

Research Article

SPATIAL DATA INFRASTRUCTURE (SDI) & ITS EFFECT ON PROJECT MANAGEMENT (PM)

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ABSTRACT

Project Management areas are affected negatively through the constructions industry in Saudi Arabia. This paper identifies the reasons for the causes and the solution to reveal the negatives effect, especially in Makkah. Spatial data infrastructure (SDI) will be the main solution for each negative odd. Constructors in Makkah would be costly and has a delayed schedule. In addition, it would have difficulty to communicate with the government sectors who are responsible for transportation constructors for planning and get approvals. Moreover, it would have drilling issues because of the earth layers and the buried utilities, such as water, electrical, telephone pipelines. This study fills will show the huge benefit of using SDI as a key technology partner in any construction project in Makkah and around the Kingdome of Saudi Arabia. SDI will have an e-mapping database (Geographic Information Systems, GIS) which contains all data about what is underground, like the type of layers, the pipeline's depth, and path. SDI will be an e-service for helping companies to reduce the risk and the cost of the structure and building projects. In addition, SDI will provide a high-quality project with a less cost. As a part of stakeholders, it will be easy to communicate between the specialist department that must provide approvals to start building anything that belongs to them.

Keywords:delay; Construction industry; Makkah; Saudi Arabia; HMM; Bridges; SDI; PM; knowledge areas.

INTRODUCTION

The Geographic Information Systems (GIS) has been used since 1964 AD in Canada by Roger Tomlinson. in the 70's century, the number of companies increased which were specialized in GIS. In addition, in 80's century, the budget for GIS in government commissions remarkable increased as a result of the importance of GIS in the field. Project Management (PM) has a relationship with GIS in every area that could be covered in any project. Starting from a scratch to ending with a physical project in the real world. Saudi Arabia is going through an evolution in infrastructure with a strong economic position and new invest in construction projects. The Saudi government spent around USD \$574.7B between 2008 and 2013, however, the projects and their analysis go up to more than USD \$600B in 2020. The structure projects were delayed by the contracts, approvals and decision-making. As a result, the reason was because of the types of earth layers and buried utilities. Secondly, the cost of doing the projects was are high and over budget because of re-study, re-design and make new contracts if they faced a problem while drilling. Thirdly, the risk of breaking water pipelines or cutting the electric or telephone lines which they would pay a fee over the budget because of that. On another hand, the project would have delayed if any the issue showed up and waited until that issue been fixed. Through the paper will see the schedule and cost estimate with and without the SDI function. Furthermore, will see the risk percentage and stakeholder's communication effectiveness with and without SDI, such as in other PM areas.

The Goal of SDI

In this study, the goal of SDI as we assumed, it will help to create a unified electronic infrastructure for spatial data. The infrastructure will have all geographical information and underground services where are collected from all government sectors and organizations around The Kingdom of Saudi Arabia. The information stored in SDI database servers will be usually updated, accessible, exchangeable

and usable, as well as it will promote and support better decision-making by sharing information and reducing the waste of resources.

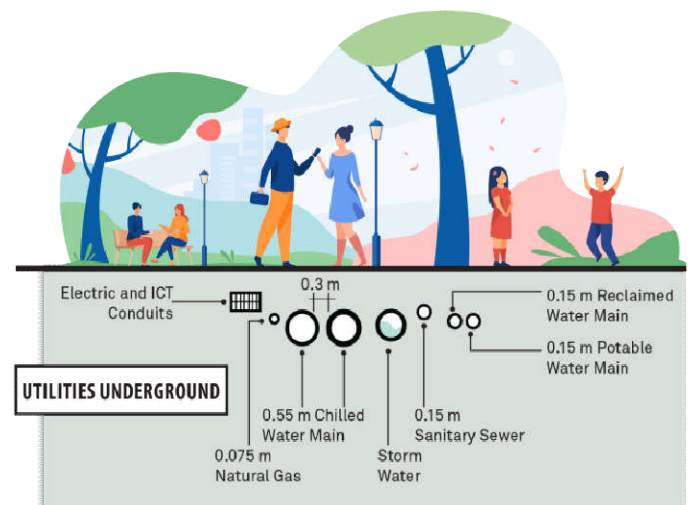


Figure 1. Spatial data infrastructure for utilities

SDI in Saudi Arabia

The Saudi government makes the GIS as an important aspect to have a geographic database, also gives it a total support by created an organization with the aim of standardizing the specifications and general principles of the requirements for establishing the national base for GIS,2001. In 2010, the Saudi government named that organization and called it "National Technical Infrastructure" (NTI). The NTI is walking on the same path and aiming to the same goals of previous organization including to make technologies, policies, resources, and best practices accessible for governmental, private, and individual organizations. On other hand, investing in any project that involves GIS without having a great database will be waste of time and money, which means losing a great benefit of it. To sum up, Spatial Data Infrastructure (SDI) will be the base of that and be the share point of all these data.

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Figure 2. SDI relationships with government sectors

CASE STUDY

Bridge project administration scenario without SDI: We have a severe daily congestion problem in one of the intersections in the city of Makkah, which is one of the important intersections in the city. Thus, the congestion leads to confusing the traffic situation at that intersection. Often this occurs at almost peak times in the morning when students go to schools and universities, as well as employees go to their works, also in the afternoon period when students exit and return to their homes. As a result, great inconvenience to those crossing that intersection, and the relevant government agencies such as security patrols (traffic), which must be present continuously to regulate traffic beside the traffic lights. Therefore, the idea of constructing a crossing the bridge for vehicles at that intersection is the daily traffic congestion and reduces congestion to a considerable extent. Implementing the idea of constructing a transit bridge for vehicles, followed by the Municipality of the Holy City (the project owner) steps:

First step, collecting information about the site, including:

1. The project area.
2. Determine the buildings that conflict with the project area, and this requires a field geographic survey for that, and it takes approximately five working days.
3. The cost of removing buildings that conflict with the project area and this requires communication with the competent authority in this regard within the Municipality to estimate the cost of removal.
4. Conducting a geographical survey of the layers of the land, and the quality of the soil on which the project will be built. Next, make a contract with a specialized consulting company to put sensors in the place to collect information and inform the project owner (HMM). This takes approximately at least a year that includes financial approval, and other necessary approvals for the company to do so.
5. Taking the opinion and approval of the relevant external service authorities, and here it is necessary to write to those authorities and wait for their approval, or comments on implementation, and

this takes approximately six months (depending on the cooperation of the authorities in the response).

Second step, begin a process that introduces the project to be implemented on the ground. In the process of starting to dig to lay and construct the foundations for building the bridge, it is expected that the executing company will face several problems or obstacles that hinder the drilling process. When the company executing the drilling process, they may cut a high-pressure water pipeline, which it must repair that pipe quickly, and these obstacles that we mentioned, for example, are not limited to being one of the obstacles that hinder the drilling process, and this certainly leads to a defect in the prepared schedule for the implementation of the project, it results in an increase in the material costs allocated to the project. Final step, after completing the excavation, establishing the bases, and building the bridge, all these steps may take approximately two to three years (depending on the area and the obstacles facing the implementation).

Bridge project administration scenario with SDI: In the previous case, the extent of the obstacles that face project executing agencies and project managers in those agencies towards implementing such projects is clear. In our research, we will make a simple comparison of the importance of having a spatial data infrastructure that contributes and helps to overcome these obstacles. If we go back to the initial steps which are mentioned in the previous case. We will find that when we have an infrastructure for spatial data, it would have been straightforward to reduce the time and effort by using this updated integrated structure. As in the fourth point of the first step, which is doing a geographic survey of the layers of the earth, we will find that it is easy to know the information about the utilities and earth layers when we enter the location coordinates. As a result, it will reduce the cost of using a consulting company to do so. Moreover, it will save time for getting that information, which is about a year as we mentioned above to less than an hour. Besides, as we mentioned in the fifth point of the first step about implementing the project, which is (taking the opinion and approval of the relevant external and internal service authorities). Based on this, the approvals can be obtained in several days, not exceeding five days only comparing with six months as we mentioned. Likewise, if we look at the second step of the aforementioned project implementation steps (the process of starting to dig), which is one of the important and serious steps that would be faced during the implementation of the projects. The percentage of those risks and obstacles can be reduced up to 80% by using SDI. For SDI, the implementing agency is informed of the most accurate details underground in the drilling area planned for the project with high accuracy and in a very short time that can be avoided, overcome, and find solutions to it and take it into account regarding (time, cost, equipment, and human resources) during drilling.

Effect of SDI on project management

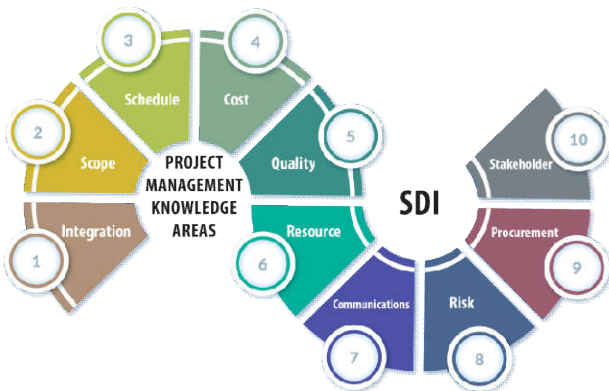
When there is an electronic portal that has the geographical data available to any organization with a secure connection to provide services to a specific organization like National Water Company (NWC), Saudi Electricity Company (SEC), Ministry of Municipal & Rural Affairs (MMRA) and Saudi Arabia Ministry of Communications and Information Technology (SAMCIT). As a result, the organization will manage its project efficiently and quickly providing information about the earth layers and what they need. In another word, it will have every detail that is needed. Defining that "Integration Management", is the mainframe for managing different PM areas. Hence, SDI will hold all related tools for the decision-making process. Furthermore, when there is one place that contains geographical data of spatial data for all involved parties, it will cause a lot of benefits for various areas in the PM.

Comparing between the two ways

The Project Areas	Without SDI	With SDI
Integration	- Hard to develop Project Charter. - The closing of the project might have delay.	- Easy to develop project charter with a clear information. - Less percentage to close the project after deadline
Scope	- Less awareness of what will be underground. - A long description about project.	- Awareness of what will be underground. - Specific description about the project.
Communication	- Depends on the size of the project. - Depends on the position of the project manager. - Depends on the cooperation of the relevant parties or project owner.	- Easy connection between the managers in different sectors. - Flexibility about deciding decisions. - The involve parties will cooperate very fast.
Cost	- High cost and support. - Unstable cost plan.	- Stable cost plan. - Saving money from unnecessary expenses.
Schedule	- Hard to identify the deadline of the project.	- Easy to identify the deadline of the project.
Recourse	- Need a lot of specialist workers. - Trained workforce. - Many drill equipment.	- Reduce the number of specialist workers. - Trained specific workers. - Specific number of drill equipment.
Quality	- The Quality of the project less than the cost.	- The quality of the project will be more than the cost.
Risk	- Not enough information about what is underground, or it will cost a lot to know what is underground.	- Specifying information about what is underground to reduce the risk.
Procurement	- Difficult to identify the seller of the project (the responsorial of the project).	- Easy to identify the seller of the project (the responsorial of the project).
Stakeholders	- Many decision makers.	- Identify specific decision makers.

Firstly, save a lot of time "Schedule Management" to collect information and identify the project deadline, as well as reduce some project costs & resource "Cost & Resource Management". Thus, that will not require them to bring specialized companies or detection devices to inform them of what is underground to build anything. Secondly, in terms of the quality of the project "Quality Management", knowing what is invisible will drive minds to choose the best and high-quality decisions. Thirdly, to reduce the risks that will take apart during the implementation plan of the project "risk management". Fourthly, it is easy to communicate with the stakeholders and buy-in their acceptance "Communication & Stakeholders Management".

Beside on that, it is flexible method for implementing and developing several projects around The Kingdome of Saudi Arabia in general and especially in Makkah. This will ensure that with the fast growth of development projects to keep pace with the development (locally and globally) and contribute to reducing the time by reducing the time of collecting information and buy-in the stakeholder approvals, as well as the building the bridge. Along with, SID will reduce effort and cost spent in projects by saving the money about the geographical study. Furthermore, reducing the obstacles that could be faced during implementation and management building process. Finally, SDI gives us high-quality management and implementation of overall projects that will be in the near future.



CONCLUSION

In our study, as we have shown, the importance of having an infrastructure and a system for (SDI), and the main key role of using it. (SDI) is a very helpful in assisting in decision-making and managing any constructor project.

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