Study of processes and procedures that affect the success of construction works by construction companies according to the guide to the project management body of knowledge (PMBOK Guide) in the municipality of Ocaña, Norte de Santander

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Abstract. Every construction project should be framed in parameters that lead to success, so the processes and procedures that integrate it must be ensured in order to consolidate it. Success in a construction project lies in good practices and knowledge of methods that contribute to this achievement; many companies lack of these items in the application of techniques and tools to the processes and procedures that allow the achievement of the project objective, leading it to failure, which is why the factors that influence failure according to previously-used methodologies should be known in order to develop actions for their continuous improvement in the search for success.

1. Introduction

Some projects around the world have failed and there are so many enterprises that have gotten great frustrations and learned from their experiences; this has brought a huge economic loss, and the lack of management in companies have led to do not accomplish their objectives.

Projects such as the installation of a high-speed train that would connect Mexico City with Queretaro that the consortium led by China Railway Construction company was in charge of it, but this mega project is currently suspended due to budget cuts in it and also in legal issues from the company.

There are several projects worldwide that share the same situation as the previous example. In a similar way, Colombia is part of this problem where many projects have not had a proper ending; every construction project must be created inside some success attributes [1], the constructor must be vigilant to ensure an optimal development that allows, since its addressing, the achievement of the planned objectives in it.

In like manner, projects face limitations regarding time, cost and requirements for their optimal development [2], which is why the use of good practices in the project management such as the one that allows to consolidate such attributes [3], like it must be finished in a proper schedule, which implies time management skills, it must be under the initial budget showing a cost management strategy; additionally, it must fulfill the promises made as scope management or fulfilling the customer’s budget which is known as quality management, among other attributes [4].
Successful projects are framed in two main components that have an impact in the mentioned success. On one hand, there is a component regarding the fulfillment of requisites of the finished goods to the clients which leads to quality management. On the other hand, there is a component regarding the project itself and the sections, processes and procedures [5] that integrate it such as what is related to scope, time and cost. What are all of these about? Everything leads us to consolidate the base line of the project [6].

A successful project should have particular important characteristics “from the participant’s point of view in every construction process (owner and constructor), a successful project must fulfill four requirements: scope, time, cost and quality” [7].

Besides that, every project should have a clear and defined objective, which has an impact in its achievement [8]. Therefore, the objective is established so it can be achieved, but framed within the project time, cost and scope producing some deliverables that correspond to work packages [9]. These packages should be directed with skills and knowledge in order to achieve success [10].

The previous idea requires the implementation of methodologies that, in the case of construction projects, allow its development in a proper way. One of these methodologies is offered by the sixth edition of the PMBOK, which is a guide of principles for project management, being a methodology that integrates the necessary processes and procedures to achieve the successful culmination of a project. This guide integrates 49 processes within 10 areas of knowledge [11-12]. The mentioned methodology has been applied in this research to carry out the analysis of construction projects that have been developed by construction companies in the municipality of Ocaña, Norte de Santander, Colombia.

2. Methodology
Two phases of the project were established for the research development: the definition of a database for studying and the application of the methodology that was divided into two phases at the same time.

2.1. Data description
Some data from different construction companies was used for the development of the study. These companies have residential building construction as their main activity, and they are legally ascribed to the Chamber of Commerce of the municipality of Ocaña. The information delivered by this entity was taken into account; in total, there are 61 companies with the International Standard Industrial Classification CIIU F4111 that corresponds to Residential Building Construction.

A sample was taken from this pool applying a simple random sampling method to the 61 possible enterprises, with a degree of confidence of 95%, with a margin of error of 5%, an expected proportion of 5% and a failure probability of 5%. The result of the sample size is 34, calculated by means of the Equation (1) [13]:

\[ n = \frac{Nz^2x(pxq)}{(N-1)XE^2+Zc^2x(pxq)} \]  

(1)

2.2. Application of the methodology
This application was carried out in two phases:

The first phase consisted of gathering information of the different construction companies in the municipality of Ocaña through a survey. This survey was created with closed questions to obtain information about the application (or its lack of application) of project management principles in them. The survey has questions about different processes and procedures which are applied according to the methodology of PMBOK-V6, with the goal of establishing which ones the critical ones were.

The second phase was to apply a Pareto statistical model to determine the most critical processes and procedures in the different construction companies that participated in the study, from the tabulation and systematization of the information that was collected through the survey.
Finally, the causes that generate the most critical processes and procedures are analyzed with the goal of suggesting solution alternatives with the use of tools and techniques of the PMBOK-V6 methodology to promote improvement of them.

3. Results
According to the survey that was carried out to the different construction companies, and after processing the information on 49 procedures, 5 processes and 10 areas of knowledge identified in the PMBOK-V6 methodology; besides, the Pareto statistical model is applied to prioritize the most critical processes and procedures.

According to the Pareto principle, 80% of the problems come from 20% of the causes, so with this principle it was desired to simplify the number of phenomena studied in the different processes and procedures according to the PMBOK-V6 methodology because 80% of these critical problems or issues are generated by 20% of the causes.

In Figure 1, there are details of the results of the processes where the studied companies fail.

![Recycling pareto diagram for processes in construction project management.](image)

**Figure 1.** Recycling pareto diagram for processes in construction project management.

The most critical processes (Figure 1) according to the PMBOK-V6 methodology are the ones related to planning, followed by monitoring and control. In Figure 2, there are details of the most critical areas of knowledge according to the study.

The most critical knowledge area according to Figure 2 belong to the base line of a construction project: cost management, schedule management and quality management. With the initial results, the next step is the analysis of the procedures within that group of 49 that were shown by the methodology as the most affected ones among the processes and areas of knowledge that have a critical impact on the construction projects in the municipality of Ocaña. The results are shown in Figure 3.

According to what is shown in Figure 3, the procedures that affect the construction projects executed by the analyzed construction companies are estimating costs and controlling them. The most critical procedures regarding schedule management are shown in Figure 4.
It is possible to establish that the procedures regarding schedule management that affect the construction projects executed by the different analyzed construction companies are estimating the duration and controlling the schedule. In Figure 5 there are details of the most critical procedures regarding quality management.

To conclude, procedures regarding quality management that affect the construction projects developed by different construction companies in the municipality are executing quality control and planning the quality management.
4. Discussion
Within the results that were obtained in the study for the set of processes that integrate a construction project while being executed by the construction companies in the municipality of Ocaña, it was possible to perceive that the processes that cause a bigger negative effect on the success of these projects are planning, followed by monitoring and controlling. It was noticed that the companies do not have a proper teamwork strategy to plan the projects.
In this process, the project costs are not estimated properly, which creates a path to cost overruns; there are no serious market studies that lead to the estimation of costs regarding the required resources, this is limited to previous projects or price lists from local suppliers.

Regarding the estimation of the duration for the different project activities, a good database is never consolidated to offer detailed information of benefits or productivity in the mentioned activities, which causes a delay in the execution of activities in the fields. There is also a lack of studies and research like this one in the municipality of Ocaña.

Quality management is another factor that has incidence on the failure of projects. The planning of the quality management is fundamental, the lack of knowledge in standards like the International Organization for Standardization - ISO makes many companies vulnerable since they do not create the quality assurance plans before the project execution.

In like manner, the process of monitoring and controlling is not performed adequately, there is a lack of knowledge related to techniques that help companies in this matter, it is limited to the everyday activities of each work, even though there are schedules that were created in an arbitrary way without a duration estimation, as it was previously stated.

Hence, it is recommended to have methodologies that help companies decrease these uncertainties and lead to the project success. PMBOK-V6 gives some key points in the use of processes that create a path to success in each procedure; each process consists of inputs, techniques, tools and outputs.

5. Conclusions
Identifying the processes and procedures contributes to the knowledge of the Guide to the Project Management Body of Knowledge (PMBOK-V6 Guide), where it is possible to know 5 groups of processes and 49 procedures within the 10 knowledge areas. It not only helped the authors perform the survey addressed to the different construction companies in the municipality of Ocaña, but also made it easier to order the research works in a precise and certain way.

Within the group of processes in the methodological guide, it was established in the study that from the top 5 processes in it, the most critical ones according to the information from the participating construction companies of the municipality are planning, followed by monitoring and controlling. These processes are part of the uncertainty because they set a valuable precedent in the project success.

The lack of personnel in specific areas inside the studied companies to perform the planning is evident, 86% of the companies do not include such a department. Another cause is that 92% do not know about guides like the PMBOK-V6 to plan projects; also, 94% do not hire a project manager to be in charge of these activities. Regarding monitoring and controlling, there are no adequate tools to perform this process, they are limited to judgment and daily measures they take to decrease negative effects through cuts in the execution of projects and works.

The knowledge areas where failure is more evident belong to the base line: scope, time, cost and quality, being the last three the most critical in the projects; it is worrying because these are the minimum requirements to accomplish in a successful project. Bad practices and lack of knowledge in methodologies lead professionals and construction companies to make mistakes in the consolidation of their projects. Lack of regional studies regarding productivity is evident, which leads to more uncertainty in construction projects, because companies are not concerned about developing good practices, but assuming day-to-day in the fields, which adds up to the lack of good consulting studies in the municipality which make the project success even more critical.

Finally, regarding the procedures in the different knowledge areas and processes, companies should rely on qualified personnel like a project manager who can optimize the aforementioned procedures. This is looking for their success, besides empowering good practices such as the Guide to the Project Management Body of Knowledge (PMBOK-V6 Guide), which helps companies in the construction industry achieve the success they look for, since it satisfies the needs that were identified during its creation.
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