

Knowledge-based Management Information Systems for the Effective Business Performance of SMEs

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ABSTRACT

This study attempts to advance current thinking around Knowledge Management Systems (KMS) and Management Information Systems (MIS) by proposing integration into a holistic information system – Knowledge-based Management Information System (KBMIS). The aim of launching this KBMIS is to build an effective, timesaving and change adapting management information system for small and medium-sized enterprises (SMEs). This KBMIS is relevant in the current business environment as knowledge and information management has become a key issue in the business practice of SMEs. It is argued that information and knowledge flows must be effectively managed in all their business activities. In particular, this research focuses on organizational management and customer knowledge management for SMEs. This is because many SMEs lack resources and knowledge of strategic thinking, prerequisites for information and knowledge management. Therefore, this study proposes a dynamic model to evaluate the degree to which SMEs current MIS and KMS correspond with their organizational management and customer management needs. To develop this model, the critical characteristics of MIS, KMS, and SMEs are integrated. This model shows how information and knowledge may flow; and how these may be stored and managed in the SMEs' business process. A pilot study of two case studies is done to test this new model and the test result shows that this model gives systematic solutions for SMEs to redesign their information and knowledge management system.

INTRODUCTION

It is widely accepted that the world economy has moved on from the industrial age into a new age of knowledge work in the information society, where the main asset of an organization, is not its physical resources but its knowledge (Stacey, 2001). This realization is based on the following recognition of the changing characters of the world economy where service and knowledge-base products have replaced industrial, manufactured products as the main wealth generators. Kluge, Stein, and Licht (2001) concluded that

“Knowledge is at the heart of much of today’s global economy, and managing knowledge has become vital to companies’ success.”

Growing interest in organizational knowledge management research, or, simply addressed as knowledge management research, stems from the above cognition. Increasing numbers of researchers and practitioners are seeking solutions to garner, retain, update, and disseminate organizational knowledge in order to apply it to future organizational problems and development

(Malhotra, 2000). This is essential to all organizations, SMEs included, for, on one hand, when organizations are looking for best practices, new ideas, creative synergies and breakthrough processes, results only come from the effective use of organizational knowledge, where information can not provide the best answers, regardless of how well it is managed (Davenport & Prussic, 2000). On the other hand, all employees hold a certain amount of institutional memory that provides history and context, and is the basis of many day-to-day decisions. This aspect of organizational knowledge, often recognized as tacit knowledge, resides in an employee's mind. Capturing and making this knowledge available not only ensures continuity but can also accelerate organizational learning, and it is particularly important to capture this knowledge before individuals leave or retire from an organization. Yet rarely is this type of knowledge documented and shared. In many organizations, there are no organization-wide mechanisms to do so. Therefore, the challenge is how to make accessible to the organizational knowledge that currently resides with individuals (Newman & Conrad, 1999).

In this study, Knowledge management refers to “*a method that simplifies the process of sharing, distributing, creating, capturing, and understanding of a company's knowledge*” (Davenport & Prusak, 2000, p15). A knowledge management system (KMS) is a system that includes all methods, e.g. tools and techniques that are used to manage knowledge.

Traditionally the complete information system of a business has been called a management information system (MIS). Under this definition, all the other types of information systems, i.e. transaction processing, decision support, expert systems, and so on are parts of the management information system (Hicks, 1993). However, the trend today is to relegate the term “management information system” to its more restricted meaning, which generally refers to a system that provides recurring information about routine and anticipated business events (Hicks, 1993). Accordingly, in this study, MIS is an information system, including all sub systems, which produces summary information about normal business activities to all levels of management. MIS exist in organizations in order to help them achieve objectives, to plan and control their processes and operations, to help deal with uncertainty and to help in adapting to change or, indeed, initiating change (Travica, 2005; Lucey, 2005).

One of the most common distinctions in contemporary knowledge management literature is between knowledge, information and data. But in practice, they are often used interchangeably. Thus, information management and knowledge management cannot be separated very clearly in an organization, but normally, the knowledge management system of organizations is separated from their management information system (Newman & Conrad, 1999). This study will address the connection between the management information system and the knowledge management system and the importance of integrating them into one system.

According to Garengo, Biazzo, Simonetti and Bernardi (2005), there is consequently a need to develop support tools and methodologies that can start a process of developing management systems and managerial practices in Small and Medium-sized Enterprises (SMEs). This is because SMEs tend to dedicate most of their attention to operational and technological aspects rather than organizational and managerial issues.

In this study, it is proposed that, by integrating the knowledge management system (KMS) into the management information system (MIS) to set up a knowledge based management information system (KB MIS), it makes the MIS not only a tool for management but also an organization-wide mechanism to enhance the speed of knowledge transference, sharing and storing. This may help the management of SMEs to effectively use the information and knowledge resources at hand without creating a separate knowledge management system.

Another significant issue that faces many companies, including SMEs, is how to cope with change. Change occurs in many ways: competitive pressures, legislation, operating environment, the change of client/consumer preferences, introduction of new technology and many more (Lucey, 1994). Again, in this study it is suggested that a knowledge-based management information system can help managers to adapt to these changes by speeding the information flow, flattening the organization, sharing the knowledge, and improving communication

This study explores information and knowledge management integration in SME management, a new research area that has been paid little attention by academics. The proposed model is intended to help SME managers improve current MIS usage for a knowledge management purposes. A pilot of two case studies is done to test this new model and the test result shows that this model gives a systematic solution for SMEs to redesign their information and knowledge management system.

LITERATURE REVIEW

Management Information System

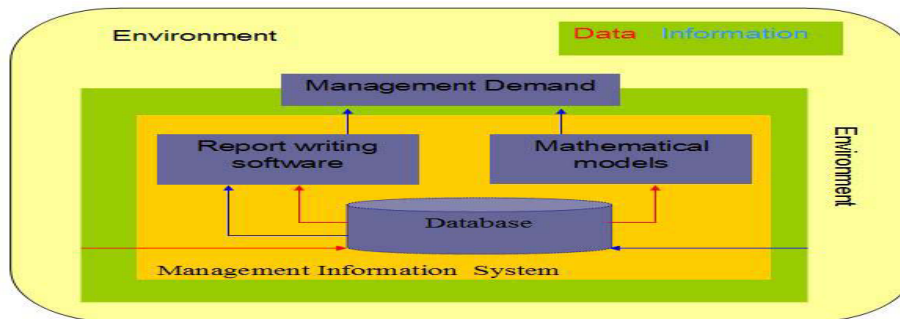
According to McLeod and Schell (2001), in current academic thinking, the term “management information systems” is still defined in two ways - firstly MIS is defined as: ‘the study and operation of information systems in business and management’ and secondly, it is defined as a more specific category of information system serving management-level functions as mentioned in the introduction. For the purpose of this study, the definition of management information system (MIS) is defined according to the second definition but is restricted to SMEs management. Therefore, MIS, in this study, is defined as “a system using formalized procedures to provide SMEs’ management at all levels in all functions with appropriate information from both internal and external sources, to enable them to timely and effectively plan, direct and control the activities for that they are responsible (adapted from Lucey, 2005).

There are two main functions of a MIS: 1) the provision of information for the purpose of daily management. 2) the provision of information to aid problem solving. The term problem needs to be clarified in that it is not necessarily something that is going wrong. There is no doubt that all levels of management in SMEs should respond quickly to harmful influences, seeking to prevent or minimize damage. However, they also need to be responsive to things that are going better than expected. Strong performance needs to be identified in order that possibilities may be transferred as “best practice” into other organizational domains, or that resources may be increased to prevent a decline in performance. Therefore, McLeod and Schell (2001)’s definition of the term ‘problem’ is adopted here as “*a condition that has the potential to cause exceptional harm or produce exceptional benefit*”. Problem solving then becomes the act of responding to

problems so as to suppress harmful effects and/or capitalize on the opportunity for benefit (McLeod & Schell, 2001; Travica, 2005).

An MIS need not be wholly computer-based. However, with the development of computer and information technologies, it is inevitable that the information derived from the high volume of data in basic operational processes will be computerized and network-based. Accordingly, an initiative, simply but widely applied MIS model is presented in Figure 1. This model uses types of software that produce information – report writing and mathematical modeling. Therefore, the MIS provides information to users (managers) in the form of reports and outputs from simulations by mathematical models. The report and model output can be provided in a written, tabular or graphic form. When the MIS is in place and functioning as intended, it can help problem solvers (managers) identify and understand problems (McLeod & Schell, 2001)

Figure 1: Management Information System.



Source: Management Information System, McLeod & Schell, 2001

Knowledge Management System

Knowledge management is a discipline that seeks to improve the performance of individuals and organizations by maintaining and leveraging the present and future value of knowledge assets (Newman & Conrad, 1999). A common recognition from knowledge management studies is to distinguish knowledge from both data and information, although the three terms are sometimes used interchangeably. Knowledge refers to information that enables action and decisions, or information with direction. Knowledge is a fluid mix of framed experience, values, contextual information, expert insight and grounded intuition that provides an environment and framework for evaluation and incorporation of new experience and information. In organizations it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices and norms (Tiwana, 2000). Information is considered as data in context. It contains substance and purpose. There are different ways in which meanings are added to data in order to transform it into information. Data become information through condensation, contextualization, calculation, categorization and/or correction process (Zile & Vinogradova, 2005). Data refer to mere facts devoid of context. All data collection methods e.g. capturing, handling, recording, processing and so on incur costs but do not produce value. Only when data are communicated and understood by the recipient and are thus transformed into information may value arise (Lucey, 2005). From the above discussion, it can be seen that knowledge, information and data are different concepts. However, the relationship between these three terms can also be detected that data, information and knowledge are interrelated in a hierarchical

structure, where the relationship is primarily unidirectional, with data supporting the generation of information that is in turn used to generate knowledge (Newman & Conrad, 1999). From this point of view, data, information and knowledge cannot be completely separated from each other (McManus & Snyder, 2003).

However, the interrelationship between these elements is much more complicated. While data and information can provide the building blocks of knowledge, equally knowledge can be used to generate data and information, therefore the relationship between them is dynamic and interactive, rather than simply unidirectional. Further, knowledge shapes the type of information /data collected, and the way it is analyzed. Thus people with different knowledge bases may develop different interpretations of the significance of the same events/results (Hislop, 2005; McManus & Snyder, 2003).

Therefore, on one hand, it is believed that knowledge helps produce information from data and/or more valuable information from less valuable information. On the other hand, it is recognized that new knowledge is created from new data and new information, and can also be stored in information systems (Becerra-Fernandez, Gonzalez, & Sabherwal, 2004; Hung, Tang, & Shu, 2008). This is the basic idea behind the knowledge management model below (Figure 2).

Figure 2: Knowledge Management System.



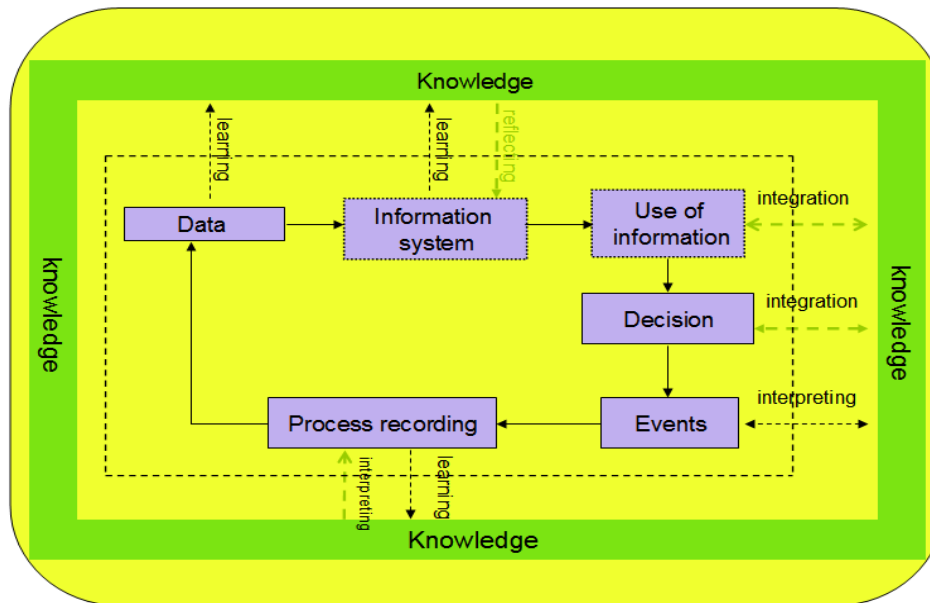
Source: Knowledge Management, Becerra-Fernandez, Gonzalez, & Sabherwal, 2004

By contrast, Stacey (2001) argued that knowledge arises in the heads of individuals and is largely tacit in form, this creates significant management problems. Knowledge is described as participative, self-organizing, process patterning and is impossible to manage. The aim of training and learning is to increase the competence, skill and knowledge of the individual, including the capacity to work as a member of a team. Spreading knowledge around an organization depends on a flexible organizational structure; behavioral change; inspiration and the removal of obstacles to informal contact. *“Organization knowledge is an evolutionary process of communicative interaction in which “you” is every member of an organization”* (Stacey, 2000).

In examining both sides of this argument in this study, it is proposed that well-designed, computerized and network-based management information systems may promote the capability to improve information flow and to enhance communicative interaction. Tacit knowledge may not be changed into explicit knowledge, stored in a database and shared by others, but the problem solving methods, working process and experiential events may be recorded, described and stored in an explicit way, i.e. in written, tabular or graphic form that is accessible to other people for the purpose of learning, training and the development of reflective practice. Learners

may not have the exact knowledge and thoughts as the knowledge providers do, but their knowledge is increased by interpreting the available and codified information according to their own experiences and from this point of view, knowledge is managed and shared. Communicative interaction is the key point in this knowledge sharing process. Communication includes both formal and informal patterns. So, the knowledge management system model is revised and is presented as the following (Figure 3).

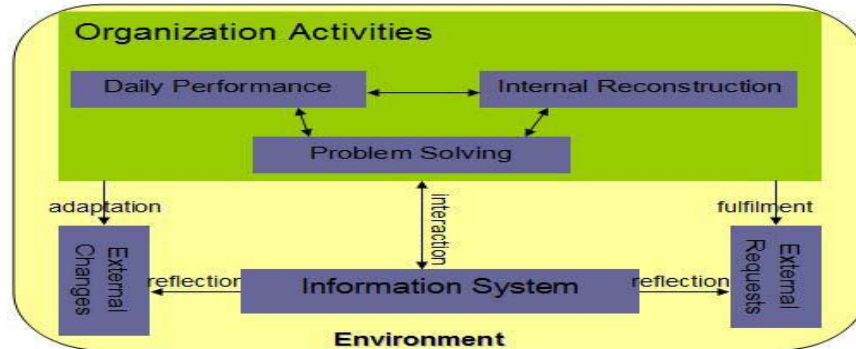
Figure 3: An Integrated Knowledge Management System.



The Co-Constructive Idea in the Development of Information Systems

When adapting a co-constructive idea into information systems development, an information system is endowed with the characteristic of being a “*socially creative unit of activity together with the actors*” (Lindgren & Ersson, 1998). The Information system, plays the role as one of the actors within the activity, and therefore, has the capacity to react to itself and its surroundings that ideally, will be a continually developing system. The information system as a co-constructive social actor may perform in two ways: 1) to collect and present information in a request-serving manner; 2) to support the constantly ongoing adaptation and development of the organization it serves (Lindgren & Ersson, 1998). The aim of building this co-constructive information system is to provide a better quality service to its user, to be resistant to data quality problems and to ease the organization’s adaptation to changes. The above idea is presented in the conceptual framework shown as below (Figure 4).

Figure 4: Co-constructive Information System.



Small and Medium-sized Enterprises

According to the European Union's definition, employment and turnover figures are used to define small and medium-sized enterprises (SMEs), within which 250 employees is the maximum employee threshold and ECU 45 million is the maximum turnover (2005, EU). Over the last decade, the rise in the importance of information and knowledge for business activity has been noted. Evidence shows that information systems can assist SMEs to work more effectively (Levy & Powell, 2005). Many SMEs already invest heavily in technologies to produce their goods or services. However, their use of IS and IT to manage business more effectively is often problematic. The problems may be due to the operational focus of many SMEs where the owner's knowledge is directed to the delivery of orders to customers. Other reasons may include difficulties in finding systems and technologies appropriate to the size of business, and limited skills and knowledge about IS within business. A key reason is the financial investment involved in IS, with many SMEs preferring to spend their limited capital on production and operational technologies rather than management support (Levy & Powell, 2005).

Compared with large companies, SMEs have their own characteristics that require support when developing managerial tools for them. Some of the essential characteristics include:

Organization: The employees in SMEs are usually closer to the entrepreneur, and because of the entrepreneur's influence, these employees must conform to his or her personality and style characteristics if they are to remain employees.

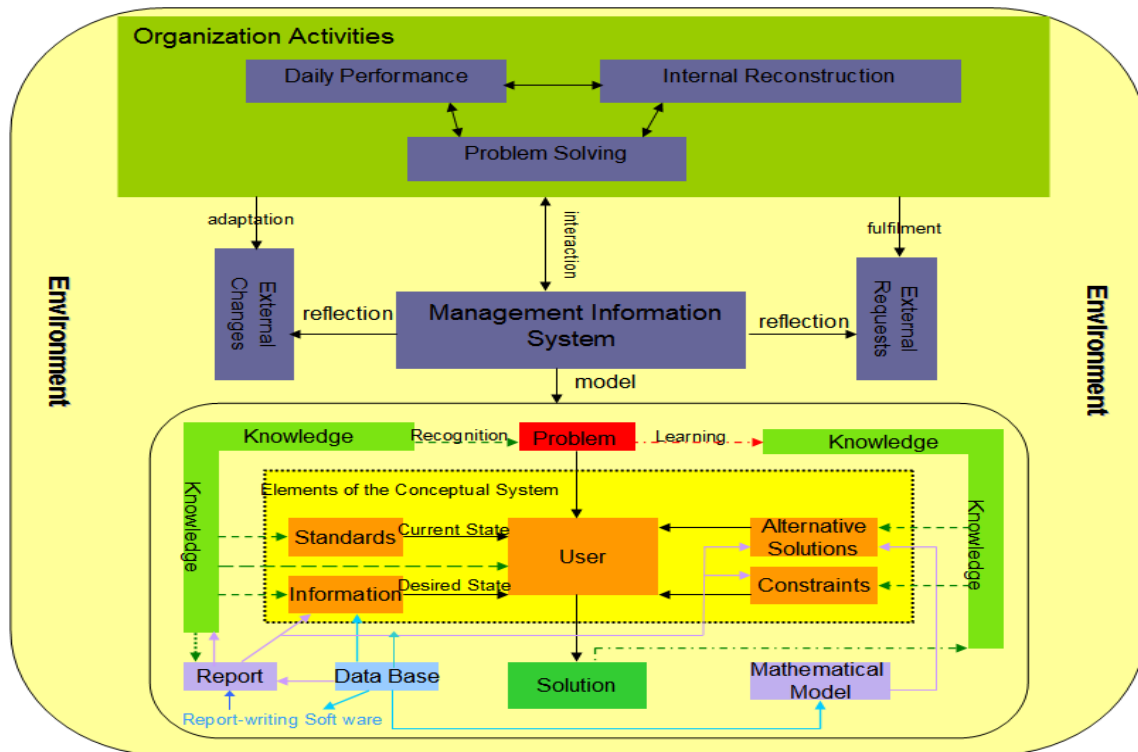
Risk taking: In SMEs risk taking depends on the circumstances. Risk taking can occur in situations where the survival of the enterprise may be under threat, or where a major competitor is undermining the activities of the enterprise. The entrepreneur may also be taking risks when he or she has not gathered all the relevant information, and thus has ignored some important facts in the decision-making process.

Flexibility: Because of the shorter communication lines between the enterprise and its customers, SMEs can react in a quicker and more flexible way to customers' enquiries (Hollensen, 2001).

MODEL CREATION

In this study, the above characteristics of MIS, KMS, and SMEs are considered in terms of system integration. A new model is created based on this consideration and is adopted to conduct this study. It is a combination of the three models that presented in Figure1, 3 and 4 and is called a knowledge-based management information system (KBMIS) in Figure 5.

Figure 5: Knowledge-based Management Information System Model.



On inspection, knowledge and information flow and exchange can be clearly seen. Personal tacit knowledge can be added to the system by writing it into reports, formulating it into mathematical models, creating/revising standards, considering constraints, and making alternative solutions. Once all these are done, tacit knowledge may be identified, stored, and shared throughout the whole system. New knowledge can also be created by obtaining new information from the database, creating/revising mathematical models, introducing new standards, recognizing new constraints, having alternative solutions and making the final decision. This new knowledge may comprise two parts: explicit knowledge and tacit knowledge. Explicit knowledge, i.e. new standards, new models and new reports, etc. may be stored within the system. Tacit knowledge may be created and reside in the brains of the people who participate in the problem-solving process. This new knowledge can be used to solve similar and/or relevant problems in the future. The MIS and KMS are integrated and interact with each other, making the new KBMIS a more effective and richer system than either of them used separately. The key function of this model is to identify the tacit knowledge that already resides in the brain and the new knowledge created from the problem-solving process and then record it. This is extremely important for SME managers, who are often regarded as deficient in the formal procedures surrounding management

functions and activities. This model presents the assumption that a well-designed information system also provides information that is in demand for the purpose of learning and training or structural change so an organization may become flatter and more flexible. Users not only use such information systems but also learn from the information they identify in order to increase their own capability and knowledge. The users' knowledge influences the process of information systems, development which improves the usability and the quality of outcome. This model is used as a conceptual framework to be implemented within this study.

RESEARCH METHODOLOGY

This study adopts an exploratory route, and applies a qualitative research approach from an interpretive viewpoint. This view represents an approach to information systems development where the focus revolves around how the quality of design, implementation and improvement is for the purpose of satisfying an organization's requirements. This perspective is combined with how well the organization is able to shift and adapt for the purpose of satisfying the information system requirements. Archival analysis and case study are the main research methods used in this study. Archival analysis is used to explore existing literature and documents plus the findings and practices in the subject area. The KB MIS model was founded in this critical review process. According to Yin (1994) a case study is a comprehensive description and analysis of a single situation. In case studies the aim of the research is to seek conformity between the results and the theory and a qualitative case study approach has a distinct advantage when "how" or "why" question is being asked about a contemporary set of events over which the investigator has little or no control. Therefore, to answer the research questions, a qualitative case study approach best suits this study. The questionnaire-based survey is the dominant research technique within the case study. Consequently, the case study is conducted on two samples of SMEs to compare the created model with the information and knowledge management models within their management and business function. The sample selection criteria of this study mainly focus on SMEs in North West England and the authors' accessibility to these SMEs. This is because the University of Bolton is located there and the Business, Logistics, Innovation and Systems (BLIS) Research Centre is undertaking a research project on SME business development with the Northwest Regional Development Agency, of which this study is part. This paper presents two studies. All the interviews have been recorded and the transcriptions have been inspected by the interviewees in order to improve the quality and validity of data.

Case Studies

Two case studies have been implemented for the primary exploration of this research. Case One focuses on the management of a small consulting organization. Case Two focuses on supply chain management of a small enterprise.

Case One

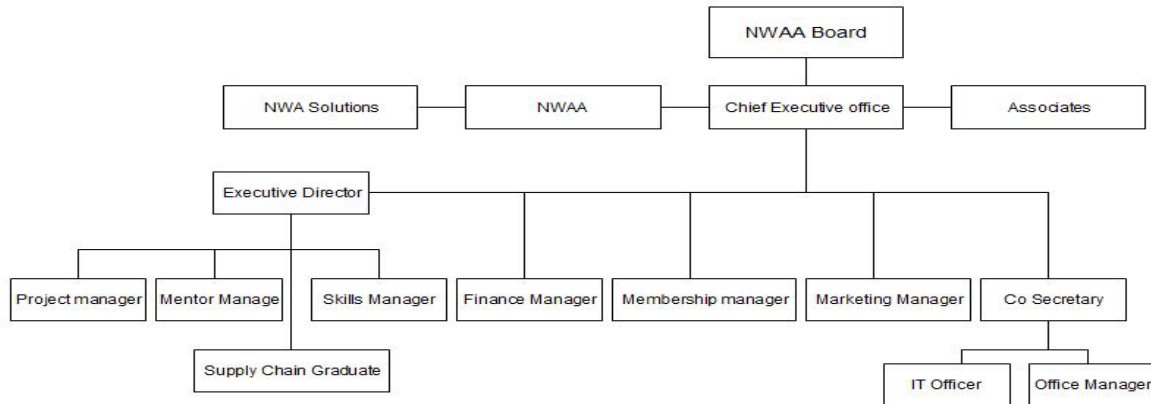
Located in North West England, the North West Aerospace Alliance (NWAA) is a leading aerospace industry cluster management organization reaching some 750 companies throughout the country and with a membership of over 300. The organization provides vital links between prime contractors, all levels of the supply chain, academia, local government and other

stakeholders in the industry. The focus of the NWAA is to provide fully integrated support for skills and supply chain development, technology and innovation for North West aerospace companies. It has 16 members of staff.

Management Structure

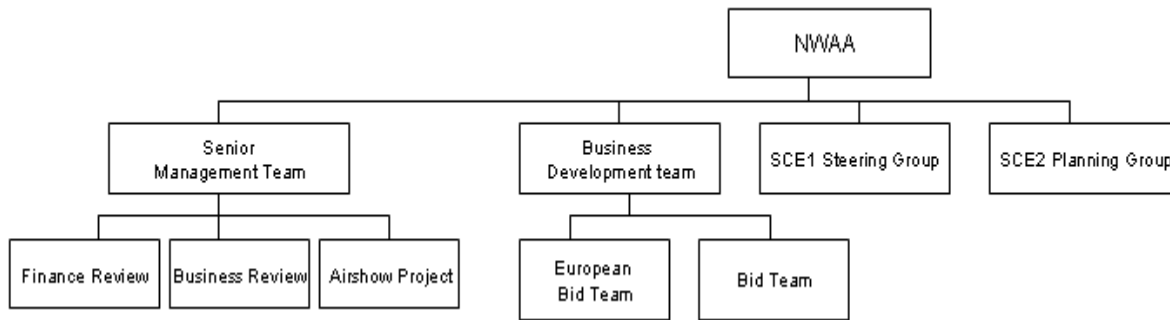
Originally, the NWAA was a government-funded non-profit small organization with a traditional type of hierarchical management structure (Figure 6).

Figure 6: Hierarchy Management Structure of NWAA.



Source: NWAA interview

Under the board, there is the chief executive's office which leads the daily work of the NWAA and NWA Solutions. North West Aerospace Solutions Ltd (NWA Solutions) is a newly created commercial section that enables the NWAA to make profits through consultancy, technology or skill support and other business activities. However, the principle is not to make profit but to further re-invest in the Alliance to support the aerospace industry in North West England. All the management teams under the Chief Executive's office are serving both NWAA and NWA Solutions. The Chief Executive's office is also in charge of managing the partnership with Associates. The Associates indicated in Figure 6 are not part of the NWAA but partners who bring in the skills that the NWAA needs. This is because the cost of keeping all the technological skills in house is too high. Therefore, the NWAA has five or six associates or consultancies with whom they cooperate in order to buy technological skills when in need or to keep the skills up to date. To adapt to organizational changes, the NWAA recently restructured to a flatter management style (Figure 7).

Figure 7: New Management Structure of NWAA.

Source: NWAA interview

The change means that the old hierarchical management structure is now broken in different teams. Each team has its own targets and functions but also enables work across teams to carry out multiple tasks and functions. This structure is intended to incorporate every member of staff and increase their accountability for more than just their own area.

Management Information Systems

As a cluster management organization, the NWAA heavily relies on information exchange, both internally and externally. To fulfill this requirement, the NWAA is fully IT equipped. All hardware is up-to-speed and up-to-date. Any equipment that cannot be updated or does not meet the technical requirements will be replaced.

Different management information systems have been created according to different tasks or functions. These include:

- the official website that is open to the public - <http://www.aerospace.co.uk/>
- The contact management system (CMS) that is used as an internal network for all members of the NWAA staff; and
- specially designed website-based information systems for different projects.

The functions of these MIS are presented below. One of the responsibilities of the NWAA is to support the aerospace industry by providing the facilities for promotion purposes. Many members of the NWAA are SMEs who do not have a marketing department. Some are family businesses that lack the awareness, knowledge or IT support to promote themselves properly. For example, not all of them have websites and some of them have not registered an email address until recently. Therefore, the NWAA has created a link called “capability search” on the homepage of its official website. This link directs to a webpage where all member companies are listed. Under the name of each company, details of its products, services, contacts and other relevant information are presented. Any individual or organization from across the globe, who is looking for a particular product, service or partnership, may use this search function to find the relevant company/companies. Both company name and key word of product or service can be used to search this webpage to enable new customers to quickly identify the company they are

looking for. In the last 3 years, since this website was launched, the member companies have attracted new customers from Europe, Asia and America.

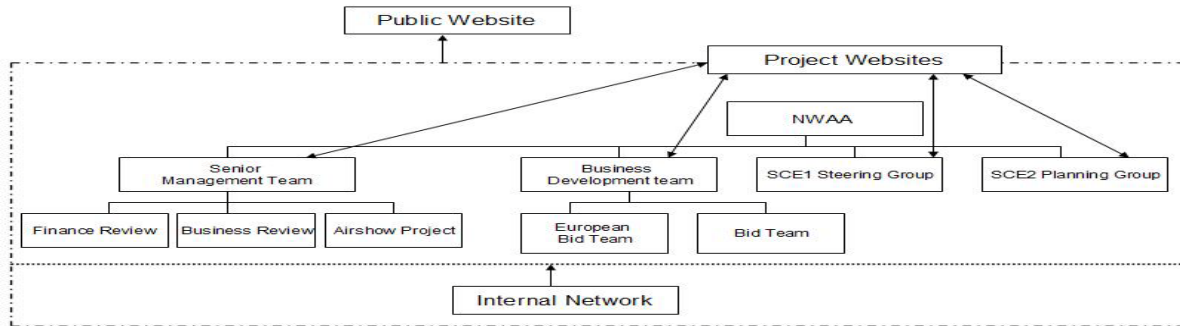
Another key facility offered by this website is the Job Bank. All the NWAA members can use this function to advertise for recruitment. The motivation for the NWAA to create this online Job Bank is from recognition that the Aerospace Industry needs people who have special skills and common recruitment methods do not work. Also, for many of the members who are SMEs, online recruitment advertisements are too costly. One month online advertising may cost hundreds of pounds. Therefore, the NWAA has slowly built up this advertising function which only costs the members fifty pounds for three months' advertising. This facility is still under development but is increasing in popularity. Job seekers can also register without charge to search vacancies and advertise themselves by uploading their CVs onto the website.

The Contact Management System (CMS) is used as an internal network for all members of staff in the NWAA. It hosts organizational profiles of all members and other organizations who have not registered as members. It also contains all records of meetings and visits from or to the members. The CMS enables the NWAA to organize its business activities, to raise purchase orders online and to reduce unnecessary visits. For example, if a member of staff plans to visit a company, he/she will put the schedule on the CMS. By checking these schedules, it may be found that more than one people plan to visit the same company in a short time. In this case, these staff will meet together trying to integrate all activities into one visit, or as few as possible.

Another important function of the CMS is to manage membership records. Every year, the NWAA emails to its members to ask them to update their profiles and pay their membership fees. A telephone call is made if there is no response from a company. All these activities are recorded onto the CMS including the details such as when the email was sent, when the call was made, who made the call, who answered and what was the result. Therefore, if a member company is missed from a new brochure, its record clearly shows the reason. Before the CMS was launched, the NWAA had about twelve different databases on Access or Excel. Different lists and entries were designed for different database. This increasingly led to difficulties in managing and controlling these databases. The situation became even worse when new staff created new databases without considering at the existing ones. The introduction of this CMS reduced overlaps, speeded up information exchange and enhanced effectiveness.

Besides supporting its members, the NWAA is conducting different projects with different partners. These partners can be members or non-members. For each project, the NWAA creates a special website-based information system that can only be accessed by project partners. Using this security-enabled management information system, partners can upload and download quarterly reports and confidential documents, view their expenditure and other partners' profiles and exchange information between each other. Different users have different levels of entry authority. For example, one company cannot view another company's financial report. These information systems enable the NWAA to effectively manage and conduct its projects.

To summarize the above discussion, the management information systems structure in the NWAA is described in the following (Figure8).

Figure 8: The NWAA Management Information Systems Structure.

The NWAA regards the above management information systems as effective and sufficient to fulfill management needs. The weakness of these systems may be that they are too comprehensive and not easy to use initially. If a new member of staff is not familiar with these systems, he/she may not be able to find the right information. Another weakness is caused not by the systems, but by the users. Internally, not all staff is willing to use these systems, especially when they have been imposed on previous work processes which were developed before these systems were created. Therefore, when these systems were introduced, staff resisted changes even though they are trained to use them – as the Business Manager of the NWAA (the interviewee) said: “You can lead a horse to water but you can’t make it drink”.

Externally, the biggest issue that the NWAA encounters is member companies who are not interested in investing in IT. It was only in 2007 that every member company obtained broadband and an email address, which enabled electronic communications to all members. This saved the NWAA more than £2,000 per year on postage. Most of NWAA member companies are SMEs and many of them are family businesses. Some old generations prefer not to change their business patterns and lack the interests to invest in IT systems because they cannot see the benefit. This can sometimes influence the new generations who simply follow the old ways and are not willing to make changes either.

Knowledge Management

Although awareness of the benefit that knowledge management may bring has been raised at senior management level, the NWAA has not yet introduced knowledge management into its management activities.

To control the quality of its management, the NWAA has created an ISO9000 proved Quality Control System (QCS). ISO is the International Organization for Standardization ISO, a non-governmental organization that develops and publishes international standards. The ISO9000 is a family of standards for quality management systems. A company or organization that has been independently audited and certified to be in conformance with ISO9000 is registered and proved by ISO (ISO website, 2009).

The NWAA quality control system has three levels - top-level quality manual from senior management; quality control procedures covering each project; and working instruction for each

position. This system standardizes and controls the business activities and processes in the NWAA. It also helps new staff to understand the content and the context of their roles. This system, however, does not have a knowledge management function.

As referenced to the management structure section, the NWAA has recently created a new commercial section. To start this new business function, the management needs to identify what part of the current business can be commercialized and how can that be achieved. This identification process requires all members of staff to centralize their knowledge and experience from different area. Obviously, this is a knowledge management process. The management of the NWAA has recognized the importance and benefits of doing so. The methods of how to conduct this process and how to record and share the outcomes have not yet been investigated.

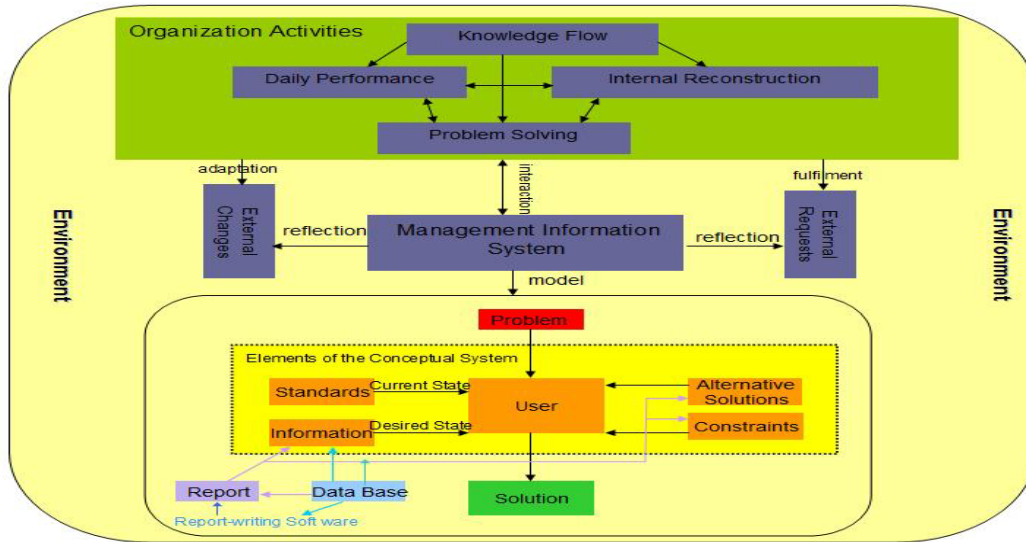
Currently, many of the NWAA meetings are recorded and are saved into a database. Most of these recordings have never been used since they were produced. Rather than looking for these recordings, people often use meeting minutes or contact the person who attended the meeting to collect information. To save time, the NWAA introduced an A3 reporting system. All meeting minutes are required not to exceeding one page of A3 paper. Sometimes the minutes may not long enough to contain all the details. To cope with these problems and to implement knowledge management, the NWAA is planning to create an online help desk on the CMS website. This new function is intended to encourage staff to record critical working processes and solutions to unexpected problems, or, to share information and experiences.

Although the management of the NWAA has recognized the importance and benefits of adopting knowledge management for their business activities, they appear to treat knowledge management more as theory than practice. A lot of effort needs to be made to transform the theory into practice. It also takes time to do so. The current management information systems cannot be used for knowledge management. They are designed only to provide information. Presently, the NWAA has no strategy on knowledge management applications. What it is doing at the moment is to track all projects into the procedures, such as workshops for gathering answers from member and non-member companies; written documents; and meeting minutes and recordings. These are considered to be helping the NWAA to move on to the next stage – knowledge management.

Analysis

To be a cluster management organization, the NWAA is leading information management and knowledge management to its member SMEs, but has only recently become aware of the benefits and importance of knowledge management and did not have any strategy on knowledge management application. Compared to the theoretical model, the NWAA management system is described as the following (Figure 9).

Figure 9: The NWAA KBMIS Model.



In its management information systems, the NWAA does not have mathematical models to generalize data, so this part does not appear in its KBMIS model. There is no separate knowledge management system in the NWAA and the current management information systems are not believed to have the capability to manage knowledge. Knowledge is shared either in a static manner, for instance, meeting recordings and minutes; working instructions; job descriptions; and written documents, which is mainly regarded as information rather than knowledge; or in a flowing manner, for instance, face to face communication, problem solving and training and therefore remains unrecorded.

The NWAA does not realize that its current management information systems may achieve some knowledge management functions, for example, to track, store and document its business activities. This is because the NWAA regards these functions as information management. It is information management, but to a limited extent, it is also knowledge management because the purpose of storing these activities is to solve future problems or to extend its future business. When fulfilling these purposes, information becomes explicit knowledge, but the NWAA appears not to be aware of this. The NWAA staff do not record their working process and the solutions to problems with the intent to transfer tacit knowledge to explicit knowledge.

Case Two

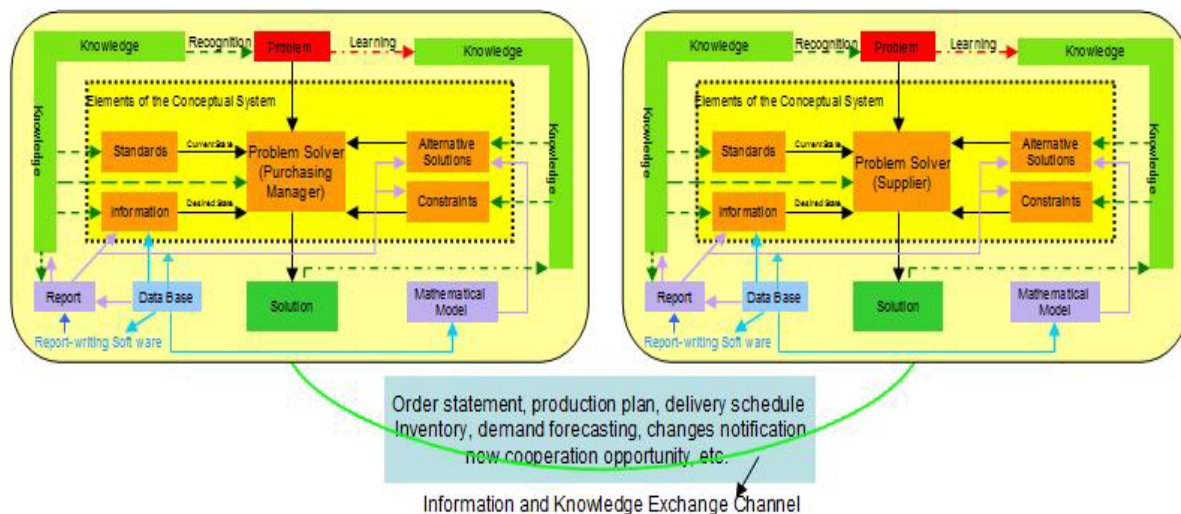
Case Two is about supply chain management in an SME.

Supply Chain Management (SCM)

SCM is the chain linking each element of the manufacturing and supply process from raw materials through to the end user (Tan, Lyman, & Wisner, 2002; Wu, Chen, & Tsai, 2006). Materials, information, fund/cash, and product/service flows are suggested as the major characteristics of the supply chain, while information is suggested to be the most important one because it precedes all other flows. The content of information flow may include order

statements, production plans, delivery schedules, inventory, demand forecasting, changes notification and new cooperation opportunity development, etc (Li & Yan, 2005). It must be effectively managed before any business activity takes place (Dimitriadis & Koh, 2005; Zsidisin, Jun, & Adams, 2000). Thus, information as a part of managing flows in SCM has an added significance if compared with the other flows (Wu, Chen, & Tsai, 2006). This significance becomes even more apparent due to the emergence of the new information and communication technologies (ICTs). It is suggested that the new ICTs enhance information sharing and coordination, and increase the quality and speed of responses throughout the supply chain, particularly for SMEs, who are regarded as lacking in resources. SMEs with more qualified and specialized employees gather more external information and create more innovations than the others (Dimitriadis & Koh, 2005). In Dimitriadis and Koh's study, most of the information flow was found to be personal through human interaction. Information technologies, and especially the use of the Internet, can enhance information flow both externally and internally. Therefore, the research model created in this research is tailored by combining the content of supply chain information flow, which is generalized as information about order statements, production plans, delivery schedules, inventory, demand forecasting, changes notification and new cooperation opportunity development, etc (Figure 10). In this model it is suggested that both buyer and supplier have their own KBMIS model to manage information and knowledge internally, and use an external information and knowledge exchange channel to share information and knowledge between them.

Figure 10: KBMIS-SCM Model.



Based on this KBMIS-SCM model, the sample company's current information and knowledge flow between itself and its twelve suppliers are analyzed.

Supply Chain Structure of Company A

The sample company, which prefers not to be named, has 124 employees. Its turnover was £18 million (ECU 27 million) in 2006. According to the EU definition mentioned above, it is a SME. In the following discussion, Company A is used as a name for the sample company.

A tailored questionnaire was sent to Company A and its twelve suppliers. All of them responded. All these suppliers are SMEs. The following table shows the feedback from the suppliers (Table 1).

Eleven of 12 suppliers view Company A as a valuable customer and want to keep or improve their long-term relationship.

All suppliers have a quality response policy not only to Company A but to all of their customers. However, only two of them use customer measurements to evaluate the quality.

Seven out of twelve obtain a quality explanation from Company A prior to order placement.

All suppliers see themselves as fully understanding the overall as well as the specific quality requirements of Company A. Company A does not agree to this concept.

Eight out of twelve suppliers require the receipt of models from Company A to perform the production, which means most of Company A suppliers produce specially designed products for Company A.

Half of the suppliers have plans to reduce costs by working closely with Company A while half of them do not.

Nine out of twelve suppliers do not have safety stock of long lead-time items. This is the main reason that all suppliers disagree with Company A's delivery report.

Company A frequently changes delivery schedules that lead to delivery delay from suppliers. There is no formal management information system used in either Company A or its suppliers. All managers of both buyers and suppliers make decisions or create solutions based on routine information and personal experience. The existing information and knowledge exchange channels are not sufficient for them to share information and knowledge.

All of the suppliers and Company A report changes to each other solely by email. Only one supplier also uses fax and only one supplier also use order amendments, schedule updates and verbal communication. So when unexpected events occur, e.g., delivery schedule changes, the other side cannot amend production plans to deal with the changes quickly.

All of the suppliers feel they need more information and communication from Company A on the following subjects – schedules and forecasts, full knowledge of potential opportunities, requirements change, and involvement in Company A's new product development, technical and quality queries. Nine out of twelve think they need to increase their visits to Company A.

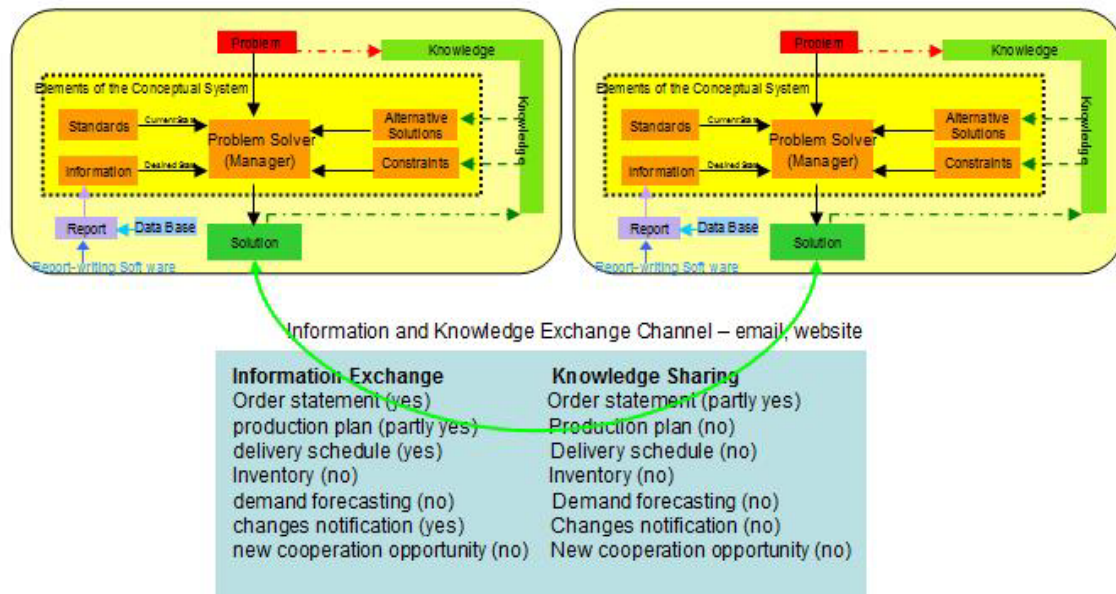
Table 1: Questionnaire Feedback (1–strongly agree, 2–agree, 3–disagree, 4–strongly disagree).

Questions	Suppliers											
	1	2	3	4	5	6	7	8	9	10	11	12
Supplier has a quality response policy to fulfill needs of Company A.	1	1	1	2	1	2	2	1	2	1	2	2
Company A defines and explains all quality requirements prior to or at order placement	3	2	3		1	3	1	1	3	2	3	2
Supplier fully understands the specific and overall quality requirements of Company A.	1	2	2	1	1	1	1	1	3	2	2	2
Supplier requires receipt of models from Company A to perform the production	1	3	4	1	4	1	3	1	1	2	1	1
Supplier has plan to reduce costs with Company A's cooperation	3	2	3	1	2	1	2	3	3	3	3	2
Company A has stable delivery schedules	3	3	4	1	3	3	4	2	3	2	3	2
Company A informs delivery schedule changes	2	2	3	1	2	3	2	3	2	3	3	3
Supplier informs delivery changes to Company A	3	2	1	1	3	2	3	2	2	2	2	1
Supplier holds safety stock of long lead-time items in order to buffer schedule changes	3	2	3	3	3	3	3	2	2	4	3	4
Supplier agrees with its delivery report produced by Company A.	3	4	4	3	4	3	3	3	3	3	3	3
Supplier's relationship attitude and flexibility with Company A is good	2	1	2	2	1	1	2	2	2	1	2	2
Supplier's queries are always initially replied to within 24hrs	3	2	2	3	3	4	4	3	2	2	3	3
Suppliers frequently needs to wait and chase for responses from Company A.	2	3	1	4	2	2	2	2	3	3	2	2
In terms of company stability/profitability, a long-term agreement with Company A is /will be valuable	2	1	1	1	2	1	2	2	2	2	2	3
Supplier rates Company A as an excellent and valuable customer and look forward to working with them on new projects	1	1	2	1	1	1	1	2	2	1	1	3
Involved in Company A new product development	3	3	0	3	3	3	2	3	3	3	3	3
Supplier has experienced late payments from Company A.	3	3	4	3	3	4	3	3	3	4	3	3

Analysis

Figure 11 shows how information and knowledge are managed in Company A and its suppliers. It also shows how information and knowledge are shared between them. This model is formulated based on the theoretical model (Figure 10) presented previously.

Figure 11: Company A Information Management and Knowledge Sharing Model.



Company A does have access, “supplier management”, on their website, for suppliers to communicate and to obtain documents. However, its functions are limited and suppliers cannot acquire sufficient information for schedule changes, new demands and plans, current inventory, new product development, and new cooperation opportunities, etc. As a result, they cannot cope with the changes that Company A makes. Company A does not involve its suppliers in new product development. It also changes delivery schedules frequently according to its own needs. These issues bring about delivery delays from suppliers. Suppliers cannot update their technology in time to fulfill the needs of Company A. The lack of information exchange and communication are still strong issues which prevent Company A and its suppliers cooperating harmoniously and coping with changes. The created model only partly applies to Company A and its suppliers. That is because information and knowledge flows between standard, alternative solution, constraints and the managers are not available in either Company A or its suppliers. Mathematical model has not been adopted for management functions amongst these companies. No knowledge management system exists for Company A and its suppliers. Tacit knowledge is used and remains within individuals. It is not recognized, shared and stored to the intention of a knowledge management process.

SUMMARY AND CONCLUSION

This study is conducted with two sample SMEs to compare the created model with the information and knowledge management models within their business performance function. The aim of this comparison is to find out whether or not this new model can be applied to SMEs. The answer is yes. By breaking the model into different functional areas and by using interview questions that are formulated and based on the model, the two sample companies’ information and knowledge management status is described and analyzed. The first case shows that the consulting SMEs are ahead of manufacturing SMEs in information and knowledge management. They invest heavily in IT, have well developed management information systems but have their member manufacturing companies acting as barriers to implement their strategies. They are

aware of the importance of knowledge management but do not know exactly what knowledge management is and how to conduct it. The theoretical model helps them to realize that some activities that they have completed move towards knowledge management; helps them to become aware of the importance of making new regulations on staff IT adoption and knowledge sharing; and helps them to identify what they fail to do, which is the strategy on knowledge management system creation and implementation. The model also suggests that the sample company may not need to create a separate knowledge management system. By using the available functions of their current management information systems and adapting them to be more knowledge based, the company may achieve its current knowledge management work at a strategic level. For example, the adaptation may include creating a new area on the internal network for staff to record their working processes, to present solutions and to exchange information experience. The adaptation may also include encouraging staff to create an informal communication forum to share their knowledge and experience in a more free and flexible way.

From the second case study, some outcomes of the first case study and other evidence shown from other research (Hick, 1993; Levy & Powell, 2005; Stokes, 2002; Lucy, 2005), in most of the manufacturing SMEs, a knowledge management department does not exist as they are unaware of the concept of knowledge management or are not ready to create one. Information is managed and shared in a way but no management information system is created up to help managers to make decisions or to find solutions more effectively and efficiently. The interview and model help the sample company to be aware of the concept of knowledge management; to be aware of the importance of knowledge sharing between suppliers; and to be aware of the need to build up a sufficient and effective management information system. The model also helps the sample company to identify the factors that they need to consider in order to develop their business. That is, except for daily production, they need to spend more time on developing strategies and procedures on their information and communication management, and from there, to seriously consider the need of knowledge exchange and management.

From this study, it can be concluded that firstly, the cases reflect some of the SMEs unique characteristics, i.e. the organizational structure is more flexible to adapt to changes (the NWAA) and the entrepreneur's influence strongly leads the direction of SMEs' businesses (the NWAA family owned member companies). Secondly, the model created in this study is an advanced idea for SMEs. It may not be achieved by SMEs in the short term, but it gives systemic solution for SMEs to design/redesign their information and knowledge management system. In future research, this model will be tested in more SMEs and will be revised to make it more practicable. Culture issues and learning styles will be considered in the model. The researchers will also explore the information systems and technologies applications appropriate to SMEs.

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