Construction Document Management Information Sharing

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The objective of this study was to identify the perceived barriers in using mobile technology for onsite document management and information sharing. A survey questionnaire was designed and emailed to 40 general contractors to identify the barriers. The intended audience for this study is general contractors and their subcontractors. The focus is primarily the subcontractors who have not been able to adopt this technology due to the perceived barriers. More than 70% of subcontractors are not using mobile technology, which creates problems for those who do. The study findings concluded that the leading barriers are training, the availability of drawings (regardless of internet access), software capacity and efficiency in management of project documents and updates.

Key Words: construction industry, information technology, information management, document management, mobile technology

Introduction

Over the past decade, information technology and mobile technology has advanced very quickly. Innovative general contractors are using software and mobile devices promoting seamless knowledge transfer in construction to directly improve their performance through more efficient document management and information sharing. The objective of this study was to identify the end-users' perceived barriers in using mobile technology for on-site document management and information sharing. The hypothesis of the study was that there are no barriers perceived by mobile technology users in the construction industry. This study provides perceived barriers of site professionals who use mobile technology for document management and information sharing at general contracting organizations. The barriers perceived by mobile technology users should be used as a baseline for developing and implementing strategies to mitigate these barriers. The intended audience for this study is general contractors and their subcontractors. The focus is primarily the subcontractors who have not been able to adopt this technology due to the perceived barriers. More than 70% of subcontractors are not using mobile technology, which creates problems for those who do.

Background

For the implementation of construction projects, construction organizations handle multiple challenges while the project is under planning or execution. The plethora of documents created, revised, and shared during a project under construction are in huge number.

Construction is one of the most information-dependent industries, mainly due to its extended fragmentation. Construction projects are often complex and unique, involving a large number of activities, and require the employment of several types of human resources with various specializations. Thus, the amount of information generated and exchanged during the construction process is enormous even for small-sized projects (A. Chassiakos et al. 2008).

The information required in construction can be classified in three broad categories. The first being financial, which includes purchase orders, payment valuations, and change orders. Second category includes documents that are technical in nature such as product catalogs, architect instructions for rectification, and amended drawings. Last category is administrative documents such as notices on changes of staff and leave records. These pieces of information are mostly interconnected in an intricate web such that a minor change in one part can trigger a ripple effect on many others (F. Won et al. 2011). Using ICT (information and communication technology) for information exchange, the communication process is now simplified and made more efficient. (F. Won et al. 2011).

Information transactions and its management is digitized, centralized, and standardized in most construction organizations; at the same time, information handling has to be convenient, accurate, comprehensive, and well-timed for end-users. The industry has been enjoying the advantages of increasing efficiency and productivity, better management and decision making, cost saving, integration of business processes, integration of design and construction, and enhanced construction performance (Deng et al. 2001; Alshawi and Ingirige 2003; Tam 1999; Johnson and Clayton 1998; Gloor 2000 and Won et at. 2011). Nonetheless, barriers at the end-user level still exist to inhibit the realization of full benefits (F. Won et al. 2011).

The success of electronic information exchange depended on the quality and accessibility of data as well as the systems designed to process (F. Won et al. 2011 and Ahmad et al. 1995), the authors agree that the attitudes of industry end users and the way they interact with the systems are of vital importance (Ahmad et al. 1995).

The good collaboration does not result from the implementation of information technology IT solutions alone, but considerations should be given to organizational and people issues (P. Lam et al. 2010, and Shelbourn et al. 2007).

Construction personnel needs to access large amounts of information ranging from project design drawings to personal diaries to support their ongoing works and to make decisions about the process of construction (M. Nourbakhsh et al. 2012, and T. Froese et al. 2007).

With the development of information and mobile technology, general contractors are choosing to implement mobile devices such as iPads, tablets, and other handheld units. Mobile devices are being used to make document management and information sharing more efficient. While various studies have been done on information technology, limited studies have been done to address the perceived barriers of using mobile technology. The aim of this study was to promote seamless knowledge transfer in construction. This study was undertaken to identify the perceived barriers of mobile technology by end users in the southeastern United States.

Research Methodology

Data Collection

Based on the review of available relevant literature and unstructured interviews with mobile technology end users, a questionnaire was developed. H. Son et al. (2012) survey variables were used as the point of departure and modified for the development of this survey.

The questionnaire included statements about the accessibility of documents, document updates, software technological complexity, technical support, training, technology literacy, software capacity to handle document management, and an open-ended question. The open question was for suggestions regarding areas that the user would like to change with respect to specifications of the mobile device and software. The questionnaire was developed without regards to type of software or mobile device. Each statement was measured on a five-point Likert scale, with 1 being "strongly disagree" and 5 being "strongly agree."

The questionnaire was sent to 40 construction professionals who use mobile technology to access construction documents. Construction professionals were selected from construction companies currently building in the southeastern United States. Responses were received from 15 construction professionals (a response rate of 38%). The 15 initial respondents were requested to forward the survey to co-workers that use mobile technology for construction document management. This resulted in 17 additional survey responses. From the 32 respondents, 12% were superintendents, 34% engineers, 19% project managers, 22% executive managers, and 13% construction support professionals.

Data Analysis

This study is a diagnostic study to identify the perceived end users' barriers with using mobile technology in construction. The data collected was plotted to generate graphs for each question's response. The data analysis allowed the ranking of the perceived barriers from an end-user perspective.

Results

The survey results led to the following inferences.

I.   The leading perceived barrier was attributed to training (31%), followed by access to project drawings at site (22%), and software capacity limitations (16%).

II.   The highest percentage of uncertainty was due to lack of technical support (16%), document updates (13%), and technological complexity (10%).

III.   The leading aspects of acceptance or justification of mobile devices were attributed to easy-to-use or low complexity of technology (90%), operability of mobile device or technology literacy (88%), and the software capacity (81%).

IV.   Everybody was in agreement with the concept of using mobile technology and software applications for construction document management sharing.

These results can be verified from the following summaries with appended graphs prepared on the basis of each question's response.

Access at Site

Most respondents 72% agree or strongly agree, 6% are unsure/uncertain, and 22% disagree or strongly disagree that documents are always available on mobile device regardless of internet connectivity.

Figure 1: "ACCESS AT SITE"
ARE CONSTRUCTION DOCUMENTS ALWAYS AVAILABLE ON YOUR MOBILE DEVICE REGARDLESS OF INTERNET CONNECTIVITY?
STRONGLY DISAGREE 0%
DISAGREE 22%
STRONGLY AGREE 28%
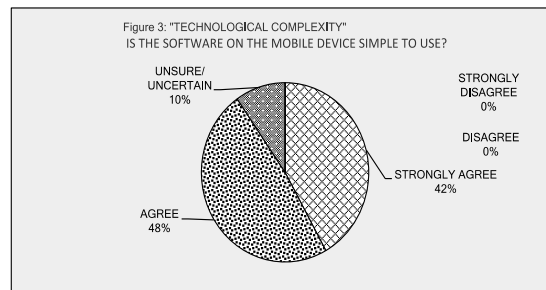UNSURE/ UNCERTAIN 6%
AGREE 44%
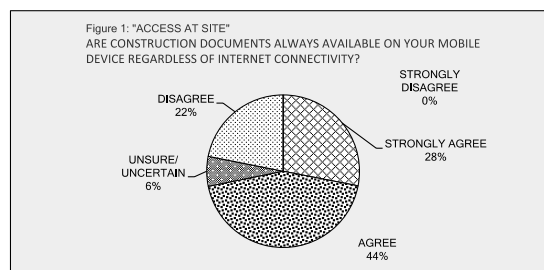
Document Updates

Most respondents 78% agree or strongly agree, 13% are unsure or uncertain, and 9% disagree or strongly disagree that project documents and updates are recorded and implemented efficiently.

Figure 2: "DOCUMENT UPDATES"
ARE THE PROJECT DOCUMENTS AND UPDATES MANAGED (RECORDED AND IMPLEMENTED) EFFICIENTLY?
DISAGREE 9%
STRONGLY DISAGREE 0%
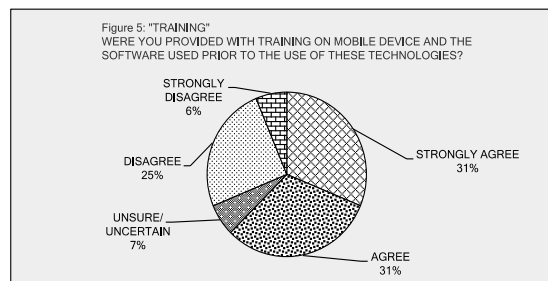UNSURE/ UNCERTAIN 13%
STRONGLY AGREE 28%
AGREE 50%
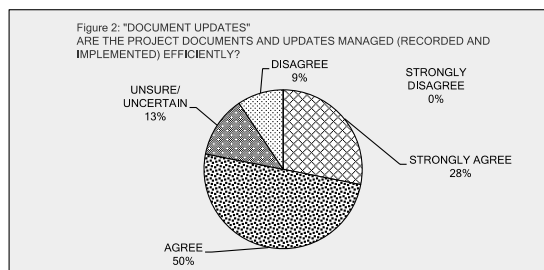
Technological Complexity

Very high number of respondents 90% agree to strongly agree and 10% are unsure/uncertain that the software on the mobile device is simple to use.

Figure 3: "TECHNOLOGICAL COMPLEXITY"
IS THE SOFTWARE ON THE MOBILE DEVICE SIMPLE TO USE?

UNSURE/ UNCERTAIN 10%

STRONGLY DISAGREE 0%

DISAGREE 0%
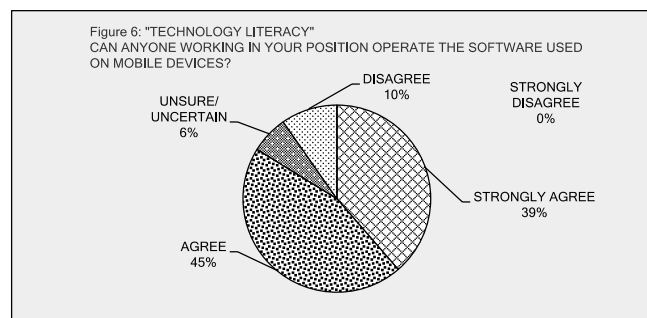
STRONGLY AGREE 42%

AGREE 48%

Training

Majority of respondents 62% agree or strongly agree, 7% are unsure or uncertain and 31% disagree or strongly disagree that respondents were provided with training on mobile device and the software prior to using these technologies.

Figure 5: "TRAINING"
WERE YOU PROVIDED WITH TRAINING ON MOBILE DEVICE AND THE SOFTWARE USED PRIOR TO THE USE OF THESE TECHNOLOGIES?

STRONGLY DISAGREE 6%

DISAGREE 25%

STRONGLY AGREE 31%

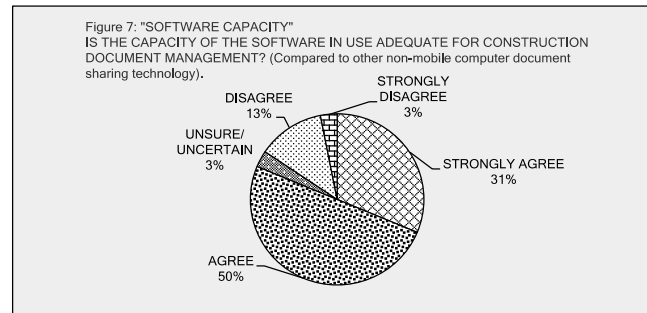UNSURE/ UNCERTAIN 7%

AGREE 31%

Technology Literacy

Most respondents 84% agree or strongly agree, 6% are unsure or uncertain and 10% disagree or strongly disagree that anyone working on their position can operate the software used on mobile devices.

Figure 6: "TECHNOLOGY LITERACY"
CAN ANYONE WORKING IN YOUR POSITION OPERATE THE SOFTWARE USED ON MOBILE DEVICES?

DISAGREE 10%

UNSURE/ UNCERTAIN 6%

STRONGLY DISAGREE 0%

STRONGLY AGREE 39%

AGREE 45%

Software Capacity

Most respondents 81% agree or strongly agree, 3% are unsure/uncertain and 16% disagree or strongly disagree that the software capacity in use is adequate for document management and sharing.

Figure 7: "SOFTWARE CAPACITY"
IS THE CAPACITY OF THE SOFTWARE IN USE ADEQUATE FOR CONSTRUCTION DOCUMENT MANAGEMENT? (Compared to other non-mobile computer document sharing technology).

Conclusions

The analysis of the results from the survey questionnaire concluded that mobile technology users in construction perceived limited training on mobile devices and software as the leading barrier, followed by accessibility of drawings at site, and software capacity.

The study also concluded that although there is a high percentage of respondents, Thirty-One Percent, receiving limited training to use mobile devices and software, Ninety Percent of the respondents believe that the software on mobile devices is simple to use and anybody in their position can operate it. These results suggest that training could be increased to get the full benefits of using mobile technology.

Twenty-Eight Percent of respondents are uncertain and disagree that the documents are always available on mobile devices regardless of internet access. This could be addressed by providing Wi-Fi internet service at the construction site or by providing software that is capable of storing documents and updating them once downloaded on their mobile devices.

Twenty-One Percent of respondents are uncertain and disagree that project documents and updates are recorded and implemented efficiently. The authors believe, this is one of the most important barriers faced by general contractors while implementing mobile technology used in construction. This is an area where the collaboration and document management system of the construction company is put to the test.

This study has provided considered views and preferences of engineers and managers mostly. The survey results also reflect the views and preferences of few superintendents and other workers involved with construction production. Due to the potential differences in background between engineers, managers, and superintendents, it is recommended that further studies be carried out to isolate the preferences of superintendents and superintendent track professionals.

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