

**Indicadores de desempenho para melhorar as dimensões competitivas da empresa de construção.**

**Key performance indicators to improve the competitive dimensions of the construction company**

**Indicadores clave de desempeño para mejorar las dimensiones competitivas de la compañía de construcción**

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**Resumo**

A indústria da construção é um setor econômico e produtivo significativo de um país. Devido à importância do setor, este estudo justifica-se não apenas para a academia, mas também para os círculos produtivos e empresariais. Identificar dimensões competitivas e compreender o desempenho organizacional por meio de indicadores de desempenho, permite que os gerentes tomem decisões por meio dessas ferramentas, de acordo com o modelo em que a organização atua, o mais próximo possível de sua realidade. O presente trabalho tem como objetivo analisar a aplicação de indicadores de desempenho através das dimensões competitivas da construtora. O método de pesquisa utilizado foi uma abordagem qualitativa, de natureza aplicada, classificada de acordo com os objetivos da pesquisa, em descritiva e explicativa. O procedimento utilizado foi a revisão da literatura através de artigos científicos nas bases de dados da Web of Science, no período dos últimos dez anos.

**Palavras-chave:** Construção civil; Dimensões competitivas; Indicador Chave de Desempenho; Sistemas produtivos.

## **Abstract**

The construction industry is a significant economic and productive sector of a country. Due to the importance of the sector, this study is justified not only for the academia, but also for the productive and business circles. Identifying competitive dimensions and comprehend the organizational performance through performance indicators, allows managers to make decisions through these tools, according to the model in which the organization operates, as close as possible to their reality. The present work aims to analyze the application of performance indicators through the competitive dimensions of the construction company. The used research method was a qualitative approach, being of an applied nature, classified according to the objectives of the research in descriptive and explanatory. The procedure used was the review of the literature through scientific articles in the Web of Science data bases, for the last ten years.

**Keywords:** Civil construction; Competitive dimensions; Key Performance Indicator (KPI); Productive systems.

## **Resumen**

La industria de la construcción es un importante sector económico y productivo en un país. Debido a la importancia del sector, este estudio está justificado no solo para la academia, sino también para los círculos productivos y empresariales. Identificar dimensiones competitivas y comprender el desempeño organizacional a través de indicadores de desempeño, les permite a los gerentes tomar decisiones utilizando estas herramientas, de acuerdo con el modelo en el que opera la organización, lo más cerca posible de su realidad. Este trabajo tiene como objetivo analizar la aplicación de indicadores de desempeño a través de las dimensiones competitivas de la empresa constructora. El método de investigación utilizado fue un enfoque cualitativo, de naturaleza aplicada, clasificado según los objetivos de la investigación, en descriptivo y explicativo. El procedimiento utilizado fue revisar la literatura a través de artículos científicos en las bases de datos de Web of Science, durante los últimos diez años.

**Palabras clave:** Construcción civil; Dimensiones competitivas; Indicador Clave de Rendimiento; Sistemas productivos.

## **1. Introduction**

The sector responsible for the construction of roads, tunnels, bridges, viaducts, urban infrastructure, industrial enterprises, among others, is part of the construction industry called

infrastructure or Heavy Construction. In Brazil, it moves an impact segment in the economy where the types of contracts are mostly with the governments, be they municipal, state or federal and the public investments are the bases for the national economic development (Arruda et al, 2013).

This sub-sector is fundamental for the competitiveness of the national industry, since it enables development conditions in all sectors of the economy. It is responsible for preparing the necessary conditions for the flow of production, participates in global value chains and has a more fragmented organization (Arbache & Aragão, 2014).

In the study on the industrial competitiveness of the sector, Arbache and Aragão (2014), emphasize that the infrastructure sector is composed of competitive and oligopolized market segments, some of these segments are characterized by the natural monopoly. Some sectors involve complex projects with long-term investments, in a context of specificity and high costs. Another feature of this subsector is the type of contracting of its projects, which in large public works, subject to legal obligations and, consequently, the need for regulation. According to the authors, in a supply chain as productive as it is in the industry and growing competition in markets in a globalized context, management, coordination and service provision in infrastructures are increasingly improved, contributes to actions for a more efficient management, effective and agile. This is because the competitiveness in the niche in which the company is inserted is a factor that determines the success of the organization and, consequently, a whole generation of value and wealth.

## **2. Theoretical Reference**

The Civil Construction Industry in Brazil is characterized by a hierarchical structure, traditional and conservative, and it is due to the fact that it was subsidized until the 1970s, through investments financed by the State (Nascimento & Santos, 2003) during this period, had no management programs for their businesses, employed a semi-literate workforce, was more disqualified and unprepared compared to other manufacturing industries.

In this period, the beginning of the 2000s, it was observed that the Civil Construction Industry underwent several transformations due to political-economic influence, such as privatizations of state-owned companies, the effects of globalization of markets, new demands on quality programs, especially public works, currency fluctuations, raising interest rates, increasing competitiveness, reducing investment risks, and increasing returns to profitability (Nascimento & Santos, 2003).

As of 2007, with the expansion of long-term credit and the increase of investments by the federal government, civil construction is going through a moment of expansion with infrastructure and housing projects (Construbusiness, 2016).

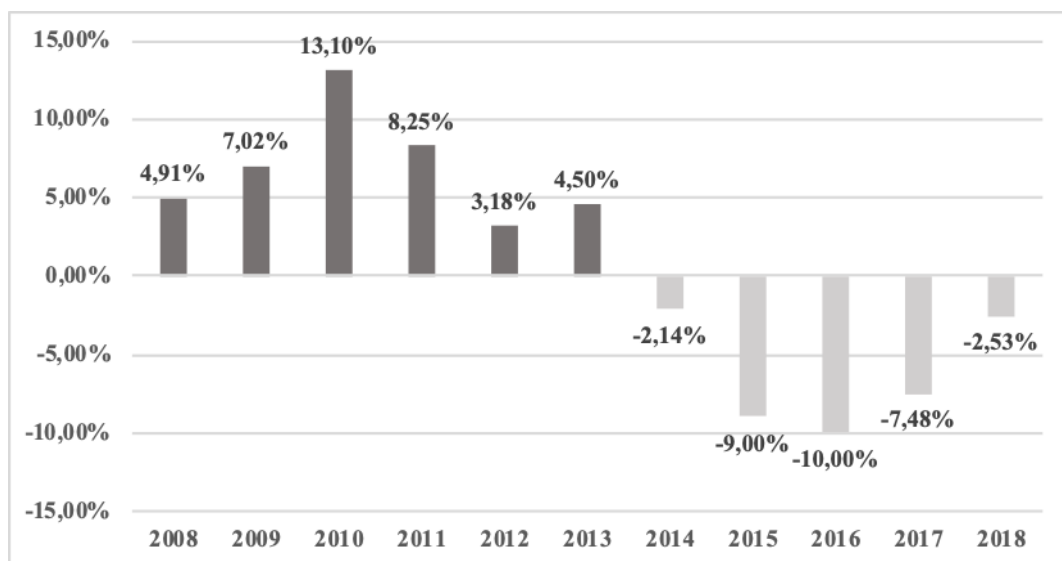
With the implementation of the Growth Acceleration Program - GAC, launched by the federal government in the same year, there was an expansion movement, a relative strategic progress for national development in which the construction industry. The Infrastructure subsector started to introduce management models for the reduction of social, environmental and economic risks, with a concern to ensure its business sustainability (Arruda et al, 2013).

According to Figure 1, construction accounted for 13.1% (US \$ 124.6 billion) of GDP - Gross Domestic Product in 2010, with a generation of formal jobs of 2.775 million jobs (CBIC, 2017).

In this period, according to market demand, the construction industry had a strong development leading manager to prioritize project management practices to assist in strategic decision, making with a focus on improving work quality and competitiveness (Azevedo et al, 2013).

In the second half of 2014, the construction industry suffers from a combination of suspension of investments derived from the strong political and economic crisis that extends from that period to the present day. This decrease in investments translates into a reduction in the pace and postponement of new projects, creating a scenario of uncertainties that have led to increase the risks of the real estate market, acting with strong credit restrictions (increased rules for hiring, lack of resources offered, among others) (CBIC,2017).

**Figure 1:** Contribution of Civil Construction to GDP - Brazilian Gross Domestic Product in the last ten years.



Source: IBGE, Research Directorate, Coordination of National Accounts. Elaboration: Database-CBIC. Table 02D0412. (Prepared by the Author). Note: (\*) The data for 2017 and 2018 refer to the Quarterly National Accounts for the 4th Quarter of 2018.

The crisis faced by the sector in the last decade was intensified by budget cuts impacting programs such as: GAP - Growth Acceleration Program and MCMV – “*Minha Casa Minha Vida*”, adding to the financial crisis of the construction companies, the credit restriction and the increase of interest rates (Lima et al, 2017).

As an alternative to create capacities and competences that allow companies to achieve competitive advantages, in the midst of the current conjecture of the Brazilian economy, the civil construction sector has sought greater efficiency in its organization, flexibility in adapting organizational structures and a greater mastery of requirements necessary for the improvement of professional performance (Maia and Iarozinski,2017)

## **2.1 Industrial Competitiveness**

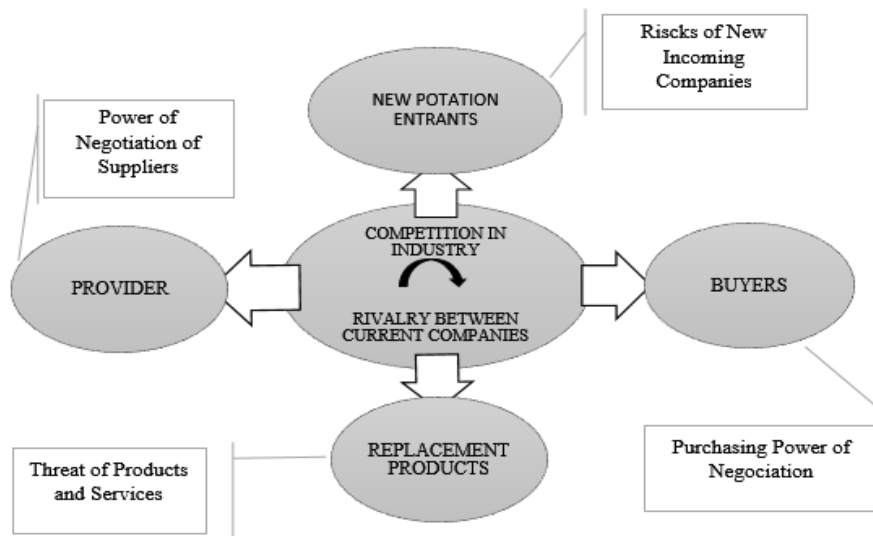
The competitiveness in the industry is in the intensity of the tacit economic structure and in the behavior of the competitors in its environment (Porter,2008). The intensity of an industry will depend on five competitive forces and its potential is measured by the long-term return on capital invested. Not all industries have the same potential and it is through knowledge of these factors that the author defines the competitive strategies so that the business unit has a position within the industrial sector that leverages its competitiveness.

The Figure 2, presents the five competitive forces of Porter, where potentiality and rivalry between industries are directly related to the potential of negotiation with suppliers, buyers, risks of new competitors entering their segment, as well as of products and / or services arise and compete with those offered, thus increasing competitiveness (Porter,2008).

In this context, the five competitive dimensions that provide the best performance and that bring the advantages discussed are: quality, reliability, flexibility, speed and cost (Porter,2008).

Cost management is an important competitive dimension for organizations to develop in order to protect or intensify the five competitive forces in their model as shown in Figure 2 (Porter,2008).

**Figure 2:** Porter's Model of the Five Competitive Forces.



Source: Adapted by the author

Keeping costs low means achieving higher return on investment, ensuring the ability to control costs compared to competitors and new entrants, and thereby increasing their competitive advantage.

Competitiveness among firms in an industrial sector differs in many dimensions and these differences influence their strategies and performance (Porter, 2008). These competitive dimensions are understood in attributes that the organizations develop, such as: specialization, brand identification, communication channels, product quality, technological leadership, value added, control costs, services, price relation, good relationship with the government and between the business units. These dimensions can vary from company to company, from region to region and the interrelationship with business units. In general, they are interrelated and internally congruent (Porter, 2008).

According to Yemal et al (2011) and Slack (2002) the competitive performance of the manufacturing industry and in most companies, it is within its own structure, such as personnel and the organizational asset that enables it to withstand competitive attacks, maintain a competitive versatility that helps it respond quickly to competing markets.

It is understood that on the competitiveness aspects, a company creates competitive advantage in its market when its operations are developed, with differentials, such as, fast deliveries, ability to insert new products, maintenance of deadlines committed, offering a mix of products which can meet the demands of their consumers, flexibility in production and

delivery dates, ability to offer products with prices that allow higher profit margin and / or exceed those of the competition.

Currently, the construction industry, according to Mello et al (2008), needs a better absorption of technological innovation by companies, so that there is organizational innovation. For the authors, the full use of innovative processes such as information and communication technology, lean construction, environmental sustainability, among others allows to produce goods or services with a high capacity to generate competitive organizational advantage.

A competitive dimension cited by the authors is the Quality Management System (QMS), a process that establishes mechanisms in which organizations can manage knowledge, establish procedures, organize processes, obtain feedbacks, identify problems and develop corrective and preventive actions (Mello et al, 2008).

The understanding and knowledge of the competitive dimensions or priorities that the company fits, according to its segment, allows to reach a degree of maturity and to develop strategies for the different levels of the organization and thus to establish competitive advantages against its competitors.

## **2.2 Competitiveness in the Civil Construction Industry in the Infrastructure Sector**

A study on the competitiveness among companies in the Brazilian civil construction sector concluded that most companies seek to diversify their areas of performance and show performance in adverse scenarios, as well as to deal with risks, which give them a competitive advantage, be a characteristic of the country (Mutti et al,2005).

Brazilian construction companies encounter certain difficulties, and these are specific both in the workplace and in the country's political and economic scenario: climate, geography, local labor quality, legislation, logistics, investment needs and financial guarantees, and cultural aspects. When they work outside the country, in addition to those already mentioned, they still face strong competition (Mutti et al,2005).

In the subsector of Infrastructures what determines the competitiveness between the companies are the capacity in the management of the contracts with respect to the management of costs, inputs and everything that relates to the product as well as to the good relationship with sectors of technology. It is observed in this subsector the existence of large economic groups which present diversification strategies through merger and acquisition of other businesses and thus, are indicated by their technological qualification, contribution and

quality. Small and medium-sized enterprises, in general, work as subcontractors (Monteiro et al,2010).

### 2.3. Dimensions and Competitive Advantages in Civil Construction

To understand the characteristics of industrial competitiveness, it is necessary to establish the concepts for Competitive Dimensions and Competitive Advantages whose definitions are generic and comprehensive, but when applied to the civil construction industry, due to its dynamics and productive peculiarities, an adequacy of these concepts (Barros neto et al, 2003).

The competitive dimensions vary from company to company, because the factors that directly influence these choices are: the internal competencies and their functions, the degree of competition in the market in which the company is inserted, the type of market in which it is sought to act, the type of the product which the company produces, among others.

Competitive dimensions will be defined through available resources, market capacities and opportunities, embedded technology, and observations on the demands, customer needs, and competition behavior. The criteria for defining these dimensions should ensure the competitiveness of the company and provide the necessary support to remain in the choice defined (Barros neto et al,2003).

In Table 1, we present the concepts of competitive dimensions according to Barros Neto et al, (2003), Santos (1998) and competitive advantages, according to Porter (1991) and Vasconcelos and Cyrino (2000).

**Table 1** - Concepts of Dimensions and Competitive Advantages.

	CONCEPTS	AUTHORS
COMPETITIVE DIMENSIONS	"Competitive Dimensions are goals which companies must pursue more strongly in order to increase their competitiveness and, therefore, their participation in the market and their profitability."	Barros et al, 2003.
	"... are defined as being a consistent set of criteria that the company has to value to compete in the market"	
	"Refers to a set of options that a business unit, regardless of the economic sector in which it is inserted, has to compete in the market, over a certain time horizon."	Santos, 1998

Source: Adapted by the author (to be continued...)



**Table 1** - Concepts of Dimensions and Competitive Advantages (Continuation)

COMPETITIVE ADVANTAGES	"Competitive advantage is an attribute of positioning, external to the organization, derived from the structure of industry, the dynamics of competition and the market"	Vasconcelos & Cyrino,2000.
	"... superior performance as a phenomenon stemming primarily from internal characteristics of the organization."	Vasconcelos & Cyrino,2000.
	"Competitive advantage is thus the result of the firm's ability to efficiently perform the set of activities necessary to obtain a lower cost than competitors, or to organize these activities in a unique way, capable of generating a differentiated value for the buyers. "	Porter, 1991.

Source: Adapted by the author

In civil construction, for a long time, the competitive dimension was efficiency, that is, achieving the objectives, carrying out processes and procedures in a correct way, aligned with the technical regulations to the detriment of other priorities. Currently, customers' needs, in general, have become a factor for valuing other criteria such as: cost reduction, quality improvement, shorter deadlines, increased flexibility, innovation and services (Barros Neto et al,2003).

According to the authors, the relationship of customer requirements and competitive dimensions are closely related, as represented in Table 2.

**Table 2** - Relationship of customers' requirements in the function of the competitive dimensions

Customer Requirement	Competitive Dimensions
PRICE	COST
<ul style="list-style-type: none"> <li>• Lower priced products</li> <li>• Differentiated payment terms</li> </ul>	<ul style="list-style-type: none"> <li>• Lower cost (productivity improvement)</li> <li>• Adequacy of Cash Flow</li> </ul>
TERM	DELIVERY PERFORMANCE
<ul style="list-style-type: none"> <li>• Deadline</li> <li>• On-time delivery guarantee</li> </ul>	<ul style="list-style-type: none"> <li>• Production Speed</li> <li>• Reliability of Delivery</li> </ul>
PRODUCT	QUALITY AND FLEXIBILITY
<ul style="list-style-type: none"> <li>• Product Performance</li> </ul>	<ul style="list-style-type: none"> <li>• QUALITY: Conformity with contracts; Conformation with projects; Quality of the Process (good execution)</li> </ul>

Source: Barros Neto et al, 2003 (to be continued...)

**Table 2** - Relationship of customers' requirements in the function of the competitive dimensions (continuation)

• Possibility of changes	• FLEXIBILITY: product flexibility
• Introduction of New Products	• INNOVATION
ASSOCIATED SERVICES	SERVICES
• During construction	• Attendance
• After construction	• Technical assistance

Source: (Barros Neto et al,2003).

The analysis presented Table 2 in relation to the requirements of the clients, according to the competitive dimensions, according Barros Neto et al (2003), define the following questions:

- a) Dimensions such as Costs, refer to the product generated in construction, has a high cost which directly influences the decision making by the customer. It is an important competitive dimension because it is directly related to the efficiency of the company.
- b) Delivery Performance is related to time appreciation and reliability in meeting deadlines, which characterizes a company's ability not only to execute the project faster than the competition, but to guarantee delivery within the agreed deadlines.
- c) Quality, has a differentiation, since the civil construction industry in relation to other industries, has a specific dynamics, and thus, the criteria of product quality received by the customer were divided into three, being: criteria of the project, which establishes the delivered product is within the specifications with attendance to the needs of the customers. The quality of conformation, which establishes that the delivered product is within the specifications with service to the requirements of projects and, finally, the conformation with the contracts, that establishes the full respect to the contracts, memorials, technical specifications and other project documents.
- d) In terms of Flexibility, in the case of construction, this term is related to the product tied to the ability of the company to adapt them to the needs of customers. This phenomenon is observed in the construction of buildings more commonly than in heavy construction works, such as, for example, the size of infrastructures. In order for this competitive dimension to achieve the expected results, the company must invest in planning, standardization of production processes and definition of possibilities for change.
- e) When it comes to innovation, for the authors, the criterion is evident by the new architectural conceptions, technology of materials and more demanding customers.

But for companies in the industry, to have innovation as a competitive dimension, greater investment in innovation is needed, to develop an entrepreneurial culture to value innovation and change. Few companies in the industry value this criterion.

f) According to the authors, the Services sector is an important competitive criterion, since increasingly, services in the civil construction industry are being directed to the clients' needs. In this criterion, we establish the following competitive dimensions:

i. Attendance: it is related to the promptness of the company, courtesy, agility in the customer service, during the execution of the enterprise.

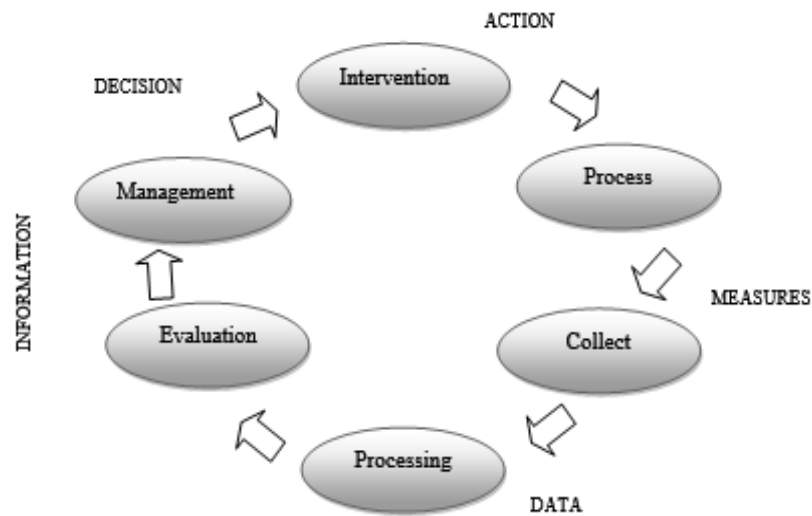
ii. Technical Assistance: after the completion of the work, in the first periods of occupation by customers, this competitive dimension contributes to understand the degree of customers' satisfaction, design or production problems, to feed back the production system and to work with professionals qualified and capable of improving the company image through direct contact with the client.

#### **2.4. Performance Measurement**

The measurement of business performance, according to Neely (1999) are evidenced by the needs of companies to improve their efficiency due mainly to: the changing nature of work, increased competition, improvement initiatives, national and international quality awards, changing organizational roles, changing external demands and the power of information technology.

Performance measurement is a process which defines the measurement criteria (what to measure?), The measurement methods (how to measure?), Obtain the data, generate the information according to the criteria adopted and finally , the information, as represented in Figure 3, is evaluated in the performance measurement model of Sink and Tuttle (1993). This process makes it possible to understand the capacity, level of performance, identify what can be improved, feedback the system or the processes of the organization (Costa et al, 2005).

**Figure 3** - Performance Measurement Model.



Source: Sink & Tuttle (1993)

In a research on performance measurement in construction Sousa et al (2017) they cite that companies in general have changed their strategies in order to serve a more competitive market. For this it is important that the measurement of company performance is also applied to one of the sectors that have changed their competitive strategies, the construction industry. The performance indicators allow companies to self-assess and thus, compare their performance with their competitors and thus measure their organizational strategies.

In Brazil, in the 1990s, with the advent of the new managerial philosophies based on the concepts of the Japanese automobile companies of the 60s, there was an intense dissemination of these new concepts in various sectors of the industry and started to be adapted to Civil Construction (Costa,2003).

In this period, the importance of the performance measurement systems of the companies in the sector is growing, mainly due to the implementation of their quality systems based on NBR ISO 9001 and programs such as the PBQP-H (Brazilian Program for Quality and Productivity in Habitat).

According to Costa (2003), performance measurement is considered through normative needs and mainly as a way for the organization to evaluate its results and successes. Performance indicators have become the main tool for measuring this criterion and related to company strategies, the interests of its stakeholders and the organization's plans and goals.

## 2.5. Performance indicators

Performance indicators or measures of performance, according to Azevedo et al

(2013) is an instrument that has the function of assisting companies in decision making. In the management of the organization, performance indicators are not only diagnostic tools, but also contribute to monitor processes, provide continuous improvement in their production systems and consequently integrate employees, increasing the participation of people in improving processes. When performance measurement systems are linked to the organization's strategic goals, it can also present the company positioning in relation to the external market and signal its strengths, weaknesses and competitive advantages.

Performance indicators can be classified according to Lantelme (1989):

a) Specific performance indicators: these are indicators that are related to the strategic aspects of the company and can be applied in global processes or individual activities. They contribute to application in planning, control and continuous improvement and are divided into:

(i) Indicators of managerial performance: directly related to the implementation of strategies, action plan and process improvement.

(ii) Operational performance indicators: related to the individual activities in the company, contribute to the control and management of the company's daily activities.

b) Global performance indicators: it has a more aggregated characteristic and demonstrates the company performance in the business environment in which it is inserted. According to the author, they are divided into two types of aggregation:

(iii) Performance Indicator of the Company: assist in the strategic planning, in the definitions of internal policies, indicate the competitive dimensions that the company has in front of the sector to which it belongs.

(iv) Sector Performance Indicator: they contribute to the measurement of the performance of the sector as a whole and thus indicate government policies, resource competition and economic incentives.

In 2005, Costa et al (2005) they elaborated a manual for the implementation and use of performance indicators aimed at the improvement of the civil construction sector together with the Nucleus Oriented for Building Innovation, at the Federal University of Rio Grande do Sul, research results which have permeated since the beginning of the 1990s. The study was carried out with 18 constructors from the state of Rio Grande do Sul and through the use of a computerized system they collected the data and thus established the performance indicators, being classified in two categories: Indicators for the Company and Indicators for the Work, as in Table 3.

**Table 3** - Relationship of the requirements of customers in the function of the competitive dimensions

Strategic Indicators	Operational Indicators
Accident Frequency Rate	Cost Deviation
Material Provider Evaluation	Time Deviation
Service Hiring Indicator	PPC - Percentage of Planning Completed
Non-Conformities in External and Internal Audits Index	Index of Good Practices in Construction Site
Training Index	Evaluation of Service Provider
Percentage of Trained Employees	Project Provider Evaluation
Employee Satisfaction Index (Administration and Construction)	Customer Satisfaction Index User
	Client Satisfaction Index
	Non-Conformities Delivery Index
	Construction Employee Satisfaction Index

Source: User Manual - Benchmarking Indicator System for Civil Construction, Costa et al. (2005)

Through research done on construction firms in Ceará, regarding the Measurement of Performance in Civil Construction, it was identified that each company has different dimensions of performance, aligned to their own motives and uses.

The study verified that the performance indicators remain in a departmental and segmented form, hampering their integration (Sousa et al, 2017).

Accordingly, Neely (1999), the measurement systems must be dynamic and conforming to the characteristics of the organization where their systems are evolved and as business circumstances change.

In Table 4, were present some common indicators used by researched companies in the researched works.

**Table 4** - Consolidation of Key Performance Indicators of Construction Companies.

Key Performance Indicators	Measuring Company Performance	Measurement Building Performance
<b>Construction Control and Safety</b>		
Work Cost Deviation Index		X
Term Deviation Index		X
Percent of Completed Plan		X
Index of Good Practices in Construction Site		X
Accident Frequency Rate		X
<b>Customer Requirements</b>		
Customer Satisfaction Index User	X	
Customer Satisfaction Index	X	
<b>Sales</b>		
Hiring Index	X	
Sales Under Offer	X	
Sales Speed Index	X	

Source: Costa et. al. (2005) and Sousa et.al (2017) (to be continued...)

**Table 4** - Consolidation of Key Performance Indicators of Construction Companies. (Continuation)

Key Performance Indicators	Measuring Company Performance	Measurement Building Performance
Global Sales Volume	X	
<b>Providers</b>		
Evaluation of Service Providers		X
Evaluation of Materials Suppliers	X	X
Evaluation of Project Suppliers	X	X
<b>Quality</b>		
Index of Non-Conformity in the Construction		X
Non-Conformance Rate on Delivery of the Property		X
<b>Personnel</b>		
Construction Employee Satisfaction Index		X
Administration Employee Satisfaction Index	X	
Training Index	X	
Percentage of Trained Employees	X	
Rotativity Index	X	
Staff Retention Index (quality in selection - HR)	X	

Source: Costa et. al. (2005) and Sousa et.al (2017)

Neely (1999), still describes that the performance measurement system must have continuous oversight, internal and external, to oversee the development of these movements and changes, be it within or without the organization. In the same manner, decision making systems must be prioritized, when the defined limits of performance are not met as well as prioritization of the critical parts of the system.

For this work were verified the strategic and operational performance indicators, according to the characteristics of the civil construction companies, evidencing their competitive dimension in relation with the indicators that support them.

### 3. Research Method

For Gil (2002) the research can be defined as a systematic procedure to obtain answers to a given problem. Also, applicable when little or no information is available on a given fact or phenomenon or when the available information needs to be addressed in order to be related to the problem. It involves numerous phases and is developed using scientific methods, techniques and procedures.

This research according to the objectives can be classified as: descriptive, when it is intended to describe the characteristics of a given population or phenomena and to establish the relationship between its variables and explanatory, which has the central objective in explaining the occurrences of a certain phenomenon, explains reason and "why" of things, deepening the knowledge obtained from the studied phenomenon (Gil, 2002). This research,

according to the techniques of data collection, analysis and treatment, is classified as predominantly qualitative, considering a dynamic relationship between the real world and the subjects where subjectivity cannot be translated into numbers. It reflects opinion, is inductive and descriptive (Pradanov and Freitas, 2013).

As for the nature of the research, it can be classified as basic, when it aims to generate new knowledge for the progress of science, but without practical application (Pradanov and Freitas, 2013).

As for technical procedures and data collection, a literature review was applied through a bibliometric study with the key words in the Web of Science databases in the time cut of the last ten years.

#### **4. Results And Discussions**

According to the theoretical background, in line with the research objective, a study was carried out through the analysis of the competitive dimensions in the construction industry a proposal for the use of a set of performance indicators.

Barros et. al (2003), claim that the competitive dimensions in organizations must guarantee a minimum level of performance and in the authors' research, for this sector, the focus on the customer is prioritized, even if a company develops more of a competitive dimension.

Some authors Costa (2003), Costa et al (2005), Sousa et al (2017), Mello et al, 2008), have studied the application of performance indicators in the construction industry and their results corroborated the importance of performance measurement so that companies stay competitive and can develop. Through the studies the performance indicators that support the competitive dimensions as shown in Table 5 (a) until (g) were organized.

The tables present the competitive dimensions, the performance indicators, their formulation for practical application and the expected results to improve the processes of the companies.

*Costs* - The production system acts directly on production costs, the more efforts in the search for lower costs and a more productive and efficient balance in the company's cash flow. The performance indicators chosen and described in Table 5 (a) are directly related to this dimension.



**Table 5 (a)** - Consolidation of cost performance indicators of construction companies

Competitive dimensions	Performance indicators (construction)	Formulation	Expected results
<b>COSTS</b>	Cost Performance Index	$((\text{Actual Cost} - \text{Budgeted Cost}) / \text{budgeted cost}) \times 100$	Control of costs during construction and information for decision making to mitigate possible deviations (COSTA, 2003).
	Percentage of Completed Tasks	$(\text{Number of 100\% completed work packages} / \text{Number of planned work packages}) \times 100$	Identify during construction the tasks performed in relation to the planned and thus, take preventive or corrective actions, as well as feedback processes with progress updates (COSTA, 2003).
	Best Practice Index (In Construction Site)	$(\text{Sum of Obtained Points} / \text{Total of Evaluated Items}) \times 10$	This indicator can present information about the works carried out in construction sites: economy of the use of resources, compliance with Regulatory Norms and possibility of feedback. (SOUSA et al, 2017).
	Accident Frequency Rate	$(\text{Number of accidents occurring in the month with absence of one day} / \text{number of hours worked by all company employees in the month}) \times 10^6$	Accidents are costly, either by the employee who is absent or by the costs of compensation. This indicator allows us to measure safety performance in the work environment and to take corrective and preventive actions (SOUSA et al, 2017).

Source: Adapted by the author

*Sales or Marketing* - lists the performance indicators that demonstrate the organization's ability to remain in the market in which it operates and measure its performance, to establish strategies to improve its competitive advantage. These indicators are considered critical because they are related to the financial performance of the organization.

Many factors influence the results of the indicators on sales, the political-economic conjecture, changes in bidding laws, market demand, changes in prices, payment conditions, among others.

**Table 5 (b)** - Consolidation of sales performance indicators of construction companies

Competitive dimensions	Performance indicators (company)	Formulation	Expected results
<b>SALE (MARKETING)</b>	Sales Under Offer		This indicator is related to the sales of products with lower price and together with other indicators, it is expected to understand if there is reach the market demands and to plan the sales strategies (MELLO et al, 2008).
	Sales Speed Index	$(\text{Number of units sold} / \text{Number of units for sale}) \times 100$	This indicator is related to the inventory turnover and enables the tactical-operational planning of works (MELLO et al, 2008).

Source: Adapted by the author (to be continued)

**Table 5 (b)** - Consolidation of sales performance indicators of construction companies (continuation)

Competitive dimensions	Performance indicators (company)	Formulation	Expected results
	Global Sales Volume	(Total units sold (m <sup>2</sup> ) / Total units available for sale (m <sup>2</sup> )) x 100	This indicator is related to the company's market share. Associated with other indicators, it has a competitive advantage (MELLO et al, 2008).
	New Contracts Index	(Value of contracts / Budgeted total value) x 100	This indicator is related to the company participation in the market and its competitive capacity (MELLO et al, 2008).

Source: Adapted by the author

*Performance in Delivery* - This dimension is related to both aspects of build and the company. With respect to the company, it falls under the Customer Satisfaction Index, since through this indicator it is possible to measure in relation to the final deliveries, the fulfillment of the deadlines established between client and contractor or even between specific sectors of the organization and the client. Nowadays, meeting deadlines, guaranteeing the delivery of the enterprise, is not only a factor of confidence, it includes the legal and regulatory aspects of the commercialization.

**Table 5 (c)** - Consolidation of delivery performance indicators of construction companies

Competitive dimensions	Performance indicators		Formulation	Expected results
	Company	Construction		
<b>DELIVERY PERFORMANCE</b>	Customer Satisfaction - Product and Service	Schedule Performance Index	(Actual term - estimated period / estimated period) x 100	This indicator relates the deadline for completion of the project to the planned deadline. It enables corrective and / or preventive actions to be taken to mitigate deviations of time (COSTA,2003).
			(Number of user's customer complaints ** / total number of units) x 100	By relating this indicator to the Schedule Performance Index, corrective and / or preventive actions are obtained from the client in case of delays in delivery of the work (MELLO et al, 2008).

Source: Adapted by the author

*Quality* - divided into 3 characteristics perceived by the customer: the quality of the project that refers to the customer's expectations, the quality of the conformation, which refers to compliance with specifications, regulations, standards and other legal relations with the customer and finally, the quality of the production process, which refers to the final product, concluded, taking into account the client's expectations, as to the quality of services provided, materials applied, health, among others.

**Table 5 (d)** - Consolidation of quality performance indicators of construction companies

Competitive dimensions	Performance indicators		Formulation	Expected results
	Company	Construction		
QUALITY: CONFORMATION WITH CONTRACTS	Evaluation of <u>Material Suppliers</u>		To measure the quality in conformation with contracts, you should assign scores from 0 to 10 for the items evaluated (term, payment, taxes, fulfillment of legal duties).The level of conformation with contracts by the total of points attributed, divided by the number of items evaluated.	These indicators aim to evaluate suppliers of materials and services regarding delivery times, quality of services and products. It is related to the quality procedures of the company and contributes to the taking of corrective and preventive actions with the suppliers Costa et al (2005).
		Evaluation of Service Providers		
QUALITY: CONFORMATION WITH PROJECTS	<u>Evaluation of Project Suppliers</u>		To measure the quality in conformation with projects, you should assign scores from 0 to 10 for the items evaluated (technical specifications, design, areas, project development and accuracy, deadline, etc.). The level of conformation with project by the total of points attributed, divided by the number of items evaluated.	The purpose of this indicator is to evaluate project suppliers, in terms of quality, deadline and other requirements for the smooth running of the works Costa et al (2005).
QUALITY IN THE CONSTRUCTION PROCESS		Non-Conformance Index to Construction	(Non-Conformance number / Number of checks) x 100	This indicator is linked to the quality criteria through the relation of the number of non-conformance with the number of observations. Contributes to preventive actions for quality assurance Costa et al (2005).

Source: Adapted by the author

*Flexibility and Innovation* - Conceptualized for the construction industry, Flexibility as the ability to adapt your product to a group or an individual customer. Most common in the segment of Buildings with custom plants of residential units. In the subsector of Infrastructures, fit the flexibility of adapting the demands and fast response to the needs of the customer (market). As innovation, it is a determining factor in the subsector of

infrastructures, which develops competitive advantage when allied to the new technologies is of processes or even of management.

Performance indicators in the traditional system, as Costa (2003) are not enough to measure the performance of innovations in construction. A set of outcome indicators would be the most assertive adequacy. The indicators of result according to the author and that can be applied: Index of deviation of Costs, Index of Deviations of Time, Index of Satisfaction of the Client, among others.

**Table 5 (e)** - Consolidation of flexibility and innovation performance indicators of construction companies

Competitive dimensions	Performance indicators (company)	Formulation	Expected results
<b>FLEXIBILITY</b>	Customer Satisfaction - Product and Service; Non-Conformance Index to Construction; Non-Conformance Rate on Delivery of the Property	Several indicators of performance of results.	Flexibility in the construction industry is related to the company ability to adapt to changes in the product, which infers directly with customer requirements in conjunction with other indicators Barros Neto et al (2003).
<b>INNOVATION</b>			

Source: Adapted by the author

*Qualified Professionals / Specialists* - such as project and / or consulting firms. These performance indicators that support these dimensions, allow to improve the planning of human resources management in the organization.

**Table 5 (f)** - Consolidation of quality professionals and innovation performance indicators of construction company (to be continued)

Competitive dimensions	Performance indicators (company)	Performance indicators (construction)	Formulation	Expected results
<b>QUALIFIED PROFESSIONALS / SPECIALISTS</b>	Employee Satisfaction Index	Employee Satisfaction Index	To measure employee satisfaction, you should assign scores from 0 to 10 for the items evaluated (benefits, training, staff relationship, workplace, working conditions, among others). The level of satisfaction is measured by the total of points attributed, divided by the number of items evaluated.	This indicator aims to identify the level of internal customer satisfaction, with feedback to improve performance and tactical-operational planning by managers (Mello et al, 2008; Costa et al, 2005).
<b>QUALIFIED PROFESSIONALS / SPECIALISTS</b>	Training Index		(Total number of hours of training / Number of hours worked) x 100	This indicator aims to identify the number of training hours for the organization's teams (Mello et al, 2008; Costa et al, 2005).

Source: Adapted by the author

**Table 5 (f)** - Consolidation of quality professionals and innovation performance indicators of construction company (continuation)

Competitive dimensions	Performance indicators (company)	Performance indicators (construction)	Formulation	Expected results
	Percentage of Trained Employees		$(\text{Total number of employees trained} / \text{Total number of employees}) \times 100$	This indicator represents the number of employees trained in the organization, contributes to the planning of human resources management in the organization (Mello et al, 2008; Costa et al, 2005).
	Rotativity Index		$((\text{Number of Employees (Admitted} + \text{Dismissed)} / 2) / \text{Effective Total}) \times 100$	This indicator aims to identify the turnover of employees by the ratio of professionals hired and dismissed by the total number of employees. It is an important indicator, related to other indicators, that contributes to strategies regarding labor (Mello et al, 2008).
	Staff Retention Index (quality in selection - HR)		This indicator is related to the Employee Satisfaction Index, the higher the satisfaction, the greater the probability of this employee remaining in the company.	Companies with high technical qualifications need to retain professionals to remain competitive. This indicator represents the quality of the selection of professionals by HR - Human Resources and also contributes to the people management strategy (Sousa et al, 2017).

Source: Adapted by the author

*Services: Customer Service During Construction* - the dimensions presented are those that cover the provision of services within the civil construction, but with the look to the end customer. In these aspects, two types were defined, the performance during the execution of the project and the post-work. Companies generally work with these two approaches throughout the business year, because in a given degree of importance, customer service is a strong competitive criterion.

The construction industry can accept many other performance indicators, that support the competitive dimensions, in the complexity of their projects and business characteristic.

**Table 5 (g)** - Consolidation of services performance indicators of construction companies

Competitive dimensions	Performance indicators (company)	Formulation	Expected results
<b>SERVICES: CUSTOMER SERVICE DURING CONSTRUCTION</b>	Customer Satisfaction - Product and Service	To measure Customer Satisfaction with a product and/ or service: you should assign scores from 0 to 10 for the items evaluated (care during construction, agility, satisfaction, care after construction, price, among others).	This indicator refers to external or priority customer satisfaction of the organization. The customer satisfaction index can be obtained in each sector, regarding the service (during or after construction), the quality of the product, and specific needs that may be related to materials, projects, innovation, among others (Costa, 2003).
<b>SERVICES: CUSTOMER SERVICE DURING AFTER CONSTRUCTION</b>		The level of satisfaction is measured by the total of points attributed, divided by the number of items evaluated.	

Source: Adapted by the author

## 5. Conclusions

According to the objective of the present study, an analysis was made of the competitive dimensions of the civil construction industry, specifically in the infrastructure sector and a set of performance indicators were identified and verified if they support the competitive dimensions.

By applying a set of performance indicators from the understanding of the competitive dimensions of the company, it then establishes a focus so that business management processes, such as planning, acquisitions, sales, production, customer service, among others, become be monitored with the focus on strengthening the competitive dimensions and with that, establish strategies for the progress and development of the organization in the sector. It is concluded that, according to the authors studied, the construction industry, within its complexity, can have other sets of related indicators and according to the competitive dimensions of an organization the processes of performance dimension must be implemented and developed so that there is always a continuous improvement in the processes, whether related to the customer, the sector or product.

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