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## **Productivity & Innovation as a Support in Project Management: A Study through Construction Industry in Brazil\***

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### **Abstract**

Construction in Brazil occupies an important role in the economy, with direct participation in the GDP and acting on an extensive productive chain of suppliers, commercialization services and maintenance. The sector has undergone major changes in recent years, facilitated by factors such as the resumption of public investments, the creation of laws that facilitate the construction of real estate, investments and funding of external resources. However, the sector faces problems of productivity that can meet the growth needs of the sector. The aspects of lack of skilled labour, nonconformity, low quality, high tax burden, outsourcing and informality of the workforce were not yet adequately addressed and resolved. This article illustrated the economics Brazilian construction scenario. Through the use of indicators of innovation, productivity, economic growth and project management actions, the main challenges of construction in Brazil industry are reported. A proposal for implanting productivity and innovation steps in construction sites is presented, searching for possible paths for the sector allow their improvement, in times of increasing productivity and competitiveness in the global economy.

**Key words:** *Productivity; Innovation; Construction; Developing Countries Economics; Management;*

**JEL code:** O1; O2.

### **Introduction**

#### ***Brazilian Construction Scenario of the Last Decade: Economic growth of the sector***

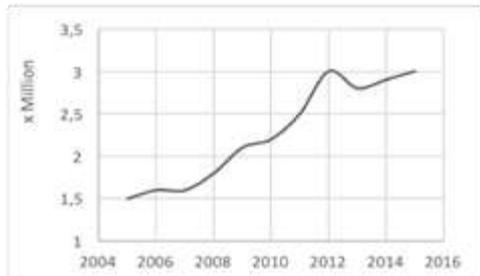
Civil construction in Brazil, starting in 2000, once again plays a leading role in the national economy and is on the road to a new and important virtuous cycle of growth. Construction as a development lever has important socio-economic standpoints, helping to cope with the housing shortage, as well as contributing to infrastructure solutions, which constrain the country's rapid growth. The industry continues to be one of the leaders of the current pattern of economic growth in the country (Sinduscon, 2015).

The construction sector has a significant socio-economic role in Brazil, with a formal participation of 5.6% of total salaries paid to workers in the Brazilian economy and 9% of employed persons. The building industry needs more growth. In 2010, the Brazilian housing shortage was estimated at 6,273 million households, of which 82.6% are concentrated in urban areas (IBGE, 2015).

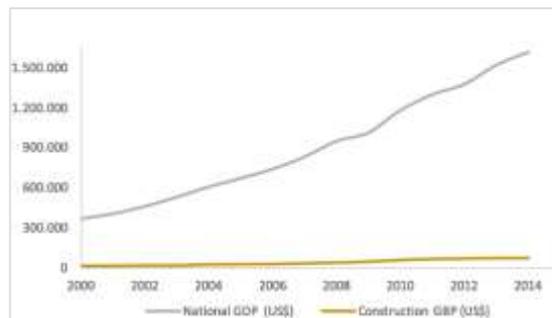
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Data on the expansion of construction indicates that there is robust growth in the sector. Between 2006 and 2013, construction investments totalled more than 39.3% of the country's gross fixed capital formation (FGV, 2011). Fig. 1 shows the evolution of cement consumption in construction in Brazil in the last years. However, in comparison with the growth of the country, it can be seen that Brazilian construction has not been following the real growth of its GDP in relation to National GDP (Fig. 2). Although improving compared to the previous period, the proportion of growth in relation to national growth is small, to the detriment of achieving better results and proportional development.



**Figure 1.** Jobs generated in construction.



**Figure 2.** National growth in relation to Construction GDP in Brazil.

### ***Factors impeding faster development of the sector***

It is also considered that the sector has high indices of informality and self-employed professionals that amounts to around 40% of workers in some regions, which can be explained by the large amount of light construction, maintenance and repair, where a great part of the workers exercise their professional activity as self-employed (Dieese, 2011). The construction industry has different characteristics to other industrial sectors, including the nature of the raw material and associated products, as peculiarities of its production process. In Brazil, the products are variable and complex and may vary according to region, with a long useful life, while the production process involves a large number of players and a large quantity and diversity of inputs. It has a high staff turnover and low education level of workers. Currently, it is oriented by the decentralization of activities and by the discontinuity of the productive process, as the services are outsourced and the worker does not participate in the whole construction process of the project (Isoldi; Sattler; Gutierrez, 2009). Since 2015, Brazil has faced a scenario marked by fiscal deterioration, political uncertainties, economic recession and inflation exceeding government targets, construction has been recording falls that will slow the growth of the sector.

## **Productivity in Brazilian Construction**

### **The particularities of the sector**

**The production process in construction is a relevant aspect in management and productivity analysis. No two construction projects are exactly the same and vary in many ways such as design, size, capacity, utilities, location, orientation, and so on. When projects are planned and budgeted based on historical data, it is important to consider the differentiators and variables unique to the project and**

**factor them accordingly. All projects are unique and have some variables. In this way, the construction requires management indices associated to the type of project, to the workers and production methodology to obtain reference results.**

### ***Productivity measurement in construction***

Productivity is influenced by many external factors. These can be related to the quality and comfort of the workplace, with the quality and quantity of work tools, with the motivation and number of workers, with the climatic conditions and with the degree of difficulty associated with the productive process, among others.

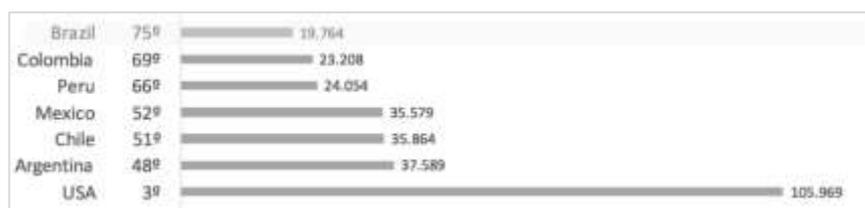
The productivity evaluation models are derived from the mass production industry, where most of the working conditions are predictable unlike the construction industry, where the number of unknowns is immense and impossible to know previously. Measurement provides performance information to workers, ensuring greater control and a possibility of improvement in those aspects that have not demonstrated the maximum yield. It is only possible to improve a task when there is a physical evaluation of it, which makes the measurement of productivity an indispensable part of any industry.

In this way, the basic tool for productivity management is measurement, resulting in several methods of measuring productivity in recent years. In Brazil, the adoption of measurement of sector productivity by construction companies is limited. Measurement is basically based on productivity on a global basis and on the financial results obtained in the activities and stages. However, global market demand, and the competitiveness and demand of customers and investors, have altered the conception of some companies that have been looking for alternatives to structure the management of production and to reduce the number of workers in constructions sites

### ***Construction Productivity in the Brazilian Economy***

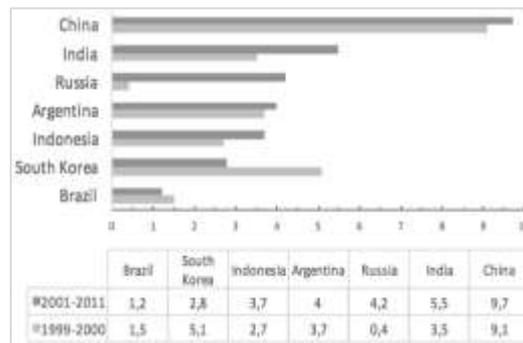
The use of a productivity measurement of a process is similar to the evaluation of the performance of a work model, for a later analysis before other similar processes. Productivity indicators are present in most organizations that are active in several activities, since the measurement and control of this indicator is a guiding factor for the achievement of high performance results, continuous improvement, cost reduction, quality improvement and maintenance of the organization's sustainability.

According to the World Economic Forum (WEF, 2015), even with the economic growth of the last years, an analysis of industry productivity in Brazilian economy identifies the low levels of productivity of the workers in relation to other countries (Fig. 3).



**Figure 3.** Productivity of each worker in the countries (US\$ / year).

From the point of view of the growth of production and the economy (WEF, 2015), Brazil's productivity in relation to other developing countries in the last decades (Fig.4).



**Figure 4.** Productivity Growth: Average rates by selected countries (%)

There is a consensus in the identification of the main factors that influence productivity, but there remains no clear answer to the correct correlation between them, although there are some mathematical models that propose to explain this complex relation, but that are unable to respond satisfactorily to some phenomena. However, China may be cited as an example of a country that invests in education and the maintenance of an environment that is extremely conducive to the implementation of new business, and however questionable the policies adopted by this nation to achieve and maintain high economic growth and productivity, its success is irrefutable.

#### **Quality development in construction sites**

The introduction of new management models by the construction companies, which consider quality from a strategic perspective, is the result of a series of factors that characterize the current situation of Brazilian construction, especially building's subsector. ISO quality standards have not been developed focused on the construction industry; it is fundamental to undertake a discussion of their requirements in order to enable their implementation in the sector. An efficient construction site project, in addition to ensuring the safety of its workers, brings in its core qualities that reflect in the total performance of the enterprise, such as:

- *Better use of the energy expended by the worker;*
- *Rational use of equipment;*
- *Optimization of time (human and material resources);*
- *Rationalization of activities and use of spaces;*
- *Minimizing interference that can cause waste.*

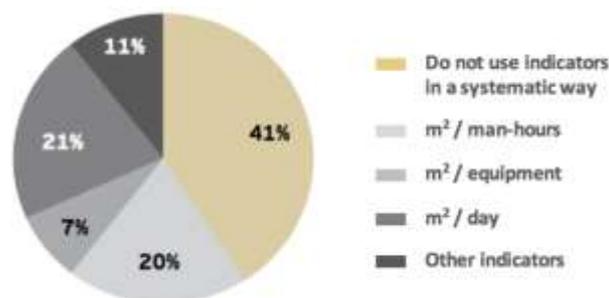
In Brazil, a growing increase has been observed in the introduction of improvements in the search for quality in construction sites. More companies have developed checklists, work orders, logistics and material storage, accessibility, quality tools, compliance with safety standards in workplaces, implementation of ISO certifications, Integrated Management System and the implementation of the Brazilian Program of Quality and Productivity (PBQP-H). Even though initially the awareness and training reside in the top management of the companies, through the directors and managers in search of a lean model, it is perceived that the demand for productivity is essential for development of the sector.

#### **Project Management in Brazilian construction companies**

### **Productivity measurement**

An increasing number of studies on management and quality have been observed in recent years in order to identify deficiencies in the process and propose solutions for performance improvement in Brazilian construction. Modern construction technology is employed by companies that use technical and scientific knowledge to develop their systems and constructive processes. In the Brazilian construction industry, it is evident in the last decades that it has presented an increasing technological demand, mainly related to the productive processes. This growing demand is reflected in the gradual replacement of artisanal processes by mechanized activities that incorporate a higher level of industrial technology. Thus, the acquisition or development of technologies, and the awareness and training of workers for industry become an essential issue for the competitiveness of companies (Martins, 2013).

However, it is observed that the adoption of measurement of sector productivity by construction companies is limited. Measurement is basically based on productivity on a global basis and on the financial results obtained in the activities and stages. The use of productivity indicators in Brazilian construction is illustrated in the figure 5.



**Figure 5.** Use of productivity indicators in Brazilian construction.

Source: EY Brazil, 2014.

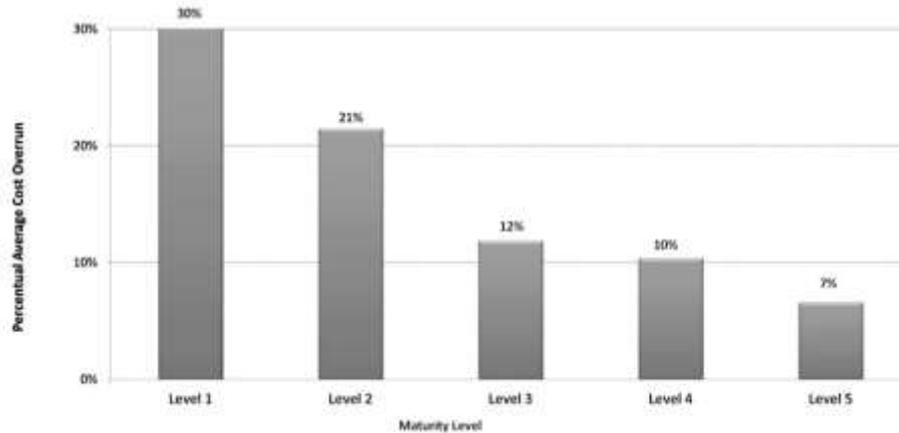
### **Project management maturity**

The maturity of project management refers to the continued development in the process for strategic analysis and decision making in the company. The appropriate level of maturity may vary for each organization based on its goals, strategies and capabilities. Analysis of Project Management Maturity can help the company identify gaps and take important operational steps to improve its entire culture around project management.

In Brazil, the construction sector has sought to adapt concepts, methods and techniques developed for industrial production environments. However, these systems are not always able to adapt to situations that occur in civil construction, causing them to end up generating inadequate and inefficient systems (Martins, 2013).

A continuing study on the maturity of project management by companies in the Brazilian construction sector involving medium and large companies that have project management models accompanied by qualified professionals illustrate the scenario of the construction industry. Its latest indicators involve 415 organizations in 7,885 projects. Of this universe, 15.2% are from the Engineering and Construction areas (Archibald & Prado, 2014).

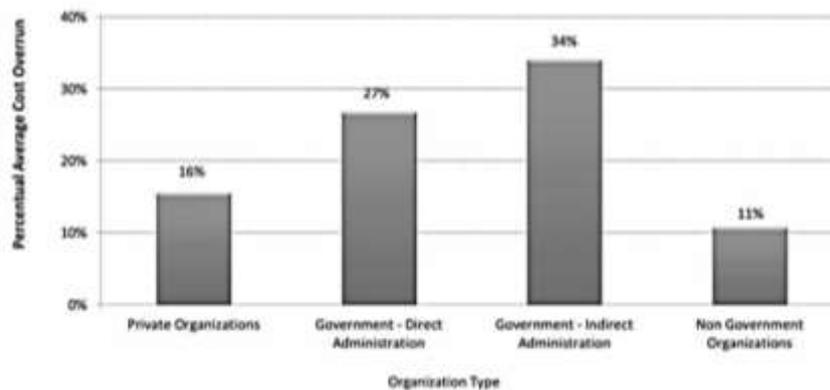
Fig. 6 illustrates the Construction average cost overrun of the companies studied, as shown.



**Figure 6.** Construction average cost overrun (Archibald & Prado, 2014).

In engineering and construction companies studied, it is observed that only 11% of them reach 80% (level 4/5 maturity), representing a maturity average 2.9 (Level 3) - 58% of the maximum allowed in the analysis. This value can be considered good, considering the short time in which the Project Management subject became popular in Brazil. But it is certainly a low score considering how much still has to be done (Archibald & Prado, 2014).

The proposed maturity study of project management also addresses the analysis of the types of organization and the distinct differences observed in the private and governmental sectors. Fig. 7 shows the cost overrun by Brazilian organization type, as illustrated below.



**Figure 7.** Cost overrun by Brazilian organization type (Archibald & Prado, 2014).

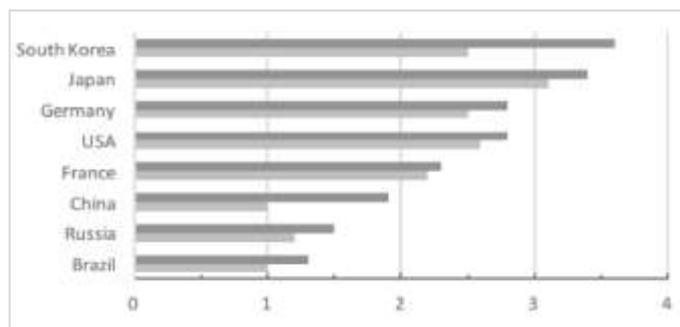
According to the organization type, it is observed that the Government reaches a percentage more than 100% of differentiation with respect to the private organizations.

### Importance of innovation in strengthening growth

There is broad consensus on the role of innovation as a major source for countries' economic growth. The relationship between innovation and economic growth has been demonstrated by several studies over several decades that have found positive correlations between various measures of innovative performance and economic growth.

It is through innovation that productive knowledge and creative ideas are transformed by companies into products and services with greater added value and novelty. It is not by chance that several governments have recognized that innovation has been playing an increasing role in the growth of their countries. For example, over the last 25 years, innovation has accounted for more than 60% of UK economic growth. Innovation appears as one of the main drivers of development and main motivation for the need for industrial policy. Precisely because of this, the competitiveness indicators try to capture this dimension of countries' economic development processes. The Index of Industrial Competitiveness Development released by the United Nations Industrial Development Organization measures industrial competitiveness as the capacity of countries to increase their presence in international and domestic markets – including indicators that seek to measure the success of nations in diverting their productive structure towards sectors that would be more innovation-intensive.

Fig. 8 compares research and development (R&D) spending in some countries. Typically, more developed countries have relatively higher expenditures as a proportion of GDP. South Korea, with an R&D expenditure of 3.6%, is larger than the developed countries selected in the sample. Another highlight is the substantial increase of this variable for China. Brazil has made little progress in the last decade and it is small compared to emerging countries like Russia.



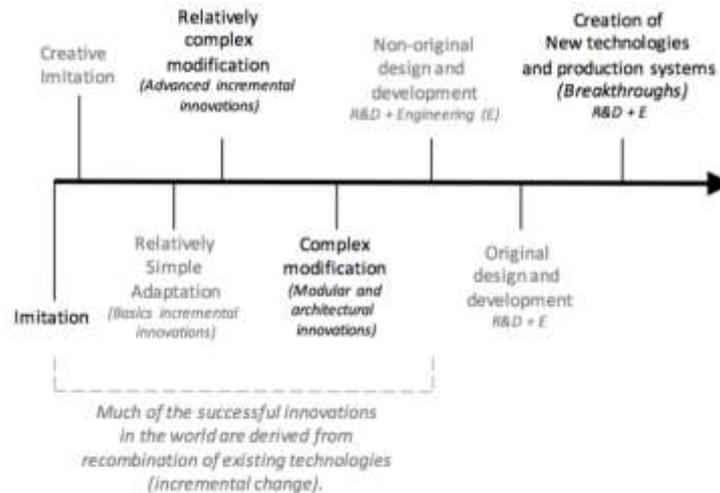
**Figure 8.** R&D investments in relation to GDP by selected countries (%).

However, innovation should not be related only to R&D or patents. For companies in emerging countries, although R&D labs are rarer, many innovative activities can be found in the practical and commercial application of ideas not necessarily linked to cutting-edge technology.

At the same time, significant innovations can emerge not only from sophisticated labs, but also from engineering areas. Therefore, a broad concept of innovation encompasses the implementation of changes in products and services, processes and organizational systems. In emerging countries, innovative activities often lie in engineering and design. In a second step, they can form the foundation and preconditions for achieving world-class R&D activities. Enterprises from the emerging high-tech world have begun their trajectory with duplicative imitation. Imitation practices can be preconditions for the implementation of more sophisticated engineering and R&D activities, including the expressive generation of patents (Martins, 2013).

Much of the innovation does not depend on science, and the recombination of existing technologies accounts for a large part of innovative activity over the past 50 years.

Fig. 9 illustrates the scales of types and degrees of innovation, as shown.



**Figure 9.** Scales of types and degrees of innovation.

In the longer term, rather than focusing on innovative activities, it is important to strengthen the technological capabilities that allow companies to move from innovation to an advanced R & D. Technological capabilities are a stock of resources based on human capital, technical-physical systems (software, hardware, labs, databases) and organizational systems, such as routines, procedures, standards, etc. The accumulation of technological capabilities, at the level of companies and industries, is fundamental for economic growth.

### **Challenges of construction companies in Brazil and proposals for actions**

Although Brazil has obtained good economic growth rates, the literature indicates that there are several aspects to be faced. Studies indicate Latin America's low economic growth relative to other developing countries. Differences in growth rates of labour participation or the accumulation of capital (human in the form of labour skills and physical in the form of capital per worker) typically pale in comparison with the gap opened by lagging productivity improvements, or reversals, in the typical Latin American country (Ungor, 2016). The productivity failure can be traced to distortions in the workings of the economy that drive aggregate efficiency below the technological frontier (Blyde & Arias, 2006).

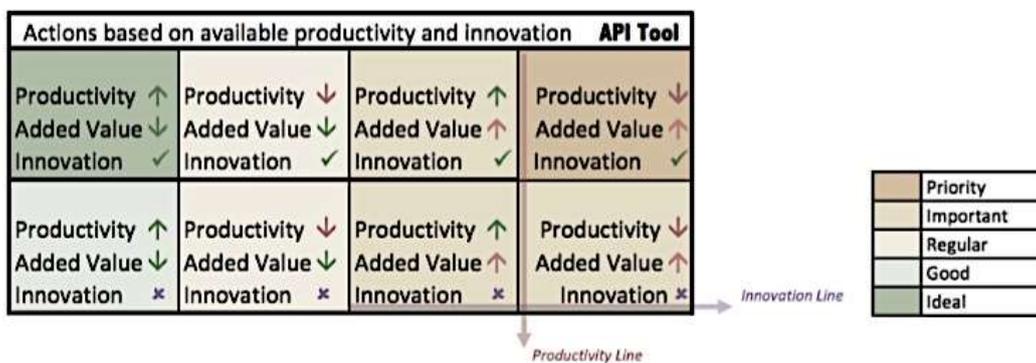
Among the main challenges in civil construction, the following stand out:

- *reducing the informality of the workforce;*
- *statutory, labour and social security reforms for companies;*
- *government investments to increase and improve professional education;*
- *encourage to raise level in small and medium-sized construction companies;*
- *partnership between companies and educational institutions to promote R&T;*
- *continuous training in companies;*
- *insertion of management tools and indicators;*
- *tax incentives for companies to invest in management and knowledge management;*
- *continued monitoring of indicators and tools for sector improvements;*
- *insertion and innovation indicators.*

**Proposal of actions based on productivity and innovation available**

A control option is planning is through actions based on productivity and innovation available in the company or in the market, which is known to those involved.

The productivity control associated with the value added in the activity and the innovations available in the company can be managed in the construction industry through the API Tool (Barbosa, 2016). It is a proposal for simplified control of the priority actions to be provided by the company, focusing on productivity optimizations in the most significant items of significant value added, which have alternatives and / or innovative solutions available in the company or in the market. Figure 10 illustrates the proposed API Tool, as shown.



**Figure 10.** Proposal of a management tool that identifies priority actions based on productivity, associated with added value and available innovation - API Tool.

From worksheets to job productivity and value added, options for implementing improvements through innovative solutions known to those involved and applicable to processes are indicated. It is a simplified option especially for companies that are unfamiliar or specialists in project management, but need to be guided by indicators for decision making in the planning and development of processes.

The main objective is not to use this tool, but to suggest the adoption of decision-making that adopt the productivity and added value associated as parameters and using methodologies already tried by the involved ones. Making the actions available to professionals is a more pleasant beginning and does not change the daily routine of professionals. In Brazil, especially in the construction industry, it is observed that the traditionally high margin of gains and coefficients of safety make the control global, which makes it difficult to act in Gaps. With the globalization and advent of information technology expanded today, the industry needs transformation, which is felt especially in times of crisis, as today.

**Conclusions**

Planning and control are interlaced processes that form a continuous cycle. While planning is a pre-action decision-making process and aims to set goals and course, control is a process that ensures that the course of action is maintained and that desired goals are being achieved and how much margin Expected and unforeseen events. Brazil needs to overcome difficulties and restore growth in order to converge with the socioeconomic pattern of developed countries. It is of the utmost importance for construction firms to increase competitiveness, which depends on raising productivity and developing innovative technological capabilities.

In view of the literature, the size of the Brazilian challenge in the pursuit of higher productivity is clear, and that it incorporates the necessary innovation, both effective and lasting, since success depends on changes to the main structural problems of Brazil, such as social and cultural limitations due to the low quality of Brazilian education, lack of infrastructure, excessive bureaucracy, levels of informality in the workforce, high tax rates and little investment in technologies.

In addition, it is not only the government that needs to leave its comfort zone and seek new actions to promote efficiency, companies must invest in the renewal of their productive processes and in the development of really effective management processes, but such actions derive from increased competition. Therefore, there will only be productivity growth if we work in partnership. An action proposal for improvements would be the adoption of a management that uses productivity and its added value associated as parameters and using innovative methodologies and solutions already tried by those involved.

The success of a construction company can not be basically defined in terms of profitability and success in the project. Control and planning to support strategies and support in the competitiveness of the sector, make companies have a need for strategic indicators, such as those involving productivity and innovation, in line with the interests of the company.

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**Adriano Barbosa** has a degree and PhD in civil engineering, and master's degree in production management. Consultant in construction management, quality and work safety. Fixed in Brazil, has solid knowledge in public resources management and has directed a number of domestic and foreign financial and planning projects. Acting in Latin America and Europe. Researcher professor at the Federal Institute of Sao Paulo. Author of technical books and published papers in periodicals, highlighting the topic "Exploring your self-awareness", and the tool for building management based on value added, productivity and innovation - API Tool.

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