Benchmarking of IT based Tools for Site Security, Safety and Communication on Construction Work-sites in a Metropolitan city of a Developing Country

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Abstract

In this modern era of Information Technology (IT), where a number of applications of IT can be found easily in different sectors the significance of IT also emerges in construction sector as well, where different contractors have shown their tendency to employ the latest technology as well as to equipped them efficiently; enhancing the safety, security and the process of communication on the construction worksites. Pakistan as a developing country, is trailing behind in the field of technology unfortunately. To benchmark the usage of IT based tools for site security, safety and communication, this study initiates with the literature review that assists in listing of significant IT based tools. The research work comprises of two parts , first part constitutes of assessing the utility of IT tools on the basis of three subject domains i.e., site safety, site security and communication on worksites. The other part of this study is targeted to assess the impact of IT tools on overall work productivity, on cost effectiveness, availability of tools on worksites and to identify the level of skill required by the workers in using IT Tools. A structured questionnaire is designed and used for data collection purpose. In total, 13 questionnaires were filled on the basis of site based interviews and site observations. A 5-point scale is used in the questionnaire to get the respondents response. This study concluded that due to the global economic competition, construction firms are beginning to adopt IT tools and explore different possible options for improving the delivery of their products and services. It is recommended to initiate programs in local sector to create awareness regarding different IT tools helping in all the three subject categories; safety, communications, site security.

Keywords

Information Technology, Technical Tools, Site Security, Site Safety, Communication

1. RESEARCH BACKGROUND

Technology has revolutionized the world in each and every aspect of life. Technology has given birth to too many technological devices such as radio, television, mobile phones etc. This study covers the applications of IT tools in construction sector. Modern way of construction incorporates many IT devices such as mobile phones, CCTV Cameras, Walkie Talkie, Internet etc. These tools have tremendously increased the efficiency of project execution work. Stakeholders in particular construction contractors are compelled to use these devices in order to compete and retain their positions in the market. The study of information technology applications in construction is a premature field of research, still struggling to define its place within the large family of academic disciplines .There is consequently an urgent need for some consensus on what the domain of study of IT in construction is. It is difficult to give a very precise definition of the domain of IT in construction and to draw crystal clear boundaries between IT in construction and nearly related research domains. Often the discussion of IT technologies of interest to construction is centered on the most recent tools that general developments in commercial IT or in Computer science research have to offer (a "technology push" viewpoint).

Information technology (IT) can be defined as the use of electronic machines and programs for the processing, storage, transfer and presentation of information. (Beckinsale & Ram, 2006) also defined ICT as 'any technology used to support information gathering, processing, distribution and use'. During the early decades, IT was almost exclusively used to support activities which could be categorized as creation of new information. Since the latter half of the 20th century machines have increasingly been used also to aid in information processing tasks. Early uses were in particular computer applications for engineering analysis. Since the 1980's IT use, in the form of Computer Aided Drawings (CAD) and word processing software, copying machines, faxes, mobile phones, computer networks, etc. has increased enormously and now affects all aspects of the information process.

Nowadays the use of information technology is no longer confined to huge number-crunching machines housed in air-conditioned computer halls but permeates all aspects of everyday life. Communications technology is today an important part of IT. Not only computers and their software, but also devices such as the telephone, the photocopying machine and the telefax should thus be included in the definition of information technology. Many of the functions of these devices are in fact increasingly integrated. With the latest generation of laptop computers it is already possible to send and receive faxes and emails. Recently, mobile phones which incorporate small microcomputers have started to appear on the market. The information and material sub-processes are integrated by information flows in two directions. Firstly, the information process produces information which indirectly or directly controls the material activities taking place. Secondly the information processing activities constantly need feedback information about what is actually happening in the material process, in order to check compliance with the designs or monitor the progress of the work against the schedules. In a longer time perspective the information process also needs feedback on the performance of buildings during the maintenance stages.

While other industries have been able to achieve very significant improvements in productivity and quality over the last few decades, the construction industry seems to have been at a standstill. The industry has not been able to combine high quality with productivity, customer satisfaction and flexibility. Competition remains mainly focused on lowest cost and offering capacity instead of quality,

sustainability and customer-perceived value. The construction industry is, in particular, lagging far behind other industries in using modern technology as a major catalyst for improving its processes. According to a study carried out in the UK (Latham 1994), 30% of the total building costs should be saved when information problems such as repeated work, overlapping work, false information, redoing, etc., are solved. Improved data exchange and the overall managing of the information will be a key solution to this. These problems along with the more advanced IT tools can be solved adequately with re-engineering of the process that itself necessary (Betts 1997).

During the last few years new emerging IT-technologies have increasingly been used to facilitate information management and transfer in the construction process. Currently construction worksite layout planning heavily relies on 2D paper media where the worksite planners sketch the future worksite layout adjacent to their real environment. This traditional approach turns out to be ineffective and prone to error because only experienced and well-trained planners are able to generate effective construction layout design with paper scratch. The major advantage of this IT tool is that it could give construction worksite planners an easy and quick setup where even unskilled novice could easily capture the entire intelligent system. With the help of innovative, light-weight and inexpensive interaction and display devices it enables the users to immerse themselves in a new reality which is augmented with computer-generated information. The introduction of this IT tool is completely new approach to the development of construction worksite layout (Wang 2007). According to (Bansal, 2011) GIS may maintain different kinds of information about a building such as site plan, drawings, sub-surface detail, component specifications, building evacuation plans, landscaping. The statement from author strengthens the selection of GIS as IT tool in this study.

Construction information management has greatly benefited from the advances in information and communication technology (ICT) in increasing the speed of information flow, enhancing the efficiency and effectiveness of information communication, and reducing the cost of information transfer. Current ICT support has been extended to construction site offices. However, construction projects typically take place in the field where construction personnel have difficulty in gaining access to conventional information systems for their information requirements. (Chen & Kamara, 2008). Following are the IT tools that were identified during literature review for this study, email, intranet, extranet, 4D simulation, social websites (Facebook, Twitter, YouTube), video conference, mobile phone, surveillance camera, GPS, RFID, wireless, CCTV, WEBCAST. These tools were identified in keeping the view of the applications of IT tools in all the three subject categories i.e., construction safety, communications and construction site security.

2.   RESEARCH SCOPE & OBJECTIVES

Following are the objectives of this study.
- To find the extent at which IT based tools were used in the three subject domains.
- To assess the impact of IT tools on overall work productivity.
- To prioritize the identified factors on the basis of cost effectiveness.
- To identify the level of skill required by the workers in using IT Tools.

The scope of this study is limited to Karachi based construction sites for data collection from residential building sector only. Data collection are free from any cultural barriers like, language barrier in order to have a true representation of adoptability of IT tools in local construction sector as a whole.

3.   RESEARCH METHODOLOGY:

The study is targeted to establish the need of IT tools for the safety, security and communication in construction worksites in local construction sector. In order to achieve the research target the overall methodology is divided into different sequential activities. Study starts with the thorough literature review that enables the researcher to prepare the list of IT tools presented in table 02 in the data analysis part. A structured questionnaire was then designed based on the list prepared and use for data collection purpose. Field surveys were carried out as a data collection exercise. A total of 13 questionnaires were filled on the basis of site based interviews and site observations. After data collection data were analyzed to get the results. Conclusions and future recommendations were made on the basis of results achieved.

4. Data Collection

Questionnaire used for data collection contains: Personal information of the respondents as part 1 of the questionnaire like name (optional), contact no. , email address and company details etc. Part 2 of the questionnaire involves list of IT tools that are targeted to identify its usage; on the basis of three subject domains i.e., site safety, site security and communication on worksites. Part 3 of the questionnaire involves list of IT tools that are targeted to assess the impact of IT tools on overall work productivity, to prioritize the list of IT tools on the basis of cost effectiveness and to identify the level of skill required by the workers in using IT Tools. A 5-point scale constitutes of "very low, low, medium, high and very high" is used in this questionnaire to get the respondents response. A total of 13 questionnaires were filled on the basis of site based interviews and site observations.

5. Data Analysis

Data collected then analyzed using Microsoft Excel to create graphs and charts to draw conclusions and provide some recommendations on the basis of results achieved through analysis. Table 1 shows the percent use of IT tools as a whole in three different dimensions of construction site safety, construction site security and communication on construction site. Based on the percentages it can be clearly stated that the usage of IT tools is mostly frequent in communications on sites, moderately frequent in site safety perspectives and least frequent in respect to site security perspective.

Table 1: Usage of IT Tools in different Domains

Usage of IT tools	Very Low (%)	Low (%)	Medium (%)	High (%)	Very High (%)
Construction Site Safety	-	-	23	23	54
Construction Site Security	-	23	23	31	23
Communication on Construction Site	-	-	-	23	77

5.1. List of IT tools

Table 2 shows the list of IT tools that were used in this study. This list is being used in order to achieve the remaining objectives of the study to assess the impact of IT tools on overall work productivity, to prioritize the list of IT tools on the basis of cost effectiveness and to identify the level of skill required by the workers in using IT Tools. A brief analysis has been done based on the survey responses.

Table 2: List of different IT Tools

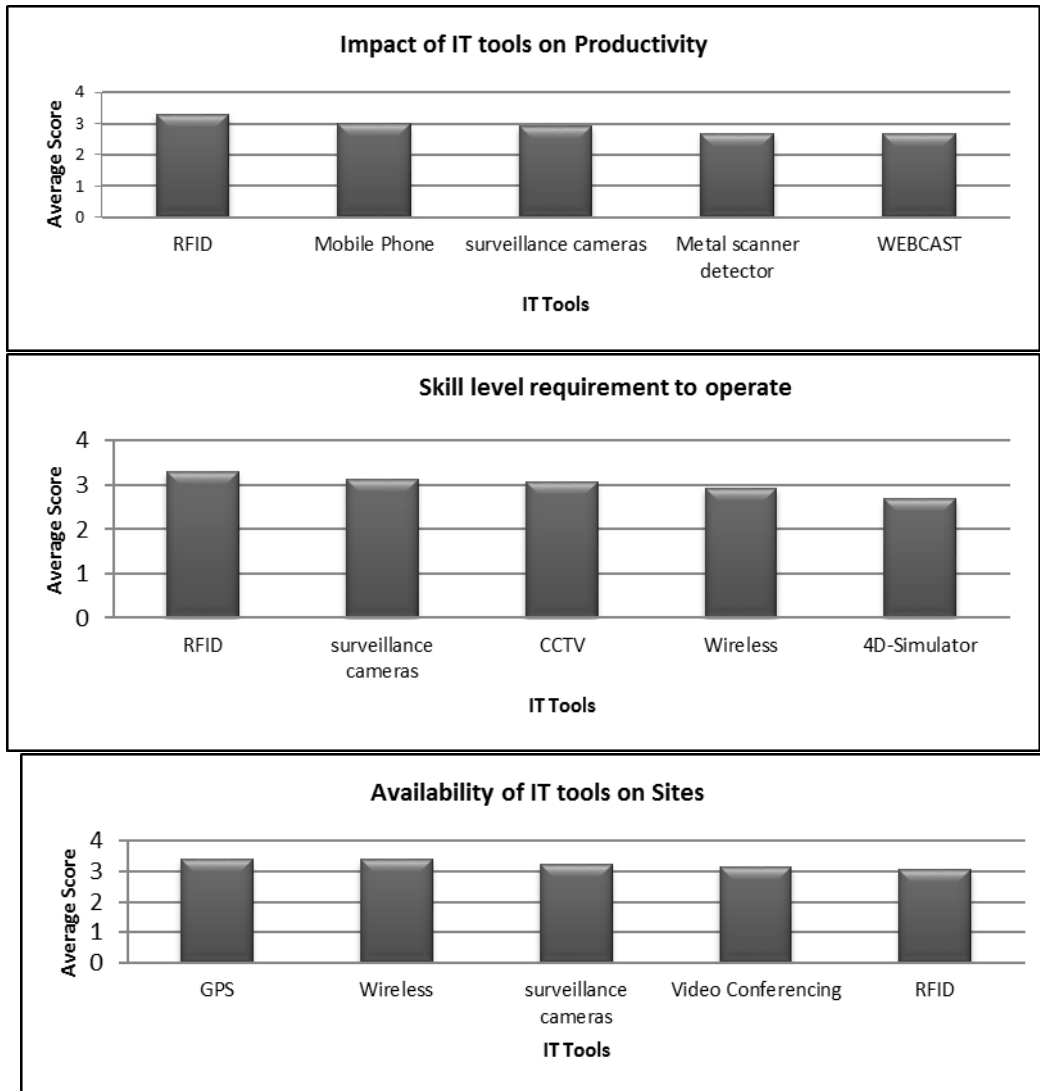| S.No	Different IT Tools
1	Metal scanner detector
2	surveillance cameras
3	Email
4	GPS
5	4D-Simulator
6	RFID
7	Video Conferencing
8	Wireless
9	Mobile Phone
10	You Tube
11	CCTV
12	WEBCAST
13	Alarm System

Table 3 shows the overall view of Part 03 of this study. On the basis of analysis results it can be stated that RFID has the larger impact on productivity while the email as an IT Tool has the least impact on Productivity. Similarly GPS along with Wireless tools has got maximum scores from the perspective of its availability or being used on sites and Mobile Phone is considered to be least available on construction worksites which in this regard up to some extent highlights the ideal picture to avoid loss of productivity during working times as it may result in loss of focus to work. WEBCAST has got maximum scores on the basis of its cost incurred which shows that it is the most less effective in terms of cost and email has got the minimum score which reflects that it is the most cost effective among all others IT tools. RFID has got the maximum scores on level of skill required to operate that IT tool while Alarm system has got the low scores which means it is easy to operate or local staff has some basic level training to use this in case of any emergency at worksite.

Table 3: Overall Weighted Average score for IT Tools

S. No	IT Tools	Impact on Productivity	Availability on Sites	Cost Effectiveness	Skill Level Requirement
1	Metal scanner detector	2.68	2.92	1.7	2.54
2	surveillance cameras	2.92	3.23	2.39	3.14
3	Email	1.77	1.69	1.47	2.29
4	GPS	2.31	3.38	2.76	2.38
5	4D-Simulator	2.16	2.66	2.47	2.69
6	RFID	3.3	3.08	2.61	3.31
7	Video Conferencing	2.23	3.15	2.31	2.38
8	Wireless	2.16	3.38	2.68	2.93
9	Mobile Phone	2.99	1.24	2.32	1.93
10	You Tube	2.45	2.62	1.85	1.92
11	CCTV	1.91	2.68	2.01	3.08
12	WEBCAST	2.68	1.68	2.83	1.75
13	Alarm System	1.85	1.45	1.69	1.62

5.2. Analysis for Part 3 of Questionnaire

Part 03 of the questionnaire targeted to assess the impact of IT tools on overall work productivity, to cost effectiveness, availability on sites and to the level of skill required by the workers in using IT Tools. Based on the weighted average scores i.e., impact of IT Tools on productivity the top five impacting factors were identified. Figure 01 shows the top 5 IT Tools from each aspect.
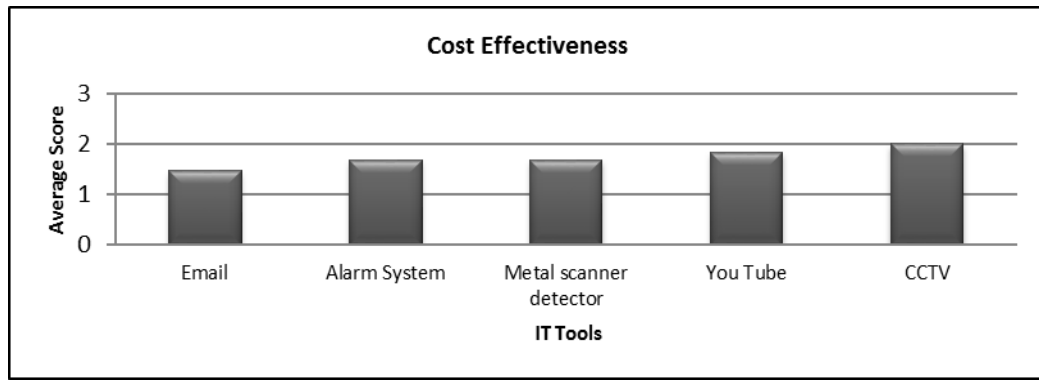
Figure 1: Top 5 IT Tools from Different Aspects

The graphs represent what people related to construction industry think about the application of IT tools. In the graphs of Impact of IT tools on productivity, Availability on sites and Level of skill required by the workers in using IT Tools, closer the average value to 5 means that the factors were ranked high means very high impact. While in graph of cost effectiveness the interpretation approach is inverse i.e., lower values means more cost effective the IT tool was.

6. Conclusion

This study focused on identifying different IT tools that are being used on construction worksites in Karachi. A list of IT tools was prepared through literature review which then used to address the research goal. On the basis of results it can be concluded that the impact of IT tools on communication is very significant. IT tools has increased the productivity on a construction site tremendously when it comes to communication. This can also be seen from the analysis part that shows how high or low is the use of IT tools on a construction sites. Analysis also indicates the impact of IT tools is very high when it comes to safety of labors, material and equipments at construction worksites . Security aspect though scored less as compare to Communication and Safety but it has got its own significance. The dispersion on the impact assesment indicates that industry personals have got the awareness on the use of it but some of them are using and some still making their selves ready to benefit from IT. Due to the global economic competition, construction firms are beginning to adopt IT tools and explore different possible options for improving the delivery of their products and services. This has challenged the construction industry to become more efficient, and consequently pushing the contractors to ensure the usage of IT tools on construction worksites.

7. Recommendations

It is recommended that construction firms in Karachi should equipped themselves with the latest IT tools which are now being used worldwide. This would help them in improving the overall performance of the construction industry. Programs can be conducted to create awareness regarding how different IT tools would help project objectives and overall performance in all the three research domains i.e., construction safety, site communications and construction site security. It is also recommended to increase the data set by performing extended data collection exercises throughout country that would help in presenting an overall view of construction industry of Pakistan. The current study were targeted to approach only residential building sector separate studies can be done from the perspective of different building sectors.

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