Document Management in Construction for Shorter Project Lead Time using Web-based Software

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ABSTRACT

The efficiency improvement of construction projects depends on the effective communication among the project participants. However, the problem of communication occurs due to high amount and variety of information during the construction process. Thus, this study aims at applying Microsoft Office Groove as a method for reducing construction lead time and facilitating document management at the construction site. Lead times of the new method were compared with those of the conventional method of documentation in construction. Reduction in delivery time and lead time of the documentation process and improvement in communication between constructions participants are observed as the results of implementing the proposed method.

1 Introduction

The construction industry is generally highly fragmented compared with other industries (Hajjar & Abou Rizk, 2000). This causes construction projects to be more complex in nature. The complexity arises from involvement of multiple team-players and huge amount and wide dissimilarity of information (Chen & M. Kamara, 2011). Therefore, there is a necessity for timely coordination and efficient management of information toward successful completion of the project (Deng, Li, Tam, Shen, & Love, 2001).

Doug (2010) stated that there are four groups of challenges faced by construction contractors in any given project. These are on time receiving of documents, on time reviewing and approving of documents, completeness of documentation, and keeping clients aware of the process. He has also proposed that the challenges can be lessened using a web-based collaboration system that helps construction teams to communicate accurately. Many researchers (Chassiakos, 2008; Nash, 2002; Swee-Lean and Nga-Na, 2004) have used databases as data repositories. There are also information management and communication deficiencies that can be overcome using technological tools. However, there are notable problems faced by construction professionals with learning and using these tools and software (Becerik, 2006). It is costly to implement and purchase suitable software and is also difficult to work with them. So it is recommended to consider cost as the most decisive practical issue (Swee-

Lean & Nga-Na, 2004). Therefore, this paper aims at introducing a user-friendly method with reasonable implementation cost in order to reduce the lead time of a construction project.

This paper is structured as follows. The next section is dedicated to reviewing the current information management problems in the construction industry and some research efforts that have been conducted using web-based application. After that, our proposed approach is introduced and implemented in a case study. After implementation of the approach, its performance is assessed in terms of lead time improvement and the final conclusions are drawn.

2.1 Information management problem:

According to Cornick (1990), two-thirds of the construction problems refer to poor coordination and inefficient system of information communication. Improvements in communication and means of exchanging information highly influence project performance (Nash, Akinsola, & Hobbs, 2002).

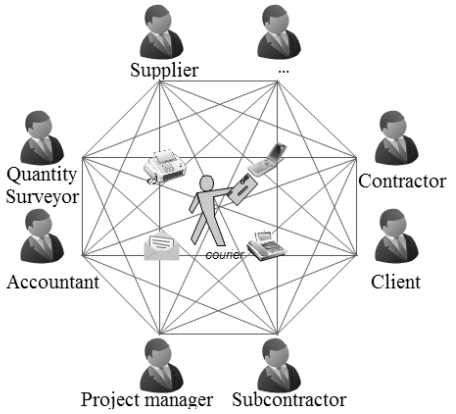

Figure 1. Conventional communication system

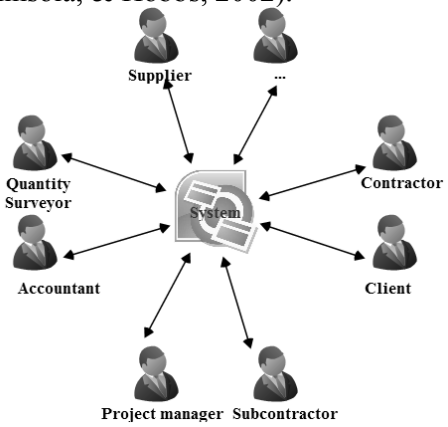

Figure 2.Micro view of Proposed system

Figure 1 indicates the conventional system of communication between different construction practitioners in various functional areas. Nowadays, the way in which information is exchanged is the same as past. The main weakness of this method is that it is costly and time-consuming. In the conventional system, it takes a long time to deliver information and use it in decision making. These problems result in reducing the project performance. The risk of data redundancy and missing information are the other issues related to the mentioned approach. Figure 2 can be considered as an improved method of communication in construction projects. The proposed system is highly dependent on evolving IT facilities. In the proposed system, information is shared among construction practitioners in such a way that all of them can have access to information with the aid of personal computers and the internet (Chassiakos & Sakellaropoulos, 2008; Dawood et al., 2002).

2.2 Previous researches in communication and information technology

Many studies have been conducted to show the importance of communication in the construction industry. Chan et al (2004) stated that one of the significant factors that affects the success of projects is communication. There

are research efforts that have been done for improving communication and information technology in the construction industry. Tam (1999) studied the potential of improving information transfer in a construction project known as Total Information Transfer System (TITS). He has concentrated on developing a communication system with the aid of the internet. In the proposed system, one database used as a central repository is provided for all project participants. Within the system, the server supervisor has the authority to observe server functions such as people who logged into the database, information retrieved such as the time, and type of files downloaded and uploaded. Having considered all features of the proposed system, it has a serious problem related to its legality. The problem appears when a special drawing or evidence needs to be verified and signed by architects and to be sent as a hardcopy to contractors (Tam, 1999). In order to overcome the challenge, there are some improvement tools that can be classified as follows (Chassiakos & Sakellaropoulos, 2008):

1. Conceptual frameworks of web databases
2. Electronic document management (EDM) systems
3. Information analysis in construction
4. Web-based applications in construction management
5. Reviews and case studies
6. Application service providers (ASP)
7. Construction information standardization.

This study aims at improving communication in construction projects using web-based applications, which are commonly known as Project management and collaboration system (PMCS). A project management system (PMS) is a comprehensive structure that includes document management, schedule, cost control, task management and reporting in an interface (Nitithamyong & Skibniewski, 2004). This system (PMS) is likely to contain a collaboration module. Most of the PMCSs provide basic collaboration among project participants such as e-mailing, team calendar and chatting. Therefore, PMCSs are most likely integrated products, which gather both management and collaboration functions at the same time. The web-based applications in the construction industry are introduced in the following section.

2.3 Web-based application in construction

Regarding the concept of web-based application in construction management, Chassiakos and Sakellaropoulos (2008) demonstrated a system that was capable of forming communication between different construction areas such as design, estimation, etc. However, lack of legal considerations is still a problem in the system when signing documents. Nash et al. (2002) suggested an information exchange system in which easy access to information is provided through the internet. In the proposed system, the internet and WWW are main technologies that help users to connect to the database. There is also a problem related to difficulties in the implementation of such a model and its cost. Zhiliang et al (2004) proposed a web-based system for exchanging information through a construction site using Extensible Markup Language known as XML. In this paper, a database is used as a data repository which is divided into three parts, XML, relational and attachment file. The consideration for the signing and legality of documents is addressed, but the weak point of the latter research is the inconsideration of the time effect on the performance of the project.

3. Case study

The case study is a construction project whose documentation process is aimed to be improved. The project is located in the city of Mashhad, Iran. The project's purpose is the construction of a hotel in the city of Mashhad. The project participants involved in the documentation process are contractors, project supervisors and clients. The current method used in the project for documentation is the paper-based one in which documents are filled and printed in an office and are verified in a workshop office in terms of information accuracy. After that, a copy of the form will be documented. Having documented the copied form, another copy of the form is sent to the supervisor's office in order to verify its information. After that, the final version of the form is sent to the client for assessment and documentation. In all the mentioned steps, documents are delivered by couriers and the personnel inside the construction site. This process is done for publishing daily report forms and can vary for producing different types of forms.

4. Implementing a new approach in the case study

To achieve the research objectives, the following steps were executed:

1. Substitution of paper-based forms and documents with computer-based forms: This process was done by Adobe Acrobat reader pro. The legality of documents was secured by Adobe Acrobat reader pro signature.

2. Sharing and exchanging information among construction participants: The forms and tables designed in the previous step have been shared amongst construction members by Microsoft Office Groove to increase the level of information accessibility for project participants and reduce the lead time. To gain the benefits of the PMCS, efficient software should be selected. Among all PMCSs used in the construction industry, Microsoft Office Groove offers some features that are not included in other PMCSs. According to Kamer Yuksel (2008), wireless integration is one of the advantages of Microsoft Groove over other PMCSs such as Buzzsaw, Citadon, Project talk, BIW technology, Bric Nets, and Home Sphere. In contrast to Buzzsaw, Construct W@re, Iron Spire JobSite, Home Sphere, and CX, Microsoft Groove offers a website customization feature. Finally, project camera is another feature included in Microsoft Office Groove that does not exist in other systems such as Causeway Solution, CX, and Citadon.

Microsoft Groove is applicable software by which both offline and online collaborations and communications are supported. Project participants can interact and communicate with each other in a cyber environment called workspace. Microsoft Groove will synchronize all the members of any workspace when they connect to the internet. So, it provides a good platform in this study for sharing and exchanging the designed forms and tables.

3. Testing (Time study): In this step, adoption and customization of Groove was tested in the case study and results were revealed. This step started with recording, exchanging, and documenting the information of daily reports with both conventional and new approaches. After that, the lead times of both approaches

were recorded and finally the differences between lead times were discussed. To achieve this, the following steps have been considered.

- A time study method, Westinghouse method, was selected.
- The observed times for both paper-based and computer-based processes for different kinds of forms were recorded.
- The standard times of all processes were obtained from the observed times.

5. Data Analysis and Discussion

In this section, the results of the testing step are discussed. The observed times for the documentation process of daily report form were gathered. After that, a rate was required to be calculated by the Westinghouse system. Westinghouse method is a system of rating that considers four factors (Skill, Effort, Conditions, and Consistency) for evaluating the performance of an operator in order to compute the standard time. Tables 1 and 2 show the calculated rates and allowances considered for both of paper-based and computer-based processes. It should be noted that the documentation process of daily report forms is divided into nine elements. The total time of the nine elements is considered as the time required for the documentation process of a daily report form. The next step is the calculation of the standard time. To achieve this, the observed data are multiplied by the rates obtained from the Westinghouse system and at the end, the allowances are added to the results.

Table 1. Time study analysis sheet for daily report in paper-based method

Time study observation/analysis sheet								
Hossein Khanegir	Analyst	Ario Vazinzadeh	Head of Section	Documentation	Section	Supervisor office		Department
			Date	Daily report				Type of operation
std.Time (min)	Allowance	b.t x freq.	frequency	Basic time	Average Observed time	Rate	Element description	El.
60.4	7	56.2	1	56.2	63.1	0.89	Filling the form of daily report in computer	1
2.2	7	2.0	1	2.0	2.0	1	Print daily report form	2
13.3	7	12.4	1	12.4	11.7	1.06	Verification of information by head of workshop	3
1.9	4	1.8	1	1.8	1.9	0.97	Record a copy of the daily report	4
46.7	5	44.3	1	44.3	58.3	0.76	Send a copy of daily report to supervisor office for verification	5
20.9	7	19.4	1	19.4	19.4	1	Assess and verification of daily report by supervisor	6
2.1	4	2.0	1	2.0	2.1	0.97	Record a copy of daily report in supervisor office	7
24.9	5	23.6	1	23.6	31.1	0.76	Send to client for review and comment	8
2.1	7	1.9	1	1.9	2.0	0.96	Assess and record a copy of daily report	9
174.4	Total	-						(etc.)

As can be seen in Tables 1 and 2, in comparison to the paper-based method, three elements are omitted in the new method by Microsoft office Groove. These elements are printing the daily report form, sending the form to the client for review and comment, and sending a copy of the daily report to the supervisor's office for verification.

Table 2. Time study analysis sheet for daily report in computer-based method

Time study observation/analysis sheet								
Hossein Khanegir	Analyst	Ario Vazinzadeh	Head of Section	Documentation	Section	Supervisor office		Department
			Date	Daily report				Type of operation
std.Time (min)	Allowance	b.t x freq.	frequency	Basic time	Average Observed time	Rate	Element description	El.
60.4	7	56.2	1	56.2	63.1	0.89	Filling the form of daily report in computer	1
-	-	-	0	0.0	0.0	0	Print daily report form	2
12.5	7	11.7	1	11.7	11.7	1	Verification of information by head of workshop	3
1.3	4	1.3	1	1.3	1.2	1.03	Record a copy of the daily report and sharing	4
-	-	-	0	0.0	0.0	0	Send a copy of daily report to supervisor office for verification	5
20.3	4	19.4	1	19.4	19.4	1	Assess and verification of daily report by supervisor	6
1.3	4	1.3	1	1.3	1.2	1.03	Record a copy of daily report in supervisor office and sharing	7
-	-	-	0	0.0	0.0	0	Send to client for review and comment	8
2.2	7	2.0	1	2.0	2.0	1	Assess and record a copy of daily report	9
98.0	Total	-						(etc.)

In Table 2, the final standard time of the whole documentation process of daily report form is obtained. The time for the new method is 98 minutes while the time for the previous method (conventional method) is 174.4 minutes. The discrepancy is 174.4-98= 76.4 min which implies 43.9 % improvement in lead time of the process.

Finally, two Pareto charts are drawn for both new and conventional documentation processes. Figures 3 and 4 show the charts in which 80% of problems come from 20% of causes. In Pareto charts, the most time consuming elements are identified by finding the interaction between Cumulative and Cut off lines.

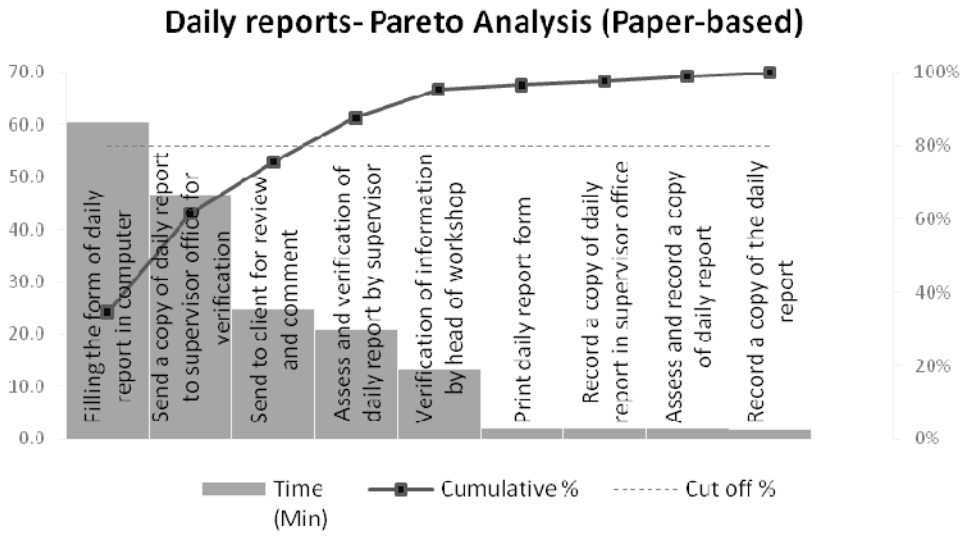

Figure 3. Pareto chart of the daily report process for paper-based method

As can be seen in Figure 3, the point of intersection shows that only three causes out of nine are responsible for 80% of the problems. The other six causes are responsible for 20% of the problems. There is a good chance that if the issue is focused on solving the 3 key causes, the other 6 will be solved as well. Filling the daily report form in computer, sending a copy of the form to the supervisor's office for verification, and sending the form to the client for review and comment are considered as 20% of the causes which lead to an increase in the lead time of the daily report process by 80%. The other causes contribute only 20% of the lead time in the mentioned process. In this case, the Pareto chart proposes to reduce the time of filling and delivering the daily report form. Sending the daily report form to the supervisor and client is not only time-consuming, but it is also costly for any company because of the expenditure of delivery and complexity of the work.

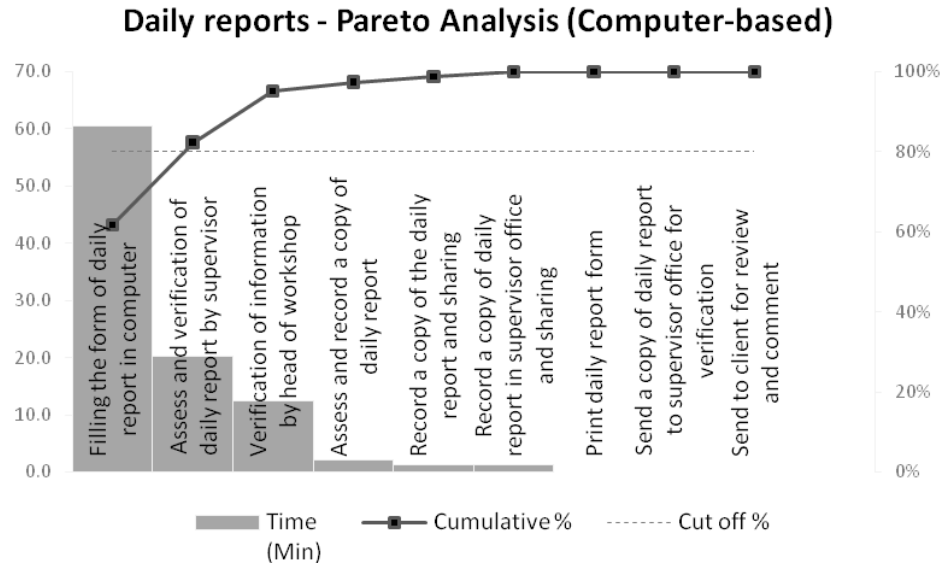

Figure 4. Pareto chart of the daily report process for computer-based method

Figure 4 reveals the results of the new approach of information management implementation using Microsoft Office Groove. The results show that the time required for delivery of the daily report is completely omitted from the process and is indicated as 0% in the graph. In Figure 4, there are two elements that contribute 80% of the lead time. The elements are filling the form of the daily report in computer and assessing and verification of the daily report by supervisor. The first element is the same as the one in the conventional method. So, the new method cannot make any effort in reducing the time of this element. However, the new method reduces the time required for sending and delivering of documents to 0%. Using Microsoft Groove proves that it is an effective solution for reducing the lead time.

Conclusion

Construction industry is one of the industries with a high rate of information dependency that comes from its fragmentation in all aspects and involvement of lots of human resources. Regardless of the size and type of a construction project, the complexity leads to creation and exchange of enormous

amount of information and documents. To overcome this communication deficiency, Microsoft Office Groove has been proposed to improve document management.

According to the Pareto results, sending and exchanging information in the considered case study are among the main causes that lead to problems related to project lead time. The delivery time becomes critical when one specific form should be sent to more than one destination, and needs to be documented by more than one company or legal person.

Implementing the proposed system results in a reduction of document redundancy and delivery time. In addition, providing the opportunity for searching documented files improves the efficiency of assessing information and leads to better decision making in comparison to the paper-based procedure without any searching opportunity.

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