APPLICATION OF INFORMATION TECHNOLOGY IN CONSTRUCTION MANAGEMENT

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Abstract: The use of Information Technology (IT) is expanding rapidly. However, construction industry seems to make slow progress towards effective use of information technology due to a number of barriers. This paper analyses the application of IT in the construction industry in China. IT can be of assistance in all aspects of project planning and control. The main use of IT in construction is office software, computer aided design (CAD), tools software and communication networks. Tools software includes cost evaluation software, quota management software, quantity calculation software, steel quantity calculation software. Internet based communication is the area that grows fastest. Most construction firms are connected to external networks, the internet in particular. Further, the paper provides significant barriers to implementing IT in construction industry in China and suggests some possible coping strategies. Application of IT in the construction industry remains weak because managers are not aware whether high levels of capital investment directed to computer systems and communication networks can guarantee significant gains in productivity and economic returns. Tools software can solve simple task. Information communication remains weak and data can not be exchanged efficiently. To assist construction organizations in effective use of IT, coping strategies then fully presented.

Keywords: information technology; construction industry; construction management; barriers

1 Introduction

IT is defined as “the use of electronic machines and programs for the processing, storage, transfer and presentation of information,” (Bjork 1999). It has been an essential component of an organization’s internal control system.

The use of IT in construction industry is now beginning to expand rapidly. However, construction industry seems to make slow progress towards effective IT implementation for its unique features which distinguish it from other industries; namely one-off projects, industry fragmentation, low level of technology awareness and training, required up-front investment, on-going maintenance costs and resistance to change (Betts 1999).

IT can be of great assistance in all aspects of project planning, organizing, operation and control. The main use of IT in construction in China now is office application, computer aided design (CAD), tools software and communication networks. Implementation of IT in the office work mainly involves the automation of routine tasks, including, exchange building document in digital form. CAD prevails in the construction industry. Different types of tools software can perform different tasks: cost evaluation software can evaluate construction cost according to given bill of quantities, quota management software can manage quota data, quantity calculation software can calculate quantities according to CAD drawings, steel quantity calculation software can calculate steel quantities. Internet based communication is the area that grows fastest. Most construction firms are connected to external networks for information as material price, cost index.

However, the application of IT in construction industry is not effective as in other industries. The most prominent problems occur in tools software and information communication. One type of tool software can solve one simple task. They are not project centered, so can’t help in decision making. Information communication remains weak, and data can not be exchanged efficiently.

To ensure continuous increase in IT application and productivity improvement in construction industry, it is important to analyze problems in IT application in construction and develop coping strategies.
2 Nature of the Construction Industry

The construction industry is unique in its organization nature. Firstly, one-off projects feature. Each project is unique in planning, organization, operation. During the operation, the information needed and construction problems are all different from each other. However, similarities of the problems at hand with previous solved problems may help in solving construction problems. Apparently, experiential knowledge and information data are important in construction. Secondly, feature of multi-participant. During the project construction, a ‘temporary multi-organization’ is combined to exchange information (Alter 1999). When construction problems arise, relevant organizations have to work together to determine appropriate concessions and before solutions can be obtained (Scott Morton 1991).

3 Application of Information Technology in the Construction Industry in China

The use of IT in construction industry is growing rapidly in China, and the main use is office application, computer aided design (CAD), tools software, including, cost evaluation software, quota management software, quantity calculation software, steel quantity calculation software, and communication networks. Internet based communication is the area that grows fastest.

Office application is the most prevalent use of IT, that is, computers for word processing and spreadsheets for office and contract administration (Best et al 1996). It’s meant building documents can be exchanged in digital form. The application of office automation may improve internal management efficiency, and control cost. CAD is used in almost all construction offices in China and most of architects have some CAD.

There are different types of tool software used in construction management, including, cost evaluation software, quota management software, quantity calculation software and steel quantity calculation software. The project cost can be budgeted with the help of cost evaluation software system. That is, according to the bill of quantities, the bidding documents and taking into account of own strength, possible risk, the bidder submit competitive rates, prices and total bid price. Though project bidding is gradually adopting bill of quantities, quota is still indispensable. Quota management software can help maintaining quota database and reduce management cost. The main technical problem lies in quantity calculation software system is how to identify drawings. Generally speaking, we can input once more components and sizes respectively; then, the system may automatically calculate quantities and form the bill of quantities. We can also raster scan drawings first, then, the system may calculate quantities by identifying components and corresponding sizes.

Steel quantity calculation software aims to calculate quantities of steel used in construction. In this system, component drawings and parameters are also needed to calculate quantities and form of steel.

The fastest growth in the application of IT in the construction industry has occurred in the area of internal or external communication networks for sharing information. The ability to exchange data and information between all those involved in a building project depends on the communication networks. When the flow of information improves, ‘teamwork and coordination may be enhanced. For example, it may make it easier for an estimating department to work closer with site management through a communication network so that their subcontract estimates can be monitored and compared with actual trade letting figures;’ (Heng Li 2000). And instant access to the price of goods (e.g., concrete, steel, wood), ordering on-line may occur. Further more, data of previous constructed project can be shared internally and externally.

4 Significant Barriers to Effective Implementation

As a relatively new technology, IT application is becoming ubiquitous to construction; however, managing IT effectively is becoming complex due to a number of well-documented barriers. Betts in 1999 pointed out these barriers include the nature of how the industry operates one-off projects, industry fragmentation, lack of client leadership, low level of technology awareness and training, required up-front investment, on-going maintenance costs and resistance to change (Betts 1999). Particularly specific barriers to developing countries include the lack of personnel skilled in the management, use and support of IT, poor quality and /or quantity of telecommunications infrastructure, web-based information primarily in English and the high rate of
computer illiteracy amongst employees (Montealegre 1998) (De Boer 1999). Study by Love, et al. (1996) pointed out the most significant problems were the lack of system knowledge and lack of training associated with the implementation (Love 1996). Tuck and Mohamed (1996) identified barriers, including, manager’s reluctance to change, both financial and personnel resource shortage, lack of time for training (Tucker 1996). Rodney and Sheriff compiled these barriers and rated their significance. The research found that the relatively low level of IT awareness and high cost of IT applications are the most significant barriers.

As in China, the most prominent IT implementation problem is also that managers are not sure if high levels of capital investment to computer systems and communication networks can yield significant gains in productivity and economic returns. A research by English (1993) found that in construction, the typical process of initiating an IT application starts when an individual or group thinks it has a task or operation that could be improved by its implementation (English 1993). As a result, the unclear initial reasons for investing impede IT application in construction. Senior managers are reluctant to change the work processes especially when they are not convinced of immediate gains.

Secondly, tools software is not highly specialized and not project centered. As above-mentioned, the main 4 types of tool software can solve 4 tasks respectively. One of the main reasons is the disordered nature of the construction software market. That a number of unprofessional software companies enter into the construction market contributes to the numerous types of software, most of which are not so specialized. Also, it is essential to improve the capabilities of the existing software. As above-mentioned, when applying quantity calculation software system, we should input once more components and sizes first; then, the system may automatically calculate quantities. Apparently, the software is not so capable of the automatic calculation. In some developed countries, advanced applications such as knowledge-based expert systems and simulation have been applied in construction.

Lastly, information communication remains weak, and data can not be exchanged efficiently. Many construction firms have set up internal networks for internal data sharing and are connected to external networks, the Internet in particular; some have their own Web pages. However, most of construction firms are utilizing basic IT application such as Local Area Networks (LAN) and the most prevalent use of external networks is to supply corresponding statute, the price of goods and project bidding information. Unfortunately, these basic applications can not realize large-scale information share. Innovative communication such as online remote networking has not been adopted large-scale in China.

5 Developing Coping Strategies in China

To overcome problems above-mentioned, many coping strategies were developed (Miozza 1998) (Pena-Mora 1999) (Mark 2001). They include: increase government capital expenditure into telecommunications infrastructure; Promote IT education and the development of human capital; Utilize on-line/web-based information management systems to facilitate a common, efficient data flow systems; Publicize the advantages and quantify the benefits in adopting IT-based communication systems; develop IT implementation policy and push for tax concessions to encourage the industry to invest in IT and conduct industry forums to raise IT awareness among small and medium enterprises.

As for China, publicizing the advantages in adopting IT is of the most importance. The significant nature of IT is high levels of capital investment to computer systems and networks. So, without an explicit understanding of organizational productivity improvement, managers would not spend money on IT. In fact, in the long run, the company may gain more from IT investment. Yet, simply spending money on IT is not enough. Lack of time for training staff and changes to work processes are problems too. To ensure effective IT implementation, personnel with construction management and IT abilities are cried for. Therefore it is important to develop technology training and change conventional work processes. Corresponding management departments may develop IT implementation policy, integrate technology training with talent introduction to solve personnel source shortage associated with the IT implementation. That is, construction administration may hold lectures publicizing IT application, organize research to quantify the benefits in adopting IT, improve technology training of available man-power; and introduce qualified persons.
Compelling statute, such as stipulating IT training time each year and setting up check-up system, may be issued to ensure effective technology training.

Neatening construction software market and perfecting existing tools software are important too. On account of the disordered market, government should reinforce its management system to stop unprofessional software companies entering into the market; and only those of qualified companies could engage in the software research. On the other hand, industry criterions should be set up and each software company is asked to conform to these criterions when developing software. Further, capabilities of tools software are expected to improve. Tools software should be more specialized; project centered and may help in decision making.

Because of the weak information communication, utilizing on-line based information management system is essential to facilitate efficient data flow. Firstly, develop on-line remote networking to realize large-scale information share. Secondly, information supplied on-line should be sorted out. There have existed many external networks to supply information. Unfortunately, most of supplied information are those on paper, not sorted out and should be more deeply developed. Information “on-line” means duly updating data, not simply enter information on paper into computer. Also, the sphere of information application supplied on-line should be far going, covering each aspect in project construction, not restricted to the price of goods, especially that of materials.

References


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