
INVESTIGATION OF THE CURRENT STATUS OF DOCUMENT AND INFORMATION MANAGEMENT

Cynthia Changxin Wang, Senior Lecturer, cynthia.wang@unsw.edu.au

Alex Chew, Honors Student, alexchao5607@gmail.com

Program of Construction Management and Property, The University of NSW, Sydney, NSW 2052 Australia

ABSTRACT

Document and information management is important in any project environment, especially in the building and construction industry. As a large amount of project information is exchanged and shared in the project life cycle, good document management is essential for efficient communication and decision making. Although the use of electronic and web-based document management systems is common in the industry, there are technical barriers and behavioral barriers for improving the document management process in the industry. What is the current status of document and information management in the industry? Can professional training help to overcome these barriers? This research attempts to answer these questions. The objective of this research is to identify the key knowledge and skills for efficient document and information management, and to investigate effective training methods that can enhance the document and information management skills in the construction industry. A questionnaire survey was adopted for this study. The data was collected by using a structured online survey. Simple random sample method was used as the sampling method for drawing participants from a series of document control training courses. This research has identified that there are seven key knowledge and skills for efficient document and information management, which are compliance requirements, quality management, communication skills and knowledge of the computer system, collaboration skills, risk management and process mapping. In addition, the most effective document management training methods are group discussion and lecture presentation, and most respondents prefer more collaborative and interactive training methods to enhance their document management skills.

Keywords: document management, information management, training method, construction industry

1. INTRODUCTION

The construction industry is fragmented due to many stakeholders and phases involved in a construction project (Nitithamyong and Skibniewski 2004). This fragmentation and the growing complexity of construction projects results in an increase in problems associated with document management and retrieval techniques (Elghamrawy and Boukamp 2010), and also lead to problems with communication and information processing that has contributed to the proliferation of adversarial relationships between the parties to a project (Nitithamyong and Skibniewski 2004). Thus, managing construction documents is a real challenge, and many researchers believe that more efficient document management is a primary step for the construction industry (Bjork 2003).

Over the last decades, the widespread use of information technologies for construction dramatically motivated the development of construction management information systems, such as the Electronic Document Management (EDM) systems (Caldas and Soibelman 2003). These document management systems are helpful in cost reduction, time savings, and enhancement of productivity by providing timely and concise information, reduction in project delays (Sidawi and Omairi 2010, Nitithamyong and Skibniewski 2004). However, technical barriers and the behavioral are the main obstacles to the effectiveness of document management system in construction. Technical barriers are determined in terms of ease of use and system reliability (Nitithamyong and Skibniewski 2006). The behavioral barriers are defined as the difficulties to get people to change their individual way of work (Bjork 2003). Many of the behavioral barrier factors are due to poor training skills (Forcada et. al. 2007). Effective training can help the users to understand better about using those systems and influence their acceptance (Peansupap and Walker 2005), but lack of time and lack of personal initiatives for training can still restrict its effectiveness (Peansupap and Walker 2005; Whyte and Bouchlaghem 2001).

Although there are many existed researches on document and information management, but few mentioned either on the key knowledge and skills for effective document and information management or on the effective training method enhance the document and information management skills and knowledge. Besides, many previous researches focused on the building construction industry, very little attention was paid to other document and information intensive industries, such as mining industry as well as oil and gas industry. These industries are usually heavily project-orientated and a lot of documents and information are shared between the project participants in those industries.

Thus the aim of this study is to investigate the current status of document and information management in the construction industry and other document and information intensive industries. To achieve this, the specific objectives are defined as follows:

- Identify the key knowledge and skills for efficient document and information management that are required in the construction related industry.
- Investigate what kinds of methods for document management training can effectively enhance the document and information management skills and knowledge.

2. LITERATURE REVIEW

2.1 The evolution and benefit of document management methods

Over the last decades, the widespread use of information technologies for construction dramatically motivated the development of construction management information systems, such as the Electronic Document Management (EDM) systems (Caldas and Soibelman 2003). EDM systems have been developed to track and store electronic documents, providing storage, versioning, metadata, security, as well as indexing and retrieval capabilities (Chassiakos and Sakellariopoulos 2008), and the systems focus on facilitating the management of documents pertinent to particular enterprises, projects and work groups in computer networks (Bjork 2003). Nevertheless, Bjork (2003) criticised that early EDM systems are often limited to usage within dedicated networks and user interfaces of their own and it was often very difficult to get the technical infrastructure in place. With the boom of the internet, almost all EDM systems are migrating to using the general internet as their physical network, web servers as storage medium and web browsers as the main platform for building user interfaces (Bjork 2003). A number of professional information technology companies to develop commercial web-based systems for document management in the construction industry (Chassiakos and Sakellariopoulos 2008). This truly reflects a clear trend that has been away from in-house solutions, typically

provided by one of the dominating project participants such as the architect or the main contractor, towards outsourcing of document management to third parties known as Application Service Providers (ASP) (Hjelt and Bjork 2006).

A good way of encouraging the usage of document management systems in the construction projects is to promote the benefits for using those systems, as the benefits of using IT-integrated systems have motivated numerous construction organizations to adopt and invest in this technology (Peansupap and Walker 2005), such as EDMS and WPMS. Edwards et. al. (1996) have highlighted a few fundamental benefits of using EDMS, such as time and cost savings and also EDMS help to act as an enhanced communication links between the various participants of the construction industry which will improve communication flow. Sidawi and Omairi (2010) also agreed that this system would ensure the smooth flow of project work, providing accurate, speedy and updated information as well as reducing the cost of construction by 25% through the efficient transfer of information between the construction teams. Edwards et. al. (1996) also revealed that EDMS can provide improvements in quality and efficiency in terms of reducing the time dramatically for information transfers, and minimizing the likelihood of information becoming mislaid or lost, as well as EDMS can lead to increased productivity like sorting out constructions problems quickly (Sidawi and Omairi 2010). In addition, Sidawi and Omairi (2010) and Nitithamyong and Skibniewski (2004) also highlighted a number of benefits from using WPMS technology for document and information management, such as cost reduction, time savings, enhancement of productivity by providing timely and concise information in order to make more effective decisions, reduction in project delays, heightened all participants' awareness of the project issues, and ease of access and retrieval of project information. Other advantages include avoiding delays because of the arrival of updated drawings documents, reducing visits to site and travelling time to meeting, avoiding drawings mistakes, reducing time and money spent on disputes, sharing and exchanging project information, automate repetitive routine processes and elimination of paper reports (Sidawi and Omairi 2010).

2.2 Barriers to effective document management

Technical barrier is one of the main obstacles to the effective document management in construction. Nitithamyong and Skibniewski (2006) mentioned that the technical barriers are determined in terms of ease of use and system reliability. Bjork (2003) described that technical barriers were often prominent during the early pilot use of EDM systems in construction projects from the mid 1990's, for instance the difficulties in setting up the connections for the EDM systems. Apart from that, although the boom of information technology and internet have led to the trend of using web-based project management systems (WPMSs) for document and information management, WPMSs are still relatively new and have not yet fulfilled initial expectations regarding their usefulness and reliability, as research conducted to date have mainly aimed at solving existing technical problems with WPMS (Forcada et al 2007). In addition, inadequate interoperability between different systems is another major source of inefficiency for document and information management (Froese 2005). According to Froese (2005), there is still little direct exchange of data between different systems used in the construction industry. Those systems usually provide point solutions with no real data and workflow integration between them and data is still being recreated multiple times and transferred manually within and across enterprises (Vaidyanathan and O'Brien 2003). Although there are many initiatives that are focused on integration and interoperability to enable information to flow from one computer application to the next throughout the life cycle of a project (Forcada et al 2007), the fragmentation of the construction industry and the short duration partnering of many small companies (Turner and Muller 2003) inhibits this type of solution. Inadequate interoperability is mainly due to the lack of data standardization which has been a major

obstacle for computer-integrated construction projects (Chassiakos and Sakellaropoulos 2008), thus it is essential for a solution based on industry-wide data interoperability standards as systems must interoperate across all project participants with little customized configuration to improve the distribution of information (Goedert and Meadati 2008, Froese 2005).

Behavioral factor is another key barrier to efficient document management. According to Bjork (2003), one of the behavioral barriers is the fact that it is very difficult to get people to change their individual way of work, of which it is often due to the forgone of user freedom as well as it requires a great deal of discipline. Using the example of implementing EDM, Bjork (2003) explained that the effective reuse and search for information in an EDM system requires a lot of discipline on the part of the producers of the documents, for instance in filling out meta-data in forms, while on the other hand people who have always been used to being able to organize their personal archives as they please, are now forced into a new document management structure that many experience as a straightjacket, which would then create tension between user freedom and company control. In addition, problems in EDM-based projects are that EDM competes with numerous traditional, well-established channels of communication such as facsimile, e-mail, phone and courier services which are still playing an important role in EDM-enabled projects (Hjelt and Bjork 2006), thus the users who face technical difficulties in using EDM are quick to fall back to traditional channels of communication. O'Brien (2000) supported that individual's resistance to change is the barrier to successful implementation of web-based project document management system in the construction industry, although Bjork (2003) suggested that this barrier can be overcome through the motivation and training of users to ensure effective document management in the construction industry. Team attitude is also a behavioral barrier factor to effective construction document management. Nititharmyong and Skibniewski (2006) found that team attitudes towards information technology (IT) and web-based project management systems (WPMS) are among the failure factors for implementing those systems as tools for improving document organization. Hjelt and Bjork (2006) and O'Brien (2000) have highlighted the fact that the users of a system in a project cannot be treated as one uniform or homogenous group, but rather consist of several groups with different attitudes and skills. The problem with an EDM system is that successful use requires that all of these groups to adopt the system at the same time (Bjork 2003), of which this situation does not happen all the time, for instance between architects or engineers and subcontractors groups. Generally, architects and engineers are most likely to use EDM systems because they have the necessary infrastructure to support them and are more familiar with technological solutions such as CAD (Forcada et al. 2007). In contrast, the subcontractors in general have less EDM systems experience than architects and they primarily are pure information retrievers who never store any documents in the EDM systems (Hjelt and Bjork 2006) and they also show most resistance to adopting these tools (Forcada et al. 2007). Hence, the fact that subcontractors do not show the mutual interests as a "team" with architects or engineers in using EDM systems or WPMS are because they do not perceive them as adding value, due to poor exposure, lack of education (Forcada et al. 2007) or poor IT skills (Takamoto et al. 2003), and eventually this poor team attitude will hamper any effective construction document management efforts.

2.3 Training initiative of document management

Many of the barriers are due to the poor training skills (Forcada et al. 2007). Training helps the users to understand how to best use and adopt IT applications, such as document management systems, as well as the training can influence the users' ability and acceptance of the systems because they take time to learn and use (Peansupap and Walker 2005). Furthermore, there are limitations regarding self-learning which is still popular among the users, therefore users still require actual training and group support to help them clearly understand

how to effectively use an IT application (Peansupap and Walker 2005). Consequently, it is essential that training programs should provide quality training that avoids disinterest and boredom.

Nevertheless, time factor could be another problem to document management training initiatives. Peansupap and Walker (2005) stated that users need time to actively participate during the training program because they generally do not have time to learn as they are busy with or distracted by their work duties, or they are reluctant to commit their time to learning and training if they have no time to practice and reflect. Whyte and Bouchlaghem (2001) supported that staff in construction organizations can feel especially limited in their time to effectively learn to use new IT/ICT applications, of which this lack of time will also restrict the effectiveness of implementing a change initiative in construction organization, especially involving effective document management.

3. RESEARCH METHODOLOGY

Questionnaire survey is used in this study. The online questionnaire is supported by the University of New South Wales' (UNSW) Survey Platform. The prospective questionnaire respondents are invited to participate in the survey through an email invitation letter, which contains the instructions as well as the link to complete the online questionnaire. The duration to complete the questionnaire is approximately 8-10 minutes.

The questionnaire is comprised of 3 parts: (1) Participant profile. This part consists of 'background' or 'demographic' questions (Creswell 2004:405), serving to categorize the respondents by their gender, age group, occupation, and industry. Respondents are asked to indicate their name and their organization. (2) The participant's industrial experience. This part basically seeks the respondents' information pertaining to their document and information management experience and practice at work or in their organization. (3) Questions on the training course. The final part of the questionnaire seeks information and post-course feedbacks regarding the document and information management training course delivered. The questionnaire contains a total of 25 questions. A majority of the questions follows a five-point Likert Scale. The reason five-point Likert Scale is chosen over the more accurate seven-point Likert Scale is because it will be easier for the respondents to decide their point of view on the scale. Nevertheless, this uneven five-point Likert scale can still provide accurate answers and allow relatively small variance for data analysis, as well as it will allow neutral or undecided responses to prevent bias or misleading responses as compared to using an even Likert scale of which the respondents are forced to lean to one side or another on the Likert scale. A pilot-testing of the questionnaire is carried out among a few selected respondents, particularly the company representative.

In this study, the target respondents are chosen from the training participants for the ACONEX's "Document Control Essentials (DCE)". The main reason is that DCE is the "Certificate IV in Document Control in a Project Environment" that offers training, qualification and professional development opportunity for those involved in the role of document control who comes from different industries, i.e. building construction industry, mining industry, oil and gas industry, from Perth, Adelaide, Melbourne, Christchurch, Auckland or other locations. Random sample method is used as the sampling method for this study. Random sample will be drawn from the sample frame of participants which are predominantly involved in document and information intensive industries as well as in the field of document control, which are better suited to be targeted for this study in relevant with the aim and objectives of this research.

Finally 54 surveys are distributed using emails to the targeted sample, and a total of 42 surveys are completed. The response rate is 77.8%. The female respondents (86%) outnumber the male respondents (14%) by approximately 6:1 ratio, and 82% respondents are over 30 years old. 48% of the respondents are from building and construction industry, 24% from mining industry, 17% from oil and gas industry and 12% are working in the other construction related industries. They are working as document controller (64%), administrator (19%),

document control manager (5%), project manager (2%), secretary (2%) and other occupations (7%). 90% respondents have experience in the field of document control, and particularly 26% among them even have over 10-year experience.

4. RESULTS

The survey results are reported below in the following areas:

4.1 Document Management System Used At Work

It is shown that in Figure 1 the application of web-based document management systems is very common, supported by 86% respondents, and only 22% use non-networked system. Although the document management system is widely-used, 38% respondents argued that manual work still remain as an important way to process, organize and store documents.

4.2 Computer-based Document Management System

Figure 2 shows that ACONEX is used by most respondents (57%), followed by ProjectCentre (12%), Documentum (10%), QDMS (10%), Objective systems (10%), Livelink (5%), Teambinder (5%), ProjectWise (5%) and Lotus Notes systems (5%). However, 2% respondents are found not to use any computer-based document management system.

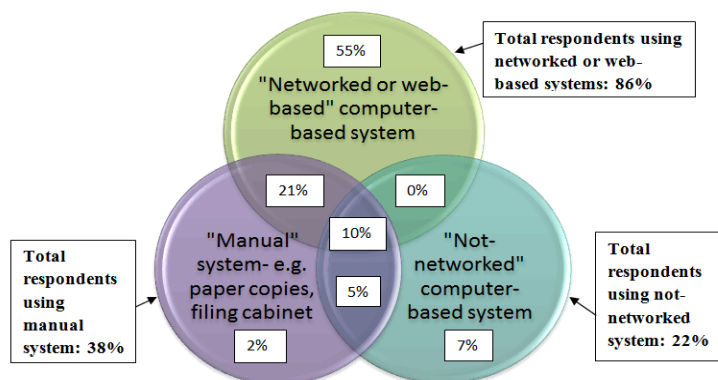


Figure 1: Document management system used at work

4.3 Document Management Practice

In the survey, 60% respondents think the document management practice in their current organization is efficient, while 19% of the respondents complained the document management practice is inefficient (Detailed breakdown in Figure 3). As for the percentage of the daily work or decision-making process in their organization which is delayed or affected due to inefficient document management, as presented in Figure 4, a majority (76%) of the respondents have estimated a little less than “40%”, while 16% respondents argued that over 60% of the daily work or decision-making process in their organization is delayed or affected due to inefficient document management. Basically, it can be inferred that among the reasons for the inefficiency of the document management practice in the respondents’ organization which have affected or delayed their daily work or decision-making process, are most probably due to the usage of different computer-based document management systems (refer Figure 2) which has then led to the lack of interoperability problems among the different systems, as well as the source of inefficiency could also be attributed to the resistance to

change and the continuing trend of using the manual document management system (refer Figure 1), such as paper copies and filing cabinet, especially among the older generation.

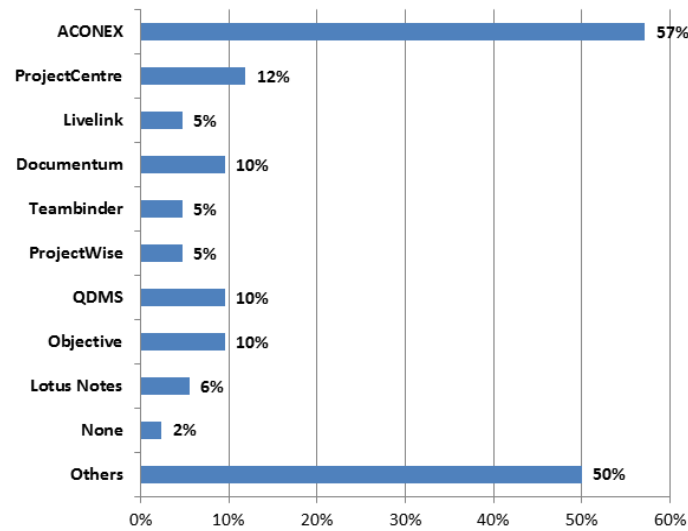


Figure 2: Computer-based document management system that the respondents have worked on

4.4 Key Knowledge and Skills on Information Management

The respondents are asked to indicate the level of importance for the knowledge and skills for efficient document and information management in their organization via a five-point Likert scale, which are “very unimportant”, “not important”, “neutral”, “important”, and “very important”. Each point on the scale is assigned a value to enable the calculations of mean and standard deviation for each knowledge and skill, which are specified as “very unimportant=1”, “not important=2”, “neutral=3”, “important= 4” or “very important= 5”. It is found that the most important document and information knowledge or skill is “compliance requirements”, followed by “quality management”, “communication skills”, “knowledge of the computer system”, “collaboration skills”, “risk management” and “process mapping”.

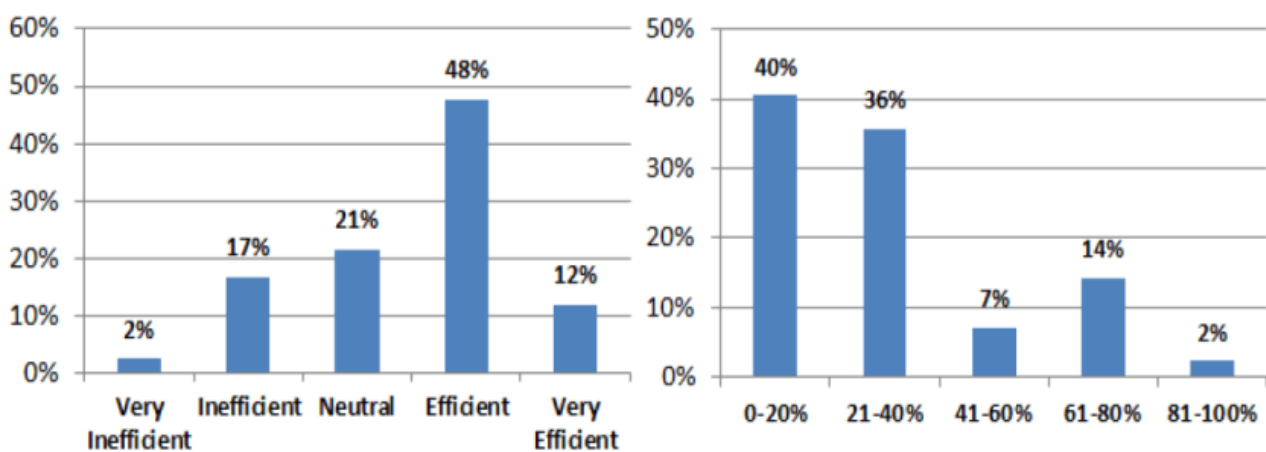


Figure 3: (left): Efficiency of the document management practice in current organization

Figure 4: (right): Percentage of the daily work or decision-making process that is delayed or affected due to inefficient document management

4.5 Most Relevant Aspects of the Training Course

The document control training course covers various aspects particularly on the document control processes, risk management, industry overview, shop drawing submittal, process mapping, and also on general knowledge. In Figure 5, 83% respondents think that the “document control processes” is the most relevant course to their work. “General knowledge” is supported by 71% respondents, “risk management” and “process mapping” are supported by 57% respectively. On the other hand, a large number of respondents think that the course aspects on “industry overview” and “shop drawing submittal” are least relevant to their work.

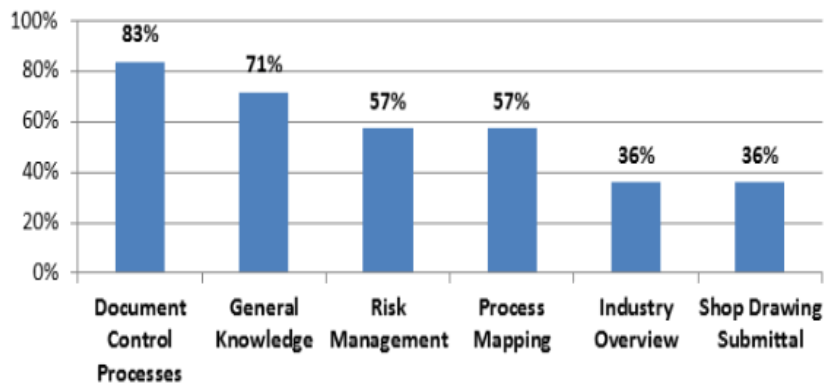


Figure 5: The course aspects that are most relevant to the respondents’ work

4.6 Most Relevant Document Control Processes

As the primary focus of the training course is on the document control processes, the respondents are also asked about the document control processes or records management course topics covered in the course which are most relevant to them especially in their work. Survey findings presented in Figure 6 above show that more than half of the respondents have voted that all the topics related to records management are relevant to them which can also be applied back at work, with “tracking and use” being selected by the most number of respondents (71%), followed by “classification” (69%), “capture” and “disposition” (57% respectively), as well as “registration” at 55%.

4.7 Effective Training Activities or Methods

In terms of the document control training activities or methods that are most effective in conveying the course content, Figure 7 shows that a majority of the respondents (86%) think that group discussion method is the most effective, followed by presentation (52%), individual worksheets (38%), case study (36%) and workplace assignment (33%). The least popular method is the self- assessment questionnaire, as the lowest number of respondents (19%) perceives that this method is effective in conveying the training content.

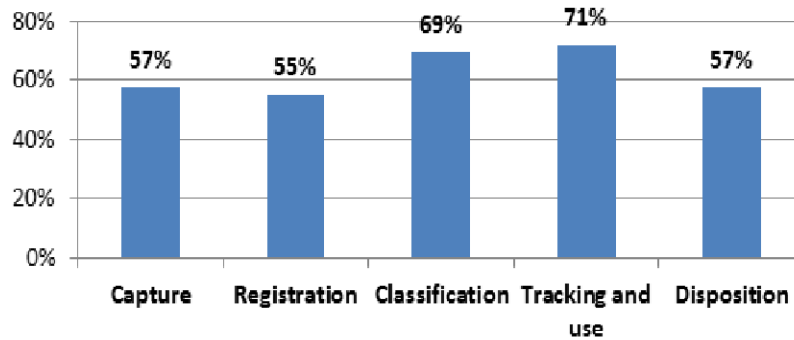


Figure 6: The document control processes that are most relevant to the respondents and that the respondents are able to apply back at work

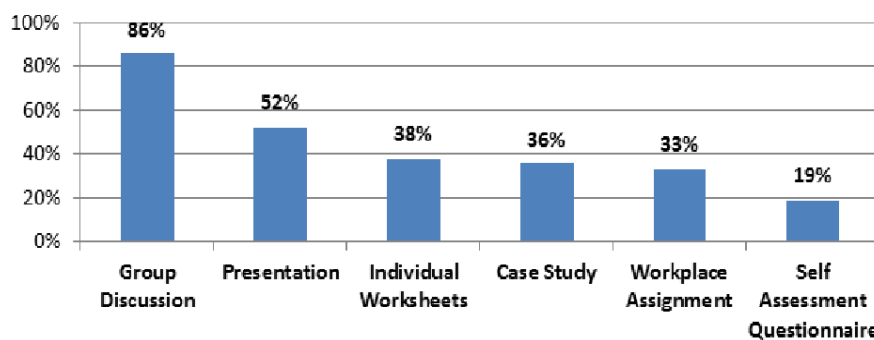


Figure 7: Training activities or methods that the respondents find most effective in conveying the content

5 FINDINGS AND DISCUSSIONS

The findings of the investigation on key knowledge and skills for effective document and information management are discussed in the following areas:

5.1 Compliance Requirements and Quality Management

Among the key knowledge and skills for efficient document and information management are compliance requirements and quality management. Basically, there are certain industry-specific standards, policies and regulations that govern the document and information management process, and it is important for the users to understand and comply with the compliance requirements. In addition, quality management skill is essential to satisfy the compliance requirements. The compliance requirements cover a wide range of document control activities, which is aimed to provide timely, complete and accurate information and also to protect all the documents and information which are related to any particular project. Therefore, good quality management will involve proper planning to ensure all the document control processes meets the required specifications and quality standard. Poor quality management and failure to abide by the compliance requirements will result in possible litigation issues.

5.2 Communication Skills and Collaboration Skills

Besides that, efficient document and information management also requires the industry users to have strong communication and collaboration skills. These skills are particularly important although the project communication and collaboration are usually being carried out in an online environment. Essentially, various documents and information are exchanged between the various project participants of the industry, therefore good

communication and collaboration skills will ensure good coordination of the working relationship of different teams who are working towards a common objective of any project, as well as overcoming the barriers caused by interoperability issues between different types of system. Therefore, in order to achieve these skills, it will involve the optimum interaction of human resources (document users) as well as utilization of document management computer systems.

5.3 Risk Management

There are a number of risks associated with document control, which is a core component of document and information management. The document control and information risk adds an extra dimension to the business or project risk, which could lead to project delays as well as litigation and dispute issue, especially due to document and information losses. Thus, the risk management skill and knowledge is important for all users to ensure efficient document and information management by applying risk management technique in their document control works.

5.4 Knowledge of the Computer System

The knowledge of the computer system is a key and also basic knowledge that is required for efficient document and information management. In this modern computer and internet age, online project management is very common for most document and information intensive industries such as building and construction industry, thus the importance of information technology (IT) applications in all fields of work is obvious. Hence, the knowledge of the computer system will assist the users in developing a good understanding in using the industry-specific information technology applications, especially electronic document management system, for more efficient document and information exchange or management.

5.5 Process Mapping

Process mapping is also one of the key knowledge and skills for efficient document and information management that is useful for all document control users. It is essential as this allows the users to understand about the significance of creating a process map for document control activities and understand every step within the process, including the inputs, outputs and resources used, in order to apply the process management tool to improve the existing process.

6 CONCLUSION

This research is conducted to investigate the current status of document and information management in the Australian construction and related industry. A questionnaire survey was adopted for this study. The data was collected by using structured online survey. Simple random sample method was used as the sampling method for drawing participants from a series of document control training courses. This research has identified that there are seven key knowledge and skills for efficient document and information management, which are compliance requirements, quality management, communication skills, knowledge of the computer system, collaboration skills, risk management and process mapping. In addition, the most effective document management training methods are group discussion and lecture presentation, and most respondents prefer more collaborative and interactive training methods to enhance their document management skills. As document and information management are closely related to decision making, it is essential to provide effective information management training to professionals in the construction industry.

ACKNOWLEDGMENTS

This paper is supported by the Emerging Digital Technology Research Cluster in the Faculty of Built Environment, University of New South Wales.

REFERENCES

- Bjork, B.C., (2003) "Electronic document management in construction- research issues and results", *ITcon*, Vol. 8, pp. 105-117.
- Caldas, C.H. and Soibelman, L., (2003) "Automating hierarchical document classification for construction management information systems", *Automation in Construction*, 12(4), pp. 395-406.
- Chassiakos, A.P. and Sakellariopoulos, S.P., (2008) "A web-based system for managing construction information", *Advances in Engineering Software*, 39(11), pp. 865-876.
- Creswell, J.W., (2004) *Educational Research: Planning, Conducting and Evaluating Quantitative and Qualitative Research*, 2nd ed., Prentice Hall, USA, pp. 405 and 409.
- Edwards, D.J., Shaw, T. and Holt, G.D., (1996) "Electronic document management systems and the management of UK construction projects", *Building Research and Information*, 24(5) pp. 287-291.
- Elghamrawy, T. and Boukamp, F., (2010) "Managing construction information using RFID-based semantic contexts", *Automation in Construction*, 19(8), pp. 1056-1066.
- Forcada, N., Casals, M., Roca, X. and Gangoells, M., (2007) "Adoption of web databases for document management in SMEs of the construction sector in Spain", *Automation in Construction*, 16(4), pp. 411-424.
- Froese, T.M., (2005) "Information Management for Construction", 4th International Workshop on Construction Information Technology, Dresden University of Technology, Germany, 18 July, pp. 7-16.
- Goedert, J. D. and Meadati, P., (2008) "Integrating construction process documentation into Building Information Modeling", *Journal of Construction Engineering and Management*, 134(7), pp. 509-516.
- Hjelt, M. and Bjork, B.C., (2006) "Experiences of EDM usage in construction projects", *Journal of Information Technology in Construction*, Vol. 11, pp. 113-125.
- Nitithamyong, P. and Skibniewski, M.J., (2004) "Web-based construction project management systems: how to make them successful?" *Automation in Construction*, 13(4), pp. 491-506.
- Nitithamyong, P. and Skibniewski, M.J., (2006) "Success/failure factors and performance measures of web-based construction project management systems: Professionals' viewpoint", *Journal of Construction Engineering and Management*, 132(1), pp. 80-87.
- O'Brien, W.J., (2000) "Implementation issues in project web sites: A practitioner's viewpoint", *Journal of Management in Engineering*, 16(3), pp. 34- 39.
- Peansupap, V. and Walker, D.H.T., (2005) "Factors enabling information and communication technology diffusion and actual implementation in construction organisations", *Journal of Information Technology in Construction*, 10(1), pp. 193-218.
- Sidawi, B. and Omairi, S.A., (2010) "An Exploration of the Potential Use Of a Web-Based Project Management System To Manage Construction Projects By Royal Commission Of Jubail", *Emirates Journal for Engineering Research*, 15(2), pp. 67-74.
- Takamoto, T., Mizuno, R., Furusaka, S. and Kaneta, T., (2003) "Development of the project management supporting system in the Japanese construction market-Users' needs and systems development", in 19th Construction Production Symposium, Architectural Institute of Japan, Japan, pp. 73-80.

- Turner, J.R. and Muller, R., (2003) "On the nature of the project as a temporary organization", *International Journal of Project Management*, 21(1), pp.1-8.
- Vaidyanathan, K. and O'Brien, W., (2003) "Opportunities for IT to Support the Construction Supply Chain", in proceedings of 4th Joint International Symposium on Information Technology in Civil Engineering, Nashville, Tennessee, USA, pp. 1-19.
- Whyte, J. and Bouchlaghem, D., (2001) "IT Innovation within the Construction Organisation", in proceedings of the IT in Construction in Africa 2001 Conference, Mpumalunga, South Africa, 30 May- 1 June.