

The Role of Information and Communication Technology in Construction Risk Management

Amani Sulaiman Bu Qammaz

Civil Engineering Department
Kuwait University
Kuwait

amani.buqammaz@ku.edu.kw

Rufaidah Yousef AlMaian

Industrial and Management Systems Engineering Department
Kuwait University
Kuwait

rufaidah.almaian@ku.edu.kw

Abstract

The lifecycle of a construction project would start with the need for a new facility by an owner. Therefore, the construction projects are known for having unique characteristics, which stem from the diversity of the owners' needs. The vast amount of the projects' components is usually undertaken in uncontrollable environments. The unique nature of the construction industry makes it risky and competitive endeavor. One of the critical competitive advantages for a construction organization is its ability to implement the previous experience and to maximize the organizational learning. This would aid the construction organization to manage the expected business risk effectively. Information and communication technology (ICT) can provide efficient tools for adequate risk management process that would lead to successfully managing and responding to project risks. This paper is part of an ongoing research that aims to study the available ICT tools and techniques and discuss how the ICT would facilitate the success of construction risk management process.

The main objective of the ongoing research is to reveal the areas where these tools and techniques can be implemented and its anticipated effectiveness if it were applied appropriately. The current paper discusses briefly the scope and the expected benefits from the study.

Keywords

Construction Industry, Risk Management, Information and Communication Technology (ICT).

1. Introduction

The construction industry is a product based business. The construction projects are the main product of the industry, the type and the design complexity of these projects are derived from the clients. Accordingly, the diverse needs and requirements of the clients would lead to projects having unique characteristics. Moreover, there are many other attributes that make it impossible to have identical construction projects, for example the design, location, available resource, weather, and project team represent essential criteria that would have direct effect on the project outcomes. Accordingly, it can be argued that it is impossible to have identical construction projects.

The nature of the construction industry makes it very risky endeavor, for a construction organization to succeed in this line of business, optimum utilization of its capabilities and resources is vital. Effective implementation of previous experience and maximizing organizational learning abilities are great assets for managing the risk that would be encountered while conducting business in the construction industry. Information and communication technology (ICT) can provide efficient tools for adequate risk management process that would lead to successfully managing and responding to project risks.

The risk management process is dynamic, and it involves handling and analyzing a vast amount of information. Risk management deals with risk identification, evaluation (assessment/analysis), responding, and controlling risk. Through the project lifecycle, the continuous implementation of risk management process would assist the project team to successfully achieve project objectives. This paper is part of an ongoing research that aims to assess the available ICT tools and techniques that can be implemented to manage project risk and to highlight its role in facilitating the successful implementation of the construction risk management process. In this paper, the ICT tools and techniques implementation in construction risk management will be revealed and its anticipated effectiveness will be briefly discussed.

2. The Role of ICT in the Construction Project

The diversity of the construction team and the different cultures of the project parties make the communication and integration among them very difficult. Integration and cooperation of the project team is essential for the project success. The effective flow of information within the team is critical during the construction phase. In construction projects, the amount of the daily information that must be processed and communicated is tremendous. Moreover, the type and complexity of the technical reports varies based on the level of reporting and the reporting intervals. Accordingly, it is inevitable for a project team to structure standardized templates and a secured cloud that allow for sharing and saving the processed information efficiently and in a safe manner. More to this point, the construction process is dynamic and there are many uncertainties that are involved with this process. Creating control systems is very important to aid the construction team to manage the project successfully and to ensure achieving the target outcomes. The experience of a construction organization is a great asset while developing standardized management and control systems. Huber, G. P. (1991) assumed that an organization learns if any of its units acquires knowledge that it recognizes as potentially useful to the organization and further explained that it is important to perceive organizational learning together with four constructs that are linked to it, which include: knowledge acquisition, information distribution, information interpretation, and organizational memory. The concept of organizational learning, is related to the ability of an organization to utilize its own knowledge to improve its future performance.

ICT as it is perceived in this research are the tools and techniques that use both hardware and software to assist the management and decision making during the construction processes. The ICT can be involved in collecting, processing, controlling, sharing, storing and retrieving project information. It may be implemented to handle complex or simple information. On the other hand, it may be general tool that is used among several projects or tailored specifically to serve a specific project or a given task within a project.

Despite the apparent need for the ICT in the construction industry, the pace of adoption of the ICT into the construction industry was low compared to other industries (Hosseini et. al., 2012, and Ern et al., 2017). Nevertheless, Hosseini et. al. (2012) revealed that the construction industry awareness for the need to implement the ICT into the construction practices has increased over the time and there exist many studies that were conducted to perceive the potential benefits for ICT utilization in the construction industry. The authors (Hosseini et. al., 2012) further explained that there were studies dedicated to expose the gap between ICT and the construction industry and to reveal the barriers for ICT adoption into the construction process. Hosseini et. al. (2012) summarized the driving forces behind the implementation of ICTs within construction industry into: increasing the level of productivity in the construction processes, globalization, and unique characteristics of the construction industry.

Ern et. al. (2017) listed six critical ICT implementation barriers for the construction industry, these barriers include: high costs or substantial financial commitment in acquiring the technologies, resistance to change, high cost of specialist software, conventional process, conservative attitude of professionals, and high cost for training staff. In order to overcome these barriers, a culture of change must be supported by the upper management. In fact, Ern et. al. (2017) found that "Top management support and commitment" is the top driver among the critical ICT implementation drivers that they have defined. Obtaining such support from the upper management requires providing definite evidences that would guarantee the feasibility of investing into the ICT. It is important to assure that for a given construction project investing into ICT would be feasible with respect to either cost, time, quality, or safety aspects. Linderoth and Jacobsson (2008) concluded their research with the fact that the project based nature of the construction industry, and the limited project time and costs, creates barriers for the implementation of ICT. They further explained that without immediate rewards that can be perceived by the project team for adopting the ICT, it will not be used.

Adwan and Al-Soufi (2016) investigated the publications related to the ICT in construction, they found many research articles or papers, which indicates the significance of the ICT technologies area in the construction industry. Adwan and Al-Soufi (2016) also found that most researchers focused on introducing construction-related ICT solutions to many problems within the construction industry. These findings reveal that the construction practitioners are tending towards investing in the ICT because of its promised advantages.

3. ICT and Construction Risk Management

The construction business culture is hard to change. The temporary nature of the industry increases the difficulty of implementing new tools and techniques. During the construction phase the project team is usually under a great pressure to meet the project's milestones within a limited time and budget. For a new tool or method to be accepted it must be simple and its effectiveness is evident. The construction risk management process is relatively new framework that was not widely implemented into the construction projects, particularly during the construction phase. The lack of awareness regarding its promised rewards is the main cause for such delay in applying the risk management framework in the construction industry.

The construction team usually tends to utilize the intuitive approach that is heavily dependent on the team's experience while managing the construction process. Tah and Carr (2000) discussed the fact of the unformalized approach for carrying risk management in the construction projects. They further explained that this approach would lead to the adoption of different methodologies and terminologies while using risk management. Although the intuitive approach may be effective to some extent, but its success would be highly dependent on the abilities and experience of the individuals in the project team. Tah and Carr (2000) emphasized on the need for a common language in describing risk as a basis for implementing risk methodologies. Therefore, it can be argued that having a systematic approach would assist the project team to have standardized measures while dealing with the project risk, which would maximize the chance of achieving project success with optimum efforts and resources. On the other hand, it is essential to emphasize that for accepting the construction risk management as an independent and systematic management process it must be simple, effective and systematic.

It was discussed earlier that implementing the ICT into the construction process would support construction projects in diverse areas. The ICT can assist construction project team in managing the project effectively. Therefore, the ICT can provide valuable tools that would promote for the successful implementation of the construction risk management. Decision support systems and management tools, which utilize ICT are essentials in risk management process. Therefore, the areas where the ICT can aid the adequate implementation of risk management may include: data collection, information processing, expert/knowledge-based systems, web-based management, reporting and controlling systems. There are many other areas where ICT can provide support to the project team for successfully managing project risk.

Teymouria and Ashoori (2011) studied the impact of information technology on risk management, they considered the impacts of information technology on three indices which show efficiency and effectiveness of process: time, cost, performance. They found that information technology tools have positive impacts on time rather than cost and performance of risk management process. They explained that one of the reasons may be improper information technology implementation or incomplete risk management execution.

4. Discussion

In literature, there exists numerous research studies that are related to construction risk management. These studies have different objectives and diverse perspectives. Reliable results and tools proposed by the available studies would assist construction professionals in many fields. To develop trustworthy risk models and to have such reliable findings relevant data need to be processed efficiently. Therefore, most of the research studies that are related to risk management would involve handling a vast amount of information. Researcher would have to collect and analyze data related to market conditions, organizational performance, or even project specific information. Moreover, the results of these research studies would propose decision-making or project control tools. It can be stated that utilizing the ICT tools the researchers were able to provide reliable results in a timely manner. However, an in-depth review to the available studies would reveal that the majority focused on identifying and analyzing risks that would assist in deciding on the adequate bid markups or the proactive planning before starting the execution of the project, other studies focused on creating risk management models for the bid/no bid and internationalization decisions. Following are

examples of these studies, which include the work of Bing and Tiong (1999) who developed a risk management model for international construction joint venture. Dikmen and Birgonul (2004) used Neural Network to create a model that would support international market entry decisions. Gunhan and Arditi (2005) study was related to international expansion decision for construction companies to facilitate the entry decision into foreign markets. Han, Diekmann, & Ock (2004) worked on a multicriteria financial portfolio risk management for international projects; to demonstrate their approach, they conducted a case study based on real projects collected from some multinational general contractors. In another study the same authors (2005) investigated contractor's risk attitude in the selection of international construction projects. Bu-Qammaz, Dikmen, and Birgonul (2009) created a model for risk assessment of international construction projects using the analytic network process. Al-Azemi, Bhamra, and Salman (2014) proposed a risk management framework for Build, Operate, and Transfer (BOT) Projects in Kuwait. Serpella et. al. (2014) implemented a knowledge-based approach to study the risk management in construction projects. To close with, investigating the listed examples and many other researches would reveal that the need for ICT is inevitable to implement the risk management process, and there is a need to propose risk management models for construction project success during the construction phase, which is one of the most critical phases of the project lifecycle.

5. Conclusion and Recommendation

This paper is presented under a preliminary comprehensive research that focuses on the role of ICT in promoting for successful implementation of the risk management into the construction industry. Revealing the expected rewards would promote for implementing ICT into risk management, the feasibility for investing in the offered software and information systems need to be further investigated. The literature discussed both barriers and drivers for implementing the ICT in the construction process. It was found that the involvement and support of the top management is the most critical factor that would promote for ICT implementation. The ICT barriers include: high cost, complexity, business culture. On the other hand, the foreseen advantages for implementing ICT in the risk management process include: increased productivity, improved communication, integrated project information, more efficient decision-making process, controlled project performance. More work need to be done to investigate the areas where the ICT can assist and improve the construction risk management process and to assess the expected benefits from implementing the ICT in the managing construction project risks.

Acknowledgement

This paper is part of project No. EV01/17 entitled "an assessment of risk awareness of medium and large size construction organizations in Kuwait" funded by Office of Vice President for Research – Kuwait University.

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Amani S. Bu Qammaz is an Assitant Professor in Civil Engineering at Kuwait University. She received her Ph.D. degree in Civil Engineering from The Ohio State University (USA – Ohio) in 2015. Her M.S. is in Civil Engineering from the Middle East Technical University (Ankara – Turkey) in 2007 and B.S. in Civil Engineering from Kuwait University in 1999. Prior to pursuing her graduate studies, Bu-Qammaz joined a specialized training program for fresh graduate engineers and then spent 12 years working for The Ministry of Public Works – Kuwait, she was a specialist engineer when she left the MPW to join Kuwiat University. Her research interests are in construction management, risk management, contract claims and exetension of time, international construction and decision making analysis.

Rufaidah Y. AlMaian is an Assitant Professor in Industrial and Management Systems Engineering at Kuwait University. She received her Ph.D. degree in Industrial Engineering from the University of Arkansas. Her M.S. is in Industrial Engineering from the University of Pittsburgh in 2011 and B.S. in Industrial and Management Systems Engineering from Kuwait University in 2005. Prior to pursuing her graduate studies, AlMaian joined a specialized training program for engineers and spent four years in industry working for a financial institution. Her research interests are in engineering management, engineering education, decision making analysis, and project management.