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POTENTIAL BENEFITS IN ACTIVITIES USING CRANE IN CIVIL CONSTRUCTION

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ABSTRACT

An increasing number of construction companies realize the importance of project management to become more competitive. As a result, there is an increase in the use of technological equipment such as the crane, as these contribute to reduce the costs of the works, meet predetermined project deadlines. The purpose of this article was to verify the advantages of the use of the crane in two companies operating in the civil construction sector in the city of Montes Claros, MG and the relevance of this use, and aims to analyze possible differentials and importance. In this study the methodology used was qualitative research, exploratory research through questionnaire application to the project manager, as well as bibliographic research. Works were carried out, and the questionnaires were then applied to the managers of the two works using cranes, then the data were collected and analyzed. Through the study it was concluded that the crane can be a method to reduce project costs, because it is gained with productivity, reduction of hiring of workers, reduction in the time of activities.

Keywords: Project Management. Cranes. Construction. Deadlines. Costs

1. INTRODUCTION

Companies began to give greater importance to project management, with the growth of civil construction, a fact that is relevant for strategic decision making. (WINTER, CHECKLAND, 2003, *apud* AZEVEDO *et al*, 2011, p.86). In Brazil the construction industry is revealed by the delay in the managerial procedures and constructive techniques, by the low productivity, and also by delays in the deadlines of delivery. The construction sector demonstrates a distinct sector, which needs more efficient management, requires defined and more effective decisions and objectives (FREJ; ALENCAR 2010).

The management of production in construction has some obstacles of the sector such as numerous inputs and suppliers, temporary organization for production, among others. This together with managerial errors, difficult planning, lead to predictable and repetitive results. (FAZINGA, SAFFARO, 2012).

In civil construction planning deficiencies result in difficulty in obtaining results, a stable production process occurs. The projects are developed in an environment of high uncertainty due to the presence of variability (FAZINGA, SAFFARO 2012). According to Souza, Melo (2011) the value chain of a company is represented by interrelated activities that aim to add specific value to the customer.

Civil construction has been seeking to increase the quality of products and services, and as a consequence, to guarantee products with greater conformity to meet customers, Brazilian Program of Quality and Productivity of Habitat (PBQP-H, 2005). In relation to production management, new tools can be used for information extraction and decision making, this encompasses the operation of construction systems. Organizations that develop new complex technological products work with ever shorter deadlines, and costs evaluated with risks (NASCIMENTO 2007 *apud* GUIMARÃES *et al,* 2011, p.37).

The evaluation of performance in construction is a worldwide trend, however in Brazil there are still many processes to be covered (PICOLLI *et al* 2010). Existing technical standards regarding construction are based on form rather than performance (BORGES 2008).

With competition in the market, new, more systematic and efficient approaches are required that involve and interfere with time, money, personnel (Nascimento, 2007 apud Guimarães *et al*, 2011, p.37). Productivity, quality, of the product in the construction industry is low compared to other industries, this may occur due to the lack of technological innovation

in the industry (GRADVOHL et al 2012). In order for companies to have a continuity in the construction market, it is necessary to have a competitive capacity, and must seek the implementation of new strategies that bring new values and results to the owners. (SOUZA; MELO 2011).

Currently in construction, multiple projects occur simultaneously, the vast majority of companies run more than one project at a time, which makes the process more complex.Construction products have multiple organizations, and have a wide variety of production technologies, which requires project information (BALLARD *et al* 2010 apud BIOTTO *et al* 2012).

In construction management, the flows in construction are important for the completion of an activity, and also for conversion activities. The model where the result of conversions of materials and labor (human and machinery) to produce the building, is a dominant model in this sector (OLIVEIRA *et al* 2010).

For Aro and Amorim (2004 apud GRADVOHL *et al* 2011, p.45) designers can take new materials, these professionals can add technological innovations to companies in the industry. In construction, compliance with the pre-established schedule and the reduction of construction costs are directly related to the planning of the construction site and the adequacy of the construction methods that will be worked on. (JUNIOR BARKOKÉBAS *et al*.2010)

One of the purposes of the planning phase of the work is to reduce the routes of bulky transport, and to manage the execution of work and flow of materials at the construction site. Incorrect planning leads to additional costs, which means more spending on corrections (GEHBAUER, 2002).

Considering the reduction of costs and compliance with deadlines, the investment in equipment that carries vertical and horizontal transport of loads and bulky materials within the construction site can be a differential for companies in the construction sector (JUNIOR BARKOKÉBAS *et al* 2010). For Gehbauer (2002) vertical and horizontal transport can constitute 80% of the activities in a construction, so these can be considered as key points in this construction.

Regulatory standard NR 18.14 deals with the movement and transportation of materials and people, and the use of vertical and horizontal transport, and NR 18.14.24 specifies the use of cranes. The crane is an equipment used in the horizontal and vertical transport of materials. Some companies in Brazil have been looking for the use of cranes, due to the shorter deadlines to complete works and the technological advance of the construction systems. This equipment is chosen according to the material that will be transported and this is related to the

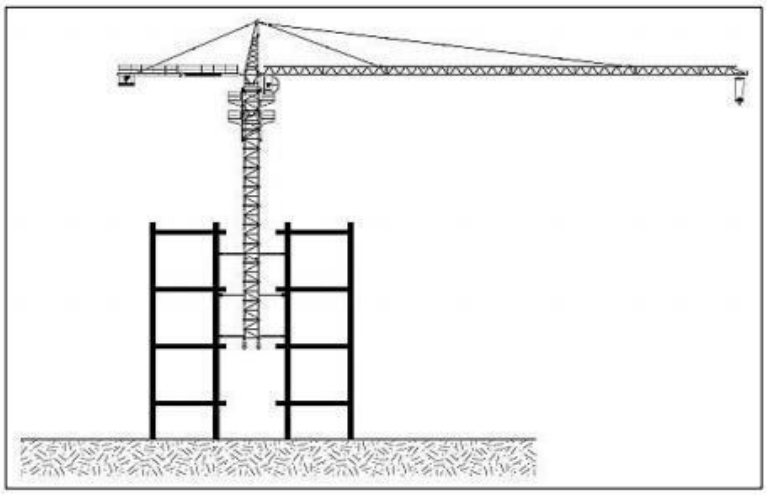
constructive method of the work. The cranes differ according to the type of tower. (SENAI 2016).

According to Carvalho (2009) the cranes can be classified as ascensional, fixed tower with fixed lance, mobile tower, fixed tower with horizontal and vertical pivot lance. Here are the definitions:

- **Ascending Cranes**

Crane installed inside the building under construction, it is like a tower crane, it passes through open holes in the slabs or the elevator shaft and accompanies the vertical advance of the building, figure 1, and is changed to upper floors with the evolution of the work. It uses the very foundation of the building (CARVALHO, ESPINELLI 2009).

Figure 1: Ascent Crane

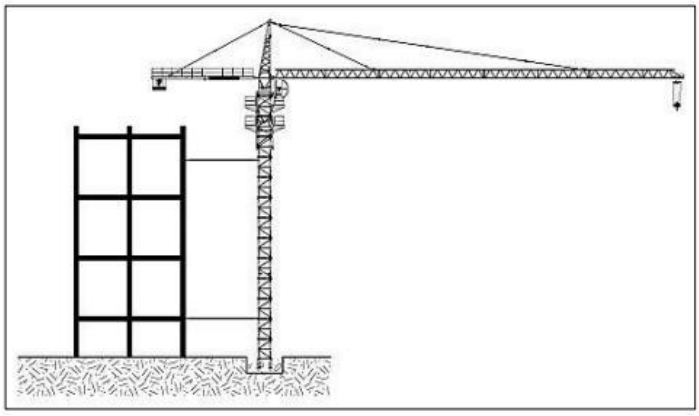


Source: Santos, 2013.

- **Fixed tower cranes with fixed boom**

The crane is fixed to the floor of the construction site, it must be stationed or attached to the body of the building, figure 2. When dismantling, there should be space in the construction site so that the entire lance is on the floor after the pieces of the structure have been removed (CARVALHO, ESPINELLI 2009).

Figure 2: Fixed Crane

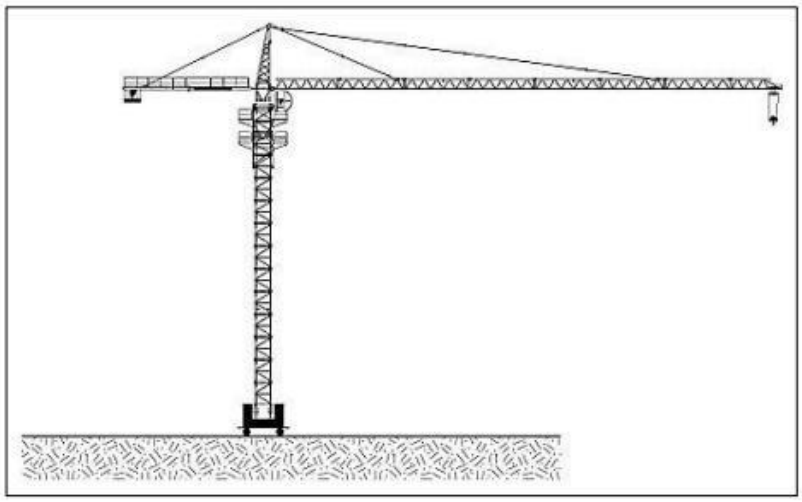


Source: Santos, 2013.

- **Mobile Tower Canes**

In this crane the tower moves by a rail, and this one must be anchored in the ground, figure 3. (CARVALHO, ESPINELLI 2009).

Figure 3: Mobile Tower Crane



Source: Santos, 2013.

- **Fixed Tower Cranes with vertical and horizontal swivel boom**

This tower-mounted crane is different from the fixed fixed-pitch crane by performing vertical movements with the movable lance. (CARVALHO, ESPINELLI 2009).

The general objective of the present study was to evaluate the use of cranes for vertical and horizontal transport of materials in civil construction works, and to analyze possible differentials and importance.

6. MATERIALS AND METHODS

The present research was classified as qualitative, exploratory through a field study and also bibliographical, based on national articles and magazines that discuss topics related to technological innovation in civil construction.

The population was composed by two construction companies in Montes Claros-MG that use vertical and horizontal transportation equipment- crane at its construction site under construction of vertical buildings. The works of the companies surveyed were large, and were works of buildings with multiple floors. Classified as large according to number of employees.

The field research was carried out through the application of a questionnaire with the managers of these works that use cranes in the city of Montes Claros in the year 2016, with the objective of analyzing the information obtained through the questionnaire showing the possible differentials offered by these equipments in activities at the construction site.

The questionnaire was composed of ten questions related to the use of cranes in these works, being four objective and six discursive questions, see Annex 1.

After the field research was carried out, the information was analyzed and the results were discussed and exposed. Some data collected was analyzed using Microsoft Office Excel 2010 software.

7. DISCUSSION OF RESULTS

The use of a crane on a construction site is classified by its suitability for its geometry, which facilitates and provides agility in the positioning of the structural elements. For handling the crane in the work is made a calculation for the feasibility of the same, as it should reach the entire outer perimeter of buildings with slack, from the point of grab to the points of application of the parts in the work. It is also important that the crane has the characteristic of turning without obstacles with the pieces, without having the possibility of bats at any point of the work (SANTOS, 2013).

In both companies, the classification of cranes is the same, fixed type with movable lance, being one of the most used in the civil construction sector, as shown in table 1. When asked about the load capacity of the crane, according to the manager of the The capacity of the crane is 2800 kg at the base and 1000 kg at the top. While in work B the load capacity of the crane according to the manager close to the base can reach up to 8000 kg.

Table 1: Crane Characterization

Data on Cranes	**Work A**	**Work B**
Classification of cranes	Fixed with movable boom	Fixed with movable boom
Crane Installation Height (m)	28	35
Crane Radius (m)	42	50

Source: Leaders, 2016

According to Table 2, the question of productivity was asked about the gain in productivity and the time of execution of the activities of the works that use cranes, and in both the managers considered that this gain was great and there was reduction in the time of

execution as well, since the use of this tool optimizes the process, providing greater agility in the activities. It was observed with the research productivity gains and reduction in the execution time with the use of the cranes.

Table 2: Productivity of cranes and time of execution of activities using cranes

Works	**A**	**B**
Gains in productivity	Great	Great
Significant reduction in activity execution time	Yes	Yes

Source: Leaders, 2016

The present study confirmed the results of a study by Oliveira et al. (2000), which identified that 53% of the companies studied used cranes in their services, in order to facilitate the transportation of materials within the work. An important point for companies, as they are investing more in the use of cranes.

For Oliveira et al. (2000) the result of their study reveals that companies that are investing in equipment, machines and new techniques of execution of services are improving the productivity within the work and with that presenting a higher quality of the final product.

Regarding labor, it was asked if the use of the crane interfered in relation to the number of employees and if there was a significant reduction in the contractions due to the use of this one and the managers of the two works reported that there was a reduction of the employees and with that a gain reduction in the need for manpower, thus reducing the budget spent on employees. The data collected showed a reduction in contracting with the use of cranes.

According to table 3, on the activities in the construction site that showed greater benefits with the use of the crane, in the work A the manager considered the activities that use vertical transportation and when there are heavy loads. Already for the manager of the work B all the activities that involve transport of load, mainly in height which would make manual transportation difficult. This manager mentioned the example of masonry, and described that for a good performance in its execution it is necessary that the material as blocks, cement, sand, are close to the place of use.

Table 3: Activities at the construction site that showed benefits from the use of the crane

Works	Activities that show benefits from using the crane
A	Activities that use vertical transport and when there are heavy loads
B	Activities with cargo transportation, mainly in height

Source: Leaders, 2016

About the schedule of the works that use crane for the work manager A the expected result is good and for the manager of the work B, the works that use crane have excellent results.

Regarding the costs / benefits raised in the questionnaire, the manager of the work A considers that there are differences in the works that make use of this vertical-horizontal transport, and it should be considered that in works where lift truck or column winch is used delay when compared to works with crane use (considering works of the same type and size). He also reported that for better optimization of costs, it is necessary to use the crane in near-integral time, as well as its cost becomes feasible.

For the manager of the work B, on the costs / benefits if there are differences of works that make use of this vertical-horizontal transport, this considers that although an investment is necessary in the purchase or rent of the equipment, a gain in the course of construction in relation to the economy of labor and agility of processes, but there must be a study that involves several variables to reach a conclusion.

It was observed with the results of the study that the use of vertical-horizontal transport crane in civil construction works, can be a method for meeting deadlines, and reducing project costs. According to Gehbauer (2002) vertical and horizontal transport can constitute 80% of the activities in a construction, so these can be considered as key points in this construction. Therefore the importance of investing in the rationalization of activities.

In terms of cost reduction and deadlines, the investment in equipment that carries vertical and horizontal transport of loads and bulky materials within the construction site can be a differential for companies in the construction sector (JUNIOR BARKOKÉBAS et al 2010).

Considering the importance of the use of technological innovations in a competitive sector such as construction, the manager of construction A affirms that new technologies are always created to streamline processes. And professionals should be open to new solutions, due to the main problem being the change of custos.

The manager of construction A also states that in civil construction, it is dependent on manpower for the execution of controlled and uncontrolled services and it is always up to

the employee to use the tools for the correct execution, and it is at this moment that managers can make the difference with new forms and practices for civil construction. The work manager B did not respond to this question because he considered it generic and very comprehensive.

With the research it was observed how the technological innovations can be differences for the civil construction, offering benefits and how they can be important for productivity, schedule of the work, reduction of costs, and for the activities of the construction site. According to Oliveira et al (2010) companies need research in search of technologies and innovations according to their needs to remain competitive in the market.

The research carried out shows the crane as a method to reduce project costs, as it is gained through productivity, a reduction in the time of activities, a reduction in hiring of workers, and a method to reduce the time of execution of activities in the construction site. construction. The study showed the relevance of the use of technologies such as vertical transport equipment such as the crane at the construction site, and this as a method for meeting deadlines, reducing costs.

8. CONCLUSION

Through this study it is possible to observe the differentials in the works that use cranes. The use of equipment that carries vertical and horizontal transport in civil works may be relevant within an increasingly competitive environment and that seeks greater efficiency and greater management of the works.

It can be concluded that the use of innovations such as the crane is very relevant as a method of rationalizing activities at the construction site, controlling costs and meeting deadlines. Construction professionals are expected to have a better planning of the work, such as vertical and horizontal transportation of materials, and with this a greater rationalization of activities and better results.

In order for companies to have a continuity in the construction market, it is necessary to have a competitive capacity, and must seek the implementation of new strategies that bring new values and results to the owners. (SOUZA; MELO 2011).

With the study it was realized that the investment in equipment, which carry vertical and horizontal transport of loads and bulky materials inside the construction site, can be a differential for the companies of the construction sector. As there are not many articles on the subject it is suggested to carry out new studies that investigate on the relation of the use of

cranes in the construction sites and its advantages, measuring and comparing the gains, since this subject is of great importance for professionals who seek a good management of the works.

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