

Automated Data Collection Technology Usage by UK Construction

Javad Majrouhi Sardroud

Assistant Professor, Faculty of Engineering and Technology, Central Tehran Branch, Islamic Azad University, Tehran, Iran. J.Majrouhi@iauctb.ac.ir

AmirHooshang Fakhimi

PhD Researcher, Faculty of Engineering and Technology, Central Tehran Branch, Islamic Azad University, Tehran, Iran. ahfakhimi@gmail.com

Mojtaba Abbasi

PhD Researcher, Faculty of Engineering and Technology, Central Tehran Branch, Islamic Azad University, Tehran, Iran. moj.abbasi310@gmail.com

Abstract

Recently, Information and Communication Technology (ICT) has received a great deal of attention and some solutions have been developed to assist the management activities throughout various industries. One of the current significant issues involved with ICT is Automated Data Collection (ADC) technology that also known as Automated Data Capture; the use of which has grown in recent years. However, little attention has been paid to the issues regarding the adoption and implementation of these technologies. This paper investigates the current state of ADC technology usage in the UK construction, and identifies reasons why construction industry in the UK is a late adopter of ADC technologies. Key factors are identified as barriers from literature review for adoption of ADC technology in construction, and validated through an online questionnaire survey. According to the results, process related factors play an essential role in adopting ADC technologies in the UK construction industry.

Keywords

Automated Data Collection (ADC) technologies, UK construction industry

1. Introduction

Construction industry is one of the fragmented industries. Projects in this industry are extremely complex and generally take place in an unprepared and dynamic environment. This industry is recognised internationally as one of the labour and information-intensive industries and heavy exchange of data and information between project participants on a daily basis is a facet of major construction processes. Thus, accurate and real time information systems have become an important tool in the management of construction projects (Majrouhi Sardroud, 2012). The industry and research partners to the project believed that sufficient Information and Communication Technology (ICT) was already available for use in real projects, albeit with care and an acceptable risk of failure (Watson and Underwood, 2002). ICT is an umbrella term that includes any communication device or application associated with them, which recently has received a great deal of attention and some solutions have been developed to assist the management activities throughout various industries (Majrouhi Sardroud, 2013). One of the current significant issues involved with ICT is Automated Data Capture (ADC) technology or technologies that also known as Automated Data Collection; the use of which has grown in recent years. ADC technologies

can be recognised as most promising technologies, Laser Detection and Ranging (LADAR), General packet radio service (GPRS), Global Positioning System (GPS), and Radio Frequency Identification (RFID) are examples of such kind of technologies, which can be used for the identification, collection, storage, transmission, and presentation of information (Caldas, Torrent and Hass, 2004; Majrouhi Sardroud *et al*, 2012). Not only using of ADC technologies for efficient information management is needed but also construction industry has greatly benefited from technology in raising the speed of information flow, reducing data entry errors caused by human transcription, enhancing efficiency and effectiveness of information communication, and reducing labour costs and cost of information transfer (Wang, Lin and Lin, 2007).

Automated data collection technologies present greater opportunities to establish effective management tools by supporting information integration and construction communication (Zavadskas, 2010), which leads to develop a decision-making framework that enables organisations to fully integrate ICT and its associated people and business issues into their projects and individual businesses (Shelbourn *et al*, 2007). Thus, ADC technologies are capable to facilitate paperless construction management, modernise information collection and sharing by supporting automatic access to reliable real-time information, and undoubtedly have a profound impact on effective management of construction activities. Although ADC technologies have the potential to improve information integration and enhancing team communication, studies and researches have proven that the UK construction industry is a late adopter of ADC technologies (Love, Irani and Edwards, 2004). In view of this, the study investigates the perception of ADC technology usage in the UK construction industry and identifies reasons why available ADC technologies were not fully introduced in the UK construction industry using an online questionnaire survey. Figure 1 shows ‘research methodology diagram’ for this research.

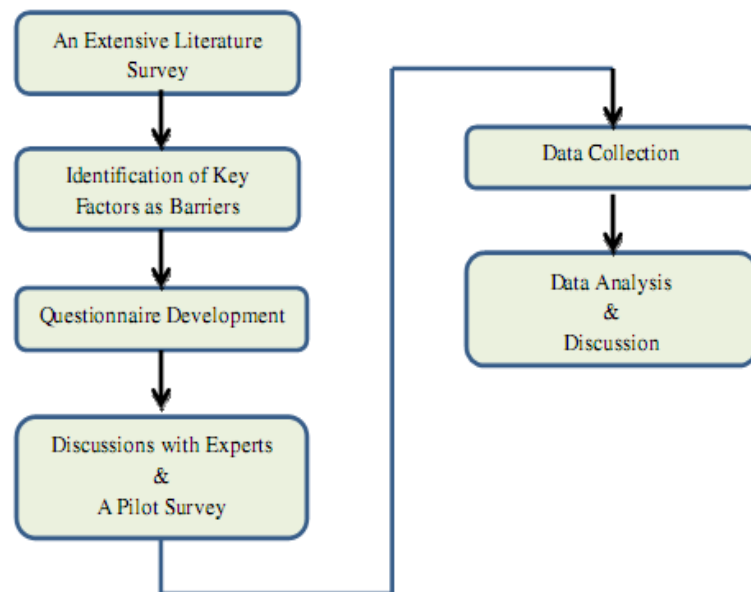


Figure 1. Research Methodology Diagram

2. Literature Review

Several surveys have been conducted in various countries to identify barriers to the effective implementation of information and communication technologies in construction (Barthorpe, Chien and Shih, 2003; Ahuja, Yang and Shankar, 2009; Adriaanse, Voordijk and Dewulf, 2010). A recent study has shown that the barriers of information and communication technology use and adoption have moved

beyond technical and cost problems to ICT management problems within the construction organisations (O'Brien, 2000).

Literature reviewed by Love *et al.* (2004) showed that IT research in construction mostly had a technical rather than a managerial focus such as investment justification, strategy and strategic information systems planning. Despite the technological advancement in hardware and software in ICT, it has been observed from real life examples and contemporary literature that the human affinity in its use has not forged ahead at the same pace.

Songer *et al.* (2001) found that unclear strategy and actual implementation process can lead to excessive technological investment costs and delay the implementation. This survey also indicated that respondents had little perception of how IT investment increases project and organisational performance.

As stated earlier, ICT use in the construction industry has remains low as compared to other industries. One significant reason is due to lack of understanding of how to implement ICT into a construction organisation (Peansupap and Walker, 2005). In particular, construction organisations remain uncertain about the expected impact the investment might have on the business. According to Love *et al.* (2001) other problematic ICT implementation issues could be lack of an IT infrastructure, unclear benefits of ICT use, investment cost, and behavioural barriers.

In addition, some studies highlighted significance of the ICT implementation barriers such as lack of perceived return on investment, limited resources available to small and medium enterprises, low levels of IT skills and resistance to change by staff (Stewart, Mohamed and Marosszaky, 2004; Henderson and Ruikar, 2010; Stephenson and Blaza, 2001).

Barthorpe *et al.* (2003) conducted a research to examine the current use of state of ICT by UK construction companies. According to their results, the three most significant non-financial barriers to the effective implementation of ICT in the UK construction industry were: a lack of established IT system standards, traditional business practice of the construction industry and the fragmented nature of this industry.

According to Stephenson and Blaza (2001), Anumba and Ruikar (2002), Lam, Wong and Tse (2010) and Peansupap and Walker (2005) the construction industry is very much fixed in what they have traditionally done, and despite the advancement of ICT systems, resistance to change is a significant barrier to implementation of such systems.

Furthermore, Frits (2007) discovered that the reasons of ICT technology was not fully introduced in construction companies are due to lack of perceived suitability of the software, ICT Immaturity levels, poor availability of tools for evaluating benefits of using ICT, financial constraints, and a lack of understanding of the ICT implementation process.

More factors affecting use of ICT have been identified and categorised as factors affecting at the industry level (e.g. high cost associated with IT applications), organisation level (e.g. resistance to change by staff) and at the level of people (e.g. individuals IT knowledge characteristics) (Stewart, Mohamed and Marosszaky, 2004; Henderson and Ruikar, 2010). According to the developed model which is investigated by Ahuja *et al.* (2010), if strategic ICT adoption is implemented at the industry and organisation levels, it would lead to effective ICT adoption by the people in the project teams. This would lead back to successful implementation of the organisation level strategy, further leading to successful implementation of the industry level strategy. Thus, it is a cyclic process, which in totality would lead to the strategic diffusion of ICT for construction project management.

3. Questionnaire Development

A comprehensive review of related literature on the use and adoption of Information Technology (IT) and ICT in the construction industry has enabled the identification of key factors as barriers for ADC technologies adoption in construction, which underpin a questionnaire.

Discussions with experts and a pilot survey were used to support content validity of the questionnaire. The Cronbach's Alpha analysis was also carried out using SPSS (Statistical Package for the Social Sciences) software to assess the reliability of the questionnaire. One factor has been removed to ensure all factors fell within the 0.6 or greater range in terms of reliability (Lam, Wong and Tse, 2010). This indicates that answers based on the five-point Likert scale were reliable and internally consistent. After evaluation of the validity and reliability of the questionnaire, emails with the link to the online survey were sent to selected construction professionals.

4. Results and Discussion

The link of the survey was distributed to 71 construction professionals across the UK. Of the responses, 22 were returned completed, representing a response rate of 30.9% (approx. 31%). Although the results can in no way be considered to be representative of the industry as a whole, they still present useful information and do provide important indications pertinent to the construction industry.

The General Respondent Demographics (GRD) revealed that the majority of the respondents (55%) had more than 10 years of experience in the construction industry. Where respondents are divided according to occupation, contractors form the largest number of respondents (32%). Amongst the respondents, those working as a researcher accounted for 23%, with consultant firms 18%, and from owner 14%.

The respondents were asked to provide their opinions toward the listed key identified factors on a 5-point Likert scale where 1 = unimportant, 2 = somewhat important, 3 = moderate important, 4= very important, 5= extremely important.

Remarkable as it is, the importance level of all perceived factors were of moderate importance or higher than this level of importance. According to the results, the first three rankings in descending order are:

- 1) Uncertain return on investment; This factor has found highest importance level amongst all perceived factors because 77% of the respondents expressed as their opinion that it is extremely important (41%) or very important (36%).
- 2) Lack of economical assessment and business value analysis of ADC use; and
- 3) No innovative culture.

The cluster of technology related factors received the lowest level of importance amongst all clusters from contractors', consultants' and researchers' points of view. Table 1 represents the respondents' opinions about the priorities of the factors in descending order from the UK contractors', consultants', and researchers' points of view.

According to the analysis of the respondents' agreement about the statement, there was a 86% (19 out of 22) consensus amongst the respondents that construction cannot continue without adopting the ADC technologies. These respondents stated that they agreed or strongly agreed with adopting ADC technologies to overcome construction complexity.

The presented data analysis lead to the identification of issues, which require action at the levels of industry, organisation and people. In other words, strategic adoption and deployment of ADC technologies in the construction industry necessitates developing a strategic plan, designing a framework,

creating a management team, and training construction workers and managers. The strategic plan should address all related issues to support the wider use of ADC technologies in the construction industry. The framework clarifies the implementation requirements, and addresses all key issues in the ADC technology field in an efficient way. The management team has to be responsible for purchasing and implementing the system.

Table 1: Respondents’ Opinions about the Priorities of the Factors from the UK Contractors’, Consultants’, and Researchers’ Points of View

Factors	Rsearchers' opinions	Consultants' opinions	Contractors' opinions
F.1) High investment	F18	F17	F3
F.2) Maintenance cost	F3	F18	F9
F.3) Uncertain return on investment	F8	F8	F12
F.4) ADC immaturity levels	F12	F6	F13
F.5) ADC management problems	F1	F3	F14
F.6) Lack of understanding of the ADC implementation process	F10	F7	F19
F.7) Unsure of how to begin this process	F6	F9	F8
F.8) Lack of economical assessment and business value analysis of ADC use	F2	F15	F6
F.9) Poor availability of tools for evaluating benefits of using ADC technologies	F13	F5	F5
F.10) No market information	F14	F10	F17
F.11) Lack of flexibility and adaptability of ADC technologies	F19	F19	F2
F.12) Lack of reliability	F4	F1	F4
F.13) Risk of technical malfunction	F9	F4	F11
F.14) Limited technical life cycle	F15	F16	F15
F.15) Needs for infrastructure or network	F17	F11	F18
F.16) Difficult to integrate and combine in existing process	F7	F12	F16
F.17) No innovative culture	F5	F14	F10
F.18) Lack of successful evidence from case studies	F11	F13	F1
F.19) Lack of perceived suitability of the software	F16	F2	F7

5. Conclusions

In order to investigate the late adoption of ADC technologies, the study provides a useful insight into the ADC technologies adoption barriers within the UK construction industry by identifying key factors using an online questionnaire survey. The identified barriers are divided into four main groups, which are cost related, technology related, process related, and other factors. The results also indicated that the importance level of all process related factors are higher than technology related factors. The survey also showed that 41% of the respondents believe that ‘uncertain return on investment’ is extremely important, and also 36% of them expressed as their opinion that it is very important. Thus, this factor has found highest importance level amongst all perceived factors. It is hoped that the survey results will help future researchers for decision making regarding the challenges relating to the adoption and implementation of the ADC technologies.

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