ICT UTILIZATION IN ADMINISTRATIVE TASKS IN IRANIAN CONSTRUCTION ORGANIZATIONS

Ali Alaghband Rad[1], Ehsan Asnaashari[2], Andrew Knight[2] and Alan Hurst[2]

[1] *Scientific Association of Construction Engineering and Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
[2] *School of Architecture, Design and the Built Environment, Nottingham Trent University, Nottingham, NG1 4BU, UK.*

Information and communication technologies (ICT) have influenced areas of design and construction in the recent years. Much new software and hardware has been developed to aid administrating, planning, designing, and executing of projects and are being implemented by construction firms in different countries in the last two decades. Iranian construction firms also attempt to apply ICT in projects. However the extent and quality of ICT utilization in construction projects in Iran are still unknown. This paper explains how Iranian firms utilize ICT in administrative affairs. Trends and patterns of the Iranian organization towards administration ICT application are described. The research has a qualitative approach and focuses on meanings and opinions. Twelve semi-structured interviews were conducted with high-experienced construction practitioners and software developers associated with the Iranian construction industry. Responses are qualitatively analyzed and a narrative interpretation is developed. The results showed that the Iranian construction organization acquire ICT facilities based on their needs and functionality of the facility. This paper also explains that important sections of a typical automation system in construction in Iran that are archiving, personnel management and communication.

Keywords: administration, automation, ICT, Iran.

INTRODUCTION

Prompt and fast access to accurate and reliable information is a key for different organizations to achieve success. In the construction industry, information is vital. A typical construction project usually starts with information from a client. This information will be processed by consultants to generate data for contractors. Information acts as glue to bind different phases of the construction process. Owing to the importance of information in construction organizations, information and communication technology (ICT) have had a deep impact on how construction activities are done. User-friendly software facilities have been developed and utilized in different stages of construction that receive data, process it and represent it in different formats for different uses. Hardware tools, also, make heavy calculation or visualization possible and improve the way people communicate in construction projects. Indeed, construction organizations are experiencing a paradigm shift from

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Rad, A A, Ehsan Asnaashari, E, Knight, A and Hurst, A (2010) ICT Utilization in Administrative Tasks in Iranian Construction organizations. *In:* Egbu, C. (Ed) *Procs 26th Annual ARCOM Conference,* 6-8 September 2010, Leeds, UK, Association of Researchers in Construction Management, 615-624.

traditional paper-based drawings, calculation and documentation to a digital world that promotes accuracy, integrity and sharing.

In recent years, the use of ICT in the construction organizations in Iran has increased. Although the level of utilization varies depending on size of organizations, most managers are aware of its importance in projects and the impacts that it may have on improving efficiency and effectively of firms (Rajaee *et al.* 2009). However, there is a lack of investigation about how the Iranian construction organizations utilize ICT. In fact the patterns and trends of ICT adaptation and use in the Iranian construction industry are unknown. What software is used for what purposes, which hardware tools are employed and what value they add to the firms are important questions. This paper is focused on the role of ICT in administrative tasks in construction organizations.

PREVIOUS RESEARCH

Information and communication technology (ICT) is referenced as the integration of computing technology and information processing includes a wide range of technical approaches to a variety of problems (El-Ghandour and Al-Hussein 2004). In construction industry, ICT is the application of decision support tools, which uses electronic machines and programmes for processing, storage, analysis, control, transfer and presentation of construction information data during the whole life cycle of a construction project (El-Ghandour and Al-Hussein 2004). The process of computerization in construction started with use of machines for project planning and scheduling and then became focused on computer-aided design (CAD) (Cutting-Decelle *et al.* 1997). In recent years, the industry is going to adopt the electronic document management systems, wireless technology and web-based software. Although there is a fast improvement in ICT application in construction industry, the lack of investment is still the main obstacle for most firms to adopt ICT in their projects (Andersen, *et al.* 2000).

The importance of ICT in construction organizations has been emphasized by a number of researchers such as Aouad *et al.* (1996), El-Ghandour and Al-Hussein (2004), Hewage *et al.* (2008), El-Saboni *et al.* (2009) and Kazi *et al.* (2009). The aim of most research in ICT field has been to highlight the benefits of ICT application in construction, explain the barriers and describe the adaptation process. Much research has been carried out in different countries to investigate ICT utilization in the construction industry. Hewage *et al.* (2008) studied IT usage in Alberta's building projects (Canada). They claimed IT can improve the working efficiency in projects by lubricating communication process. They reported that the use of IT to overcome communication issues is limited in the construction industry and construction companies are spending a small proportion of their total budget on IT improvements. Hewage *et al.* (2008) made a list of managers' expectations for the future IT developments as: economic feasibility, employee involvement in IT developments, proper training and support, a step-by-step implementation process and an industry-wide ICT standard.

Trefor Williams *et al.* (2007) by conducting a quantitative study in United States concluded that interest in electronic approval of submittals, exchange of CAD files, web-based document and content management applications is strong, However, there is a lack of familiarity about available ICT tools and a reluctance to invest time and money to adopt them. Trefor Williams *et al.* (2007) explained that productivity, work flexibility, faster service and availability of data are benefits of ICT adaptation in U.S. construction industry. They also indicated that high cost and little return on

investment, needed training, lack of knowledgeable support personnel, risk of system failure and data loss, and unclear benefits for individuals/companies is the main obstacles of ICT adaptation in this country.

In India, Ahuja *et al.* (2009) confirmed that use of ICT provides the ability to achieve effective communication. However, they explained that effective utilization of ICT requires its adoption at the industry level. Their study showed that small and medium enterprises (SMEs) with higher turnover have higher adoption of ICT. Based on their analysis, availability of ICT infrastructure onsite, increased requirement of clients for more project information, increased involvement of geographically separated agencies in projects, and education of upcoming construction students towards ICT are enablers of ICT adaptation in the Indian construction industry. Issues that Indian firms encounter, as Ahuja *et al.* (2009) reported are need to periodic upgrade of hardware and software, virus threats, data security, low speed internet connection onsite and low proficiency of site staffs in ICT.

El-Saboni *et al.* (2009) found that the implementation of the projects electronic communication system played a significant role in the transformation of the construction organizations, from a functional structure, into a matrix and project-oriented form of organization in United Arab Emirates. They expressed that the benefits of ICT adaptation in UAE are expedited decision making, transparency, availability of information, maintaining relationships, and trust.

Kazi *et al.* (2009) believed that ICT is becoming a strategic asset for any organization to deliver business improvement and achieve sustainable competitive advantage in Turkey. The results of their study indicated that the focus of investments in ICT is very much towards business demand rather than achieving strategic competitive advantage. Their study also showed that the barriers to successful ICT implementation can only be overcome by training on new technologies and improvement of adaptation processes.

Little research has been conducted in the field of ICT in Iran. Most efforts has been put on applying a particular technology in construction projects such as using radio frequency identification (RFID) tags in linear construction (Farshidfard *et al.* 2009) and establishing management information system for construction organization (Zargarpoor and Ataee-Jafari 2009). Rajaee *et al.* (2009) believed that having a management information system (MIS) for construction projects that receives, stores, processes and analyzes available information will play a major role in improving information flow. They claimed that despite of availability of new project management and MIS packages, most construction organizations in Iran have serious weaknesses in terms of sharing information among different parties involved in the projects. Khosh-Alhan and Nowrouzi (2006) indicated that connecting different elements of the project together, availability of infrastructure and clear definition of ICT adaptation process are factors that should be considered for successful utilization of ICT in different organizations in Iran. No research has been found that evaluate the condition of ICT utilization in the Iranian construction projects. Hence, this research is established to fulfil this gap in the current body of knowledge.

METHODOLOGY

This research is based on qualitative paradigm to give the opportunity to the researcher to emphasize more on describing the current condition of ICT adaptation in construction industry in Iran by getting help from experienced practitioners.

Qualitative strategy helps the research to be focused on personal histories, perspectives, and experts' experiences of construction industry (Bryman and Bell 2003). The result would be rich and explanatory in nature and describes variations, trends, patterns and norms.

At the first stage of this research available literature was reviewed to investigate and summarize the previous efforts in the area of ICT adaptation in construction industry in different countries. Then a set of semi-structured interviews was carried out as the major data collection method of this research.

Naoum (2007) expressed that selected sampling is the most appropriate sampling method for qualitative interviewing. Hence, owing to qualitative nature of the study, a small, but focused and carefully selected sample is chosen to be interviewed. To achieve reliable data, interviewees were selected carefully among construction practitioners who have four specifications: a) to have work experience as a senior manager in a construction company, b) to have ten or more years of experience in construction, c) to be completely familiar with the culture and environment of construction industry in Iran, and d) to apply a minimum level of ICT in their organizations (to have personal computer, CAD/CAM software, Microsoft Office, and access to internet). Ten interviews with the experienced Iranian construction practitioners with above characteristics were conducted. Furthermore, to understand the role of software developers, two interviews were carried out with the senior managers of two local construction software developers. The selection of these two was based on recommendation of seven interviewees as they expressed that they use software supplied by one of these two developers in their companies.

In the interview sessions, respondents were asked to explain how they use ICT in their organizations and describe what benefits ICT application has brought for them. In fact, researchers had a framework of ICT themes to be explored. However, because it was a set of semi-structured interviews, new questions were brought up during the interview as a result of what the interviewee said. To focus interviews on the topic an interview guide was developed that encompassed several questions and topics. Some of the main questions are:

1. What are advantages and disadvantages of utilizing ICT in your organization?

2. What obstacles have you faced during ICT adaptation?

3. Can you describe a case that you start using ICT in your company (from having an idea to purchase facilities and usage)?

4. How do you keep and archive your information and documents?

5. Can you describe different ways of communicating and sharing information in your company?

6. What is your ideal for using ICT in your company in the future?

Interviewing had been continued up to the point that desired level of data saturation was achieved. That was the point that the interviewer understood responses are being repeated by new interviewees and critical and sensitive information could not be received from them anymore.

In the analysis stage, the conventional template analysis has been used where the researcher produces a list of codes (template) representing themes identified in the textual data (King 2004). In fact, codes are devices to label, separate, compile and

organize data (Charmez 1983). At the first step of coding, responses were classified under relevant categories. The process of categorizing data was tentative and therefore tended to be in a constant state of potential revision and fluidity. Indeed, categories emerged from data by progressing through the transcript of interviews. Under these categories, new sub-categories were developed with the same logic and process explained before. Then, a comprehensive interpretation was developed to reveal the hidden aspects of ICT utilization in construction projects. Wherever it was suitable, the participants' direct quotes are cited anonymously to make the interpretation more meaningful.

It should be explained that the result of this study is restricted to the participants' experiences and their viewpoints and cannot be generalized in wider contexts. Furthermore, the result may not be the whole reality as in social studies like this there may be multiple realities.

QUALITATIVE DATA ANALYSIS

Based on information collected from interviews, the current condition of ICT adaptation in Iran is described in seven general categories as: (1) History, (2) Administration, (3) Consultants, (4) Contractors, (5) Hardware/Software Facilities, (6) Iranian software, and (7) Training. As it was expressed before this paper will discuss only the use of ICT in administrative affairs. Administration is chosen because during the data analysis it was revealed that the Iranian construction firms put so much effort on enhancing the efficiency of their administrative affairs by adopting different ICT features.
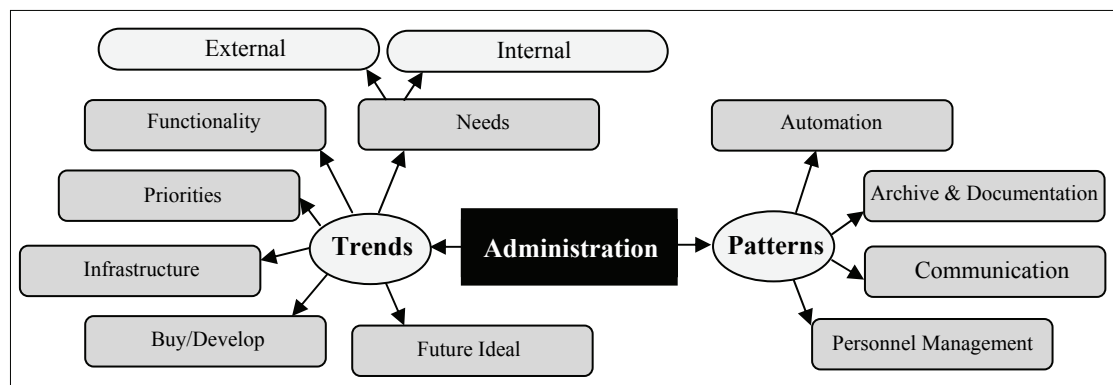

Figure 1: Administration subcategories

Administration category is divided into two sub-categories as: (1) Trends and (2) Patterns. Trends sub-category discusses the way that construction organizations approach toward ICT. It describes internal and external needs to ICT, functionality of ICT features, firms' priorities in adopting ICT, the role of infra-structure in ICT application, two options of buying or developing software, and experts' expectation from ICT in the future. Patterns sub-category includes how organizations use ICT and which facilities are utilized more. This covers business automation, personnel management system, communication channels and electronic archive. A summary of the qualitative data analysis result is visualized in Figure 1 that indicates categories and sub-categories emerged from transcript of interviews.

Trends
According to data gathered from interviews, interest in adopting ICT in construction organization in Iran is strong. Most respondents emphasized the importance of ICT in

construction and expressed that they are looking for ways to utilize its abilities in their firms.

Needs

By considering responses, it is revealed that the main motivator for adopting ICT is identifying a need in the organization. In fact, the need for fast, reliable, and accurate data processing necessitates ICT application in construction firms. In other words, construction organizations acquire software and hardware facilities based on their needs.

The needs can be categorized into two groups: (1) Internal needs and (2) External needs. Internal needs are identified by firms. Construction organizations often want to carry out their job in the fastest way and with least mistakes and errors and this can be done by effective ICT utilization. A respondent expressed that "when you get so many projects, you should be able to receive and process huge amount of information. Managing data on papers is a dilemma. However, if you receive them in the electronic format, you do not need huge space for storing them, you can search through your information easily and you can share them quickly". Some respondents also emphasized that investment in ICT also may reduce administration costs. Paperless communication, shrinking the firms' size, reducing working journeys between the head quarter and projects' sites are positive consequences of ICT adaptation that will lead to cost reduction.

External needs are enforced by external organizations and authorities. Companies that want to adopt ISO (International Organization for Standardization) standards are given a systematic guideline for ICT utilization. Beside this some clients have established ICT requirements for companies that want to bid for a contract. One of the respondents said "One of our clients has asked us to establish a portal for the project. They want to be informed about day-to-day affairs, decisions that are made, most recent drawings and documentations. All of this information can be accessed via our company portal easily". Moreover, some governmental institutions such as Ministry of Economic Affairs and Finance (tax matters) and municipalities only accept information in digital format and this forces organizations to utilize ICT.

Functionality

Another factor that stimulates the construction firms to apply ICT is competitors' behaviour in terms of acquiring new ICT facilities. A respondent explained that "some large companies are leaders in adopting ICT. When they use the new technology and gain benefits, other follower companies will soon or late apply that technology." In fact, interest in ICT adaptation will increase when firms make sure about the proper functionality of the facilities. When they notice that their needs are being addressed, they will invest more in ICT adaptation.

To Buy or To Develop

When decide to purchase a new ICT facility, most firms buy a standard system or software from the market. These standard packages are relatively cheap, can be acquired quickly, are being used by many firms and have acceptable quality. However, they are not tailored to the specific needs of the company. Large enterprises which have strong ICT departments try to meet their needs within the company or order a tailored system to an IT company. The benefit of developing ICT system in a company is that it is produced on specific company requirements and can be applied gradually in different departments.

Priorities

All respondents expressed that quality is the main concern when they want to adopt ICT facilities. One respondent defined the quality as "the service that meets our expectations and fulfil our needs". Beside quality, respondents emphasized that the price is also a determining factor. They believed availability of cash have a direct impact on ICT adaptation. After sale customer supports, availability of training and ICT developers' reputation are other factors considered by construction firms when they want to purchase a new ICT facility.

Infrastructure

Availability and quality of ICT infrastructure is an important issue. In some construction sites that are located outside of the urban areas access to telephone landline and internet is not possible. Some respondents believed that Iran's ICT infrastructure is not enough for the huge demand of different industries. They explained that much effort should be put on updating and developing telecommunication and internet infrastructure of the country to make the future development of construction ICT possible.

Future Ideal

During the interviews respondents were asked about the ideal that they have in mind about future development of ICT in construction industry. Respondents explained that remote access to the information, integration of information systems in companies, and linking headquarters and sites are at the focal points of ICT development for construction industry. Working in the wireless environment and audio/visual communication with site staffs are other ICT facilities that respondents expected to have them in near future. Respondents also hoped that an industry-wide standard for ICT utilization will be developed. They thought that all firms regardless of their role and size should adopt basic ICT facilities. Indeed, all potential capabilities of ICT cannot be utilized if a company uses an updated ICT facilities and the other one has low level of ICT adaptation. One of the respondents described his ideal about ICT use in construction projects in the following: "Our aim is to have an integrated virtual environment for visualizing, managing and controlling construction projects remotely. In this system all parties involved in the project such as clients, consultants and contractors are able to access to the latest information and news of the project at any time and in any place".

Patterns

During interviews respondents were asked about how administrative tasks are carried out in their organization, which ICT facilities are used for administration and what are their benefits. These questions aim to explicate the pattern of ICT utilization in administrative tasks in construction organizations.

Automation

All respondents expressed that they have a sort of automation system in their companies that integrate administration, financial and personnel management software modules in an organization. Based on data gained from interviews, automation increases the speed of information flow, enhances the accuracy of processed information, reduces time of report making and provides close communication among people work in a construction firm.

There are different types of automation systems such as Virtual Private Network (VPN), Management Information System (MIS) and Enterprise Resource Planning (ERP) on the market and firms considering their needs acquire one of them.

A respondent described the different modules of ERP that is established in his company as the following: "Our ERP system includes sections about personnel management, documentation, communication, archive, finance, accounting, IT service, technical supports, procurement information, basic information about projects, project management and control".

Personnel management

This is a basic task of most automation systems. Attendance systems provide access control and produce time sheet for employees. It is linked with payroll department that automatically calculates wages and issues payslips. This feature may also used for establishing human resource strategy of the company by visualizing annual leaves, new roles, promotions and vacancies.

Communication

Fast and effective communication is a vital factor in construction organizations as all respondents indicated. Landline telephones, mobile phones, fax, the company portal and emails are normal modes of communication in construction projects in Iran. Using emails instead of paper letters is quite popular specifically in inter-organization communication. One respondent said "by using emails, we reduce the numbers of our faxed documents by 80%. This has had a great impact on minimizing time and cost of communication in our organization".

Archive and documentation

Each construction project has huge amount of technical or administrative document such as drawing, estimations, correspondence, calculations, photos, bidding documents, financial reports, inventories and contracts. Managing paper based documents is a tough job that takes time and needs hard efforts. One of the noticeable ability of ICT systems is to save and maintain documents in an electronic format. All respondents preferred to file their documents and correspondence electronically. However, they expressed that some important documents such as certificates and financial records should be stored in both electronic and hard formats. Some respondents expressed that owing to the risk of data loss and virus threats, they usually keep records of their under construction projects in hard format as well as digital format. The benefits of digital archive, as explained by respondents, are saving physical space, electronic data search, information filtering, remote access to documents, video attachments, multiple access by different operators, reducing printing costs, and fast replacing of old documents with recently updated documents.

DISCUSSION

Trends of the Iranian construction organizations shows that they need incentives to utilize ICT. Cost and time saving are popular incentives that most firms expect to receive. Hence, organizations should be clearly informed about the advantages of using ICT in construction. Any strategy for promoting ICT utilization should be specific, developed based on a vital need in the industry and include time and cost advantages.

High level of functionality and achieving reliable result is the best way to encourage firms to adopt ICT. Therefore, monitoring and documenting the working process before and after utilizing an specific ICT feature is important. This information can be circulated among firms in the form of case studies to shows the real benefits of ICT utilization.

For future, the focus should be put on virtual environment and wireless networks as most respondents expressed that they expect to have them in the near future. However, low speed connection, expensive high speed internet connection, lack of an integrated online payment system, lack of construction ICT standards and costly hardware are obstacles that block the way of firms to utilize ICT. To overcome these issues, the Iranian Government should invest more on ICT and give more freedom to privet firms to establish developed ICT infrastructure. Beside this, professional institutions should be involved to craft a common policy and standard for using ICT in construction industry. This standard should be addressed the needs of the industry and consider that many construction firms in Iran are small and medium size organization with limited financial capabilities.

Construction firms are involved with large amounts of administrative tasks. Hence, administration is a vital point that may receive ICT helps to achieve time, cost and quality advantages. Dealing with different kinds of documents (texts, drawings, and photos), office and site staffs, different sub-contractors and several stakeholders is a complex administrative task that can be done efficiently by using ICT to enhance archiving, communication and staff management processes.

CONCLUSIONS

In this paper, the results of a qualitative study on ICT adaptation in administrative tasks in construction projects are presented. The goal of the effort is to better understand the trends and patterns of ICT utilization for administration. The process of ICT adaptation in Iran usually starts with identifying need for fast information flow. Also, functionality of a facility may motivate firms to utilize it. Quality in ICT application is a key for construction organization. However, investing wisely is a priority for the managers. Future ICT development in construction industry should be focused on integration of facilities, remote access and visual inter-organizational communication. Using automation system is popular among the Iranian construction firms. Personnel management, electronic communication and digital archive are the main modules of automation systems that are used in construction organization in Iran.

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