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Competitive positioning and performance assessment in the construction industry

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ABSTRACT

The purpose of this paper is to characterize the competitive positioning of the construction industry companies and evaluate their financial performance. The methodology proposed involves three major stages. The first stage concerns the identification of the competitive positioning of companies within the construction sector. This is achieved using a hierarchical clustering algorithm suitable for large datasets and mixed type variables. The second stage is the analysis of performance of the different clusters. This is done using the Data Envelopment Analysis technique. To characterize in detail the main performance features of each cluster, a decision tree is used to extract the main rules concerning the performance spread within each cluster and the gap between the cluster best practices and the national benchmarks. The third stage concerns the analysis of the strengths, weaknesses and areas of potential improvement for contractors in each competitive positioning. This required the analysis of benchmark companies of each cluster. The methodology proposed was applied for the analysis of performance of all contractors that operate in the Portuguese construction industry.

1. Introduction

The importance of construction industry (CI) in the economy of both developed and developing countries has increased in recent years. This sector has also witnessed major structural changes, such as globalization, technological evolution and increased regulation, which contributed to a considerable increase in competition among construction companies.

Globalization has become an unavoidable fact in the activity of construction companies. The recent developments in transport and communication, coupled with the creation of protocols promoted by the World Trade Organization (WTO), enabled access to markets previously isolated. One of the most important changes in the CI owing to globalization is the emergence of business opportunities for contractors to expand into new foreign markets. Construction companies, mainly from the developed countries, are adopting strategies of internationalization that enable them to benefit from the global market. In developing countries, construction companies are acquiring technological, financial and managerial know-how from international companies, narrowing the gap between both.

The CI is a very fragmented industry with a huge proportion of small companies. It is driven by unique construction projects undertaken by specific teams integrating different types of companies. The construction projects are typically characterized by the involvement of many agents, including the owner, architectural and engineering companies, general contractors, subcontractors, and construction materials' suppliers. In addition, the CI is a labor intensive sector with low qualified labor force. No substantial training is provided due to the cyclical activity of the CI that implies rotation of workers. Due to the multi-relational, multi-dimensional and multi-disciplinary nature of the CI, it is difficult to implement in-depth technological advances. However, a few capable contractors are benefitting from technological advantages (e.g. building information model) and encouraging the spread of cutting edge technology in the CI.

The increased regulation of the CI activity worldwide has contributed to a significant change in the way of working and partnering in the CI. The bidding process for public sector projects is increasingly governed by local and national regulations, often subject to supranational rules, such as the Europe Union Public Procurement Directives, or WTO rules. This lead to a more accurate selection of companies and improvements in transparency in the industry.

The highly competitive environment of the CI has caused performance improvement to be an increasingly relevant objective. The construction companies are aware of the challenges imposed by this environment and attempt to implement systematic methods to measure performance and search for best practices to achieve competitive advantage and prosperity in the long-run. The topic of performance improvement is also of particular interest

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to encourage excellence in the sector, which is essential to foster economic development.

This paper proposes a new methodology to characterize competitive positioning of construction companies, and to evaluate the performance of the industry. The methodology proposed involves three major steps. First, we defined the competitive positioning within the CI sector, using clustering analysis. Second, we evaluated the performance of the construction companies using Data Envelopment Analysis (DEA). To characterize the performance of companies from each competitive positioning we used a decision tree. Third, we analyzed the strengths, weaknesses and areas of potential improvement for contractors in each competitive positioning, by comparing their performance with the benchmark companies.

The methodology is illustrated in a real world context, using all Portuguese contractors operating in the sector in year 2010. The variables underlying the identification of competitive positioning in the sector are related to company main activity area, subcontracting level, company size, and headquarter geographic location. The individual indicators used for performance assessment are profitability, financial autonomy, liquidity and productivity. These variables are intended to characterize company financial soundness.

The main contributions of this paper concern: (i) the selection of a set of variables to identify clusters of companies corresponding to different competitive positioning alternatives within the CI, (ii) the use of clustering to find comparable groups within the CI, (iii) the evaluation of performance of CI companies adopting a financial perspective. This was achieved using the DEA technique, based on a selection of relevant indicators to characterize CI activity, (iv) the decomposition of the performance score into two components, that evaluate the spread in companies performance within each cluster, and the gap between the cluster best practices and national benchmarks, (v) the use of a classification technique (i.e. decision tree) to characterize the main features of companies' performance for each competitive positioning. The findings of the paper provide a clear picture of the construction sector at a national level, and thus can help managers of CI companies to select the most appropriate strategies to succeed in this highly competitive industry.

The remainder of this paper is organized as follows. Section 2 provides an overview of performance evaluation and competitive positioning in the CI. Section 3 includes the methodology followed in the paper. Section 4 presents the data and the variables used for clustering and performance assessment. Section 5 discusses the results obtained. The last section presents the conclusions and suggestions for future research.

2. Performance assessment and competitive positioning in the construction industry

Traditionally, performance measurement in the CI relied on financial indicators, such as profitability or return on capital. A company would be evaluated comparing its financial indicators with the average value of the industry. However, construction companies became more complex organizations with a multivariate nature, and judging performance merely based on a financial diagnosis resulted in a limited assessment.

During the 1990's, company-wide approaches to measure performance, including financial and nonfinancial indicators, started to be common practice in the CI. Kaplan and Norton (1992) revolutionized company performance assessments by developing the Balanced Scorecard (BSC). The BSC complements traditional financial measures by incorporating criteria from three additional perspectives, namely customer satisfaction, internal business processes, and innovation and learning. This was followed by the development of other performance measurement systems, including new paradigms and dimensions of performance. Among them, the following are frequently mentioned in the literature: the Strategic Measurement Analysis and Reporting Technique (SMART) system (Lynch & Cross, 1991), and the Performance Prism (Neely, Adams, & Kennerley, 2002). Other company-wide performance frameworks used by companies are based on quality management models. The most commonly used models are the Excellence Model developed by the European Foundation for Quality Management (EFQM) (www.efqm.org), the Malcolm Baldrige model from the National Institute of Standards and Technology (www.baldridge.com) in the US, and the Deming Prize model developed by the Union of Japanese Scientists and Engineers (www.juse.or.jp). A few researchers have tailored these frameworks to the specific needs of the CI. For instance, Kagioglou, Cooper, and Aouad (2001) developed a conceptual performance measurement framework based on the BSC, adding "project" and "supplier" perspectives. Beatham, Anumba, Thorpe, and Murray (2002) reported different uses of the EFQM Excellence Model applied to the CI, and Bassioni, Price, and Hassan (2005) proposed a framework that combined the BSC and EFQM Excellence Model.

After the publication of the seminal reports of Latham (1994) and Egan (1998) related to the assessment of performance in the CI, construction companies have been mostly concerned with benchmarking systems based on performance indicators. These systems are usually available in the internet, and enable collecting data and producing real-time results concerning performance levels. The first benchmarking initiative was launched in the United Kingdom (UK), called "Key Performance Indicators" (KPIs), and it is currently lead by the Construction Excellence organization (www.constructingexcellence.org.uk). Nowadays, KPIs are a tool used by many construction organizations worldwide. Other relevant CI web benchmarking platforms appeared later. Those relate to benchmarking programs developed in Brazil (Costa, Formoso, Kagioglou, Alarcon, & Caldas, 2006), Chile (Ramirez, Alarcon, & Knights, 2004), United States (Lee, Thomas, & Tucker, 2005), Portugal (Costa et al., 2007), and Canada (Haas, Rankin, Fayek, Forgues, & Ruwanpura, 2012).

More recently, the potential for using frontier methods to analyze performance in the CI started to be explored. In particular, the literature describes successful applications of the DEA technique to the CI. The studies using the DEA technique mainly cover three research topics. The first is to complement the information available in web benchmarking platforms. El-Mashaleh, Minchin, and O'Brien (2007) proposed the use of DEA models to allow construction companies to be evaluated on a company-wide basis and to identify specific areas of improvement. Horta, Camanho, and Costa (2010) developed a methodology for assessing company performance combining the use of KPIs and DEA. The models proposed evaluate the relative efficiency of the companies and provide performance improvement targets for all companies, even for the best practice companies. The second research topic is related to the assessment of the CI sector of particular countries. Those relate to the CI sectors in Canada (Pilateris & McCabe, 2003), Korea (You & Zi, 2007), China (Xue, Shen, Wang, & Lu, 2008), and Iran (Wong, Gholipour, & Bazrafshan, 2012). A methodology to compare the performance of the CI sector in different regions worldwide was developed by Horta, Camanho, Johnes, and Johnes (2013). The third research topic concerns the selection of construction companies during the bidding process. McCabe, Tran, and Ramani (2005) used DEA to develop a contractor prequalification system aiming to assist owners in the bidding process to select the best contractors. The system also informs contractors concerning their performance, which can provide guidance for future improvement. El-Mashaleh (2010) proposed a DEA approach to guide contractors