considered

In a systems implementation planning, there are numerous potential constraints as well as assumptions that must be recognised and analysed. Some of these include; specific time constraints, resource constraints, compliance/regulatory constraints, infrastructure constraints, organisational/political constraints as well client or supplier relationships that must be taken into account. Questions such as; what business processes problems must be solved to reduce costs and improve productivity, and especially, are there any budgetary constraints? In addition, all technical or other assumptions for the project must be considered.

5.5 Conclusion

This chapter has been structured to present the research recommendations in a straightforward and easily readable manner. Emphasis has been placed on suggestions for handling the human factor aspects of the proposed implementation because of its overarching level of importance. As this report comes to an end, the final chapter will now briefly review the entire research to draw attention to the issues raised and how they have been resolved.

6.0   CHAPTER SIX- CONCLUSIONS AND FUTURE RESEARCH

6.1   Introduction

The focus of this research was on the strategy for the selection and implementation of an integrated document management and information management system in a railways engineering environment. The implications for document management in engineering and project environments and specifically for the situation of Signalling Solutions Ltd will be discussed in this chapter. Further areas of potential research projects are also briefly outlined.

There is ample evidence from the literature that there are important gains to be made by linking business with document management strategies or any IT strategy for that matter. Inability to plan at this strategic level may lead to organisations failing in their bid to manage change in such a strategic area of the business. In the words of Ojiako & Maguire (2008) "The generally accepted technology dominated hard systems approach to IT implementation is counterproductive in any dynamic business environments characterised by competition and changes in the market". Technology is in fact only one segment of the change process. Companies should be aware of the other issues that are critical for the success of any IT led business transformation such as the organisational, user, customer, process, political, cultural, risk management, resistance to change, project management and change management issues.

It is crucial that time and resources spent in planning and giving consideration to these issues be not taken for granted as any lapse in this critical planning stage carries the risk that the system improvement will be a half measure, or a complete failure. The effects of failure in the long term can be devastating, especially as it destroys the morale of employees and their receptiveness to any future reengineering or change process, thereby limiting the ability of the company to compete in a dynamic business environment.

6.2   Major Challenges Encountered during this Research Project

The first major challenge encountered in this project was the huge amount of data, both primary and secondary that seemed to pour out endlessly as the investigations proceeded. To overcome this problem, frameworks were developed to help contain the literature review, the research process as well as the data collection and analysis. These helped in cutting through the chase and outlining boundaries for the literature review methodology and data collection and analysis processes.

The second big challenge was the time-limitation of this project. All of the activities had to be scheduled and followed through as closely as possible to be successful. To overcome the potential 'student syndrome' problem, the initial schedule was planned to complete at least three weeks before deadline in the research proposal.

A final challenge was in the area of terms-definition in the existing published literature. There is still a hazy approach to identifying and defining basic technological and systems terminologies in the Enterprise Content Management domain. This is an area of further research which should attempt to synthesize or hybridize the concepts definitions existing in the academic journals and industry or market application of basic terms with a view to identifying common usages as well as postulating acceptable definitions.

6.3   Purpose and Objectives of the Research Achieved

This research has as its purpose, to evaluate the capabilities and extents of deployment of current document management systems, assess the document management needs of the company, and make recommendations based on gap analysis between needs, available systems and business requirements. This purpose has been achieved with the finding that the current systems available for managing documents and information sources at Signalling Solutions Ltd had hitherto not been properly deployed. This situation has led to the perception by end-users, and rightly too that current systems are ineffective. Efforts to assess the document management needs of the organisation based on end-user requirements had been successfully carried out, producing a ranked set of required features and a comparison between existing systems presented in chapter four of this report.

The objective is to produce a workable program for the planning, selection and implementation of an enterprise content management system for the management of information assets by Signalling Solutions Ltd, a UK provider of engineering solutions for railways signalling. The carefully collated outline of recommendations and suggestions on handling the people issues involved presented in chapter five successfully fulfils this objective.

6.4   Research Questions Answered

This research set out to answer the following four questions;

- How can user and organisational needs be evaluated in a document management systems implementation? The clear answer that resonated from the literature review was to

analyse and streamline business processes to understand the nature of work performed and how it is being carried out, and then to survey the end-users for their requirements. The emphasis should be on processes and the users, as the technology focus may not necessarily result in systems that will be put to full productive use.

- Why is the current state of document management perceived to be ineffective by end-users in the organisation? Inadequate exposure and training that resulted in lack of commitment and apathy from employees is the main culprit for this perception and apparent rejection of the current systems. The lapses observed in the management of content, management of infrastructure and the management of change have been given considerable discussion in chapter four of this report. Other issues raised in this regards including the people, policy, procedure and technology problems have also been highlighted in the cause and effect diagram shown in the data analysis section of the same chapter.

- What ideal or future state do we need to envision? As indicated by end-users who actually do the work. The users are those who perform business activities and the document management system is only a tool at their disposal in achieving business goals. If the system does not reflect their needs, it will not be used and the effects will not be favourable for the organisation. The ideal state is one where the following capabilities are available as indicated by the employees (See frequency table and ranking in appendix 4);

1. Information availability and accessibility from all locations.

2. Prevent information duplication.

3. Ensure information currency. (E.g. versions, revisions, changes, etc.)

4. Ability to exchange information between systems. (E.g. MRP and CAD, emails and projects, etc.)

5. Use of single standard for classifying and organising information resources.

6. Information access controls.

7. Validation of information completeness and accuracy at all times.

8. Integrated and centralised system management.

9. Evaluative and computational capabilities. (E.g. automatic up-to-date reports, status alerts, etc)

10. Support for collaboration across multi-disciplinary teams.

11. Traceability of information or communication exchanges.

12. Ability to monitor and control time, costs, etc. with visibility.

13. Facilitate effective and quick change-management implementation.

14. Completely paperless processes, master records, etc.

15. Fully automated data entry systems.

16. Interface with client document systems and requirements.

• How can the organisation be led from the current state to the ideal future state of information management? The recommendations proposed in chapter five takes care of this question as it contains some techniques to manage the people issues as well as a step by step procedure for the implementation of a carefully planned system deployment.

6.5 Potential Future Projects

There exists several opportunities for further research and interventions within the Signalling Solutions business model in order to improve its efficiency and deliver greater value to shareholders, employees and clients. The following four projects are potential areas for future interventions of this nature;

1. Business process Base-lining and Value Stream Mapping- Inadequately mapped processes results in variations in process inputs, producing a larger than proportionate variation in process outputs. The current process steps and the activities performed in the course of functional and project operations need to be made visible through process base-lining, and then value stream mapped to identify sources of waste and inefficiencies.

2. Business Process Reengineering- This project will aim at taking the process value stream maps as inputs with a view to making recommendations for changes to both functional and project processes activities, as well as organisational structure in order to deliver greater value and cut out waste from the system.

3. Business and Competitive Strategy Study and Definition- Business and Operational Strategy could either be deployed as a Management action or emergent from operational experiences and decision patterns over time. There is urgent need to study the evolution of strategy at Signalling Solutions Ltd as well as the adoption of a defined and well thought out business and operational strategy which should be communicated clearly to all the employees in order to guide and focus decision making to an expected end. This is also a prerequisite for the establishment of an IT-Business strategy alignment which is necessary for the long term success of any information systems adoption.

4. Lean Systems for Office and Project Management- The identification and elimination of waste will have an incredible impact on the bottom-line for Signalling Solutions Ltd. There are lean systems that can help to eradicate waste and increase value both in office and project management operations. This project will make recommendations based on reducing the costs related to operating processes and show in clear monetary terms how much can be save by implementing lean ideas.

6.6   Impacts and Benefits of this Research

This research project has produced significant gains for all stake holders and participants. The case study company is now able to benefit form virtually cost-free third-party interventions and consultations in solving nagging business problems, both through this project and the establishment of a continuing link with the Nottingham University Business School academic community for future knowledge sharing and student research schemes. The University benefits by having the opportunity to validate and apply research efforts in practical real-life organisation, thereby increasing the relevance of academic research. The research student in this case has also benefited by being able to experience firsthand how lessons learnt in the classroom could be put to use, thereby adding a valuable practical experience to his resume.

6.7   Conclusion

This chapter has been used to demonstrate the extents to which the research purpose and objective were achieved as well as sum up the answers arrived at for the research questions. Areas of future interventions are highlighted, showing that a collection of business improvement activities are needed in the case organisation. The benefits of this project to the various stakeholders also got a mention.

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APPENDIX

1-   Presentation to the Company

Literature Review; Main Concepts

1. Data and Metadata
2. Knowledge and Knowledge Management
3. Information and Information Management
4. Records and Records Management
5. Document/Content and their Management
6. Related Issues in Engineering and Project Operations
7. IT-Business Alignment and BPM

Literature Review; ECM as the Conversion of Knowledge to Productive Activities

" Where is the wisdom that we have lost in knowledge and where is the knowledge that we have lost in information"- TS Elliot
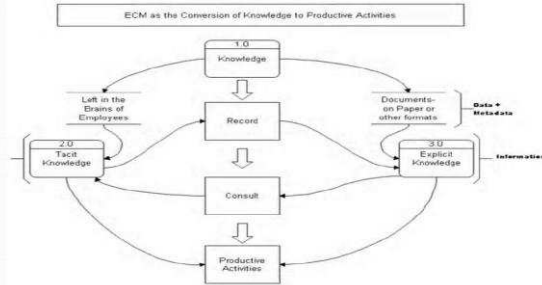
The Research Questions

1. How can user and organisational needs be evaluated in a document management systems implementation?
2. Why is the current state of document management perceived to be ineffective by end-users in the organisation?
3. What ideal or future state do we need to envision?
4. How can the organisation be led from the current state to the ideal future state of information management?

The Research Process
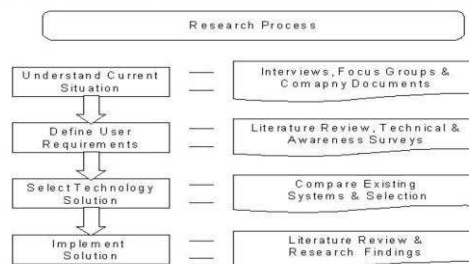
Data Collection and Analysis Process
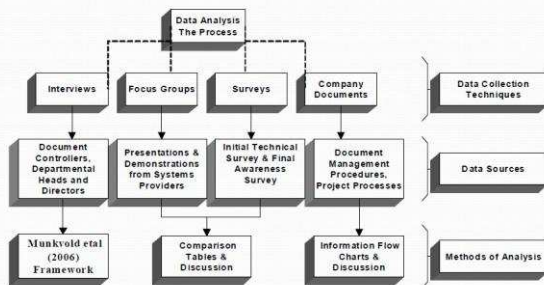
Data Collection

- Interviews
- Surveys
- Systems Suppliers Presentation
- Company Documents and Site Visits

Interviews Process and Activities

- **Unstructured interviews to understand the problem were held with the following people during the first phase of data collection;**
  1. Operations Director
  2. HR Director
  3. BPI Director
  4. Engineering Director
  5. A Project Director
  6. Document Controllers at Borehamwood, Birmingham and Derby
  7. Planning Manager
  8. Head of Commercial
  9. Designer

- **The purpose of the interviews was to gather information on the following;**
  1. What processes are currently being observed in document management.
  2. What systems are currently available for document management.
  3. What document management roles were being performed by document controllers.
  4. What document management roles were being performed by frontline employees.
  5. What document management problems are being encountered in the various departments.

The Survey Process and Activities

- Initial questionnaire made up of two worksheets to evaluate the existing document management systems as well as carry out technical needs assessment. Served mainly to validate some aspects of the interviews and also to get an appraisal of the level of technical functionalities required by the various departments.
- The second survey conducted represented a wider cross section of the workforce whose work involved the use of an electronic information management system.
- It aimed at assessing document types and the roles of employees in their life-cycle management such as generating, processing, transmitting, applying, storage and disposal of the documents.
- Also, the systems currently employed in the lifecycle management of the various documents were identified, such as eB, CABiNET, iGrafx, O:Drive, H:Drive, Local Server, Local PC Hard Drive, the E-mail system as well as prints and other media or applications.
- This survey which was conducted after the systems suppliers' seminars also sought to compare some of the employees' perceptions of the existing and proposed systems based on prior and new information emanating from the seminars and focus groups to which some were present.

System Suppliers' Presentations

- The following Providers of Document Management Systems were invited to present and demonstrate their products to a cross section of Departmental Heads and Management;

1. Bentley Systems, providers of eB (Enterprise Bridge)
2. TSA Advet, providers of Cabinet software
3. iGrafx, division of Corel Inc.

- These presentations achieved two objectives;

1. They offered an opportunity to meet the teams behind the off-the-shelf systems currently run in the company.
2. They also offered an opportunity for decision makers within the company to get a firsthand exposure to these systems.

Company Documents & Site Visits

- The review of company documents and project management processes was setup to understand the current document management system in a live project context. This produced the project information flow process charts which shows the major document types and their media for transfer.
- The site visits to Balfour Beatty rail sites to further explore the use of Cabinet was to experience from a related company, their use of one of the systems under investigation and learn some lessons about successful implementation.

Data Analysis

- The Munkvold etal (2006) Framework is used for analyzing the results of the interviews.
- Comparison Tables is used for showing current systems and end-users' perceived ideal system's functionalities.
- Information Flow charts and Process Diagrams is used to show how the current document management system operates.

Munkvold etal (2006) Framework

- **Management of Content-**
1. Control and configuration non-compliance
2. Departmental focus
3. Emails and attachments
4. Personal Drives
5. Wide latitude for discretion in document management processes

- **Management of Infrastructure**
1. Heterogeneous and parallel applications
2. O;drive, eB, iGrafx repositories
3. Lack of integration between applications and repositories
4. Requirements of main client
5. Relationship with Parent-Companies

- **Change Management**
1. Inherited eB system
2. Introduced iGrafx system
3. Opposition to tool and content standardization?
4. Reluctance to adopt a new technology?
5. The lack of user training!

Information Flow Process Charts; Project Information Flow
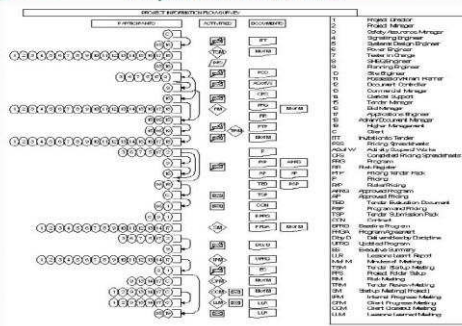
Information Flow Process Charts; Document Flow During Project Initiation Phase
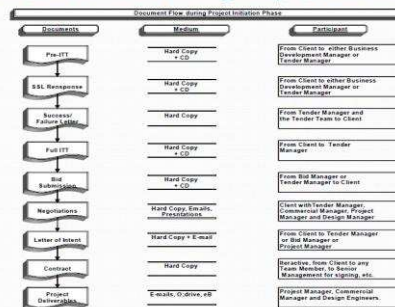
Research Findings- Cause & Effect
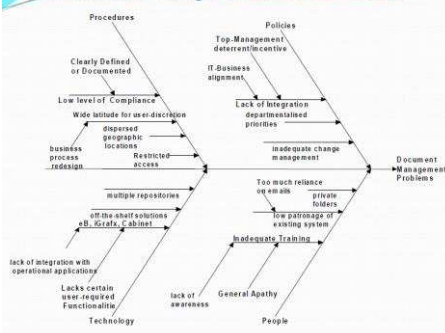
Research Findings- Force-Field Analysis

84
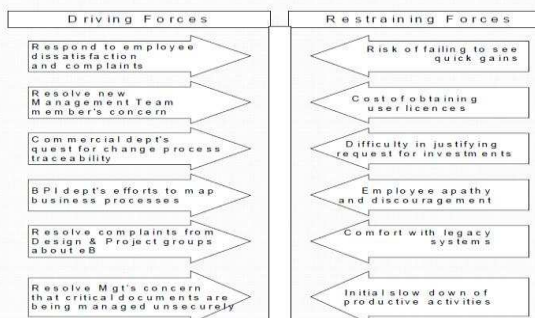
Research Findings- iGrafx

o   iGrafx as an application software for process modelling which is only being considered as a document management system because of its Process Central add-on component which serves as a repository with three components called the 'database', a Microsoft SQL or Oracle server, 'web central' for content viewing using any standard browser, and 'mail central' for approvals via email notifications.

o   It can handle the following features;

1. Document check-in, check-out
2. Version control/ audit history
3. Search and retrieval
4. Security access rights
5. Email Notification
6. Audit trail of document changes and history
7. Supports digital signatures
8. Bookmark enabled
9. Can store documents of any format and will launch the appropriate application when the document is selected.

o   The consideration for having this system should mainly be to integrate it as a process modeling application with a fully functional document management system. It has no capability for handling transmittals neither can it be used to handle process workflows or collaboration.

Research Findings- eB

- The eB system offers enterprise information management solutions that ensure access to accurate information of documents, people, assets, processes and organisational elements at the time and in the context that it is needed for decision making at all levels of the enterprise.
- **The features of this system includes the following;**
1. Identify, classify and define relationships between documents in the repository
2. Manage change through control and impact analysis
3. Auditing to prove compliance and for internal reporting
4. Manage records in the repository

Research Findings- eB

- **The pros of adopting this system includes the following;**
1. 1.   Incumbency factor- it is the current system in use in the business and there are document controllers who are quite familiar with its features.
2. 2.   Very effective for managing change, transmittals and security control for established records.
- **The cons of this system includes;**
1. Does not support collaboration and workflow processes, requires project-wise, an extra system to be able to do this.
2. Only required for managing records and does not support live operations
3. Cannot handle live workflows in collaborative environments
4. Difficult to integrate with other project and operations applications
5. Additional software tools are required to allow a URL link to understand which application needs to be launched to open up a stored document
6. Trying to provide a link to a document from, say, the intranet is difficult without additional software due to the way the files are stored.

Research Findings- Cabinet

- The cabinet software solution consist of five core modules which are the **'explorer'** which provides the desktop access to the document stores, the **'workflow publisher'** which processes workflows for any document type, the **'browser'** which enable access to the document stores through intranet and internet protocols, the **'transmittals'** which generates transmittals of document packs for paper.CD/DVD copies and the **'SMTP server'** which is used for managing emails within the system.
- **The features of this system as demonstrated by the TSA Advet representatives during their product presentation include;**
1. Ability to work from dispersed locations to the same project standards using standard project templates.
2. Data Security and access control
3. Document creation using standard master templates
4. Automatic Document numbering systems
5. Prevents duplication of master document
6. Revision history with past versions saved with automatic issue updating
7. Workflows to follow business processes
8. Provides for audit trails
9. Ease of Use as it is set up to follow organisation's business processes
10. Automates repetitive tasks
11. Accurate reporting on current progress
12. Automatic PDF creation
13. E-mail notification
14. Address book for contacts
15. Automatic transmittals and publications

Research Findings- Cabinet

- **The pros of adopting this system include the following;**
1. Ease of use- the system display screens is organised using the same format as the familiar Microsoft Windows Explorer systems, thereby requiring minimum training.
2. Open architecture- Not locked in by proprietary data formats and non-encrypted folders, files and database.
3. Not tied to any applications- Can interact with most legacy systems and applications and can be adapted to any customers requirements
4. Ease of deployment- Same version for all users, no customisation of versions to particular users but can be configured to specific customer needs.
5. Promised high levels of service and support by the system supplier
6. Proven in the Signalling engineering environment given the number of such companies as current clients which includes Balfour Beatty Rail where additional support and experience sharing can be gained.
- **The cons for adopting this system may include the following;**
1. New system- never been used by anyone within the business and as such there will be no internal experience about its functionality
2. Cost of migrating documents from the current eB system as well as those related to replacing the old system with this new one.
3. Non-visual process mapping- may require the continuous use of the process mapping software which could be integrated

Research Findings- Systems Comparison

- Each of the Systems compared which are iGrafx, eB and Cabinet all have repositories for document management, configuration and control.
- iGrafx is special for its ability to model processes and link process steps with user-required information sources and can be integrated to the cabinet system as an ideal.
- eB is special for its ability to control business-critical records and handle transmittals of project deliverables.
- Cabinet is special for its ability to handle workflows and collaboration but it can as well handle all the other functionalities of the eB system.

Research Findings- The Ideal System

- **What the end-users perceive as the ideal System should have the following features, ranked according to the number of respondents who required each of the features;**
1. Information availability and accessibility from all locations.
2. Prevent information duplication.
3. Ensure information currency. (E.g. versions, revisions, changes, etc.)
4. Ability to exchange information between systems. (E.g. MRP and CAD, emails and projects, etc.)
5. Use of single standard for classifying and organising information resources.
6. Information access controls.
7. Validation of information completeness and accuracy at all times.
8. Integrated and centralised system management.
9. Evaluative and computational capabilities. (E.g. automatic up-to-date reports, status alerts, etc)
10. Support for collaboration across multi-disciplinary teams.
11. Traceability of information or communication exchanges.
12. Ability to monitor and control time, costs, etc. with visibility.
13. Facilitate effective and quick change-management implementation.
14. Completely paperless processes, master records, etc.
15. Fully automated data entry systems.
16. Interface with client document systems and requirements.

Recommendations

"There is no absolute point of view from which real and ideal can be finally separated and labelled." TS Elliot

- The Cabinet System more closely meets the end-users' requirements of the three systems evaluated.
- ✓ There is a major justification for the selection of a system that offers both content management, as well as workflow and have the capability to lead predefined processes and potentially prevent the commitment of errors in process steps implementation. This system will not function merely as a repository or just for configuration management.
- ✓ As it has the potential for high level adaptation, the Organizations' needs will continually be met through developments.
- ✓ The iGrafx software if integrated with Cabinet, can provide high level process visibility which is a critical need.
- There should be a deliberate effort to document and communicate the Company's business strategy to the employees in order to establish an IT-Business Alignment.
- BPM- There is need for clearly defined processes to be mapped for every type of business activity, departmental functions and projects
- Disciplined execution of procedures will require greater direct management support through motivation incentives and deterrents.

Recommendations

A carefully executed implementation plan should involve the following:

1. Design a clear implementation plan to include selection of an interdepartmental project team, assign specific roles to team members, establish reporting structure, develop project work plan, milestones and task breakdowns, develop communication plans and meetings, develop support plan detailing access to required resources, etc.
2. Select the system vendor and product, to include developing specification documents with rules on scope change management.
3. Start with a pilot project or department before general rollout, to include comprehensive testing in a clone system outside the main network.
4. Train the administrators and then the users, mostly onsite and hands-on with a test system and with real data
5. Rollout to the entire organisation, to include resolution of all communication issues about changes and potential issues
6. Use support of system vendor and possibly a consultant system integrator.
7. Set up and follow through with procedures for problem escalation and plan maintenance processes.
8. Publish project audit to include project goals, issues faced and final outcomes of implementation.
9. Evaluate the system by surveying the users again to identify if the project goals including scope, users, activities, document types, metadata etc have been included in the set up

Summary and Conclusion

- This research Project evaluates the capabilities and extents of deployment of current document management systems, assesses the document management needs of the company, and makes recommendations based on gap analysis between needs, available systems and business requirements. – Not yet properly deployed!
- The objective is to produce a workable program for the planning, selection and implementation of an enterprise content management system for the management of information assets by Signalling Solutions Ltd, a UK provider of engineering solutions for railways signalling.- See Recommendations.

Summary and Conclusion

- How can user and organisational needs be evaluated in a document management systems implementation?- Analyse processes, and survey the end-users.
- Why is the current state of document management perceived to be ineffective by end-users in the organisation?- Inadequate exposure and training resulting in lack of commitment and apathy.
- What ideal or future state do we need to envision?- As indicated by end-users who actually do the work.
- How can the organisation be led from the current state to the ideal future state of information management?- See Recommendations.

Potential Future Projects

1. Business process Base-lining and Value Stream Mapping.
2. Business Process Reengineering.
3. Business and Competitive Strategy Study and Definition.
4. Lean Systems for Office and Project Management

Questions?

Acknowledgements

- Dr. Jane Guinery and the Nottingham Business School Faculty and Staff.
- Tony Davis, Mike Stevens, Alan Wiggins, the Management Team and the very warm and supportive employees of Signalling Solutions Ltd with special mention going to Leanne Hill and Paul Hickman.
- My wonderful family.

2- Gantt Chart for the Research Activities

Task \ Dates	4-11 Jun	11-18 Jun	18-25 Jun	25-2 Jul	2-9 Jul	9-16 Jul	16-23 Jul	23-30 Jul
Meet Case Organisation and Get Briefing	■							
Meet Stakeholders to understand Business	■	■						
Informal Interviews and Pilot Study		■	■					
In-depth Interviews with Key Employees			■	■				
Initial Literature Review and Initial Survey				■	■	■	■	
Vendo s' Presentations/ Focus Groups				■		■		
Final Survey Questionnaire Administration								■
Investigate Systems in Parent Organisation							■	■
Literature Review And Report Writing								
Presentation to Company Management								
Submit Dissertation to University								

30-6 Aug							■		■		
6-13 Aug							■		■		
13-20 Aug									■		
20-27 Aug									■		
27-3 Sep									■		
3-10 Sep									■		
10-17 Sep										■	
17-24 Sep											■

3-   Summary of End-Users' Perceived Features of Existing Systems

Components	Features	o;drive	eb	igrafx	cabinet
capture	26	8	4	1	0.33
storage	9	4.5	2.67	1	0
indexing	10	2.5	1.33	0.33	0
search	12		3.17	0.67	0
distribution	10	4.33	2	0.33	0
security	20	6.67	6.5	2.5	0
workflow	5	0.17	0.83	1	0
doc mgt	18	7.83	5.33	2.33	0
records mgt	14	3.33	3.83	1.5	0
Total Features	**124**	**37**	**29**	**10**	**0.3**
Percentages	**100**	**30**	**24**	**8**	**0.5**

O;drive	capture	storage	indexing	search& Retrieve	distribution	security	workflow	doc mgt	records mgt	
BPI	8	3	2	2	3	6	0	9	1	**34**
Project Mgt	14	6	4	6	7	12	0	11	3	**63**
Engineering	13	9	2	11	10	12	1	13	7	**78**
HR	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers	11	6	5	3	5	8	0	13	7	**58**
Doc Controllers2	2	3	2	1	1	2	0	1	2	**14**
Total Features	**48**	**27**	**15**	**23**	**26**	**40**	**1**	**47**	**20**	

eB	capture	storage	indexing	search	distribution	security	workflow	doc mgt	records mgt	
BPI	4	2	2	3	4	4	0	2	0	**21**
Project Mgt	0	0	0	0	0	0	0	0	0	**0**
Engineering	0	3	0	0	0	13	2	6	9	**33**
HR	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers	4	4	3	9	4	15	1	11	6	**57**
Doc Controllers2	16	7	3	7	4	7	2	13	8	**67**
Total Features	**24**	**16**	**8**	**19**	**12**	**39**	**5**	**32**	**23**	

CABiNET	capture	storage	indexing	search	distribution	security	workflow	doc mgt	records mgt	
BPI	2	0	0	0	0	0	0	0	0	**2**
Project Mgt	0	0	0	0	0	0	0	0	0	**0**
Engineering	0	0	0	0	0	0	0	0	0	**0**
HR	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers2	0	0	0	0	0	0	0	0	0	**0**
Total Features	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	

iGrafx	capture	storage	indexing	search	distribution	security	workflow	doc mgt	records mgt	
BPI	4	3	2	4	2	8	4	6	3	**36**
Project Mgt	0	0	0	0	0	0	0	0	0	**0**
Engineering	2	3	0	0	0	7	2	8	6	**28**
HR	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers	0	0	0	0	0	0	0	0	0	**0**
Doc Controllers2	0	0	0	0	0	0	0	0	0	**0**
Total Features	**6**	**6**	**2**	**4**	**2**	**15**	**6**	**14**	**9**	

4-   **Summary of End-Users' Perceived Required Functionalities**

S/N	FUNCTIONALITY	SCORE	RANK
1	Information availability and accessibility from all locations.	36	1
2	Prevent information duplication.	35	2
3	Ensure information currency. (E.g. versions, revisions, changes, etc.)	29	3
4	Ability to exchange information between systems. (E.g. MRP and CAD, emails and projects, etc.)	27	4
5	Use of single standard for classifying and organising information resources.	26	5
6	Information access controls.	25	6
7	Validation of information completeness and accuracy at all times.	23	7
8	Integrated and centralised system management.	23	7
9	Evaluative and computational capabilities. (E.g. automatic up-to-date reports, status alerts, etc)	22	8
10	Support for collaboration across multi-disciplinary teams.	22	8
11	Traceability of information or communication exchanges.	22	8
12	Ability to monitor and control time, costs, etc. with visibility.	20	9
13	Facilitate effective and quick change-management implementation.	19	10
14	Completely paperless processes, master records, etc.	17	11
15	Fully automated data entry systems.	15	12
16	Interface with client document systems and requirements.	15	12

5-   Final Survey Questionnaire

Signalling Solutions Limited is reviewing the systems that are used to handle documentation. This questionnaire is being sent throughout the business to gain a central understanding of all documents handled by the business, how they are handled and to seek your views of what is good and where improvements can be made. Your feedback will help us determine whether changes may be of benefit and, if so, identify the most appropriate solution for our business needs.

This questionnaire should take between 20 and 30 minutes to complete.

Please return the completed questionnaire as indicated at the end of the form **BY MIDDAY FRIDAY 16th JULY 2010**.

Many thanks in anticipation of your input to this important aspect of our business.

1. Role title: ……………………………………………
2. Area of functional responsibility: ………………………
3. For the following please list the various types of documents you encounter in the course of your work and tick under the various document management functions indicating your participation in the life-cycle management of your listed documents.

Document management function : Document Type	Generate/ Initiate/ Produce	Modify/ Process/ Improve	Transmit/ Distribute	Reference/ Apply/ Use	Store/ Archive	Dispose

4. For each of the above documents, tick the medium or system you currently employ and also indicate if you consider it as value adding or an impediment to the delivery of your functional responsibility.

Document Type	Document function	Value-adding	Non-value-adding	eB	CAB-i-NET	iGrafx	O: Drive	Email	Paper/ print/ hard copy	Other Media/ Apps. (indicate)

5. For the following document management systems currently in use in the Company please indicate your level of awareness as well as your perception of its functionality. If you are not aware of the system please make this comment in response to question 5.1 and leave the rest of the column blank. *(For questions requiring a "rank" response please use the following scoring: 5 = Strong / High / Excellent; 1 = Weak / Low / Poor. For other questions, please type in your answer in the relevant columns.)*

Ref		O:Drive	eB	CAB-i-NET	iGrafx
5.1	Are you aware of the three systems listed to the right? How many hours of formal training/instruction/awareness sessions have you received in total for each?				

Ref		O:Drive	eB	CAB-i-NET	iGrafx
5.2	Please rank the quality of the training/instruction/awareness sessions you have received (Presentations / visual aids / opportunity to ask questions / quality of responses / discussions etc. etc)				
5.3	How strongly do you feel documents would be controlled (Recording, storing, validating, retrieval, general management, etc.) in each system? (Rank)				
5.4	Which aspects of this control are you most impressed with?				
5.5	Which elements of this control are you least impressed with?				
5.6	Which aspects of this control do you feel are most applicable to your work?				
5.7	What do you feel about the facilities to search for and find documents within the system? (Rank)				
5.8	Which aspects of these facilities impress you most?				
5.9	Which aspects of these facilities impress you least?				
5.10	Which aspects of these facilities do you feel are most applicable to your work?				

Ref		O:Drive	eB	CAB-i-NET	iGrafx
5.11	How user-friendly do you feel the system is? (Rank)				
5.12	What do you like most about the general way the system works?				
5.13	What do you like least about the general way the system works?				
5.14	How would you see each system being used in your team / department?				
5.15	How well do you think the system enables relationships between documents to be captured? (Rank)				
5.16	What particularly impresses you with the system's capabilities in this area?				
5.17	What is most disappointing to you about the system's capabilities in this area?				
5.18	How would you see these facilities being utilised in your department?				
5.19	Thinking about the way the system interfaces with other tools and systems that are used in SSL. How would you rank each of these solutions?				
5.20	What most impresses you about the way the system interfaces with other tools & processes?				

Ref		O:Drive	eB	CAB-i-NET	iGrafx
5.21	What least impressed you about the way the system interfaced with other tools and processes?				
5.22	Specifically for your team / department, with which tools or processes would you need such a system to be able to interface with?				
5.23	Each tool has its strengths. List the areas of the business that you feel each tool would be most suited to:				
5.24	Explain why:				
5.25	If we wanted to put "all our eggs in one basket" – which tool would you select?				
5.26	Explain why				

6. Which of the following information management features would you love to have in an ideal system? (Tick)

1.	Ability to exchange information between systems. (E.g. MRP and CAD, emails and projects, etc.)
2.	Use of single standard for classifying and organising information resources.
3.	Fully automated data entry systems.
4.	Completely paperless processes, master records, etc.
5.	Evaluative and computational capabilities. (E.g. automatic up-to-date reports, status alerts, etc)
6.	Ability to monitor and control time, costs, etc. with visibility.
7.	Information availability and accessibility from all locations.
8.	Validation of information completeness and accuracy at all times.
9.	Prevent information duplication.
10.	Ensure information currency. (E.g. versions, revisions, changes, etc.)
11.	Support for collaboration across multi-disciplinary teams.
12.	Facilitate effective and quick change-management implementation.
13.	Traceability of information or communication exchanges.
14.	Information access controls.
15.	Integrated and centralised system management.
16.	Interface with client document systems and requirements.

7. List any additional information management features desirable in performing your major responsibility more efficiently.

Thank you for taking the time to complete this questionnaire. Please return the completed document to: mike.stevens@signallingsolutions.com

6- Respondents For Final Survey

Role	Survey	Responses sent to Paul E.		
Account manager	Y	Y	1	
Admin	Y			1
Admin	Y			1
Admin	Y			1
Admin / Doc Controller	Y			1
Administrator	Y			1
Administrator	Y			1
Assistant Project engineer	Y	Y	1	
BPI Analyst / IT Liaison	Y	Y	1	
BPI Director	Y	Y	1	
Business Development Director	Y			1
Chief engineer	Y			1
Civiles Site Manager	Y			1
Civils Manager	Y			1
Commercial Manager	Y	Y	1	
Commercial Manager	Y	Y	1	
Contracts Manager	Y	Y	1	
Design Engineer Technical Specialist	Y	Y	1	
Design Engineer Verifiers	Y			1
Design Engineer Verifiers	Y			1
Design Engineer Verifiers	Y	Y	1	
Design Manager	Y			1
Design Manager	Y			1
Design Manager	Y			1
Design Manager	Y			1
Designer	Y	Y	1	
Designer	Y	Y	1	
Designer	Y			1
Designer	Y	Y	1	

100

Designer	Y			1
Designer	Y	Y	1	
Designer	Y			1
Designer	Y			1
Development Engineering manager	Y	Y	1	
Document Controller	Y			1
Engineering Director	Y	Y	1	
Estimator	Y			1
Finance Director	Y			1
Financial analyst	Y			1
Financial Reporting Manager	Y			1
Head of Contracts & Commercial	Y			1
Head of Design	Y	Y	1	
Head of Project Engineering	Y			1
Head of Supply Chain	Y	Y	1	
HR Competence Manager	Y			1
HR Director	Y			1
HR Manager	Y	Y	1	
HR Recruitment and Resource coordinator	Y			1
Lead Administrator	Y			1
Lead Project Manager	Y			1
Lead Project Manager	Y	Y	1	
Lead Project Manager	Y			1
Lead Project Manager	Y			1
Lead Project Manager	Y			1
Lead Safety assurance Engineer	Y			1
Lead Site Manager	Y	Y	1	
Lead Stores Controller	Y			1
Lead Systems Engineer	Y			1
Operations Director	Y			1
Operations Manager	Y	Y	1	

PA to MD	Y	Y	1
Planner	Y		1
Planner	Y		1
Planning Manager	Y	Y	1
Post development support engineer	Y		1
Power Engineering Manager	Y		1
Princilap Project Engineer	Y		1
Principal Project engineer	Y	Y	1
Principal safety assurance Engineer	Y		1
Principal Systems Engineer	Y	Y	1
Principal telecomms Support engineer	Y		1
Print Room Supervisor	Y		1
Procurement manager	Y	Y	1
Product Business Manager	Y	Y	1
Project commercial manager	Y	Y	1
Project Director	Y		1
Project Director	Y		1
Project Director	Y		1
Project Engineer	Y		1
Project Engineer	Y	Y	1
Project engineering Manager	Y	Y	1
Project Engineering Manager	Y		1
Project Environmental Advisor	Y		1
Project Manager	Y		1
Project Manager	Y		1
Project manager	Y	Y	1
Project material Management	Y		1
Purchasing Manager	Y		1
QS	Y		1
safety Assurance manager	Y		1
Scheme Project Engineer	Y	Y	1

Scheme Project Manager	Y			1
Scheme Project Manager	Y	Y	1	
SHE Manager	Y			1
SHEQ Advisor	Y	Y	1	
SHEQ Advisor	Y	Y	1	
SHEQ Assistant Advisor	Y			1
SHEQ Director	Y	Y	1	
SHEQ Manager	Y			1
SHEQ Systems & Compliance	Y	Y	1	
Site Manager	Y			1
Site Manager	Y			1
Sub-Contract QS	Y	Y	1	
Supply Chain delivery Manager	Y	Y	1	
Systems Engineer	Y			1
Systems Engineering manager (Product)	Y	Y	1	
T&C Resource Coordinator	Y			1
Team Leader	Y			1
Team Leader	Y			1
Techniacl Assurance Manager	Y	Y	1	
Technical support	Y	Y	1	
Telecomms Construction engineer	Y			1
Telecomms Engineering Manager	Y			1
Telecomms Project engineer	Y			1
Tender Engineering Manager	Y			1
Tendering Manager	Y			1
Tester In Charge	Y			1
Tester In Charge	Y			1
Testing & Commissionning manager	Y			1
			42	77
			119	