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A decision support model for identification and prioritization of key performance indicators in the logistics industry

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ABSTRACT

Performance measurement of logistics companies is based upon various performance indicators. Yet, in the logistics industry, there are several vaguenesses, such as deciding on key indicators and determining interrelationships between performance indicators. In order to resolve these vaguenesses, this paper first presents the stakeholder-informed Balanced Scorecard (BSC) model, by incorporating financial (e.g. cost) and non-financial (e.g. social media) performance indicators, with a comprehensive approach as a response to the major shortcomings of the generic BSC regarding the negligence of different stakeholders. Subsequently, since the indicators are not independent of each other, a robust multi-criteria decision making technique, the Analytic Network Process (ANP) method is implemented to analyze the interrelationships. The integration of these two techniques provides a novel way to evaluate logistics performance indicators from logisticians' perspective. This is a matter that has not been addressed in the logistics industry to date, and as such remains a gap that needs to be investigated. Therefore, the proposed model identifies key performance indicators as well as various stakeholders in the logistics industry, and analyzes the interrelationships among the indicators by using the ANP. Consequently, the results show that educated employee (15.61%) is the most important indicator for the competitiveness of logistics companies.

1. Introduction

Performance indicators are fundamental managerial tools for decision-making in organizations (Gunasekaran, Irani, Choy, Filippi, and Papadopoulos, 2015). In the past, financial indicators were largely considered in performance measurement systems (Yang, Chuang, and Huang, 2009); however, current performance measurement is based on both financial and non-financial indicators (Poveda-Bautista, Baptista, and García-Melón, 2012) due to its multidimensional structure (Gutierrez, Scavarda, Fiorencio, and Martins, 2015). Despite including financial and non-financial indicators in a system which assists companies to carry out their decision-making processes in a more conscious manner (Gunasekaran and Gallear, 2012), it brings to the fore one of the most widespread issues, which is having too many indicators in performance measurement (Keebler and Plank, 2009; Shaw, Grant, and Mangan, 2010).

Performance measurement is implemented in different areas, one of which is the logistics aspect of a supply chain. Logistics is a part of the supply chain management (Lambert and Cooper, 2000; Wu, Dong, Chang, and Liao, 2015) and diverse activities existing in logistics operations are mainly provided by logistics companies as they play crucial roles in a supply chain. Recently, logistics has become substantially more important (Gunasekaran and Ngai, 2012) as a result of globalization as well as advanced technologies (Wu et al., 2015). Increasingly, fierce competition forces logistics companies to assess their performance with a comprehensive measurement model to become more competitive in the industry. To have a comprehensive model, the consideration of a broad range of indicators from different perspectives may be required for organizations (Bhagwat and Sharma, 2009). However, logistics companies have poor capabilities for efficiently adapting performance indicators (Forslund, 2012), and, deciding on which indicators are the most important for their competitiveness

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becomes another issue to be addressed (Liu, McKinnon, Grant, and Feng, 2010a). These lead practitioners to seek answers to several questions, including, what indicators they should use and when they should use them (Gopal and Thakkar, 2012). Therefore, there is a need in the logistics industry to establish a framework for applying a strategic performance measurement system to third-party logistics (3 PL) providers (Rajesh, Pugazhendhi, Ganesh, Ducq, and Koh, 2012) by examining a good balance of indicators with a holistic approach (Gutierrez et al., 2015). However, the performance measurement and indicators with respect to 3 PL companies have received only limited interest from both researchers and practitioners (Rajesh et al., 2012). Similarly, there are few studies focusing on both logistics performance evaluation from multiple perspectives (Wang, Zhang, and Zeng, 2012) and logistics performance measurement in particular (Keebler and Plank, 2009).

Accordingly, in order to identify the key indicators in logistics performance measurement, the Balanced Scorecard (BSC) concept, which is a widely accepted approach (Rajesh et al., 2012), was found to be suitable for the present study due to its outstanding features, such as incorporating financial and non-financial indicators from different perspectives (Chia, Goh, and Hum, 2009; Jothimani and Sarmah, 2014; Poveda-Bautista et al., 2012) and allowing cause-and-effect relationships (Kaplan and Norton, 1996). Thus, the present study extends the existing knowledge on the applicability of the BSC in the logistics industry by presenting a comprehensive balanced set of logistics performance indicators from different perspectives.

Moreover, identification of key indicators is not the only challenge for performance measurement systems in companies. In complex real-life scenarios, interdependencies may also occur among indicators (Tzeng, Chiang, and Li, 2007), owing to the fact that they are not always completely independent of each other (Tsai, Chou, and Hsu, 2009; Wu and Lee, 2007). Yet, this has been barely considered by researchers working in the field of performance measurement (Grosswiele, Röglinger, and Friedl, 2013) and organizations (Thakkar, Deshmukh, Gupta, and Shankar, 2007). Since modelling the hierarchical structure as well as determining and prioritizing dependencies among diverse indicators constitute a challenging and still unresolved issue in the domain of the supply chain (Akyuz and Erkan, 2010), it is essential for logistics companies to investigate relationships between their various capabilities (Wong and Karia, 2010). Thus, logistics managers need to further try to answer several questions, such as how to prioritize the indicators and how to construct a hierarchical relationship to identify the influences among indicators (Qureshi, Kumar, and Kumar, 2008). In such cases, multi criteria decision making (MCDM) methods offer practical solutions, but, designing a framework of performance measurement in accordance with the complexity of MCDM has also been a difficult issue in terms of fulfilling the needs of the field (Shaik and Abdul-Kader, 2014). Despite this, within these methods, the Analytic Network Process (ANP) appears to be promising, since it provides a more accurate and realistic performance score (Yurdakul, 2003). Thus, the present research deploys the ANP method to capture the interdependencies among the performance indicators and to prioritize them by addressing this issue.

Consequently, to deal with the previously mentioned challenges, there is a need to develop a model for identifying the key logistics performance indicators and determining their interrelationships. Therefore, the aim of the present study is to provide a comprehensive decision model that identifies the key performance indicators for the logistics industry and assesses the interrelationships among these indicators from the perspective of logisticians by using an MCDM process. In order to achieve this aim, the main research question of this research is established as: *How can a decision model be formed by incorporating key logistics performance indicators and can help the prioritization of these indicators by considering all interrelationships?*

Although there are a number of studies focusing on the BSC concept in the logistics industry, implementing the MCDM approach with the BSC concept has received very limited attention in the logistics area. Specifically, despite the existence of some studies on the BSC-ANP integration, none of these have focused on the aforementioned integration for logistics companies. Besides, in order to deal with the major deficiency of the conventional BSC concept, the present study has replaced the 'customer' perspective with the 'stakeholders' perspective. In this way, a novel approach has been pursued to propose a comprehensive decision model that consists of four perspectives (financial, internal process, stakeholders, learning and growth) for the evaluation of logistics performance indicators by considering various stakeholders. The implementation of this approach was proven on the example of the Turkish logistics industry.

The remainder of the paper is organized as follows. In Section 2, the literature pertaining to the BSC, the ANP, and their implementations in the logistics industry are reviewed. In Section 3, the research methods employed to meet the aim of this study are explained. Section 4 presents the stakeholder-informed BSC decision model of this study, followed by the ANP application of the developed model in the Turkish logistics industry in Section 5. The implications for theory and management are listed in Section 6, followed by the conclusions, which are explained in Section 7.

2. Emergence of the need to use the BSC-ANP combination in logistics performance measurement

Performance measurement holds a complex value-creating system together, and formulates a strategy implementation which is monitored (Choy et al., 2008; Handfield and Nichols, 1999). It is an interdisciplinary field which is also applicable to logistics. Logistics performance measurement has been researched by various authors and identified as a key aspect to be focused on. Yet, there is a small amount of research relating to how logistics companies manage performance management processes (Forslund, 2012). Moreover, only few papers have so far dealt with logistics performance evaluation from multiple perspectives (Wang et al., 2012), although it is a complex task for organizations to manage these processes in a balanced approach. In order to overcome this complexity, different performance measurement models (e.g. Balanced Scorecard, Performance Prism, Performance Pyramid, Results and Determinants Framework, Performance Measurement Matrix) have been proposed. Of these models, the models developed after the mid-1980s provide a more balanced structure in terms of incorporating both financial and non-financial indicators (Garengo, Biazzo, and Bititci, 2005).

The BSC, which was initially introduced by Kaplan and Norton in 1992 as a performance measurement model (Kaplan and Norton, 2001; Kladogeni and Hatzigeorgiou, 2011), dominates the performance measurement area (Neely, 2005) and allows incorporating cause-and-effect relationships with a balanced structure (Kaplan and Norton, 1996). Similarly, Shaw et al. (2010) noted that the BSC is the most extensively accepted model by organizations, and it provides a high-level strategic view for organizational performance. However, the implementation of the BSC remains limited for studies conducted in a logistics context.

One example of these studies is Chia and Hoon's (2000) study, where they first emphasized that the performance of an organization is usually measured by financial indicators, although, for a balanced measurement it is also necessary to use non-financial indicators. For that purpose, they applied a case-based approach