

A case study on the strategic impact of information technology in the Turkish construction industry

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ABSTRACT: To study the strategic impact of information technology on the Turkish construction industry, a contractor firm is discussed in this paper. This paper helps to determine the current extent of IT usage, main purposes, benefits, obstacles and impacts of IT on the analyzed Turkish contractor firm. Main purposes on the use of IT, benefits by using IT and obstacles to a greater use of IT are evaluated. With the help of the study, it is demonstrated whether IT implementations have strategic impacts or not on the contractor firm. It is found that IT implementations have only technical and economic effects. Although firms which compete in construction industry need to use IT strategically in order to gain competitiveness; there is not much evidence that the firm take the advantage of using IT by providing strategic impacts.

1 INTRODUCTION

Technology has been continuously improving, causes high business pressures that affect organizations' current and future competitiveness. These pressures cause common and rapid changes on all industries. Construction industry is also affected by these changes but shows a different improvement from other industries in terms of its nature of activities and unpredictable conditions. By means of these rapid changes, it is obvious that construction projects have gradually been more complicated and extensive, and it has been much more difficult to achieve the required aim in terms of time, cost and quality. Thus, information technology (IT) becomes an issue to cope with the change; by means of adding, developing and competing with the modern business environment.

Moreover, successful IT implementations becomes into an important term for construction firms, against necessity of adaptation to the continuously changing business environment. When analyzing the use of IT in construction industry, it is seen that contractor firms mostly use IT at their operational level works and they obtain only technical and economic effects from the use of it. The missing point is obtaining strategic effects from the use of IT for the contractor firms; by means of gaining strategic advantage in the industry and reaching the set of objectives depending on mission and vision. Firms which compete in construction industry need to use IT strategically in order to benefit from the strategic effects and to keep their competitive advantage.

2 THE USE OF INFORMATION TECHNOLOGY IN THE CONSTRUCTION INDUSTRY

Many researchers have stated the importance of information and use of IT in the construction industry. For instance, Rivard et al. (2004) stated that "information is such an essential component of construction activities, the evolution of IT will undoubtedly have a profound impact on how organizations in the architecture-engineering-construction (AEC) industry operate". Moreover, Issa et al. (2003) emphasized that "to survive and succeed in today's business world, companies of any size, public or private, from any industry, from leaders to start-ups, feel the need and the pressure to develop strategies to catch up with IT". Before explaining the use of IT in the construction industry, it is better to define the characteristics of it; because construction industry differs from other industries in many ways.

In contrast with other industries, construction is a project-oriented industry that produces unique products. Each project based on a long process from initiation of the project, design of the project, procurement, construction, and operation of the facility to disposal of it. Secondly, the risk factor is much higher in construction than it is in other industries; because the nature of the work itself is unpredictable. In comparison with other industries, more resources are involved in performing construction activities,

more interrelationships exist between construction activities and more factors relating to environment and technology may affect the work flows in construction. Moreover, each project is almost unique and there are a large number of project participants with different specialties and multiple interrelated work flows in the construction industry. This makes it complex and fragmented. In this long and fragmented process, various usage of information technology can be seen in the construction industry.

First of all is the use of computers and software like Computer Aided Design (CAD), 3D Modeling, Computer Aided Facility Management, project planning and programming software, scheduling, costing and budgeting programs. The second place it can be seen is in communications such as access of internet, web portals, shared databases and distribution of documents in digital format. By using these, time, paper and cost savings are gained and project progress speed is increased. Moreover, as construction industry is heavily information-based, IT offers great potential to improve management practices, communication and overall productivity in the industry.

2.1 Studies from the World

Several studies have been made to demonstrate the use and to determine the impact of IT in the construction industries of different countries such as in New Zealand (Doherty, 1997); Scandinavia (Howard et al., 1998); Canada (Rivard, 2000; Rivard et al., 2004); Australia (Thomas et al. 2001); South Africa (Arif and Karam, 2001); Northern Europe (Samuelson, 2002); United States (Issa et al., 2003); Austria (Mahdavi et al., 2004). It is necessary to mention how IT usage and its impact were determined in these studies.

A survey was made in order to see the extent of computer use in the New Zealand building and construction industry (Doherty, 1997). The survey aimed to measure computer usage and to assess the direction of the industry in terms of the use of computers. Another survey was made as an IT-barometer to ascertain IT usage in the construction industry in Scandinavia (Howard et al., 1998). The survey results from Denmark, Finland and Sweden were compared regarding the use of computer hardware, software and communications. The survey in Canada was developed from the IT-barometer and conducted in order to see the current and planned use of IT and its impact on architecture, engineering and construction (AEC) industry (Rivard, 2000). Results of the survey were presented including topics such as computer availability, computer usage, computer-aided

drafting, networks and communications. The study in Australia aimed to examine the current usage of IT by Australian subcontractors, and to identify the potential problems for subcontractors in IT implementation (Thomas et al. 2001). Moreover, a survey was conducted to identify the extent of IT application in the building construction in South Africa (Arif and Karam, 2001). Another survey was repeated as an IT-barometer in 2000 to determine the use of IT in the Nordic construction industry (Samuelson, 2002). The purpose of the study was to create a method and perform a survey for measuring the use of IT in the construction industry. These surveys were carried out in Sweden in and in Denmark and Finland in 2001. Knowledge about access to computers, software and equipment, use of computers and software, communications, effects and strategies were gathered from the surveys. Advantages and disadvantages of IT were put forward by comparing the survey results from 1998 and 2000. Then, the results from the comparison between the countries were presented. A similar study was made in the US construction industry about e-business implementation (Issa et al., 2003). The study focused on determining the level of adoption of e-business within project management systems by general contractors. In the scope of the survey, e-business, e-procurement, e-marketplace and their practices in the US construction industry were researched. A series of case studies was made on the use of IT in the Canadian construction industry (Rivard et al., 2004). Architects, engineers, general contractors and owners were included in the scope of the study. Eleven construction projects were selected so as to define the practices and benefits of IT. Several types of technologies such as 3D, CAD, custom web sites, commercial web portals and in-house software development were found to be used in the projects. Furthermore, an inquiry was made into building product information acquisition and processing by architects and building owners in Austria (Mahdavi et al., 2004). As architects and building owners are the major participants of construction process, their habits about using IT in building product information acquisition were investigated.

2.2 Studies from Turkey

There are also several studies in Turkey in order to determine the importance of IT in the construction industry, but these studies can not be discussed at the same level as the studies in the world. Studies from Turkey are generally interested in presenting different kinds of information systems which are used in construction industry. One of them is a study

that aims to design a conceptual framework and develop a computerized model for recording, organizing and delivering information efficiently in order to provide effective management functions. The outcome of this study is a computer-based information system called ASAP – Automation System for Architectural Practices – that was developed to respond to the stated problem of large architectural offices (Kanoglu and Arditi, 2001). This system was developed in order to help to manage the information flow among the participants who face serious management-related problems in the design process because of a lack of an efficient information system. Another similar information system model, MITOS – Multi-phase Integrated Automation System – was designed for design/build firms (Kanoglu, 2003). An experience-based computational model was used for the estimation of the duration of construction projects, and the performance results were discussed. MITOS was developed in response to the need expressed by a large, well-established Turkish design/build firm that undertakes projects in cooperation with international partners. It is a performance-based duration estimation model integrated with an automation system model and a comprehensive model that attempts to solve the integration problem in design/build organizations.

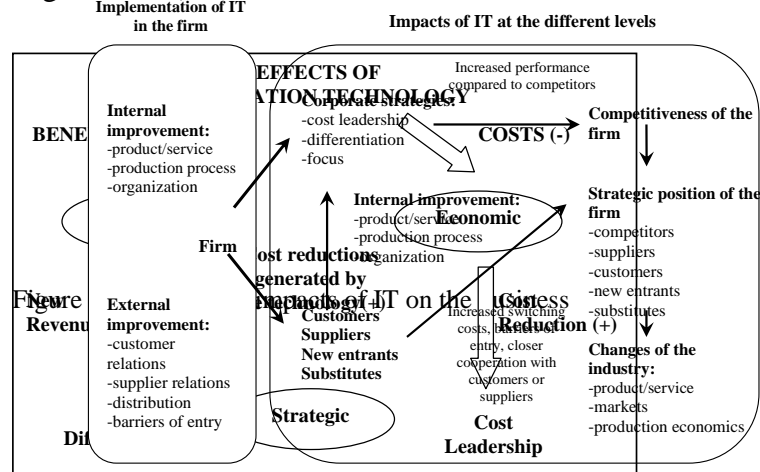
The importance of IT in the construction industry is also emphasized by conducting several studies on the building product field. For the purposes of gathering the information on different kinds of building materials, and designing a database which will be used during the design process, a research project supported by Istanbul Technical University Faculty of Architecture and the Istanbul Technical University Research Fund was carried out. The paper was based on the findings of the research project called “Designing a Building Material Relational Database Management System for Turkish Construction Sector” (Tas et al., 2002). A survey, about the current and planned use of IT and its impacts, is conducted between demand side -architects- and supply side -building product manufacturers- in Turkey. The applied methods and frequency of usage in building product information acquisition, their characteristics, importance and point of view in building product information systems were determined (Tas and Irlayici, 2007). A study has been carried out in order to determine the current extent of IT usage, main purposes, benefits, obstacles and impacts of IT in the Turkish contractor firms by making a field survey (Irlayici and Tas, 2008). With the help of the field survey it is demonstrated that, although firms which compete in construction industry need to use IT strategically in order to gain competitiveness; there is

not much evidence that the firms are affected strategically by using IT. Moreover, the database designed aims to join the supply side and the demand side in the same environment that works on the domain of building material information in the Turkish construction industry (Tas et al., 2008). To achieve this goal the information supplied by the supply side and the requirements of the demand side were evaluated from different point of views. Different data were gathered from the both side in accordance with the type of source, level of information and frequency of updating. The data gathered were integrated into the pre-construction stage and used in the analysis of the building material evaluation and selection process as to how this information was used by the demand side.

3 STRATEGIC IMPACT OF INFORMATION TECHNOLOGY IN THE CONSTRUCTION INDUSTRY

All these studies showed that IT is widely used in the construction industry, but very few companies use this technology strategically. It is stated that construction firms are often slow to formulate strategies that recognize the role of IT and result in corresponding IT strategies (Andresen et al, 2000). This is possibly influenced by a general lack of knowledge in IS and IT developments at management level. Betts et al (1991) noted that managers should be made aware of all issues concerning the use and application of IT, before strategic exploitation can occur. Furthermore, construction firms take advantage of the use of IT only at operational level works but not at strategic ones. Drejer (1996) additionally noted that managers should also consider the integration of technology into the strategic management process.

IT can have different impacts which are often difficult to identify. Different applications can have different impacts on the firms. Because of the difficulties in analyzing the impacts of IT, it is necessary to define various effects of IT on the firms. Figure 1 describes a framework for describing the different effects of IT on an organization (Björnsson and Lundegard, 1993).



(Björnsson and Lundegard, 1993)

There are three types of effects such as technical effects, economic effects and strategic effects. All IT investments involve both economic and technical effects. Although IT has negative economic effects such as expenditures on IT; new revenues added to the firm and cost reductions generated by the technology are the positive economic effects that occur in the firms. The technical effects refer to changes in the time required for an employee, the department or the firm to perform its task. Moreover, quality improvements, added value and less resource consumption can be said as other technical effects. Even if an IT implementation generates positive technical effects, this does not imply that the implementation is successful. The technical effects must be transformed into strategic effects in order to make an IT implementation successful (Björnsson and Lundegard, 1993). Successful implementation depends on the business strategy of the firm. One issue that arises is whether competitive advantages from IT are sustainable. If IT is going to create enhanced competitiveness and strategic advantage for the firm, then it has to create unique benefits to the firm that does not occur in any other firm. Porter (1985) claims that even if technology does not yield competitive advantage to any one firm, it may affect the profit potential in the industry.

IT can be implemented to enable internal and external improvements in the firm. Internal improvements refer to changes in the firm's value chain that improve the performance and competitiveness (Porter, 1985). Such changes can occur in projects, project process and organization. IT implementations that support the business strategy generate effects that are coherent with one of the generic strategies, cost leadership and differentiation. External improvements refer to changes that improve the firm's position in its environment in terms of customers, suppliers, new entrants and substitutes. Furthermore, external improvements can have impact on the performance and competitiveness of the firm. The model in Figure 2 can be used to identify how IT can create changes in a firm and within an industry.

Figure 2: how different IT implementations can affect a company's strategic position (Björnsson and Lundegard, 1993)

Several authors have gone beyond examining the strategic use of IT in order to suggest ways that IT can be a source of sustained competitive advantage. For the construction industry specifically, Betts et al. (1991) and Betts and Ofori (1992) suggested that IT offered opportunities as strategic weapons to gain competitive advantage, improve productivity and performance, enable new ways of managing and organizing, and develop new business. A strategic health check is designed to demonstrate how IT is managed in firms towards strategic ends (Betts,

1999). The health check contains questions which are grouped into three categories relating to: competition and business strategy, the role of IT and IT strategy. The questionnaire is used with a range of UK companies and by the help of it; some overall assessment of how UK companies have used IT strategically and as part of their strategic management exercises. Furthermore, Ward and Peppard (2004) have investigated successful implementation of strategic IT systems to learn in what sense these systems are strategic and have analyzed four main types of systems: (1) systems that links the company with its clients or its suppliers and in doing so increases the competitive potential, (2) systems that improve the organization and control of the business, (3) systems that provide information based products and services and (4) systems that improve productivity and performance of the company.

4 CASE STUDY

The contracting sector is one of the leading sector in which the world's largest scale companies compete. Despite the increasing job opportunities in the world, getting contracts is becoming more and more difficult under these tough competition conditions. Therefore, completing started projects rapidly with maximum profit while increasing market and customer variety is becoming a must in this competitive atmosphere. Being aware of all these issues, IT usage and providing strategic impacts of using IT is critical for contracting firms.

The purpose of this paper is to emphasize the importance of the IT usage in contracting firms by describing the current use of IT by evaluating main purposes, benefits, obstacles and finally studying the strategic impacts of IT on Turkish construction industry. In order to achieve this purpose, a field survey is conducted in Turkish contractor firms and 35 contractor firms have been researched. A questionnaire has been set up in order to collect data from participants of the field survey and is divided into three parts. The first part concerns the presentation of the firm and aims to get general profile of the firms. The second part of the questionnaire involves questions about the usage of IT among the firms. Their IT usage purposes, benefits by IT usage and obstacles to use of IT are evaluated. The last part of the questionnaire consist of questions in order to get information about the impacts of IT implementations and at what level the business is affected by them. The result of the field survey is discussed in the paper named "The Role of the Usage of Information Technology in Turkish Contractor Firms" (Irlayici and Tas, 2008). After evaluating the field survey re-

sults, a contractor firm is chosen in order to deeply analyze. This particular contractor firm is chosen because; they are considered as a leading contractor firm which see IT as an important part of their business and pay much more attention to the strategic use of IT than the other ones. The material in the study was gathered one-on-one and face-to-face interviews with the managers and discussed in this paper.

4.1 *General Profile of the Firm*

ABC is a construction firm which operates as a general contractor both in Turkey and abroad and carries out large scale infrastructure works, construction of industrial plants, business centres, hotels, hospitals and other such projects.

The firm is within the first 20 contractors in Turkey and has a place in the top 225 international contractors ranking. It has been operating in the construction industry for 55 years and has a work force between 101 employees to 500 employees. The firm has undertaken projects not only in domestic, but also in international contracting works.

4.2 *Usage of Information Technology*

The networked PCs which provide an easy way to co-ordinate and exchange documents are used by the contractor. The use of computers varies but when it analyzed, software that consists of general purpose applications are the dominant ones. The software widely used by the contractor is word processing, spread sheet packages, computer aided drafting (CAD), project planning & programming software. On the other hand, the estimating packages and database systems are also used but not as prevalent as other ones. The major purposes of IT usage are quick access of correct and up-to-date information, providing to do activities correctly and in time, continuous and permanent communication and increasing quality of activities.

IT provides various benefits for the firm. The main benefits provided by a greater use of IT are quick access of correct and up-to-date information, data storage, share of information, providing better planning, controlling and management, ease of communication, cost reduction and providing standardization. The contractor firm does not consider ease of management of concurrent projects, possibility of reducing the staff and less use of paper as important benefits.

Although the firm gains lots of benefits by taking advantages of using IT, there are some obstacles to greater use of IT. The main obstacles are the contin-

ual demand for upgrading hardware and software, high cost of investments, resistance to the change, security problems, unnecessary data input, and making employees unproductive. Nonetheless, lack of standards and providing continuous training to employees are not considered an important obstacle to the use of IT.

The last issue about the usage of IT among the firm is concerning the level of importance that attached to IT and IT skills. The firm knows that there is a need of greater use of IT for supporting business; at least some managers think the opposite. They think that IT implementations decrease social relationships and that is caused a huge difficulty to solve the problems. Nonetheless, the firm agrees that there is always a need to develop employees IT skills. The firm provides IT training when it is required; whereas it is really important that firms develop intensive education and training program for all IT users, including senior management.

4.3 *Strategic Impact of Information Technology*

After determining the purposes, benefits and obstacles of the IT usage; there is a need of demonstrating the impacts of IT implementations on the contractor firm. In order to defining these impacts, firm is asked at what level IT implementations have impacts on the business. According to the firm, IT implementations have a great impact on technical aspects such as data collection, operational support for repetitive works and developing databases. Although there is an awareness of how IT implementations supports the firm strategically; the firm does not take the advantages of using IT strategically. Contractor firm sees IT as an important part of the business, they use IT but let the technology find its own way within the organization and issues concerning IT are not discussed frequently in senior management. Managers do not aim to use IT implementations for providing support for making right decision, providing efficiency in decision making by supporting management and providing competitive advantage.

Although the firm provides great impacts on the use of IT; all these are mostly technical effects. The firm needs to transfer these technical effects into strategic ones. Unless IT creates strategic impacts for the firm, all implementations do not provide unique benefits that do not occur in any other firm.

On the other hand, it is also analyzed whether there is any impact of IT usage or not on providing competitive advantage. The firm does not aware of the fact that IT implementations contribute the formulation of competitive strategy formulation and they do

not use IT as part of a well-thought-through strategy for achieving competitive advantage.

Moreover, IT implementations are not seen critical on competitive advantage by providing important aspects such as business efficiency, financial gains, engineering excellence, research & development and innovation. It is seen that IT has the least impact on formulating strategies such as cost leadership, differentiation and focus; although as being a fragmented industry, construction firms have to adapt one of these strategies in order to improve their competitive position.

5 CONCLUSION

In a continuously improving business environment, technological advances highly affect construction firms' current and future competitiveness. Thus, IT usage becomes an issue to cope with the change; by means of adding, developing and competing with the modern business environment.

There is a common understanding of the strategic importance of IT, but providing strategic impacts by using IT implementations are not well-developed. Although there are lots of studies concerning the strategic use of IT and its impacts on the construction industry; there is not much evidence that construction industry in Turkey is aware of using IT from strategic aspects of it.

The contractor firm analyzed in the case study is aware of the importance of the usage of IT by means of providing strategic effects. On the other hand, the firm mostly takes advantages of using IT only on technical aspects; but not on strategic ones. However, using and benefit from IT only technically are not enough to survive in the construction industry and gain competitiveness. Even if IT usage generates technical effects, it does not show that the firm can successfully compete in the industry. The contractor firm needs to transform the technical effects of IT implementations into strategic ones to cope with the change and increase performance compared to competitors. If the firm manages to do this, IT will create enhanced competitiveness and strategic advantage for the firm. Using IT strategically can create unique benefits and contribute to the contractor firm in order to gain competitiveness in the industry.

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