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Key Performance Indicators applied to Construction

Sector Performance and Benchmarking

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Extended Abstract

January 2011

1. Introduction

Portugal is a country where the weakness of economic and financial situation has resulted in a gradually declining of public investment. The growth of competition between the construction sector firms has resulted in contracts awarded by total amounts increasingly more competitive and with high risks. The area of contract management has been progressively seen as crucial in the success, or survival, of these companies. At the same time, there has been a growing increase in contracts with final costs much higher than expected (Garnel, 2009).

According to Flor (2007), during the execution of a construction contract is common to note the existence of project errors and omissions due to several factors, including: 1) different terrain characteristics from those that had been predicted; 2) necessary works not counted; 3) poor detail; and 4) changes made during and after the execution of the work. These situations combined with the different interests of the various participants (Owner of the Work, Designer, Contractor, other entities) have resulted in the occurrence of deviations, sometimes significant, between the value of hired and conducted, in terms of cost and time .

With the main objectives to reduce the possible occurrence of cost and time overruns and bring a greater transparency to de construction sector, was published on 29 January of 2008, the Decree Law N.º 18/2008 approving the Public Contract Code (PCC) . This code, very pertinent to the development of the theme of this work, seeks to introduce new concepts in contracts signed in the construction sector in Portugal, such as performance measurement and performance, thereby contributing to improvement in its effectiveness and efficiency.

Performance measurement and benchmarking, in particular, have played an important role in other sectors companies, providing essential information for planning and control of management processes. They also allow the monitoring and control of the objectives and strategic goals (Sink e Tuttle, 1993; Neely et al. 1995) and performance comparing of companies in relation to its competitors (Camp, 1989).

It follows that the achievement of performance measurement and benchmarking, through Key Performance Indicators (KPIs), can represent a substantial help for professionals in the Construction Industry (CI), giving them the ability to provide products and services with the best relation quality/benefit, which will be recognized by its customers, and simultaneously allowing them a more efficient monitoring of construction projects, contract management and performance evaluation of the entities involved.

2. Public Procurement Legal Framework

The Public Contract Code (PCC) establishes the discipline applicable to public procurement and public procurement regime noun that take the form of administrative contracts. The PCC makes the

transposition of European Directives 2004/18/EC and 2004/17/EC of the European Parliament and European Council.

The main objectives of the Directives are: 1) the promotion of effective competition rules, with more transparency and equality; 2) the integration and simplification of various diplomas and decisions; 3) the commitment to promoting sustainable development, environmental protection and innovation policies; and 4) the potentiation of new technologies in the eGovernment.

According to Silva (2009), the power lines in the PCC, specifically in the Public Works Chapter, with particular relevance to the topic of this thesis, are: i) the prediction of an observatory on public works for monitoring the relevant aspects of contracts from public works; ii) rationalization of extra work conditions that come to rely on tighter assumptions and fail to include the necessary work in the resolution of errors and omissions; and iii) redefinition of the responsibility system of errors and omissions.

The n.º3 of Article 43 of the PCC shows the possibility of associating the contractor to overall and final performance levels, in the solution commonly known as design-build. This performance levels can be obtained through key performance indicators such as cost-efficiency, energy sustainability, environmental balance and functionality, among others.

3. The Performance Challenge

3.1. Performance Measurement

The word performance is widely used in all areas of management. According to Neely (2002), performance is: i) measured by a number or an expression that allows communication (in management, performance is a concept multi-person); ii) accomplish something with a specific intent (to create value), iii) the result of an action (the value created, the content measured); iv) the ability to achieve or enhance the creation of an outcome (customer satisfaction seen as a measure of the organization potential for future sales); v) comparing a result, internally or externally, with some reference standard; vi) a surprising result; vii) a demonstration that includes both actions and operations results, as well as the observation of the performers by strangers.

Performance measurement is used as a working tool for evaluating management performance, including human resources, and formulating corporative strategy. The contemporary business environment highlights the importance of performance measurement in the expression: "*If you can't measure it, you can't control it*" (Niven, 2002).

According to Neely et al. (1995) performance measurement is a topic which is often discussed but rarely defined. These authors state:

- *Performance measurement* can be defined as the process of quantifying the efficiency and effectiveness of action.
- *A performance measure* can be defined as a metric (or indicator) used to quantify the efficiency and/or effectiveness of an action.
- *A performance measurement system* can be defined as the set of metrics used to quantify both the efficiency and effectiveness of actions.

A performance measurement system can be examined at three different levels: 1) the individual performance measures; 2) the set of performance measures – the performance measurement system as an entity; and 3) the relationship between the performance measurement system and the environment within which it operates.

In general, it can be said that the performance measurements have been used by companies to:

- **Evaluate** – Performance measurement of program outputs and outcomes provides important, if not vital, information on current program status and how much progress is being made toward important program goals. Thus, performance measurement of an organization is a way to make an assessment and comparison with other companies. (Behn, 2003);
- **Control** – Processes can only be controlled from the moment the company is able to define their performance standards. Performance measurement is used in the recognition of problems, which identification occurs when a particular indicator shows a deviation from an established pattern. (Sink e Tuttle, 1993);
- **View** – Measurements are used to establish the initial diagnosis before implementing interventions for improving companies processes. They aim to identify strengths and weaknesses or dysfunctions, from which priorities are given to the implementation of improvement actions (Sink e Tuttle, 1993);
- **Motivate** – Measures can be used in a very effective way by involving and motivating people for continuous improvement, giving individuals a feedback on their own performance (Sink e Tuttle, 1993);
- **Promote** – Performance measures can be used to validate success, justify additional resources, earn customers, stakeholders, staff loyalty by showing results and win recognition inside and outside the organization (Behn, 2003);
- **Celebrate** – Celebration is important because it motivates, promotes, recruits and helps to improve performance because it motivates people to improve further in the next year, quarter, or month. Celebration helps to improve performance because it brings attention to the agency, and thus promotes its competence. (Behn, 2003);

- **Learn** – Performance measures contain information that can be used not only to evaluate, but also to learn. Indeed, learning is more than evaluation. The objective of evaluation is to determine what is working and what isn't. The objective of learning is to determine why (Behn, 2003);
- **Improve** – When companies decide to act in the process they should set targets through indicators, for example, using benchmarks as a reference. In this case, measurement is used to verify the impact of improvement actions on the process performance (Sink e Tuttle, 1993).

The importance of performance measurement is simultaneously in the values of the measures and in the discipline involved in the relationship analysis between results, activities and customers. Understanding the relationships between measurements allows a better focus on achieving organization mission and goals.

3.2. Benchmarking

The term benchmarking has its origin in the expression benchmark¹ that was introduced into the language of business by the company Xerox, which defined it as "*the continuous process of measuring and comparing our products, services and practices with the strongest competitors or those companies recognized as industry leaders*". Normally, the most successful competitors are used as a benchmark, although companies from other sectors of activity may also be used. The aim of benchmarking is, therefore, encourage and facilitate organizational change and performance improvement through learning from others.

The definition of benchmarking includes some basic criteria that should be noted (AEP, 2006):

- **Systematic** – Benchmarking is not a random method of collecting information, it is a systematic, structured step by step process that aim to evaluate the market working practices. The outputs of this process allow companies to compare their products, services and methods of working with organizations representing best practices;
- **Continuous** – Benchmarking is an improvement process that must be continuous to be truly effective. It can't be developed once and then neglected, thinking that the task is completed. It must be a continuous process, since the practices are continually changing;
- **Evaluation** – The immediate objective of benchmarking is to evaluate a process and hence, necessarily, measurements are essential and constituent parts of this process;
- **Products, Services and Processes** – Benchmarking can be applied to all business aspects. It can be applied to products and basic services, to the process to get those products and to all processes, methods and practices that constitute the support to reach the customer effectively;

¹ Benchmark is a reference or a yardstick for comparison. This performance level is recognized as the excellence standard for a specific business process.

- **Best Practices** – Benchmarking process focuses on activities labeled as best practices, however, it should not be focused only in direct competitors. Benchmarking should be directed to those companies or business activities that are recognized as the best in the sector, for example, banks with regard to errors in data processing;
- **Improvement** – Improving the organization is the ultimate goal of benchmarking. This process constitute a commitment to the principle of continuous improvement, since it allows the use of information compiled of different ways, to produce a significant effect on organizations processes.

In addition to these basic principles of benchmarking, there is one aspect that should be noted to better understand this process. Benchmarking is a practice based on reciprocity, which all participants benefit from sharing information. The idea that is good for everyone is crucial, otherwise quickly one of partners gives up (AEP, 2006).

According to AEP (2006), the main benefits that an organization can obtain from the benchmarking process are: i) increase the probability of meeting the customer needs, by understanding them as a organization's process; ii) establishment of effective objectives (targets) by forcing the organization to maintain a permanent focus on the external environment and ensuring their adaptation; iii) achieve true productivity, through employees involvement from all levels in the resolution of the organization problems; iv) ensure competitiveness, by understanding and knowing competition and customers; v) enable implementation of best practices into processes, through learning the practices used in organizations that are recognized as the best; vi) increase motivation by encouraging the organization to seek realistic goals and change existing work practices; and vii) facilitate internalization the need for change, by organization's human resources, giving a sense of urgency to improvement.

Moreover, benchmarking adds value to performance measurement because it allows companies to compare their data and a better decision making based on these comparisons (Beatham et al. 2004).

3.3. The Necessity of Performance Measurement and Benchmarking in the Portuguese Construction Industry

The construction sector in Portugal has not followed the trends of other industries, in particular as regards the implementation of performance measurement and benchmarking. This is evident in the web sites of Portuguese Business Associations related to the construction sector (AECOPS², AICCOPN³, ANEOP⁴), where there isn't any information on this matter. In fact, the industry is much delayed comparing with other countries, such as the U.K. or the U.S., due to cultural and political issues and lack of vision and

² AECOPS – Association of Construction Companies, Public Works and Services

³ AICCOPN – Association of Civil Construction Manufacturers and Public Works

⁴ AENOP – National Association of Public Works Contractors

strategy for business performance, which have hampered the implementation of performance measurement systems in organizations.

In Portugal, the construction industry is traditionally oriented to resources (income/inputs), contrary to what happens in those countries where there is an orientation towards results (outcomes/outputs). This is where performance measurement and benchmarking have a very important role, since they allow the transition between the two orientations through performance.

Usually, portuguese construction companies obtain their profits through the execution of additional works and not so much by the accomplishment of construction projects. The Public Contract Code seeks to contribute to the modification of customary practices, establishing that performance measurement can be used in order to meet the obligations of result, expressed in paragraph 3 of article 43^o, and generating value for companies through the optimization of their construction processes and products, i.e., increasing the levels of effectiveness and efficiency.

Thus, companies need to look at benchmarking and performance measurement as a mean of making them viable and profitable, something that in the future will bring, first, a sustainable competitive advantage compared with other companies in its market and, on the other hand, the possibility of attracting new customers and create more value for themselves and for their stakeholders.

4. Key Performance Indicators applied to Construction: Sector Performance and Benchmarking

4.1. International Initiatives of Web Benchmarking in Construction

The existent literature on performance measurement systems in Construction Industry focuses primarily on benchmarking web systems based on KPIs. Following the publication of Egan's Report (1998), the first initiative of benchmarking in the CI was launched in the UK, with the appointment "Key Performance Indicators", and is currently led by Construction Excellence Organization.

However other relevant benchmarking platforms emerged in the CI, which focuses on construction performance measures, such as the initiatives developed in Brazil, Denmark, Portugal, Chile and the United States of America. According to Costa et al. (2006), benchmarking programs generally allow: 1) guide to performance measurement; 2) provide benchmarks that can be used by various companies to establish business goals and objectives; and 3) identify and disseminate best practices in the industry through reports, networking and benchmarking clubs.

The Brazilian project, called SISIND-NET, has as main objectives the development and implementation of an Indicators System for Construction Benchmarking, based on Information and Communication

Technologies, associated with internet usage, particularly for dissemination, training and creation of databases.

The benchmarking system implemented in Denmark, designated Byggeriets Evaluerings Center⁵, is a business base established in 2002, by a wide range of participants in the construction sector in order to promote quality and efficiency.

In Portugal was developed the project called Performance and Productivity Indicators - icBench, which consists on a benchmarking web platform for the various companies in construction world of construction. This tool can function as a high utility auxiliary for business management, working as a support in the establishment of new levels of performance improvement and in identification of enhancing opportunities (Moreira da Costa et al. 2006).

Ramirez et al. (2004) describe that the benchmarking system established in the Chilean CI, designated National Benchmarking System, incorporate aspects of quality management and performance indicators. This program consists of two initiatives: 1) performance measurement for benchmarking, which aims to devise and implement performance measurement in the construction industry; and 2) benchmarking clubs, which are groups of companies that aim to share managerial practices and information and to compare performance through meetings and visits to construction sites.

The benchmarking program developed in the United States of America by the Construction Industry Institute (CII) is described by Lee et al. (2005). The CII Benchmarking and Metrics (BM&M) was created with four main objectives: 1) to provide the construction industry with a common set of metric definitions; 2) to provide performance norms to the industry; 3) to quantify the use and value of best practices; and 4) to help focusing CII research and implementation efforts.

4.2. The proposed KPIs to be included in the contract

In this section are presented the key performance indicators that are proposed to include in the contract to be concluded between the contracting entities and contractors, and which are the basis for accomplish the performance measurement and benchmarking process. These indicators have as main objectives to make projects and construction companies more effective and efficient, i. e., improve their overall performance, and help minimize/eliminate the financial and time overruns that often occur in sector.

The KPIs are a result of the analysis and synthesis of benchmarking international initiatives, but follow a completely different approach from that adopted in those initiatives. Its structure follows the general methodology of a constructive process. First the initial inputs are introduced in the system, such as

⁵ The Benchmark Centre for the Danish Construction Sector

materials, equipment, workers, and then these inputs are transformed into outputs, such as a residential building or a bridge, through the procedures/techniques building. The purpose of using this type of process is to generate best value for the end customer and, during its realization, it is necessary to take into account environmental factors that assume, increasingly, an important weight in the construction industry, particularly, and in the world. Table 1 shows the proposed KPIs organized according to these phases of the construction process.

Table 1 – The proposed KPIs to be included in the contract

Constructive Process Phase	Key Performance Indicators
• Inputs	<ul style="list-style-type: none"> • Cycle Time - Materials and Equipment; • Employee Satisfaction; • Amendments to Draft Index; • Suppliers Evaluation - Services, Materials, Subcontracts and Projects;
• Constructive Procedures/ Techniques	<ul style="list-style-type: none"> • Percentage of Completed Tasks; • Direct Labour Efficiency; • Service Productivity • Growth of Project Current Phase - Duration and Cost; • Safety;
• Outputs	<ul style="list-style-type: none"> • Predictability - Cost and Time; • Productivity; • Profitability; • Rework Index;
• Best value for the customer	<ul style="list-style-type: none"> • Customer Satisfaction - Product and Service; • Defects; • Impact on the Environment; • Impact on Biodiversity;
• Environment	<ul style="list-style-type: none"> • Energy Use - Product and Construction Process; • Water Use - Product and Construction Process; • Waste - Construction Process;

5. Conclusion

The recent legislation on public procurement (Public Contract Code), particularly on the Public Works, introduces new concepts, rules and tools, including the information system designated by the Observatory of Public Works, resulting from the transpositions of European Directives, with the ultimate aim of achieving greater transparency and improving the performance indices of the portuguese construction sector.

The most relevant aspect of the code to the theme of this thesis appears in n. º 3 of Article 43. It is through this point that the key performance indicators can be included in the contract to be concluded, since the contractor may be associated with overall and final performance levels, in the solution traditionally known as design-build.

CI in Portugal has not followed the trends of other sectors regarding to the implementation and use of performance measurement systems in their companies. This is a major cause of high levels of ineffectiveness and inefficiency that often occur and that, in practice, result in increased costs and durations in relation to the contractually.

Benchmarking can help increasing the sector's performance because it allows the continued improvement of the organizations and their processes, by comparing and evaluating their performance relative to best practices in the sector. In fact, benchmarking has been a very useful practice, not only in the pursuit of superior performance but also in identifying the organizations problems.

It is also concluded that the performance measurement and benchmarking should be used as a way to generate value for companies and stakeholders through the optimization of their construction processes and products, i.e. increasing the levels of effectiveness and efficiency.

Finally, it is clear that international benchmarking initiatives, based on key performance indicators, have gotten pretty good results and a growing acceptance and use in their countries. They have achieved substantial gains in productivity and performance in companies, with respect to its products and construction processes. These initiatives function based on benchmarking portals that facilitate the process of comparing and evaluating performance relative to industry best practices. Thus, information and communication technologies have contributed significantly to the modernization and innovation of the international construction industry.

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