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Investigating the Benefits of Using Information Systems in Saudi Arabia Construction Projects

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Abstract
Constructions is the second growing industry in KSA. The lion share of the national budget is directed to construction projects and this will be continue for at least 10 years or more.Ensuring the success of any construction project, many depend of success of its management. Therefore, recently, research on management of construction projects in KSA has grabbed the highest attention in both academic and industry domains. The main contribution of this paper is proposing of an Information System (IS) to handle the complication of managing construction projects in KSA. The paper starting by defining what is an IS to solve the conflict and misunderstanding between definitions of Information Communication Technology (ICT) and IS. Paper is proceed with exploring the reasons behind the complications of construction projects in KSA. These reasons will answer the question of why ICT is not enough to manage construction projects in KSA. Benefits and structure of using the proposed IS in managing construction projects in KSA have been defined.

I.   Introduction

Benefits of using Information Communication Technology (ICT) in construction projects have been proved since many years (Peansupap and Walker, 2005). Terms of ICT, Information Technology (IT), and Information System (IS) have mixed up in the literature until it seem as a one term. Technically, ICT, and IT have the same meaning while Information Systemis going very far beyond using traditional IT. Here and onwards we will use the term ICT to refer to both ICT and IT. IS aims to support decision making through computerized management and business operations(Kroenke, 2008). Therefore, IS, usually, associates with database systems or developed software systems. In other words, the term "developing IS" means the effort of creating, designing, or developing a computerized system that could be used by organization for automated its business. ICT deals with office, network, and telecommunication applications. In addition, ICT or IT as general could be considered for using engineering applications in construction design such as AutoCAD and other designing and modeling techniques. Peansupap and Walker (2005) and Fischer and Kunz (2004) illustrate the different usages of ICT and IS in managing construction projects.

Using ICT is a critical successful factor in managing any business nowadays. Therefore, there is a legacy of great usages of ICT in managing construction projects around all the world. On the other hand, just recently IS has occupied its place in managing construction projects formulated what is called Construction Information System (Donget al., 2009). Here, we should differentiate between using IS in managing general projects and using IS in managing construction projects.

This paper focuses in the usages of using IS in managing construction projects in which I investigate the expected benefits of using IS in managing construction projects in Saudi Arabia.

This paper is structured as follows: Section 2 illustrates examples of using IS in managing construction projects. Section 3 is discussed the construction industry in KSA. Sections 4 and 5 shows and presents the expected benefits and structure of the proposed IS respectively. Finally, section 6 contains conclusion and future work.

II.   Examples of using IS in managing construction projects

Thomas et al. (2004) have Proved statistically that the use of IS in managing construction projects can save cost by approximately 4%. Moreover, Zhai et al.(2009) have proved the relationship between construction Information Systems and Labor Productivity. We have mentioned the above two examples to show the importance of construction information system.

Here, in the following of this section, I have provided some more examples for illustrating how the IS could enhance managing construction projects. Xie et al.(2003) illustrated by example the

importance of developed database applications in the successful of construction project. Moon and Kwon (2007) used On-Line Analytical Processing (OLAP) for providing analytical information for estimating project cost.

On the other hand, beside managing construction data by using Database Management Systems (DBMS) and its applications, IS provides a room for intelligent solutions as I will present some examples in the following. Fayek and Oduba (2005) used fuzzy expert systems to predict labor productivity.Elazouni (2006) used Artificial Neural Network (ANN) for classifying Construction Contractors. Christodoulou (2010) developed algorithms based on AntColonyOptimization (ACO) for schedulingresourceconstrained construction projects. Chou et al. (2011) used IS in technical site as they used data-mining techniquesfor optimizing the prediction accuracy of concretecompressive strength. Salama and El-Gohary (2013)have used deontic logic for Automating Compliance Checking of ConstructionOperation Plans.

From the above examples it is very obvious that Construction Information System (CIS) provides technical solutions for managing construction projects that may not be able to be provided by tradition IT solutions. Using IS in managing construction projects provides ability to use developed database systems and developed Intelligent Systems.

The above examples have proved that the traditional IT applications such office package, or construction specialized IT software such as Primavera are notsufficient enough to cover all needs of managing construction projects and there are hard necessity for using IS. On the other hand, these examples prove the success of using IS in managing construction projects.

III. Construction project in Saudi

Currently, construction industry in KSA has a high intention due to execution of big national projects (McCarter 2013). Figure 1 shows the growing of construction projects in KSA comparing with other Arab gulf countries.
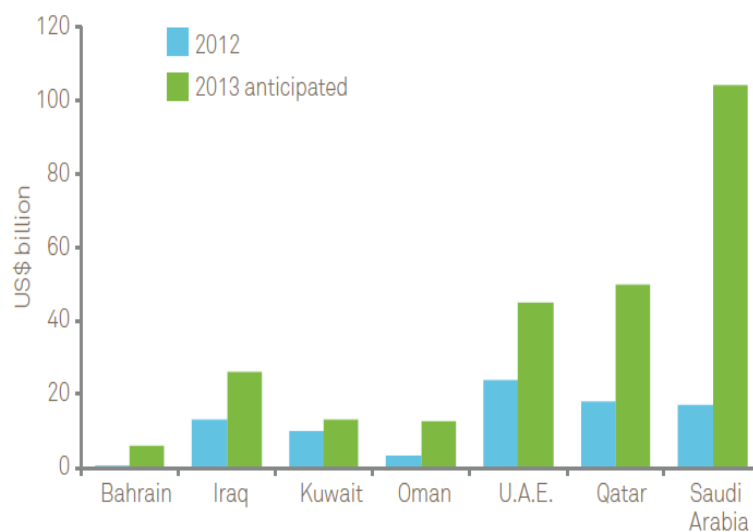

Figure 1: The growing of construction projects in KSA comparing with other Arab gulf countries (McCarter, 2013)

McCarter (2013) states that "the construction industry expects building work to outpace infrastructure projects in Saudi Arabia over the next years, with a significant increase in healthcare and education-related works, as well as residential, in particular, affordable housing projects. Infrastructure work related to transport connections, as well as water and wastewater provisions are also expected to remain in focus. In particular, the western regions of Saudi Arabia are expected to benefit from this, with the vast majority of those surveyed suggesting this will be the most active region in the years ahead". The Kingdom of Saudi Arabia is one of the fastest

growing construction markets in the Middle East. The annual new construction volume has exceeded US$ 89,897 Million by 2013 and US$ 101,886 Million in 2014 (Ventures Middle East L.L.C, 2012). In addition, construction contracting is a very competitive business with a high rate of bankruptcy (Nunnally,S., 2007). Construction Knowledge is noted to be one of the most important resources contributing towards a better understanding of the construction process.

Although using ICT in Saudi construction has a well know history still there is a critical need for in house-developed software applications due the new

challenges and high complications of construction projects' problems. According to the best of my knowledge, as I have been involved for more than 20 years in managing huge governmental construction projects, using only ready developed ICT will not provide an optimal management for construction projects in KSA. In the following, some reasons of complexity of managing construction projects in KSA are highlighted:

- The existence of change order problem. Many papers in the literature have defined the change order problem as the one of the main problems in managing construction projects in KSA.

- Changing view of top managers. Usually, huge construction projects take long time tosettle; this time may between 4 to 8 years. Definitely, during this time the governmental officers those are responsible of construction projects are subject to change. New managers might prefer to add another approach, which might lead to many complications.

- Deficiency of knowledge sharing. Up to the best of my knowledge, here, in KSA there is no any tool to keep and share the knowledge and lessons learned from previous project to be inherited and used in current and future projects.

- Lack of intelligent applications in current software that are used to manage construction projects in KSA. Lack of intelligent application deprives many benefits such as predication of future situations, or handle uncertainties.

All the above reasons have intersections among them. Therefore, depending only on ready software or ICT applications might not be enough to provide an optimal management for construction projects in KSA.

In the following section, the expected benefits of using IS in KAS are discussed in details. Then, in section 5, the structure of proposed IS to be used in managing construction projects in KSA is presented.

IV. Expected benefits and impact of using IS in managing Saudi Construction Projects

According to Jensen and Damgaard (2009)the main challenges of construction management could be summarized bythis question: how to acquire, represent, and use the learning and experiences from the current projects to be used in future projects? Implementing of Information System is a solution for the above question. In this section, the expected benefits and impact of using IS in managing Saudi construction projecthave beendiscussedand explored by comparing the usage of ICT and IS. In the following, the comparison has been explained in details:

- Managing construction projects is very complicated process. In section 3, examples of these complications have been provided. Ready Software applications are limited in terms of customization. For instance, almost it is impossible to change the database structure without avoiding very high cost. By using IS companies could develop their own software which will be more flexible to be extended even in the structures.

- Using in house developed software presentability for link the developed software with the modern analysis applications, which able to provide multi view dimensional. For instance, by using Dynamic Link Library (DLL) the developed software could be linked with Oracle OnLine Analytical Processing (OLAP) software.

- Managing construction projects at the end of day it is a management process which is a dynamic process. Dynamic process definitely needs very flexible report engine. Ready software have fixed reports' structure where IS is not.

- Nowadays, it is a common to use Artificial Intelligent (AI) within IS due to theCapabilities that could be provided by AI. In general, AI affords solutions for problems that cannot be solved by traditional mathematical computations. As examples, extract common features from unclean, fuzzy or incomplete dataset.

- Although traditional ICT has facilitatedthe transferring of information within construction projects,however knowledge transferring is a real challenge in managing construction projects. IS has facilitated the knowledge transferring by different methods. Expert system and intelligent IS are two examples of knowledge transferring techniques that have been offered by IS.

- System security is most cruel feature in any application. Ready software provides standard security features that could be suitable for public user. Standard security features could be a weak point in an application, as it is publically known.On the other hand, in house developed software, usually, developed with customized and special security features.

In addition to the all above points, IS might be a base of developing Enterprise Recourse Planning (ERP). Inayat et al. (2013) proposed critical success factors for different organizations in construction projects. All these factors have high possibility to be automated which is provides a chance for developing

ERP. Table 1 summarizes the comparison between ICT and IS which is heighted the benefits of applying IS in managing Saudi construction projects.

ICT	IS
Used ready software applications	Used In house developed software
Ability to provide two dimensional analysis	Ability to provide multi views analysis
Ability to provide fixed reports	Ability to providecustomized reports
Ability to provide traditional IT solutions such as Geographical Information System (GIS), Sensor Technology, Web applications and etc.	Ability to provide intelligent solutions by using Artificial Intelligence (AI) techniques such as Artificial Neural Network (ANN), Genetic Algorithms, etc.
Ability to provide information exchange	Ability to provide knowledge exchange
Providing standard level of security	Providing high level of security

Table 1: Comparison between usages of ICT and IS in construction Projects

V. The proposed model of using IS in Saudi Construction Projects

In this section, the proposed structure of IS that could be used in managing Saudi construction project has been proposed. Figure 2 shows the proposed structure. In the following, each step of the proposed structure is discussed:

Database Management System (DBMS): This component is the basic and most important component in the proposed model. In this component, the construction projects' information should be stored, classified, filtered, update, managed, retrieved from it. DBMS represents the brain-engine for the proposed model. Regardless of how the DBMS is implemented, centralized or distributed, the existence of it is the most important thing. Here, this section will not explain technical details. To ensure the success of the proposed model a standard and well know DBMS should be chose, such as: Oracle, or MS-SQL Server.

Software Program: This component works as a bridge to link between the DBMS and the report generator component. The existence of software component provides flexibility to the proposed model as DBMS and the report generator components could be from different producers. For instance, by using JAVA software Cristal report engine could extract reports from Oracle DBMS.

Report Generator component:The benefits of the proposed model appear in the reports thatare generated from DBMS. The expectations of the system should be reflected by its reports. Therefore, reports are the most important part of any IS system. This component is responsible for defined the data that are required for report, extract data from DBMS, and design the reports shape. Nowadays, this component has attracted high attention due to the increasedimportance of visualization. Visualization concerns with data presentation. In good visualizingdata represented in diagrams or videos. Hence, the modern versions of report generator component support different types of visualization. Crystal Report (http://www.crystalreports.com/) is an example of Report Generator component.

User Interface: This component is acting as a gate between the IS and its user. The main purpose of this component is to hide the complexity of the hardcode from the user. It has been proved that 80% of the system success id depend on the usability of its interface. A friendly user interface is an essential part of the proposed model. Minimizing number of direct inputs to avoid human factor errors is the most vital feature that should be support by a friendly user interface.

Validate the inputs: This component acts as a filter for refining users' inputs. Human errors and typos are expected in any interactive system. Usually, missing data, typos, and incorrect inputs cause uncertainties when reports are generated which leads to wrong decisions. Therefore, this component is very important to prove the correctness and validity of IS's reports.

Interface with other applications: Nowadays, managing construction project activates have been completely depend on more than one computer application. For instance, daily activities for labors need to link with the application of Microsoft Excel payroll to determine the salary. Thus, it is very important to provide a possibility for link between the proposed IS and other required applications.

Figure 2 shows the structure diagram of the proposed IS. This structure has been designed to be flexible and general to be matched with any construction project in KSA. The flexibility of the proposed IS model it is necessity to handle the complexity of managing construction projects is KSA has been discussed in section 3. Each component of Figure 2 has been defined in above.
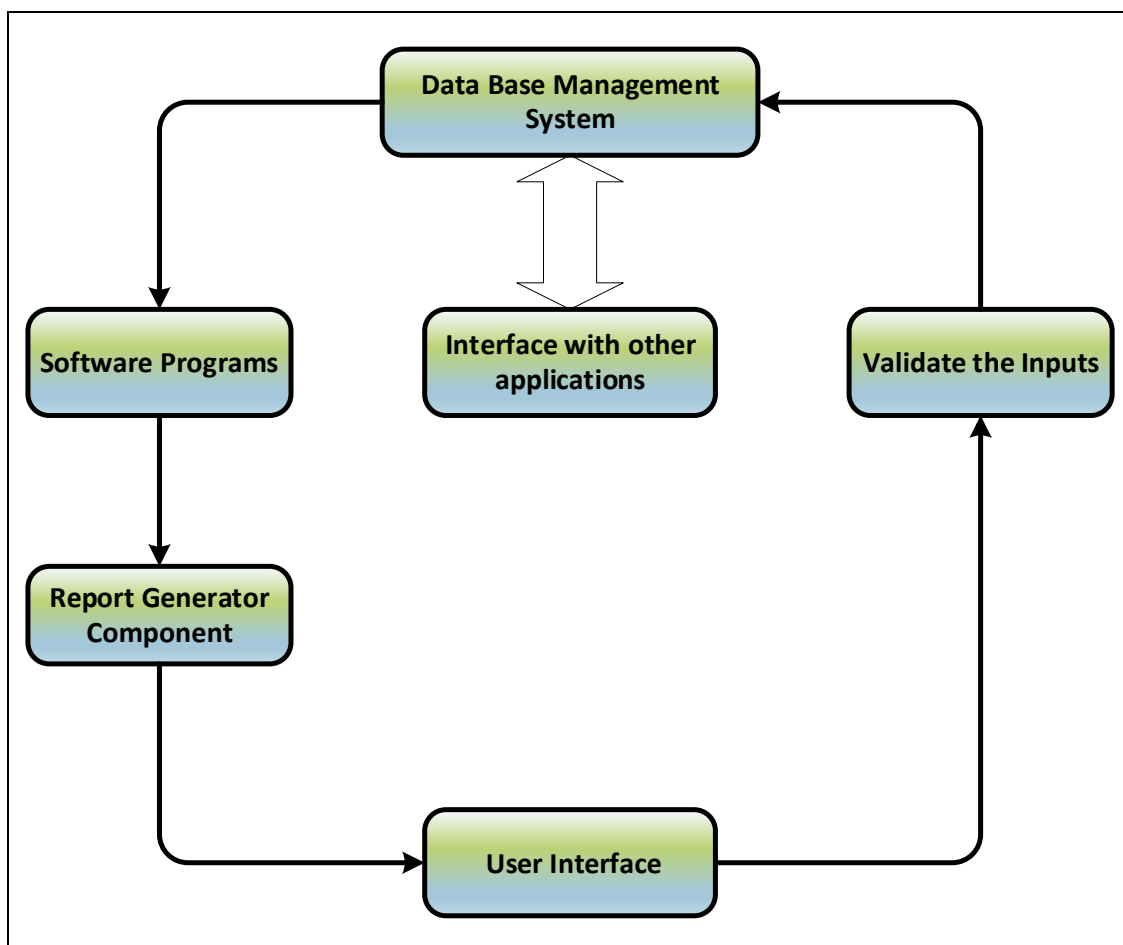
Figure 2: The proposed model of using IS in Saudi Construction Projects

VI. Conclusion and Future work

In this paper, there contributions have been delivered. First, the scientific difference between ICT and IS has been highlighted. Second, the complexity of managing construction projects in KSA has been discussed. Finally, to handle such complexity IS has been proposed. Expected benefits and structure of the proposed IS have been defined in details.

The validation of the proposed model is kept as a future work. Validation will be done by implementing this proposed model in one of the governmental companies that managed many public construction projects.

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