A HOLISTIC FRAMEWORK FOR PERFORMANCE MEASUREMENT IN LOGISTICS MANAGEMENT

Yasemin Claire ERENSAL

Abstract - The purpose of this paper is to introduce and describe an approach to performance measurement of logistics processes. The paper has four main parts. First, an introduction to logistics processes is provided. Then, the key performance indicators of the logistics processes are outlined. Third, a new improvement oriented performance measurement framework of logistics is presented. The originality/value of this paper is that it uses balanced objective matrix methodology (BOMAX) for examining key issues of logistics performance measurement at multiple levels within the organization. In this manner this article presents a comprehensive framework in constructing a strategic performance measurement system of logistic processes. It provides a multi-perspective approach which is more focused on the alignment of performance measurement framework of logistics process with company strategies and addresses the consolidation issue of these multiple viewpoints in a single, consolidated value.

Keywords - Performance Measurement, Logistics and Supply Chain Management.

1. INTRODUCTION

Nowadays logistics is seen as a value-adding process that directly supports the primary goal of the enterprise, which is to be competitive in terms of a high level of customer service, competitive price and quality, and flexibility in response to market demands. During the last decade logistics has gained much attention in increasing efficiency and flexibility of organizations as logistic costs make up a significant part of total production costs. The entire logistic process, from the acquisition of raw materials to the distribution of end-customer products, makes up a logistic chain consisting of multiple actors. Logistic activities within an enterprise can be divided into: -feed-forward flow of goods, including transportation, material handling and transformation (manufacturing, assembly, packaging, etc.); -feed-back flow of information, including information exchange regarding orders, deliveries, transportation, etc., and ; -management and control, including purchasing, marketing, forecasting, inventory management, planning, sales and after-sales service.

Stevens [11 defines a logistic chain as a system whose constituent parts include suppliers of materials, production facilities, distribution services and customers, all linked together via the feed-forward flow of materials and the feed-back flow of information. All these logistic processes are performed by using resources in the form of equipment, manpower, facilities and financial assets. In order to have a value-adding logistics process that directly supports the primary goal of the enterprise, which is competitive, an organization must position its basic strategic elements and core competencies of logistics process to adjust rapidly to critical changes in the environment. That ability implies that the organization has a measurement system in place for reviewing frequently the strategic performance of its logistics process. In this respect strategic performance management and measurement is critical to the success of any organization and needs to reflect the aims and the strategies of an organization that have been developed to achieve those aims. Through performance measurement systems managers can be able to encapsulate and ‘take hold of’ information about strategy, core competencies and future competitive ambitions of its logistic process in a tangible way. This includes monitoring results, comparing to benchmarks and best practices, evaluating the efficacy and efficiency of the logistics process, controlling for variances, and making adjustments as necessary. With sufficient and carefully selected information provided by performance measurement systems, it becomes possible for companies to understand better what is going on and what is about to happen in logistics. It is important to realize that what is not understood cannot be managed. Managers need clear, timely and relevant signals from their internal information systems to understand root causes or problems in logistics process, to initiate correction action, and to support decisions at all levels of the organizations. Therefore a new measurement concept is needed which is consistent and compatible with this process perspective. This study provides new insight into understanding the success and hindering factors of logistics management. The extensive literature

1 Doğuş University, Faculty of Engineering, Industrial Engineering Department, Acıbadem, Istanbul, Turkey, yerensal@dogus.edu.tr
review and case studies provide academics and managers a macro picture of the goals, challenges, and strategies for implementing an effective logistics management and performance measurement.

2. THE PROCESS VIEW IN LOGISTICS AND SUPPLY CHAIN MANAGEMENT

Process view is one of the key elements in logistics and supply chain management. According to Christopher [2]: Logistics is a process of strategically managing the procurement, movement and storage of materials, parts and finished inventory (and the related information flows) through the organization and its marketing channels in such a way that current and future profitability are maximized through the cost-effective fulfillment of orders. Andersen [3] has argued that several issues have stressed the logic of the transition from viewing the company as a number of departments to focusing on the business processes being performed:

- Every process has a customer, and focusing on the process ensures better focus on the customer.
- The value creation with regard to the end product takes place in horizontal processes.
- By defining process boundaries and the customers and suppliers of the processes, better communication and well-understood requirements can be achieved.
- By managing entire processes that run through many departments rather than managing individual departments, the risk of sub optimization is reduced.
- By appointing so-called process owners, who are responsible for the process, the traditional fragmentation of responsibility often seen in a functional organization is avoided.
- Managing processes provides a better foundation for controlling time and resources.

Many of these elements are based on the fact that every single process has both a supplier and a customer. A main point is that any business process has a customer, either external or internal. Based on this definition, almost all activities within a company can be seen as a business process or part of a business process, including the processes related to logistics. Performance measurement of logistics describes the feedback or information on logistics activities with respect to meeting customer expectations and strategic objectives. Performance measurement systems should answer two simple questions [4]

a. Are functions and departments doing the right things?
b. Are they doing them well?

Performance measures are used to measure and improve the efficiency and the quality of the logistics processes, and identify opportunities for progressive improvements in logistics process performance. Traditional measures, however, are usually ineffective barometers of performance because they do not isolate non-value-added costs. In addition, most measures overlook key non-financial performance indicators [4]. Performance measures are classified in several ways in the literature. When describing and measuring the performance level in a business process, a number of parameters might be used. It is pivotal to employ a balanced set of measures in order to understand the performance of the process and be able to identify improvement areas. Typical dimensions for describing and measuring performance are [5]:

- Qualitative and quantitative measures.
- ‘Hard’ versus ‘soft’ measures.
- Financial versus non-financial measures.
- Result versus process measures.
- Measures defined by their purpose (result, diagnostic, and competence).
- Efficiency, effectiveness, and changeability.
- The six classic measures (cost, time, quality, flexibility, environment, and ethics).

All areas should be considered when developing performance measures. It should be emphasized that these dimensions overlap. In order to diagnose the ‘health status’ of an organization one should ideally employ a balanced combination of measures. Fagerhaug [5] has developed a criteria sheet. The sheet provides the name and a short description of the process/structure, as well as a number of text-based and number-based measures belonging to each of the five categories mentioned above. Based on this criteria sheet the author of this paper would argue that a number of measures could be used to enhance the performance of the logistics processes (Table 1). As listed in Table 1, several concrete measures are introduced to show how logistics process performance can be measured in practice. It should be emphasized that the measures are examples rather than a final set.

Different measures are needed in different levels of organization. There should be information available for strategic management purposes at the company level. On the other hand, information is needed also for
operational management at the workshop level. Measures can be used mainly on three levels. Firstly, logistics companies can analyze general environment and their own performance at company level. These measures are global in nature, covering a wide scope of activities. Global measures provide top management with a sense of whether strategic objectives are being achieved. They are monitored month-to-month or quarter-to-quarter. In a sense they keep management in touch with the outside world. Secondly, they can measure individual projects’ performance. Finally, they can focus on processes and departments. These types of measures are more specific to the internal workflow. They represent day-to-day measures of operating effectiveness and efficiency [4]. It is better for a small company to pick only a couple of measures and start with them. This means that they can find out the current performance and improvement potential of the firm.

3. THE INTEGRATION OF OBJECTIVE MATRIX (OMAX): AN APPROACH IN DETERMINING THE PARTIAL AND OVERALL PERFORMANCE INDEXES OF LOGISTICS PROCESS - THE BALANCED OMAX (BOMAX)

Productivity in a narrow sense has been measured for several years. In 1978 an enlarged method, the POSPAK method, was introduced. This method indicates specific measures in order to improve the overall productivity of an enterprise [6]. One of the first approaches to performance measurement was published by Sink and Tuttle [7]. The model claimed that the performance of an organizational system is a complex interrelationship between seven criteria. In 1993 Hronec [8] published the book ‘Vital Signs’, where he described how to use quality, time, and cost performance measurements to chart the company’s future. In 1995 Rolstadás [9] edited the book ‘Performance Management’. It sought to provide the reader with a detailed overview of the modern enterprise by focusing on performance evaluation and measurement and performance improvement techniques. Since 1995 a number of books and papers on performance measurement and management have been published. An example of one of these published materials is the so called BOMAX performance measurement system, which was developed by the researcher himself [10]. Through performance measurement, the various performance level of the business should be monitored. Based on this business model, BOMAX has suggested three levels of hierarchy for defining performance indicators. Each performance indicator is a function of two or more performance measures. The three levels of hierarchy for defining performance indicators are: ‘Enterprise Level’, ‘Process Level’ and ‘Functional Level’. BOMAX emphasize that the self-assessment process allows the organization to discern clearly its strengths and areas in which improvements can be made and culminates in planned improvement actions which are then monitored for progress. Based on the self-assessment, improvement planning should be performed and initiated. As shown in the figure, performance measurement provides input for the improvement planning, choice of improvement tools, as well as for the self-assessment process. As it was mentioned the chapter before, there is needed a method of indexing performance measures, and calculating an overall, multi-factor, performance index. Several techniques are available for this purpose. The thesis of this article is that the BSC [11] and OMAX [12]. Philosophies complement each other quite effectively. BOMAX is one of the few techniques capable of integrating the whole gamut of strategic measures into a single coherent summary as a consolidated value. Had OMAX alone been used, a manager would have trouble making tradeoffs among alternative strategic objectives. In contrast, had the BSC alone been used, the connection between financial and non-financial criteria would have been less robust. By integrating both OMAX and the BSC, the organizations could be able to create synergies which overcame the weaknesses of the individual methodologies. By combining the strengths of the two, we end up with a stronger, more robust framework with increased predictive power, the so-called ‘Balanced Objective Matrix (BOMAX).’ Through BOMAX method performance measures are normalized and an overall, multi-factor performance index is calculated. An index is a composite number that is created by mathematically combining several individual measures. While concentrating just on only one strategic performance index simplifying the decision making of managers and avoiding the confusion caused by dealing with many performance indicators at once which usually yields only a vague general perception. The single number resulting from the BOMAX will tell management if the organization’s strategic performance qualifies as excellent, unsatisfactory or just mediocre. This single index is the indicator of how well the organization is doing against the preset target or evaluated along with other measures. The four main components of BOMAX are: the performance measures of each of the logistics processes (the scaled KPI) \( M_i \), the weights \( w_i \), the performance scale \( L_i \), and the performance index \( P_i \).
<table>
<thead>
<tr>
<th>Logistics Processes</th>
<th>BSC Perspectives – Key Performance Indicators (KPI)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Warehousing</strong></td>
<td><strong>Learning-Growth</strong></td>
</tr>
<tr>
<td>Warehousing: receiving, put-away, replenishment, cycle-counting, picking, packing, shipping, kitting, returns</td>
<td>M_{L1} Commitment /Staff → M_{P1} Packaged pcs/year → M_{C1} Failurelessness (failure rate) → M_{O1} Pers. Costs/commitment</td>
</tr>
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<td></td>
<td>M_{L2} Man-facilities relation (ergonomy, environment, protection) → M_{P4} Vol.loaded in/out/Staff → M_{C4} Advising → M_{O4} Managing costs/commitment</td>
</tr>
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<td></td>
<td>M_{L3} Optimum combination of jobs (tasks) and facilities → M_{P5} Packaged pcs/staff → M_{C5} Quick response on complaints → M_{O5} Total man.cos/total warehouse cost</td>
</tr>
<tr>
<td><strong>Inventory</strong></td>
<td><strong>Internal Process</strong></td>
</tr>
<tr>
<td>Inventory: turns, safety-stock, cycle-stock, transit-stock, strategic-stock, replenishment frequency, consignment-stock</td>
<td>M_{L4} Optimum combination of jobs (tasks) and facilities → M_{P9} Av.inVENTORY (volume, value) → M_{C7} Restorability (av.restiting time, total break-down time) → M_{O7} Pers. Costs/commitment</td>
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<td></td>
<td>M_{L5} Commitment /Staff → M_{P10} Av.storage time (day, hour, minute) → M_{C8} Politeness → M_{O8} Pers.costs/Volume, unit, value</td>
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<td></td>
<td>M_{P11} Av. Inventory efficiency (day, minute) → M_{C9} Reliability → M_{O9} Construction and op.cos/YEAR</td>
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<td></td>
<td>M_{P12} Rotation frequency /year → M_{C10} Advising → M_{O10} Interest/Volume, unit, value</td>
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<td></td>
<td>M_{P13} Commitments/year → M_{C11} Quick response on complaints → M_{O11} Total stor.&amp;inv.cos/total log.cos</td>
</tr>
<tr>
<td></td>
<td>M_{P14} Average time of comm.(hour, minute) → M_{O12} Total tr. Cos/total log.cos</td>
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<td><strong>Transportation</strong></td>
<td><strong>Customer Satisfaction</strong></td>
</tr>
<tr>
<td>Transportation: rating, routing, tracing and tracking, sourcing, auditing and payment, management</td>
<td>M_{L5} Commitment /staff → M_{P15} Tr.ed volume/Staff → M_{C12} Restorability (av.restiting time, total break-down time) → M_{O12} Total tr. Cos/total log.cos</td>
</tr>
<tr>
<td></td>
<td>M_{P16} No of transports/year → M_{C13} Politeness → M_{O13} Tr.cos/volume, tkm, km</td>
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<td></td>
<td>M_{P17} Ton km/Vehicle and year → M_{C14} Reliability → M_{O14} Tr.cost/time&amp;vehicle</td>
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<td>M_{P18} Av.Vol.Transport/Av.time. Transport → M_{C15} Trucking&amp;tracing → M_{O15} Tr.costs/commitment</td>
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<td></td>
<td>M_{P19} Average distance (km) → M_{C16} Quick response on complaints → M_{O16}</td>
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<td>M_{P20} Utilization of vehicles(%) related to time, load capacity and tkm → M_{C17} Damage events/total activities</td>
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<td>M_{P21} Error delivery/total delivery commitments → M_{O17}</td>
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<td></td>
<td><strong>Financial</strong></td>
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</tbody>
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Table 1: Key Performance Measures of Logistics Process in respect to BSC
The top row of the matrix includes the KPI which are assessed by BSC approach and defined for each BSC perspectives. The perspectives and their abbreviations are Learning and Growth (L); Finance (F); Customer-Citizen (C) and Internal Process (I). In BOMAX methodology dissimilar measures can be compared, and combined to produce an overall-global performance index. In order to be able to compare dissimilar measures, to see the inter-relationships between them, it is possible to index the measures scores, and so convert them to the same scale. The middle section holds eleven rows with different outcomes for the specific performance measures. These rows are ranked or scaled from zero to ten. The index scale is created by establishing a target value for each performance measure based on their current performance. The bottom of the target range is defined as the minimum level that can be permitted. Matching the levels of performances with the level of the rows in a way that an outcome of ten will be the most desirable and zero the least desirable typical outcomes of each indicator are aligned with a score of three. The initial baseline called the ‘as is’ performance level for each performance measure is determined and assigned to level 3. The scaling should be conducted in the way that grade 10 could be achieved with excellent performance at least in five years time horizon. That means the time horizon should be defined in BOMAX very carefully and can typically be about a year or less for short-term goals or spans several years for long-term goals. The possible outcomes-the intermediate values of the performance measures are found in the body of the matrix and are calculated for scores between these ranges (Lj). The objective of these arrangements prevents the awarding of high grades to mediocre or normal performance, and embraces the notion of stretching the work force to a superior performance and betterment of the system. Ranks in the matrix’s body should be clearly marked so they do not provide a margin of doubt when assigning a score. The bottom of the matrix weights the categories for the aggregation process. For each BSC perspective measures on BOMAX weighted according to their importance that is felt would create the biggest challenge in terms of achieving the strategic targets. These weights are determined by management and add up to one hundred. The score in each column is multiplied by the weight, producing a final number or ‘index’ that represents the ‘grade’ of the strategic activities for that specific period (Pi). Performance indexes are not an exact measure of achievement but rather provide an indication of business performance. To be useful, performance indexes must exhibit certain characteristics: appropriateness, relevance, accuracy, timeliness, completeness and comprehensiveness. When indexes begin to move outside the threshold limits, the performance measurement system can alert management, who then attempt to diagnose the problem and address its causes. The development of performance indexes is not an end in itself but rather one part of a structure of governance and accountability. They can indicate whether strategic planning has been undertaken and is well focused on the reason for the organization existing. This method of monitoring the strategic measures enables to identify the current levels of strategic performance, and where action is needed to improve them. It will provide feedback of the effects of the actions, and ensure that the strategic performance continually improves. The BOMAX can be interpreted separately in three different ways: each performance measure as an unit, the performance sub-index as an index of a BSC perspective and lastly as a sum up measure off all BSC categories pulled together in one final index as departmental and company level (Figure 1). BOMAX provide insight into different departments or levels of analysis. Most help desks have various sub sections like front desk and solution providers, etc., which all contributing to overall success of a help desk. The proposed framework, allow managers to do just that. To gauge exactly how well a section in a help desk is performing the overall performance index will allow the managers to capture and report specific data points from each section within the organization providing a ‘snapshot’ of performance. Performance Index of each Logistics Process (PPI) of each in respect of BSC perspectives at period t (Eq.1);

$$PPI_{t} = \frac{\sum_{i=1}^{l} x_{ij} \cdot w_{ij} + \sum_{i=1}^{l} x_{iF} \cdot w_{iF} + \sum_{i=1}^{l} x_{iC} \cdot w_{iC} + \sum_{i=1}^{l} x_{iI} \cdot w_{iI}}{PPI_{t}}$$

where:
- $i=1,\ldots,n$ number of measures,
- $j=1,\ldots,m$ number of logistics processes $M_{i}$=
- Performance measures $L_{i}$ = Performance scales of $M_{i}$,
- $x_{ij}$ = The current values of measures(Mi) $w_{ij}$ = weights of measures

$$\sum_{i=1}^{l} x_{ij}w_{ij}$$
This paper has sought to give an introduction to a new approach for measuring and improving performance of logistics processes. In order to describe the approach, an introduction has been given to performance measurement. A performance improvement framework has also been introduced. This method can be employed at certain intervals, for instance annually may also be used for short periods of time. The developed performance measurement systems are both focused on the results and the processes of logistics. We would argue that the use of the approach would enhance the performance of logistics processes.

References