THE SUSTAINABLE MANAGEMENT OF REMOTE CONSTRUCTION PROJECTS

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Abstract. This paper investigates the use of present project management practices and systems by the construction department of the Saudi Electric Company (SEC), Kingdom of Saudi Arabia (KSA). It highlights shortages of the current management practices and systems and how it affects badly the sustainability dimensions of projects such as quality, scope, time and cost. The literature review suggests that Computer based Project Management Systems (CPMS) may help companies in managing remote projects efficiently thus minimizing the travel time, reducing unnecessary project costs and raising the quality of projects. Little research though was done regarding this issue and it found few unique management problems. A field survey was conducted in 2009 on contractors and SEC’s supervision teams. It revealed that some of the remote project’s management problems however were caused by unprofessional and non standard project management conduct. It also found that traditional systems are very popular whereas computer based systems are of little use. Participants expressed their concerns about the SEC’s present project management practices and their views regarding the implementation of computer based project management systems and its’ possible impact on projects’ performance and process. The survey’s outcomes indicated that Computer based project management systems should be tailored to SEC’s present and prospected needs, meanwhile SEC’s present project management methodologies should be adjusted to sustainable management practices. This would guarantee that project management practices will be substantially improved and sustainable objectives of projects are met. The study should motivate the SEC and other companies in KSA to review their present project management practices and systems, investigate the potentiality of CPMS use in managing remote projects and explore how to embrace sustainability’s dimensions in project management practices.
1. Introduction

There is a worldwide growing interest of how to implement systems, tools and methodologies that would help to produce sustainable developments. Sustainable construction describes the application of sustainable development principles to the construction industry. These principles are (TSO 1999): the social, economic and environmental principals. The application of these principles to the construction industry would mean (DETR 2000):
- Constructing projects that are more cost-effective to produce and run as they have been constructed with less and yield more
- Constructing projects that contribute positively to the surrounding environment, using materials and systems that are easily replenished and perform better over their full lifecycle
- Promoting high standards of living for people

New concepts, systems and mechanisms for managing projects were invented to embrace the application of the above sustainability principals in construction projects. Among these is the golden triangle concept which initially refers to quality, time and cost and was later extended to incorporate sustainability, project team and stakeholders' satisfaction and health and safety issues. The invention of CPMS that use wireless, Satellite, Internet based or mobile tools and networks to facilitate communications and management of projects, have helped construction firms to manage the increasing complexity in construction projects and to fulfill - to a certain degree- the sustainability considerations. The management of remote construction projects in KSA however represents a unique case. They are in remote locations of rough terrain within undeveloped and environmentally sensitive regions. The supervision team experiences countless difficulties and cumbersome management problems in regards to monitoring and supervision of site activities. Furthermore, it is hard to sort out construction queries quickly which may cause substantial delays. This paper examines whether the use of CPMS would help the construction department at Saudi Electric Company (SEC) to efficiently manage remote projects thus apply sustainable principals in project’s management and construction.

2. Review of the use of CPMS

The use of Computer based Project Management Systems (CPMS) may help to embrace sustainability into construction projects. These systems have a potentiality to help project team members to effectively manage projects. They include Web Based systems which can be categorized into: Information and Enterprise portals, electronic marketplaces and web-based
project management system (Alshawi and Ingirige 2003). It also includes Mobile systems which would improve communications between project team members and enable them to share information and to quickly solve problems and this would help them to manage time and cost (Charoenngam et al 2004). It is mentioned that cost of construction can be reduced by 25% through the efficient transfer of information between the construction teams (Davidson & Moshini 1990, Bowden 2005). Research studies recommended that incorporation of Web based project management systems WPMS into project management practices would help practices to grasp potential benefits. Nitithamyong and Skibniewski (2004, 2006) suggested that benefits of using WPMS can be categorized into four main areas. These categories are: a) cost reduction and time saving, b) enhancement of communications and collaboration, c) improvement of productivity and partnership, and d) supporting e-commerce and customer. Alshawi and Ingirige (2003), Stewart and Mohamed (2004) identified the following benefits from using WPMS: productivity enhancement of communication between project participants, reduction in project delays, heightened all parties’ awareness of the project issues, and; ease of access and retrieval of project information. Thomas et al (2003) discussed how WPMS - from the contractor’s selection point of view- can help the project managers would assist in boosting contractor performance and levels of confidence by:

- Minimizing subjectivity and eliminating the potential for corrupt practices
- Improving competitiveness through increased awareness of competitors strengths and their own weaknesses; and
- Nurturing mutual trust in the exchange of sensitive information such as performance data

Leskinen (2006, 2008) identified the most important intangible benefits and these would include improved customer service, gaining competitive advantage, more timely management information, supporting core business functions, avoiding competitive disadvantages, improved management information, improved product quality, improved internal communication, change through innovation, improved external communication and job enhancement for employees. Thorpe (2000) argues that the Online Remote Construction Management (ORCM) process has the potential to be quite useful for remote construction sites. Superintendents - for instance- do not have to visit the site as often and there is an improved efficiency in project and contract management, better project control, excellent document control, better availability of information for project participants, better decision making, improved management of project knowledge and improved contractual relationships.
3. A framework for sustainable management of remote construction projects

The use of CPMS may not be enough to embrace sustainability principals in construction projects and it is important that project management practices are sustainable as well. This can be done by designing the project management actions prior to the construction stage (Koskela et al. 1993). Green (1994), and Garnett (1999), Huovila and Koskela (1998), and London et al. (2002) identified significant design management factors. These researchers highlighted that whilst traditional design and construction focuses on cost, performance and quality objectives, sustainable design and construction by comparison, focuses on value generation, minimization of resource depletion, minimization of environmental degradation and the importance of timely information flow management. Kestle & London (2002) suggested a sustainable framework for Design Management of remote construction sites. They developed a model in regards of production principles and sociological factors associated with design management and lean design management. These are later incorporated with characteristics of remote site projects. The framework emphasizes on the following management functions: a) Serving: distant management involves more serving than just leading, b) Controlling: it is the precise and frequent measurement and correction of the performance of the team members’ activity, C) Organizing: The key factors of the management for remote sites would be: value generation, knowledge integration, process integration and timely decision-making. The traditional and hierarchical management structure would change to a more open, interactive collaborated and network structure d) Economizing: the management's performance should be very economical, emphasizing effective action, efficient organization, optimal plan, and human-centered control together with expertise service.

4. Shortages of the existing remote project management practices and systems

Deng et al (2001) pointed out that extensive physical distance between project's participants, extending over national boundaries is the main cause leading to delays in decision making. The project team has not to only tackle the traditional project management’s problems⁹, but also those that

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⁹ Some of these problems were reported by: Yang, Ahuja and Shankar (2007), VadHAVKAR et al (2002), Pena-mora (2009), Biggs (1997), and centre (2000), Wamelink (2002)
specifically occur as a result of the remote locations of these often environmentally sensitive sites (Kestle & London, 2002& 2003). These sites are away from any logistic support. It is obvious however; there is a lack in the previous research regarding the problems associated with the management of remote projects particularly in the Gulf region and the Kingdom of Saudi Arabia. Thus a pilot study was conducted in 2009 by the present research to establish grounds for the main survey. The examination of archive information and questioning the project engineers/supervisors at the SEC’s regional office revealed a number of remote projects management problems and these are:

- The SEC’s supervisors sometimes postpone the site visit due to the long travel time of 4 hours and more two-way trip and being overloaded with responsibilities. The unsupervised contractors utilize this opportunity to use improper construction materials and construction systems.
- The projects’ archive showed that a 30% decrease in the number of visits to the site is associated with an increase in the project’s costs by 30%, and the project’s duration by around 20% of the original estimated time. This also has affected negatively the project’s quality by around 20%.
- There is a lack of contractor’s commitment to the project schedule
- The lack of construction materials forces the contractor to regularly leave the project site to provide it. This makes the site vulnerable to theft and the records show that there have been several cases of theft.
- The remoteness of the site hinders government officers from making frequent visits to the site
- In some remote areas, the ownership of a plot of land is vague. Thus, SEC possesses the land. Afterwards, a claim of the land’s ownership by a citizen supported by the approval of the Sheikh (head) of one of the local tribes at the area of the project would raise a legal conflict over the land ownership and causes substantial delay to the project.
- The delivery of materials and equipments is constrained by the Roads/highways regulations. This enforces the contractor to deliver materials in several batches which increases the delivery and transportation cost. In addition, bad conditions of some roads add more difficulties.

The pilot study established the grounds for the main survey whereas one hundred questionnaire forms were sent to contractors, contractors' engineers and SEC supervisors/engineers in the four regions of KSA. Twenty five supervisors/engineers and two contractors responded back and this represents 27%. 48% of the respondents said that queries related to some construction stages as Masonry works' stage takes the same period to be sorted out whereas around 30% said it would take 4-6 days. 33%- 41% said that queries during the Mechanical works and Telecommunications and computers’ works stages take one to two weeks to be sorted out. The
respondents agreed that a number of serious issues affect badly the project performance - represented by cost, time, scope and quality criterions- and the project process; these are arranged from more effective to less effective: mistakes in construction works, poor quality of construction works (performance only), the selection of unskilled workers by the contractor to work on site, shortage in site equipments, unavailability of materials, low productivity of the workers, changes to specifications/ specified materials (process only), ineffective planning and scheduling of the project by the contractor and breakdown of one of the site equipments (performance only).

5. The present use of Project Management and Communication Systems: SEC case study

The pilot study on SEC revealed that supervisors use mainly the mobile phones for communications. Branches’ managers are not authorized to undertake decisions regarding certain management issues and the decision is entirely up to the director of the regional office. This substantially prolongs the decision making time. The main survey on SEC highlighted that CPMS are of little use by contractors and supervisors. Most of the respondents (i.e. 70%- 89%) said that they use the traditional management and communications systems. They do not use mobile systems and tools apart of the mobile phones. The WPMS is not used and the email service is used by 67% only. Respondents said that communications and management systems are widely unused among the project team members. The respondents said that the CPMS would be mainly helpful in sorting out the following construction problems: mistakes in construction works, delay in the project timetable, change of the project's scope that is made by the contractor and the increase in materials' cost during the building's construction. Meanwhile, the CPMS was considered of little help regarding the following issues: improper construction methods implemented by the contractor, the selection of unskilled workers by the contractor to work on the site, inadequate equipments that are used, problems related to the transportation of materials to the site and delay in the approval of contractor's submissions by the SEC Engineers. The respondents considered the following electronic CPMS and tools would have a positive impact on various aspects of projects: efficient administrative tools and project scheduling tools, meanwhile other tools such as procurement management tools, Communications and exchange of information tools were considered to have a little impact on the project (see figure 1).
6. Discussion and conclusion

The study revealed a number of issues regarding the present management style and tools thus the potential implementation of CPMS. These will be discussed within the context of sustainability and how far the implementation of CPMS would help to embrace sustainability principals into projects and how the present management practices should be changed to enable the application of sustainability principals.

The study examined how far the present management style and the use of management tools are sustainable. This was examined in terms of its impact on: time, quality, scope and cost. It showed that the management style is not sustainable and CPMS should be optimized in order to enable sustainability. Factors that significantly influence the projects' performance and processes should be incorporated in the design of the new CPMS. A number of technical features that highlighted above should be embedded in the CPMS. The literature review listed a number of sustainable benefits from...
implementing CPMS. The present study demonstrated that CPMS has the potential to enable lean construction processes. However, the implementation of the CPMS would not be enough to embrace sustainability and changes are required to the present management practices which are – in comparison with Kestle & London (2002 & 2003) framework – seem to be non standard, inefficient, rigid and loose. The following adjustments are essential to the exiting project’s management practices:

- Factors that highly affect the management of projects should be investigated and proper mechanisms should be created to sort it out; and
- Flexible decision-making mechanisms should be created and tested

Finally, proper mechanisms for controlling and monitoring the recruitment of site personnel by contractors, and shortage of manpower and so on should be designed, tested and applied.

Finally, the results of this study can be applied on other remote projects in KSA or elsewhere but one should consider the unique environmental, economic, construction etc parameters of these projects.

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