MEASUREMENT SYSTEM FOR LOGISTICS PERFORMANCE IN WHOLESALE COMPANY

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Abstract

The paper presents an issue of measuring a logistics performance in wholesale companies. The main methodological bases are the Balanced Scorecard and the Analytic Network Process methods. Aim of this article is to create a conceptual framework for the building measurement systems of logistics key performance indicators (LKPI) in wholesale companies. The proposed conceptual framework is verified through the case study in the particular wholesale company.

Keywords: Logistics performance, Balanced Scorecard, Analytic Network Process, wholesale company

1. INTRODUCTION

One of the key processes with a direct impact on the success of wholesale companies in the market is logistics. It is represented by logistics activities in the purchase of goods, their transport, storage and sale to the customer. The main reason is the fact that wholesale companies are not engaged in production operations.

A prerequisite for achieving a high level of logistics activities is a suitable system for measurement, analysis and assessment of logistics performance [1]. Thus, aim of this article is to create a conceptual framework for the building measurement systems of logistics key performance indicators (LKPI) in wholesale companies.

2. LITERATURE REVIEW

Professional literature recommends a large number of indicators for measuring logistics performance. Their use always depends on specific conditions in the examined company and its business environment. Logistic indicators can be divided into various categories. Chow et al. distinguish between hard and soft indicators [2]. Hard performance measures such as net income or order fill rate are typically impersonal, accurate and easy and inexpensive to collect. Although there are several dimensions of logistics performance which hard measures cannot capture in a meaningful way, customer satisfaction is perhaps the most critical. A set of soft measures, collected using techniques such as the mail survey, telephone interview, or similar method are needed.

Fugate et al. state that logistics performance is multi-dimensional and is defined as the degree of efficiency, effectiveness, and differentiation associated with the accomplishment of logistics activities [3]. Logistics function as a whole strives to minimize the ratio of resource utilized against derived results (efficiency), accomplish pre-defined objectives (effectiveness), and gain superiority when compared to competitors (differentiation).

Schulte defines indicators of productivity, efficiency and quality [4]. Productivity Indicators measure the productivity of work forces and technical equipment; efficiency indicators express the ratio of logistics costs to certain units of performance while quality indicators are used to assess the degree of achievement of specified goals. A more detailed breakdown of logistics indicators is given, for example, by Macurová et al.: indicators of the level of logistics services, indicators of logistics costs and indicators of stock movement speed, indicators of productivity in logistics, indicators of proportionality and efficiency, and indicators of quality [5].

Management theory further divides the indicators according to the management level into strategic, tactical and operational. Strategic indicators are most often referred to as Key Performance Indicators (KPI).

3. METHODOLOGICAL BASE

The authors of this article propose a system for measuring the strategic logistics performance, dividing individual indicators according to the principles of Balanced Scorecard method. The proposed system takes into account various relevance of indicators for a specific wholesale company. For this purpose, Analytic Hierarchy Process multi-criteria decision making method is used.

3.1. Balanced Scorecard

The Balanced Scorecard (BSC) is a method of management that creates a link between strategy and operational activities with an emphasis on performance measurement developed by Kaplan and Norton [6].

By using the BSC, the strategy and vision of the company can be converted into performance measures that include both outcome measures and the drivers of these measures [7]. For a strategy to be successful, it needs to consider financial ambitions, processes to be improved, markets served and the people in the organization that implement the strategy. The BSC uses all these perspectives by considering both internal and external aspects [8]. Every perspective should contain four different sections: objectives, measures, targets and initiatives. For employees to be able to act upon the organization's vision, translating the strategy and mission of the company into objectives is the first step in the creation of each perspective.

Strategy like "an empowered organization" is hard to implement in practice and senior executives should therefore create understandable and actionable objectives, along with defined measures to keep track of the progress of reaching each goal [9]. Each measure should then be associated with a target (a short-term goal) that works as a milestone to assist in evaluating the progress of each objective. The last column in each perspective should be initiatives, describing actions that should be undertaken by the firm to reach each objective.

3.2. Analytic Hierarchy Process

The Analytic Hierarchy Process (AHP) is multistage decomposition method used to solve decision-making problems involving more than one criterion of optimality developed by Saaty [10]. The basic idea is to create a decision-making hierarchy and the subsequent evaluation of importance of the individual links among the interconnected elements. These evaluations are represented by weights, which are determined on the basis of pairwise comparison. The AHP methodology is described in publication [11].

The AHP does not limit human understanding and experience to force decision-making into a highly technical model that is unnatural and contrived. It is in essence a formalization of how people usually think, and it helps the decision-maker keep track of the process as the complexity of the problem and the diversity of its factors increase [12].

4. DESIGNED CONCEPTUAL FRAMEWORK

There are three basic options for incorporating logistics performance measurement into the BSC: (1) Adding a fifth logistics perspective to the BSC, (2) Developing a separate logistics BSC, (3) Integrating the logistics measures throughout the four perspectives.

Adding a fifth logistics perspective to the BSC may be the simplest approach. It could provide more visibility but not necessarily increased importance of logistics aspects for corporate management. Thus, the authors of the paper suggest to use the second approach for the logistics management level and the third approach for company level. It allows that the logistics measures will be seen as fundamental to day-to-day company

operations. Designed Logistics Balanced Scorecard (LBS) measurement system is shown in **Fig. 1**. The LBS contain four perspectives: (1) Economy - measurement of logistics cost, (2) Internal processes - measurement of internal logistics processes efficiency, (3) People - measurement of logistics employees' productivity, (4) Customer - measurement of customer (logistics) service level.

"KPIs" column includes selected logistics indicators; "Measures" column gives a method of their calculation. "Values" column includes a total of seven values: (1) Threshold - long-term minimum accepted values, (2) Strategic - long-term target values, (3) Planned - this year's target values, (4) Lower planned and (5) Upper planned - acceptable variances of this year's target values, (6) Present - this year's real values, and (7) Last year - last year's real values.

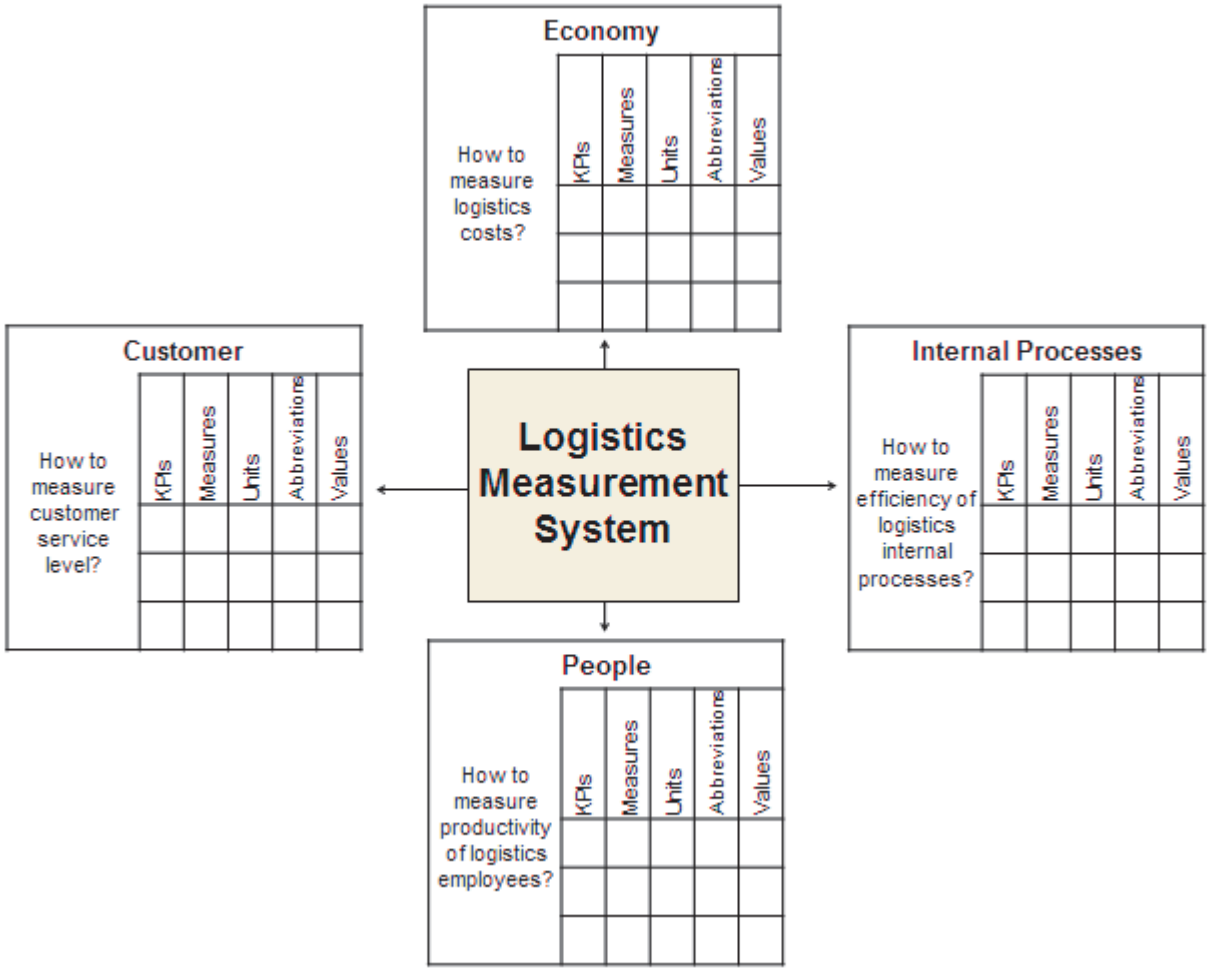

Fig. 1 Logistics Balanced Scorecard measurement system

For applying the presented system in wholesale companies, the authors propose the following procedure:

1. **Specification of LBS perspectives** - determination of specific logistics KPIs, measures, units, and abbreviations related to the researched wholesale company. For inspiration, it is possible to use logistics indicators from available literature (e.g. [2], [4], [5]). It is important to select a balanced set of the most important indicators for each perspective.
2. **Prioritization of LBS KPIs** - this step is based on the assignment of weights of the four perspectives and their KPIs. The authors of the paper suggest the AHP method for that purpose because LBS has the hierarchical structure. KPIs with the highest weight should be incorporated to the existing wholesale company BSC to ensure the unity between the company and the logistics performance.

3. **Evaluation of logistics performance** - the values (threshold, strategic, planned, lower planned, upper planned, present, and last) of the selected KPIs are collected during this step. Using AHP method, the total logistics performance of the researched wholesale company and logistics performance in the four perspectives can be calculated. The evaluation of the results is based on comparison of the calculated overall values. If there is an unsatisfactory logistics performance, it is desirable to focus on the perspectives and KPIs with the highest weight.

5. CASE STUDY

The verification of the designed conceptual framework is performed on a real wholesale company. Given the sensitivity of the used data, they were modified.

1. **Specification of LBS perspectives** - specific logistics KPIs, measures, units, and abbreviations related to the researched wholesale company for each perspective sum up **Table 1**.

Table 1 Specification of selected KPIs

Perspectives	KPIs	Measures	Units	Abbrev.	Weights
Economy	Transport costs	Transport costs (€) / margin (€)	%	LP-E-1	0.1226
	Handling costs	Handling costs (€) / margin (€)	%	LP-E-2	0.0372
	Storage costs	Storage costs (€) / margin (€)	%	LP-E-3	0.0674
Internal Business Processes	Proportion of low-quality deliveries	Value of low-quality items in deliveries (€) / value of all items in deliveries (€)	%	LP-IP-1	0.1226
	Loss of goods	Lost goods (€) / total inventory (€)	%	LP-IP-2	0.0674
	Inventory turnover	Average inventory size (€) / average daily consumption (€ / day)	days	LP-IP-3	0.0372
People	Productivity of buyers	Number of items on orders / number of hours worked by buyers	pcs / hour	LP-P-1	0.0407
	Productivity of storekeepers	Number of items delivered from warehouse / number of hours worked by storekeepers	pcs / hour	LP-P-2	0.0407
	Productivity of sellers	Number of items on orders / number of hours worked by sellers	pcs / hour	LP-P-3	0.0407
Customer	Delivery accuracy	Value of items on orders not meeting the first confirmed date of delivery (€) / total value of items on orders (€)	%	LP-C-1	0.1694
	Invoicing error rate	Values of errors in invoices (€) / total value of invoices (€)	%	LP-C-2	0.1694
	Proportion of low-quality orders	Values of low-quality items on orders (€) / total value of items in orders (€)	%	LP-C-3	0.0847

2. **Prioritization of LBS KPIs** - SuperDecisions software was used for the application of the AHP method (see **Fig. 2**). Single pairwise comparisons of the selected KPIs are summed up in **Fig. 3**. Weights of KPIs are listed in the last column of **Table 1**. The most important indicators are Delivery accuracy (17 %), Invoicing error rate (17 %), Transport costs (12 %) and Proportion of low-quality deliveries (12 %). The most important logistics perspective is Customer (42 %).

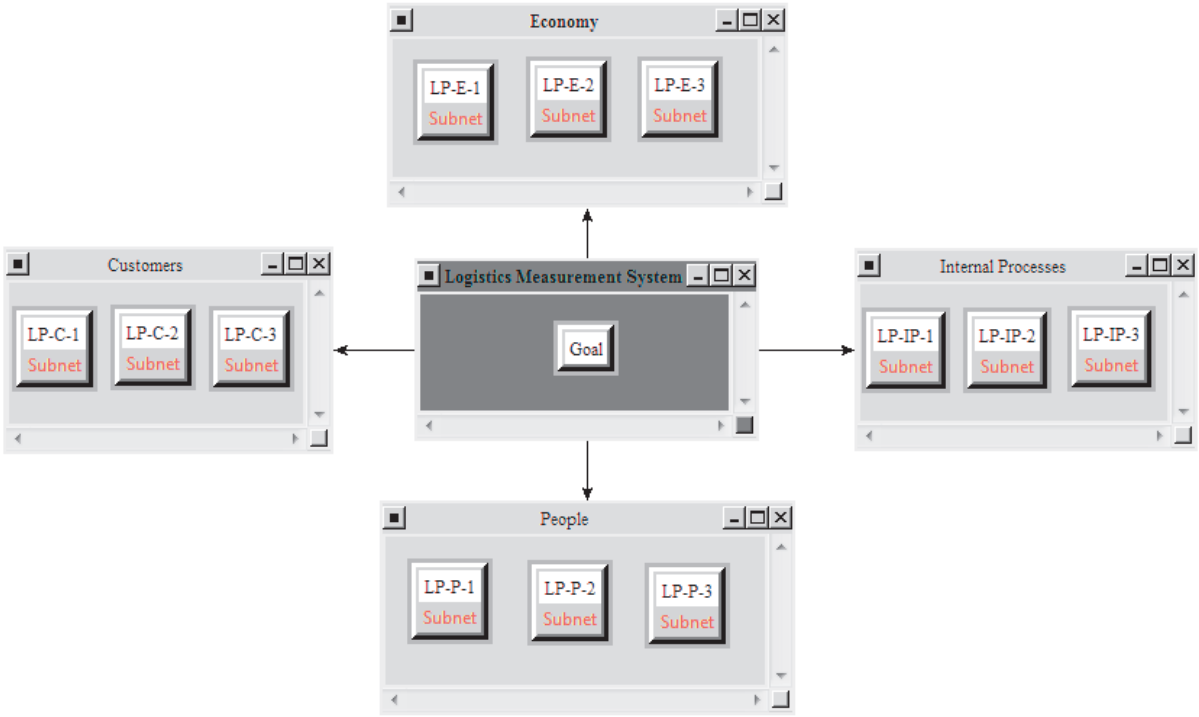

Fig. 2 Logistics Balanced Scorecard measurement system stucture in SuperDecisions software

LP	LP-E	LP-IP	LP-P
LP-C	2	2	3
LP-E		1	2
LP-IP			2

E	LP-E-2	LP-E-3
LP-E-1	3	2
LP-E-2		1/2

P	LP-P-2	LP-P-3
LP-P-1	1	1
LP-P-2		1

IP	LP-IP-2	LP-IP-3
LP-IP-1	2	3
LP-IP-2		2

C	LP-C-2	LP-C-3
LP-C-1	1	2
LP-C-2		2

Fig. 3 Pairwise comparisons of the selected KPIs

3. **Evaluation of logistics performance** - the values (threshold, strategic, planned, lower planned, upper planned, present, and last) of the selected KPIs are shown in **Table 2**.

Table 2 Values of selected KPIs

Abbreviation	Threshold values	Strategic values	Lower planned values	Planned values	Upper planed values	Present values	Last year values
LP-E-1	14	6	8	7	6.5	7.51	6.62
LP-E-2	4	1.5	2.2	2	1.8	2.19	2.02
LP-E-3	8	3	4.5	4	3.5	4.88	4.69
LP-IP-1	20	3	10	6	5	9.36	14.58
LP-IP-2	15	2	5	4	3	6.87	7.32
LP-IP-3	130	30	53	47	43	66.11	58.3
LP-P-1	0	10	7.47	8.3	9.13	6.51	6.54
LP-P-2	0	14	9.9	11	12.1	10.23	10.48
LP-P-3	0	8	6.21	6.9	7.59	5.46	5.76
LP-C-1	80	97	90	91	95	87.36	83.77
LP-C-2	8	0.25	1.5	1	0.5	1.38	2.38
LP-C-3	3	0.15	0.30	0.25	0.2	0.75	0.28

The main result of the evaluation step using the SuperDecisions software is shown in **Fig. 4**. Authors recommend more visible graphic view presented in **Fig. 5** for the company practice. The overall present state of the logistics performance in comparison with the overall strategic state (100%) is only 52 %. Neither overall planned state (66 %) nor overall lower planned state (57 %) is reached. The state is worse than the overall last year state (54 %) too. The same method can be used to asses each logistic perspective. From the perspectives and KPIs significance is obvious that it is desirable to focus on the Customer perspective and KPIs of Delivery accuracy and Invoicing error rate.

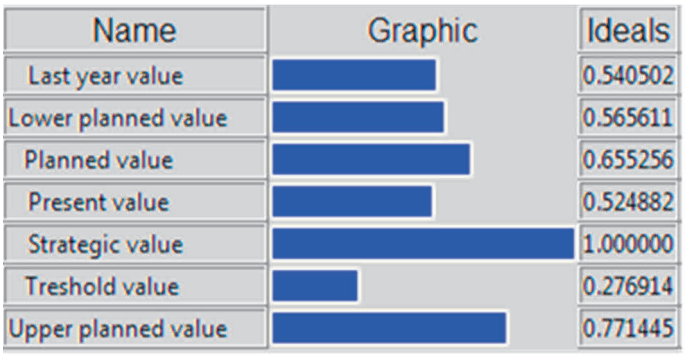

Fig. 4 Logistics performace results in SuperDecisions software

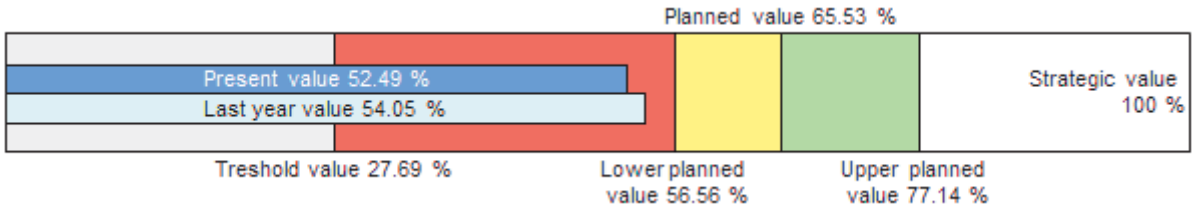

Fig. 5 Logistics performance results in reccomended graphic view

6. CONCLUSION

The presented case study has demonstrated the viability of the conceptual framework for strategic logistics performance measurement in wholesale companies. Future research will be oriented on utilization of Analytic Network Process (ANP) in the LBS. The ANP allows taking interdependencies among KPIs and logistics perspectives into consideration [13].

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