
An Analysis of Monitoring and Control Technologies Used in Construction Companies in Sultanate of Oman

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Abstract: Monitoring and control is an essential process in construction project management and delivery. It is therefore imperative for construction companies to employ the use of the most effective monitoring and control techniques available to meet project objectives. Nowadays, innovative information technology is used to optimize project management, which has a strong ability to indicate and control project activities throughout the project life cycle by using project software and utilizing this type of software to manage and develop the formalization level of project management to ensure the project is free of quality, cost, time issues, accident prevention, and other issues. As a result, the failure to use monitoring and control technologies while constructing the project has resulted in the failure of many projects and dissatisfaction with the project. Consequently, it may deliver the project with low quality and over planning budget and also exceed the target day. The goal of this research is to evaluate monitoring and control technologies used in construction projects in the Sultanate of Oman and to make recommendations for improving monitoring and control technologies and software programs in construction projects in the Sultanate of Oman. In the Sultanate of Oman, a research project was conducted using the questionnaire approach in 33 construction industries. The measurement and model reliability and validity were assessed using confirmatory factor analysis. Lastly, the conclusion has been added to aid construction firms and the project. Academically, this research contributes to students' and employees' expertise, as well as providing a breakthrough for practitioners in understanding the core functions of variables in the construction industry.

Keywords: Construction Industries, Project Monitoring and Control Technologies and Project Management.

1.0 INTRODUCTION

Oman is a member of the Gulf Cooperation Council (GCC) and is based in the Middle East. Oman's Saltant had a large number of ventures that began 46 years ago. As a result, his Majesty Sultan Qaboos bin Said began a great vision for a holistic starting point in 1970. It was regarded as one of the crucial economic and trade milestones that opened Oman to the rest of the world. The government and private sector have begun investing in infrastructure projects such as government buildings, bridges, hospitals, industrial fields, and mosques for immediate use. As a result, project management was the primary source of project management, and it was rapidly evolving (Anon 2016).

Project management has been used in the context of mankind occupying the planet. Several problems have arisen in the project's past, all of which have an impact on the project's phases. Many of these programs, in any case, have a wide scope of work and involve a significant amount of labor for a long period of time. Sadly, almost all project work is completed with no documentation, and there is a technology leak. Organizations did not begin to use effective technology and methods for project development until the 1950s. Ali and Alnuaim (2013) conducted a study on the number of construction projects in Muscat, Oman, and discovered that approximately 40% of the projects have been delayed in the completion phase, and that this delay is due to several variables as mentioned below:

- Contractors not proper planning
- Contractors have poor sit management
- Labors did not qualify and not manage properly

- Lack in resource management
- Lack of communication activities
- A mistake during construction
- Lack of labor controlling
- Design problem
- Poor quality management
- Finance problem

Based on the foregoing, the author of this study will concentrate on the design issue and poor quality management which are data storage, and material monitoring and control specifically in construction project in sultanate of Oman.

1.1 THE OBJECTIVES OF THE STUDY

the overarching goal of this research is to examine the monitoring and control of construction projects in the Sultanate of Oman. The specific objectives of this present study can be highlighted as follows:

1. Evaluate monitoring and control technologies used in design and material in construction projects in the Sultanate of Oman.
2. Make recommendations for improving monitoring and control technologies/ software programs in the construction projects in Sultanate of Oman.

2.0 LITERATURE REVIEW

The construction industry is a key figure that the Sultanate of Oman is using to achieve its long-term goal of improving the tourism sector and lowering unemployment rates (Mordor-Intelligence, 2020). Construction industries are expanding to meet the infrastructure demand from both the public and private sectors (Saleh & Alalouch, 2015). Large sums of money were spent on construction and infrastructure growth between 2011 and 2017, with a total cost of about USD 50 billion (David et al., 2013; Oxford Business Group, 2014). The construction industries were regarded as one of the most important sectors in the country (Aziz & Abdel-Hakam, 2016), serving as a key supporter of the country's economy (Alaghbari et al., 2007), and assisting in the advancement of financial growth. Al-Habsi (2013) In 2013, the construction industry in Oman subsidized 5% of the gross domestic product (GDP). The aim of the strategic plan was to hit 11% by 2030

2.1 Project Management

Project management defined as an art and science of mobilizing and managing people, materials, equipment and money to complete the assigned project work on time within budgeted costs and specified technical performance standards (Chithkara, 1998). The project management method is divided into five categories (PMI, 2008). They are responsible for initiating, preparing, implementing, tracking and overseeing, and closing the project. The process of recording, evaluating, and controlling project progress in order to meet the performance goals identified in the project management plan is known as monitoring and control of project work. Monitoring is a part of project management that takes place during the duration of the project. It includes collecting, measuring, and distributing performance information, and assessing measurements and trends to affect process improvements (PMI, 2008).

2.2 Project Monitoring and Control

The project monitoring and control process ensures that everything runs smoothly. In other words, it detects inconsistencies, manages transition, and offers input in order to update and gradually elaborate the strategy (Jack, Okeke, Okechukwu & Akinola, 2016). A project management and control framework, to put it more formally, works to reduce deviations from project plans and coordinates. As a result, it provides a collection of procedures, strategies, and resources that will ensure that the project's objectives are met (Hazir, 2014). The development of an appropriate Project Control system is an integral part of the project management process (Shtub, Bard & Globerson, 2005). A number of papers have been published to support the role of control in achieving project goals. Project success can be increased if the topic of control is given more attention (Avison, Baskerville & Myers, 2001). As a result, every owner, contractor, and engineer should become familiar with all project control technologies so that they can choose the most suitable method for their project (Attalla, 1996). The construction industry is an important part of a country's infrastructure and economic development (Tom & Paul, 2013). The industry is one of the first to be structured on a project-by-project basis (Chitkara, 2012; Roberts & Wallace, 2004). The goal of construction project management is to schedule, organize, and oversee the most efficient implementation of project goals based on the needs of stakeholders (Harris & McCaffer, 2013)

Project monitoring and control tools can effectively manage the project, such as recording, collecting, reporting details which are relative to project performance tasks which involve watching the progress of the project against schedule, performance quality and cost. Then, if required action, project control will take place to use

the data from the monitor to bring the actual performance to planned performance. This study was primarily carried out by utilizing some technologies that aid in the monitoring and control of project activities and their processes of duration, occurrence, cost, and resources required, all of which will provide an idea of tracking project resources and financial wise.

3.0 RESEARCH METHODOLOGY

The study area for this study is a construction company in the Sultanate of Oman. The population of the study consisted of respondents who were part of the project who are project leader (project manager or project team leader). The population for the study was limited to the project management team of the construction company to allow for selection of information relevant to the title and objectives of the study. A sample size of 33 was computed from the population using the formula for calculating sample size in the research. The primary source of data was employed as a gathering instrument for the survey by means of a structured questionnaire which was designed in line with the objective of the study and was personally administered by the researcher. Responses were ranked using multiple choice questions, where respondents are restricted to choosing among any of the given multiple choice answers. The scale was used as it is simple to construct, easy to read and complete and likely to produce highly reliable data. The data pulled together from the field survey were analyzed in the form of Percentages and Frequency tables. The SPSS (Statistical Package for Social Sciences) was used to analyses the data.

4.0 RESULTS AND DISCUSSION

4.1 Information technology

the project leaders agreed that advanced information technology has a positive effect on improving the monitoring and control of the project and it could help to succeed the project. As shown in table 4.1. Furthermore, almost all of them agree that the old version of the software is less accurate and slower than the modern version, as shown in table 4.2.

Table 4.1: The using of Information Technology in project Management

Position	IT_ Usage_ Project			Total
	Not important	Important	Very important	
Project leader	0	12	21	33

Table 4.2: Advance Information technology in project management

Position	old_ Modern_ technology			Total
	Fast	Accurate	Both of them	
Project leader	7	3	23	33

4.2 Project Data Control

Researchers have observed almost all of the construction project leaders use conversational type data collection method. According to table 4.3, 19 of the project team leaders used manual filing in the project. Hence, some of the project leaders used data storage systems in the project. And almost all of the project leaders agreed that the project management will improve the electric storage system.

Table 4.3: Data collection from construction project

Position	Data_ collect			Total
	Data Storage system	Manual filing	almost of the above	
Project leader	10	19	4	33

4.3 Project Design

As shown in Table 4.4, almost all construction companies use AutoCAD for design and editing, indicating. AutoCAD application is common software used in architect, structure, and technical drawings. On the other hand, only four project workers, use advanced software design such as BIM, Sketch up, 3D design, and so on.

Table 4.4: program used for design

Position	Project_ Design		Total
	AutoCAD	Advance software such as (BIM and Sketch Up)	
Project leader	29	4	33

4.4 Material Control.

This study shows that almost project leaders use manual coordination with supplier of manufacturer to provide the product to the project location. A number of the projects, on the other hand, use advanced software to monitor and control the material as shown in table 4.5. The material selection and procurement planning are critical factors in the project's success. Therefore, the stages of selecting a suitable material for the project depend on several elements, such as material type, cost and architectural appearances and also structural properties and technical details, etc. As a result, this process needs a solid definition of the specifications of the whole and the components, as well as the compatibilities between them (Albiñana & Vila, 2012). Furthermore, a material transportation strategy and plan from the supplier are commonly essential to guarantee that the delivery of products is not affect the deadline of the project schedule. That is the reason for the interest in adopting supply chain management system has been growing in the construction industry since the 1980s (Segerstedt, 2010).

Table 4.5: Material monitoring and control

Position	Material_ monitoring		Total
	Manual coordinate	(material tracking software)	
Project leader	30	3	33

5.0 RECOMMENDATION AND CONCLUSION

CONCLUSION

Based on the foregoing analysis, this research investigates the monitoring and control technologies used in construction projects in the Sultanate of Oman, with a focus on some advanced technologies used for material control, project design, and project data monitoring, indicating that some of the projects use advanced technologies and that the majority of them are not based on the explanation on Section 4.0. Moreover, the author has noticed that the project leaders agreed that advanced information technology has a positive effect on improving the monitoring and control of the project and it could help to succeed the project and almost all of them agree that the old version of the software is less accurate and slower than the modern version. This paper also provides new insights into using advanced technology for construction that can enrich performance. Therefore, there are a lot of information technologies such as SCM software and BIM to let the user aware of the correct product from raw material until the installation on the project. Lastly, the recommendation introduced in this study is to suggest a clearer picture of some of the technology that can be used to improve monitoring and controlling projects.

Recommendation

During the period of study, the researcher studied project monitoring and control technologies in some construction projects. Then the author recommended the below:

- Construction project companies have used AutoCAD for drafting, measuring the quantities as well as for design. Alternatively, there is BIM, which is a more effective one and it is an advanced technology.
- Meetings and communication between the client, construction company, consultants, and supplier, as discovered by Author, can cause delays in project and cost implications, so intergradation software must be provided to avoid this problem. Construction companies must rely on technology (software) to assist in reducing conflict.
- During the study, the author noticed that there are several issues that have caused delay from the client, such as a request for mock up and that will take a long time and it requires cost addition, but if the construction companies have 4D BIM that supports design mock up easily and clearly with less cost.
- During the design stage, there must be good coordination between the design consultant and the client to clarify if there is an error in the design by obtaining approval for junior and senior position designers and clients and using advanced tools such as BIM and stead pro.

- A good smart system, such as a biometric system, is required for monitoring and controlling the attendance of construction project employees in the Sultanate of Oman. This is also good practice for year appraisal and monthly wage.
- For monitoring and control equipment, materials, workforce, safety environment in project workplace in big size projects, it is not easy. Research recommends advanced technology such as cameras which are good for monitoring and also for remotely checking the project progress.
- According to Po-Han et al (2019), building information modeling (BIM) and web map service (WMS) software showed to be a supporting tool for planning and decisionmaking in SCM and logistics, and if the software has additional transportation means such as air, railroad, or sea transportation details available in Google Maps soon, this information technologies tools will become more expedient and maximized.

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