Omega 40 (2012) 390–403

Contents lists available at ScienceDirect

Omega

journal homepage: www.elsevier.com/locate/omega

Integrating the Data Envelopment Analysis and the Balanced Scorecard approaches for enhanced performance assessment

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ARTICLE INFO

Article history:
Received 21 April 2010
Accepted 27 June 2011
This manuscript was processed by Associate Editor Zhu
Available online 3 July 2011

Keywords:
Data Envelopment Analysis
Balanced Scorecard
Efficiency
Management

ABSTRACT

This article presents the development of a conceptual framework which aims to assess Decision Making Units (DMUs) from multiple perspectives. The proposed conceptual framework combines the Balanced Scorecard (BSC) method with the non-parametric technique known as Data Envelopment Analysis (DEA) by using various interconnected models which try to encapsulate four perspectives of performance (financial, customers, internal processes, learning and growth).

The practical relevance of the conceptual model has been tested by using it to assess the performance of DMUs in a multinational company which operates in two business areas. Various models were developed with the collaboration of the directors of the company in order to conceive an appropriate and consensual framework, which may provide useful information for the company. The application of the conceptual framework provides structured information regarding the performance of each DMU (from multiple perspectives) and ways to improve it. By integrating the BSC and the DEA approaches this research helps to identify where there is room for improving organisational performance and points out opportunities for reciprocal learning between DMUs. In doing so, this article provides a set of recommendations relating to the successful application of DEA and its integration with the BSC, in order to promote a continuous learning process and to bring about improvements in performance.

1. Introduction

In a competitive environment, characterised by the scarcity of resources, performance measurement and management assumes a crucial role. Data Envelopment Analysis (DEA) is a non-parametric technique for evaluating the performance of Decision Making Units (DMUs). Using a production metaphor, this technique, originally proposed by Charnes et al. [1], evaluates the efficiency of DMUs in converting multiple inputs into multiple outputs. Since this seminal paper, we have seen numerous theoretical developments of the DEA methodology [2]. Furthermore, we have also seen the widespread application of DEA in several contexts, such as health care, education, manufacturing, retailing, banking, etc. In recent years, we have also witnessed the development of literature relating to the need to move beyond financial measures of performance [3] and several sophisticated systems for performance assessment have been proposed. The Balanced Scorecard (BSC), developed by Kaplan and Norton [4], is one of the best-known of these performance assessment frameworks. Developed from the strategy of the organisation, this framework includes indicators related to four perspectives: financial, customers, internal processes, learning and growth.

Despite the popularity of the DEA and the BSC approaches, there have been very few studies that have explored their integration for enhanced performance assessment. This is the objective of this article. In line with what has been suggested by several authors (for example, [5–7]), the main purpose of this research project is to explore the usefulness of Operational Research techniques (in particular, the DEA method) in real operational contexts and to put forward some recommendations regarding its successful application in practice. With this purpose in mind, and using a case study from a multinational company operating in the area of vertical transportation, we have developed four interconnected DEA models, one for each of the perspectives of the BSC. The results from these models were then analysed and discussed with the General and Regional directors of the company in Portugal in order to gain insights for performance improvement. The framework we have developed and the results it has produced suggest that moving away from a unique, all embracing DEA model, towards several complementary DEA models can be advantageous for performance measurement and performance improvement. By using several complementary

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doi:10.1016/j.omega.2011.06.006

models, the multidimensional nature of performance and the need to answer to the interests of multiple stakeholders is emphasised. Furthermore, the use of several complementary models offers richer information for the DMUs, because it highlights the weakest and strongest dimensions of performance and identifies relevant benchmarks for learning in each of the dimensions, acknowledging that some DMUs might be regarded as best practice in some dimensions but not in others.

We have structured the remainder of this paper into three sections. Section 2 discusses the previous studies that have combined the use of DEA with the BSC and highlights the main contribution of this article. Section 3 details the empirical study and discusses the main results. In particular, in this section, we discuss the development of the BSC and the DEA models to capture each of the performance dimensions and the use of the results to gain insights for performance improvement. Section 4 concludes and offers suggestions for future research.

2. Literature review

2.1. Data Envelopment Analysis

DEA is a non-parametric technique used to measure the efficiency of DMUs and was first proposed by Charnes et al. [1]. It considers that each DMU is engaged in a transformation process, where by using some inputs (resources) it is trying to produce some outputs (goods or services). DEA uses all the data available to construct a best practice empirical frontier, to which each inefficient DMU is compared.

One of the interesting features of DEA is that it allows each unit to identify a benchmarking group; that is, a group of units that are following the same objectives and priorities, but performing better. In this regard DEA aims to respect the priorities of each DMU by allowing each one of them to choose the weight structure for inputs and outputs that most benefits its evaluation. As a result, it aims to classify each unit in the best possible light in comparison to the other units. Another advantage of DEA is that it does not require specification of a cost or production function, allowing for richer models. A comprehensive review of the DEA technique can be found in Cooper et al. [8] and Cook and Zhu [9]. Cook and Seiford [2] review the main theoretical developments and applications of DEA since it was first proposed in 1978.

2.2. Balanced Scorecard

The Balanced Scorecard, developed by Kaplan and Norton at Harvard Business School in the early 1990s [4], is undoubtedly one of the best-known and most widely used frameworks for performance measurement proposed in recent years. The BSC is a conceptual framework for translating an organisation's strategic objectives into a set of performance measures distributed among four perspectives: financial, customer, internal business processes, and learning and growth. As well as enabling managers to focus on their organisations from these four key perspectives, the BSC provides answers to the following questions: How do we regard our shareholders? (Financial perspective); How do our customers see us? (Customer perspective); What must we excel at? (Internal business processes perspective); How can we continue to innovate and create value? (Learning and growth perspective). For each of the four perspectives, objectives, measures, targets and initiatives are developed.

The BSC is developed from the organisation's vision and strategy and its main strength is in the way it seeks to integrate different measures and make explicit the links between different dimensions of performance in a single system. By forcing senior managers to consider all the important operational measures (some of which conflict) at the same time, it is claimed that the BSC prevents sub-optimisation of performance [10,11].

Despite its strengths and widespread use, numerous authors have identified shortcomings in the BSC. One of the criticisms that has been made is the fact that it does not specify how tradeoffs are to be made between different scorecard criteria [12], nor does it specify an objective weighting scheme for the performance measures. It has also been argued that an analysis based on the BSC may fail to identify inefficiency in the use of resources [13]. Furthermore, without a benchmarking exercise, the identification of appropriate targets for each of the performance indicators is difficult in practice. It is our conviction that the integration of DEA with the BSC can overcome some of the limitations of the BSC, providing the basis for enhanced performance assessment.

2.3. The integration of Data Envelopment Analysis and Balanced Scorecard

Traditional DEA models treat the underlying production processes as black boxes and use a single model to capture the transformation of multiple inputs into multiple outputs [14]. However, as suggested by Fitzgerald and Storbeck [15]: 199 "standard DEA scores tend to *summarise* well in providing overall measures of performance, but they can also *bury* critical information and *obscure* the needed actions of decision-makers". On one side, overall measures of performance may obscure valuable information about relative weaknesses and relative strengths of the organisation regarding the views of different stakeholders. On the other side, overall measures fail to capture the efforts of different processes and sub-processes within the organisation and might inhibit valuable managerial information [16,17].

This research suggests, therefore, that the multidimensional nature of performance can best be captured using several DEA models. Furthermore, it also suggests that in order to obtain useful information for performance improvement, the analyst must move away from a black box, and attempt to capture the dynamics of the transformation processes and sub-processes within the organisation. In this respect, we find that the family of network DEA models proposed by Färe and Grosskopf [14] can play an important role in opening the black box and identifying sources of inefficiency in parts of the organisational processes. These models have received considerable attention recently and we can find several examples of applications in different contexts [18,19]. Cook et al. [20] provide a recent review of the different DEA models developed to deal with two-stage network processes.

Considering that the BSC is a framework that tells the story of how each part of the organisation contributes to its success, by following a series of explicit cause and effect relationships [21], we believe that it can offer a useful framework to structure several interconnected DEA models. An integrated analysis of the results of these complementary models can offer rich information regarding the sub-processes where the organisation must focus to improve its overall performance, as well as identify specific learning networks for each of the sub-processes.

Mingers and Brocklesby [22] defend the combination of multiple methodologies in order to better capture the complexities of real-world problems. Franco and Lord [23] provide an example of a combination of multiple methodologies to support organisational decision making. The advantages of combining several approaches in order to obtain enhanced performance assessment frameworks have also been pointed out in the literature [24,25] and several authors have focused their attention on the DEA and BSC approaches. For instance, some authors have used DEA and BSC separately in order to assess the usefulness of these approaches [26], whilst others have complemented the DEA