Investigating the Use of Electronic Documents in the Jordanian Construction Projects

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Abstract Construction processes normally require large exchange of information among project parties on a daily basis. The wide development in Information and Communication Technology (ICT) in recent decades has helped to provide easy processing of data during the life-cycle of construction projects. However, traditional manual methods of filing are still common in the construction industry. The aim of this study is to investigate the use of different electronic documents in the construction projects. A quantitative survey was conducted with 91 respondents from the construction projects' engineers and practitioners. Also, the questionnaire survey investigates if there is an Electronic Document Management System (EDMS) applied in construction projects. Finally, the types of electronic files and the extent of using electronic-based documents were investigated. The results of this study help to understand the context of the documents in the construction projects that may be useful to seek opportunities for improvement, and provide effective solutions for EDMS application.

Keywords Construction projects · Document management system · Information and communication technology · Questionnaire survey

1 Introduction

Construction projects normally require intensive exchange of data, especially among its contract parties on a daily basis (Maqsood et al. 2004). Although there is a great potential in the construction industry to adopt electronic business (Anumba and

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Ruikar 2002; Mohammed and Stewart 2003), there are still many barriers for its adoption in a broad way (Ahmad et al. 2015, 2017; Jordanian Construction Contractors Association 2018).

DMS refers to the repository of work documents that enables end-users to retrieve required information. Some literature has combined the meanings of the term document management with other concepts such as communication, knowledge management, and information system (Aurelia and Ana 2008). Also, previous literature used different names of DMS, such as project web, project extranet, and project information management system (Björk 2003). EDMS is a software application dedicated to facilitating the management of documents by enabling secure storage, search and retrieval of documents in electronic format (Laserfiche 2007).

Many organizations have claimed saving time and efforts, increasing productivity and profitability, and improving coordination and collaboration among end-users by implementing effective EDMS (Laserfiche 2007; Al Qady and Kandil 2014a, b; Hjelt and Björk 2006; Rujirayanyong and Shi 2006). Hjelt and Björk (2006) argued that the major reason for applying EDMS is no longer technical or cost-related, but are rather related to psychology and business models. However, some factors in the construction projects may prevent the successful application of EDMS such as the complexity, the diversity of work performers, the non-repetitive nature of processes, the time and cost pressure, difficulty of systems' integration and the need to make changes to the routine procedures of work (Björk 2003; Carrillo et al. 2004; Ahmad and An 2008; Egbu 2004; Egbu and Botterill 2002; Alaghbandrad et al. 2012).

2 Literature Review

A research by Oladapo (2007) studied the conditions of ICT use in the Nigerian construction industry to evaluate its impact on the industry and the challenges to its adoption. The study categorized the factors affecting the level of ICT use into internal and external factors to the industry. The results of a questionnaire survey from 136 respondents, comprising contractors, consultants and academic researchers, showed that some of the internal factors such as type of business (contracting, consulting or academic), management awareness of the ICT benefits, and years of experience of managers on computer use were significantly correlated with the level of ICT use in the construction industry. Nevertheless, none of the external factors, such as client demands, technological demands, influence of competition, availability and affordability of hardware/software, and availability of power were significantly correlated with the level of ICT use. Also, the results showed that the highest uses of ICT in the industry are word processing, Internet communications, costing, and work scheduling. The challenges with the most effect on the use of ICT are insufficient/irregular power supply, expensive ICT hardware and software, low job order for firms, worrying from viruses and high rate of obsolescence of ICT software and hardware.

A study conducted by Bäckblom et al. (2003) examined the usage of EDMS in the Finnish construction industry. The researchers collected their data through telephone interviews with key personnel from 100 randomly chosen construction projects. The results of their study showed that about one third of large projects and only a few small projects have already adopted EDMS technology. The results also showed that the use of EDMS is yet incomplete in coverage and only a few individuals in the project can use the system efficiently due to psychological nature and insufficient training of end-users.

Moreover, a paper by Björk (2003) has surveyed and investigated individual research efforts in EDMS by examining the required specifications, frequency of use, measuring of benefits, barriers to wide-spread adoption, problems of application, scope for standardization, and evolving of the market of such systems. The results indicated that the use of project webs is becoming more common, especially in large projects. Also, the results showed that there is still a lack of reliable measurements to evaluate the overall cost saving and quality improvements for applying EDMS. The author concluded from many reported case studies that the barrier to wide adoption of EDMS is no longer the cost, but rather the willingness to use new EDMS technology by the organizational management and all project stakeholders. On the technical side, EDMS offered by vendors are almost similar in features, and their prices are not exceedingly high for development and services.

3 Methodology

The aim of this study is to investigate the extent of the use of electronic documents, the existence of EDMS, and the types of electronic documents used in the site of construction projects. A quantitative survey was designed and organized into three sections. The first section collects information about the questionnaires' respondents. The second section asks the respondents to provide their opinions about the documents' organization and types. Finally, the third section asks respondents to provide useful feedback in the form of suggestions and recommendations for successful implementation and application of EDMS. Google forms application was used to distribute and fill the questionnaires and a total of 91 respondents from the construction projects' engineers and practitioners have completed the questionnaire survey. The following sections summarize the main results of the questionnaire.

4 Characteristics of Respondents

The final number of responses, after excluding the questionnaires with many empty answers or repetitive respondents, equals 91 questionnaires. In the first part of the questionnaire the respondents were asked to provide information describing themselves and their organizations. Table 1 summarizes the results of part 1 in the questionnaire.

Table 1 Characteristics of the questionnaire respondents

Criteria	Categories	Number of respondents	Percentage of respondents
Types of respondents' organizations	Contractor	41	45.1
	Consultant	16	17.6
	Public or government representative	24	26.4
	Private client representative	10	11.0
	Total	91	100.0
Roles of respondents in their organizations	General or regional manager	8	8.8
	Project manager	19	20.9
	Site engineer	32	35.2
	Trainee engineer	12	13.2
	Other	20	22.0
	Total	91	100.0
Respondents' experience	<5 years	31	34.8
	5–9 years	13	14.6
	10–14 years	8	9.0
	15–19 years	10	11.2
	>20 years	27	30.3
	Total	89	100.0
Project financial size	<1 M $	20	22.0
	1–5 M $	32	35.2
	5–10 M $	7	7.7
	10–50 M $	10	11.0
	50–100 M $	8	8.8
	>100 M $	5	5.5
	No response	9	9.9
	Total	91	100.0
Last project finish date	Not finished yet	56	61.5
	<1 year	18	19.8
	1–2 years	7	7.7
	>2 years	4	4.4
	No response	6	6.6
	Total	91	100.0

Table 1 shows that the highest percentage of the respondents are working with contracting companies. Also, the largest percentage of the respondents are working as site engineers, which makes the results highly representative for the documents management in the sites of construction projects. The results showed that respondents are very well distributed among the categories of years of experience. The majority of the respondents (about 57%) are involved in projects with a financial size less than five million US dollars. At the time of conducting the questionnaire survey, most of the respondents were still involved in the execution of construction projects, or at least have their projects recently finished.

5 Use of Electronic Documents

The second section of the questionnaire investigates the use of electronic documents in the sites of construction projects. Firstly, the respondents were asked to evaluate the extent of use of electronic-based documents compared to paper-based documents. Figure 1 shows the results of the evaluation to these questions.

The results showed that the paper-based documents are still more commonly used than the electronic documents. According to comments from expert respondents the electronic-based files and documents are more commonly used in the organizations' management offices than in the construction site projects.

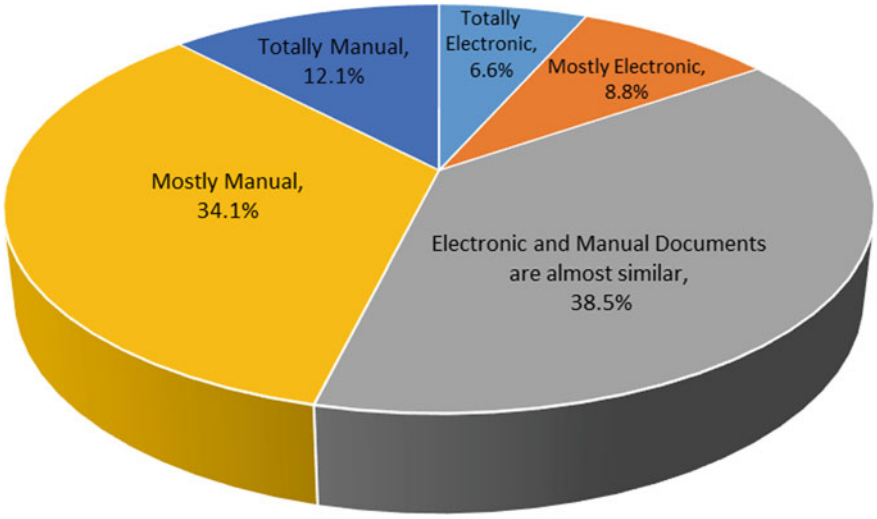

Fig. 1 Evaluation of the extent of use of electronic and paper-based documents in the sites of the construction projects

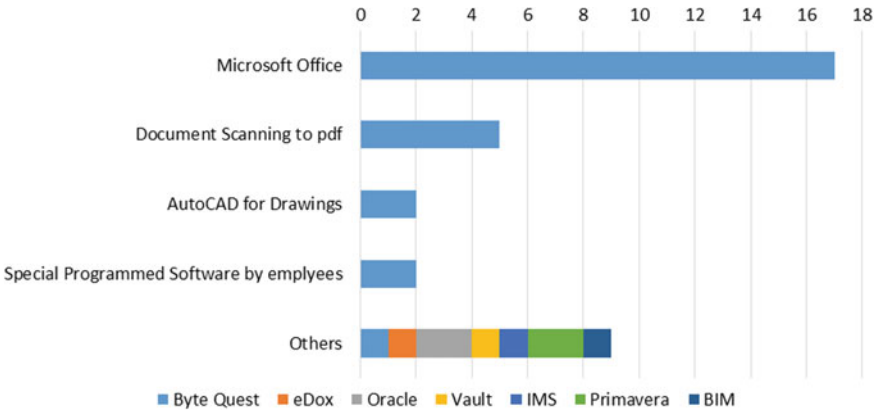

Fig. 2 The main electronic systems used for document control and management in the construction projects

Then the respondents were asked to name or describe the main electronic system used to control and manage the documents in the construction projects they are involved in. Answers were received only from 35 out of the 91 respondents. The results showed that according to the respondents' opinions, the Microsoft Office packages are the most common tools used for managing and controlling documents in the construction projects. Figure 2 represents the answers collected. Eleven out of the 35 respondents have experienced a specialized programmed software used as EDMS in their construction projects.

6 Feedback Section

The final section of the questionnaire survey asked the respondents to provide their feedback in the form of recommendations or suggestions that can be useful for successful installation, development and/or application of EDMS in the construction projects. A good number, 41 out of the 91 respondents, have provided useful comments in the feedback section. Summary of the respondents' feedback is provided in Table 2.

The results of the feedback section showed high interest from the respondents to apply EDMS in the construction projects to improve the work performance. For successful implementation and application of EDMS in the construction projects, the respondents provided recommendations to encourage training and e-learning, and to focus on appointing employees qualified for effective use of EDMS. However, some of the respondents feel that applying EDMS in the construction projects is a difficult or impossible aim in the existing conditions.

Table 2 Summary of the respondents' feedback

No.	Category of feedback	Description	Repetitions
1	Usefulness and importance of the application of EDMS in the construction projects	Improve work performance	3
		Stop losing important information	1
		Improve information searching and retrieval	1
		Reduce storage area	1
		Help to achieve financial benefits	1
2	Recommendations to motivate and improve the implementation of EDMS	Training and E-learning	5
		Appoint qualified employees and engineers for EDMS	5
		Define regulations that motivate or enforce EDMS application	4
		Encourage young employees and engineers to play important role in EDMS application and decision making	4
		Improve awareness about EDMS importance	1
		Feasibility study	1
		Transfer success stories from private to public sector	1
		Apply user friendly systems	1
		Combine required tasks in one platform	1
		Use effective categorization of information	1
		Include the use of EDMS in the education system at early stages	1
3	Challenges for EDMS application	Think that applying EDMS in the construction projects is not easy or impossible in the existing conditions	7
		Public organizations are more unwilling to apply EDMS in the construction projects	4
		Management and decision makers are not interested or unwilling to apply EDMS	3
		Unwilling to change the routine ways of doing work	3
		Some people think the application of EDMS is against their benefits	2

(continued)

Table 2 (continued)

No.	Category of feedback	Description	Repetitions
		Every organization have different way for organizing and managing their documents	1
		Benefits and feasibility of applying EDMS are not easy to prove	1
		Decision makers think the useful and effective software programs are not available	1
		Expected high cost of EDMS	1
		Information security risks	1

7 Conclusions

This study evaluated the usage of electronic documents in construction projects by a sample of engineers and practitioners involved in the construction projects. The survey was successfully completed by 91 engineers working with contractors, consultants, public organizations and private organizations. It examined the extent of use and types of electronic documents used in the construction projects, and collected useful feedback from the respondents. Some of the main findings are as follows:

- The results showed a higher percentage for using manual documents than electronic documents. However, the authors think that the extent of use of electronic documents is satisfactory for a developing country like Jordan.
- The most used tools for document management according to the engineers involved in the construction projects are the Microsoft packages, but also the results showed a good extent of the use of specialized EDMS packages.
- The feedback section showed that some of the questionnaires' respondents are confident that the application of EDMS in the construction projects is useful mainly in terms of improving work performance, in addition to preventing the loss of data, improving information retrieval, reducing required storage area and even help achieving financial benefits.
- The respondents provided recommendations to improve the application of EDMS in the construction projects, including: provision of effective training and e-learning contents, recruiting and appointing qualified employees in electronic programs, defining and enforcing regulations for EDMS application in the construction projects, and encouraging young engineers to take part in the decision-making process.
- A number of the survey respondents think that the application of EDMS in the construction projects is very difficult in the existing conditions, and that it is even more difficult in public organizations and projects.

Even though previous literature has examined the use of electronic documents and EDMS in construction projects, there is a lack of effective application of EDMS

in Jordanian construction projects. Further investigation is required concerning this issue in order to enhance the awareness of the practitioners and engineers regarding the importance of EDMS, and motivate its successful implementation in the construction projects. It is anticipated that this study can guide decision makers to adopt procedures that motivate the use of EDMS and avoid challenges to its application. Future plans of this study can aim at designing a model for successful development and implementation of EDMS for construction projects that can integrate the business operations of the different parties involved in the project. It is useful to develop and re-conduct this study every few years to detect any development in the use of electronic documents and EDMS in the field of construction project management.

References

Ahmad H, An M (2008) Knowledge management implementation in construction projects: a KM model for knowledge creation, collection and updating (KCCU). J Proj Org Manag 1(2):133–166

Ahmad HS, Ayoush MD, Bazlamit SM (2015) Document management systems in small and medium size construction companies in Jordan. In: The 6th international conference on engineering, project, and production management (EPPM2015), pp 273–281

Ahmad HS, Bazlamit IM, Ayoush MD (2017) Investigation of document management systems in small size construction companies in Jordan. Procedia Eng 182:3–9

Al Qady M, Kandil A (2014a) Automatic clustering of construction project documents based on textual similarity. Autom Constr 42:36–49

Al Qady M, Kandil A (2014b) Concept relation extraction from construction documents using natural language processing. J Constr Eng Manag ASCE 294–302

Alaghbandrad A, Asnaashari E, Preece C (2012) Problems and barriers of ICT utilization on Iranian construction sites: case study on the successful use of ICT in remote construction sites. J Inf Technol Constr 17:93–102

Anumba C, Ruikar K (2002) Electronic commerce in construction—trends and prospects. Autom Constr 11(3):265–275

Aurelia P, Ana T (2008) A document management system modeling. Ann Univ Oradea 17(4):1484–1489

Bäckblom M, Ruohtula A, Björk B (2003) Use of document management systems—a case study of the Finnish construction industry. Electron J Inf Technol Constr 8:367–380

Björk B (2003) Electronic document management in construction—research issues and results. ITcon 8:105–117

Björk B (2006) Electronic document management in temporary project organisations: construction industry experiences. Online Inf Rev 30(6):644–655

Carrillo PM, Robinson H, Al-Ghassani A, Anumba C (2004) Knowledge management in UK construction: strategies, resources and barriers. Proj Manag J 35(1):46–56

Egbu C (2004) Managing knowledge and intellectual capital for improved organizational innovations in the construction industry: an examination of critical success factors. Eng Constr Arch Manag 11(5):301–315

Egbu C, Botterill K (2002) Information technologies for knowledge management: their usage and effectiveness. ITcon 7:125–137

Hjelt M, Björk B (2006) Experiences of EDM usage in construction projects. ITcon 11:113–125

Jordanian Construction Contractors Association (2018) Annual report 2018

Laserfiche (2007) Document management overview—a guide to the benefits, technology and implementation essentials of digital document management solutions, 10th edn. Compulink Management Center, Inc., USA

Maqsood T, Walker DHT, Finegan AD (2004) An investigation of ICT diffusion in an Australian construction contractor company using SSM. In: Proceedings of the joint CIB-W107 and CIB-TG23 symposium on globalisation and construction, pp 485–495

Mohammed R, Stewart R (2003) An empirical investigation of users' perceptions of web-based communication on a construction project. Autom Constr 12(1):43–53

Oladapo A (2007) An investigation into the use of ICT in the Nigerian construction industry. ITcon 12:261–277

Rujirayanyong T, Shi JJ (2006) A project-oriented data warehouse for construction. Autom Constr