

# ASSESSMENT OF SUSTAINABILITY OF LOGISTIC ACTIVITY OF PORT OF KLAIPEDA

**Audrius Kutkaitis, Ligita Šimanskienė, Darius Burgis**

***Abstract:** In this article we analyze the relation between sustainable development and logistic activity of sea ports. The assessment of sustainability of development of logistic activity in seaports is important for determining current trends of development, to indicate problematic areas and to develop means of adjusting development according to predetermined goals. The main problem that the article deals with is the complexity of sustainable development assessment that usually requires specific approach when trying to determine sustainability of specific activity of specific organization. In this article we showed how we used a developed instrument to assess sustainable development of logistic activity of Port of Klaipeda. We determined that social level of sustainable development, developed especially fast in Port of Klaipeda, but it was not related to the development of the ecological and economic levels, general trends of sustainable development tended to decrease.*

***Keywords:** Sustainable development, Logistics, Seaports, Assessment, Transportation.*

***JEL Classification:** Q56, R11, L90.*

## **Introduction**

Various logistics systems significantly influence globalization processes that affect the development of national economies. Emergence of new logistics centers and continues development of the existing ones is one of indicators of a favorable environment created for the logistic processes [20], [23]. The benefits provided by sustainability and sustainable development are emphasized both in research works and in the national development strategies. Researchers [8], [31], [13], [5] emphasize society's view of the global ecological, economic, and social problems and state that each person can affect the resolution of those problems by starting to improve their own fields of activity. Therefore, the subject of this article is logistic activity of seaport which affects all three above mentioned fields, and is significant for the development of the region. The aim of the research is to develop a model for sustainability assessment of port logistic activity and to use it for the assessment of the sustainability of Port of Klaipeda logistic activity.

## **1 Statement of a problem**

Port development is to be related to sustainable development of the port logistic activity that enables cargo flow generation. The development of port logistic activity is thought to lack sustainability due to a number of factors that affect port activities (political, financial, the level of industrialization, geographical location, etc.). Contemporary mathematical-statistical methods of cargo flows forecasting [6], [24], [26] used in the development of port logistic activity do not fully evaluate the potential impact of general processes and are not related to sustainable development, which is one of the contemporary priorities in the development of organization activities [2], [3]. Authors who deal with the subject of sustainable development essentially agree about the levels of sustainable development (ecological, economic, and social), which makes the assessment

of sustainability a complex process. The factors of sustainable development at a regional level and in organizations performing different activities and located in different places could be different. Due to different reasons, they are not topical for some organizations or cannot be displayed, while for other fields of activities, the same factors can be essential, therefore, assessment of sustainability becomes quite problematic.

## **2 Methods**

In this article the method of scientific literature analysis was employed with the aim of identifying the criteria of port sustainable development and collecting secondary data to be compared with the primary data of the author's research. Reconnaissance method was employed to analyze port documents, interviews with specialists and consultants of respective fields. Qualitative research was employed and data was collected by means of expert survey and depth interviews. To verify the research instrument, i.e. a partly structured questionnaire, statistical analysis methods by means of the SPSS software were used. And finally the results of research were presented using graphical display.

## **3 Problem solving**

### **3.1 Theoretical aspects of sustainable logistic activity**

Scientific research related to logistics is developing fast all over the world, numerous research projects of both analytical and empirical character are devoted to logistic processes under market economy conditions. Scientific analysis of sustainable logistics is based on the experience of these researchers: [1], [10], [11], [2], [3], [18],[15], [25], [9], [23], [27]. The authors, mentioned above, have the experience of implementation of novelties and viable technologies in organizations in different countries of the world, however, their works do not feature the links between port logistics, sustainable development, and the sustainability of logistics activity.

In his research, V. Paulauskas [21], [22], [23] dealt with the subject of port management and discussed technological criteria and parameters of port management. He identified the processes taking place in port, defined the technological parameters of ports, and presented the principal characteristics. He partly discussed the principles of sustainable development in port management by describing the circumstances of maritime security, environmental protection, and pollution reduction in ports and by justifying economic indicators of linear shipping.

Quite a few works discussed the general aspects of port development. The authors were noticed to most frequently deal with specific aspects of port development. Scientific articles lacked a holistic approach to port development in the context of sustainable development. The proposed models are valuable, however, in order to apply them, one needs numerous precise and exhaustive primary data; therefore, their practical application is not easy. G. Dievulis [6] studied the modeling and planning of transport flows. His general methods of huge volume and complicated relationships for the solution of problems of transport flows distribution were ineffective, and the proposed algorithms could be used merely for the solution of practical transport objectives. As mentioned above, V. Paulauskas [20], [21], [22], [23] provided abundant materials on the management of maritime transport, port activity, and port development. His works discussed the factors that influence port activities and whose impact was to be assessed in a complex way, presented the methodological framework of research into cargo flows in port and discussed the application of the

principles of logistics in transport systems; however, they were not related to sustainable development and the application of its principles to logistics.

The issues of sustainable development in terms of ecology were analyzed by V. Smailys [28]. Both the positive outcomes of the development of the Baltic and Lithuanian maritime transport and additional ecological problems were considered in works of V. Smailys [28] and O. Stepanov [29]. R. Maksimavičius et al. looked into the relationship of port development and flow changes: cargo flows affected the development of port terminals [14].

Current standards of living that we enjoy in European Union [12], are greatly dependent on the development of ports. The articles on the growth of economics and labor productivity occasionally featured statements that the processes of logistics were affected by international trade, although the role of the transport infrastructure was difficult to establish, the designing of large and complex logistic systems made a great impact on port activity [17]. On the basis of publication data [7], one could state that half of the international trade took place between the countries that were distanced by no more than 3,000 km, as a huge distance meant an increase in transport expenses. The World Bank [32] emphasized the significance of technical characteristics of cargo flows at an international level for the improvement of transport infrastructure by observing the principles of sustainable development. It is important to establish the dependence of the processes of logistics on sustainable development.

An important role in the transport movement between ports and inland regions was performed by external and transit trade [1]. Well-functioning corridors of all type cargo flows were significant because they enabled internal trade operations, an increase in competitive capacity, and effectiveness in the development of economic collaboration and regional integration.

The issues of competitiveness of transport links between ports were considered by the Joint Transport Research Centre [17]. The costs of internal transportations were established to have exceeded the sum of the costs of maritime transportation and port operations [4]. To quote some authors [16], [19], shipping lines managing organizations admitted that their clients considered a most important thing to be the development of transport links in the general link “from door to door” of the logistics [30]. The assessment both from the viewpoints of a specific port and of the link of production and trade proved that the significance of transport links between ports and inland regions was increasing. Currently, there is a general agreement on the fact that sustainable transporting links between ports and inland regions were of utmost importance.

### **3.2 Modeling of sustainability calculation of seaport logistic activity**

Sustainable development of logistic activity should be one of the goals of any given seaport that is why it is important to calculate the level of sustainability, so one could evaluate the progress. Our calculation is based on the works of R. Čiegis [2], [3] on determining the level of sustainability; to calculate the integrated index of sustainable development ( $I_{SD}$ ) of logistic activity we used this formula:

$$I_{SD} = \sum_i a_i I_i, \quad (1)$$

Where:

$I_i$  – indicators of sustainable development of logistic activity;

$a_i$  – weighs of sustainable development indexes (where  $\sum_i a_i = 1$ );  
 $I_{SD}$  – integrated index of sustainable development of logistic activity.

In this formula all of the levels of sustainable development (economic, social and ecological) are accounted for:

$$I_{SD} = a_1 I_{ED} + a_2 I_{SD} + a_3 I_{CD}, \quad (2)$$

Where:

$I_{ED}, I_{SD}, I_{CD}$  – indexes of economic, social and ecological development;  
 $a_1, a_2, a_3$  – weighs of said indexes ( $a_1 + a_2 + a_3 = 1$ );  
 $a_1, a_2$  ir  $a_3$  – ekonominio, socialinio vystymosi ir aplinkos būklės indeksų svoriai (galioja sąlyga:  $a_1 + a_2 + a_3 = 1$ );  
 $I_{SD}$  – integrated index of sustainable development of logistic activity.

Each of the indexes ( $I_{ED}, I_{SD}, I_{CD}$ ) in turn is comprised of several indicators:

$$I_m = \sum_i a_i R_i \quad (3)$$

Where:

$R_i$  – indicator of particular index;  
 $a_i$  – weigh of the indicator in the particular index (where  $\sum_i a_i = 1$ );  
 $I_m$  – particular index.

When forming the integrated indicator, if the increase in the values of the comprising indicators is considered as harmful, the indexes are recalculated:

$$I_{LA} = 1/I_m. \quad (4)$$

This way all indicators get the values that are applicable to the integrated index of sustainable development of logistic activity of seaport.

### 3.3 Research in Port of Klaipeda

During research the factors of assessment of port logistic activity were presented in seven assessment actions whose consistent implementation enabled the assessment of sustainability of logistic activity in Port of Klaipeda. By action 1, seven settings in which port developed its activities were established. By action 2, the levels of sustainability relevant to the assessment of sustainability in Port of Klaipeda were defined. By action 3, the criteria significant for the logistics activity in the port were established. Later the specialists of the port logistics were selected who assisted in the choice of measurable indicators important for port logistic activities. By action 3, we also selected sustainability assessment specialists able to establish whether the indicators that identified logistic activities were significant for the levels of sustainability. The specialists of sustainability assessment understood the essence of the activity and were able to properly assess the identified indicators significant for logistic activities. By action 4, expert assessment was performed when the specialists of logistics development in the port defined measurable indicators significant for the port logistic activity. By action 5, the specialists of sustainability assessment invited to the research assisted in the selection of indicators significant for logistic activity and the levels of sustainable development. By action 6, after the specialists of port logistics development and sustainable assessment tested the indicators, the analysis of indicator sensitivity was made: we tested whether the indicators of sustainability assessment of logistics activity did not repeat or did not measure the same state expressed in a different way. At that stage, not only the levels of sustainability

at which the assessment was done were identified, but also the settings in which the indicators were located were established. By action 7, the sustainability assessment of the logistic activity of Port of Klaipeda was done. Specific meanings of the identified indicators were established; the reliability of the indicators and their component values were tested. At that stage, the compliance of the indicators distributed over the levels of sustainability to the nominal size was calculated.

The principles of the worked out methodology were applied to the sustainability assessment of logistics activities in Port of Klaipeda. The components of the sustainability levels of port logistic activity were calculated. The research data obtained from Klaipeda State Seaport Authority (KSSA), were processed by means of descriptive comparative statistics and the factor analysis methods.

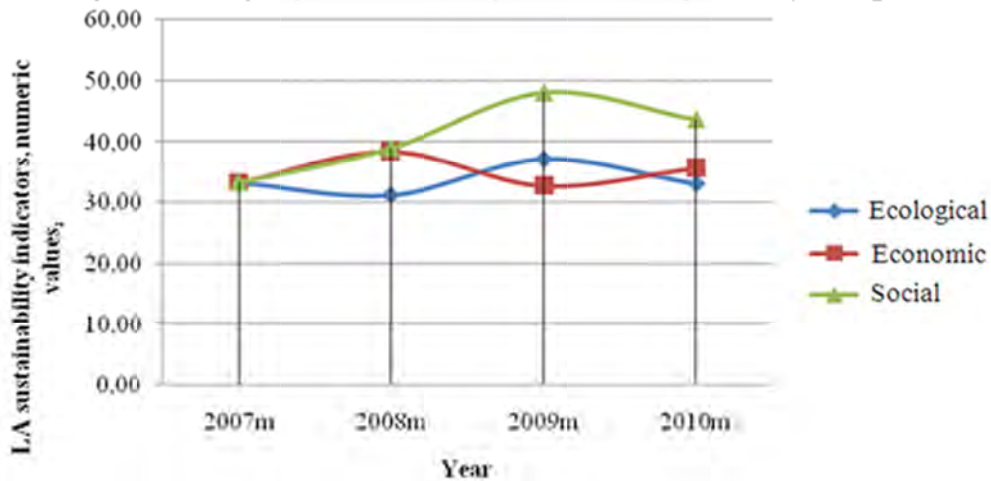
**Tab. 1: Values of indicators of sustainability of Port of Klaipeda logistic activity**

Code	Indicator		Period of assessment			
			2007	2008	2009	2010
E.3	Air quality	Number of hard particles in air, mg/m <sup>3</sup>	20	20	25	28
		NO <sub>2</sub> , mg/m <sup>3</sup>	22	25	15	21
		SO <sub>2</sub> , mg/m <sup>3</sup>	2	5	2	2,9
E.15	Total of harmful material gathered as a result of logistic activity, m <sup>3</sup>		11109,69	8187,15	3809,58	4752,51
E. 19	Heavy metals in the sediments of seaport water area, mg/kg		2225,51	2013,48	2143,04	1759,46
K.1	Percent of GDP created, %		0,138576	0,132317	0,155916	0,156082
K.3	Investments per year, Euros		33949938,0	48080109,0	18538867,0	22749942,0
K.16	Cargo, 1000 t.		27360,0	29880,0	27865,90	31277,7
S.8	Expenses on social security, Euros		3.877.469	4.272.549	4.345.019	4.234.948
S.11	Area affected by noise pollution near port facilities, ha		1132,91	1127,72	1133,93	1146,37
S.13	Funds for employ education, GDP %		0,000135	0,000191	0,000301	0,000252

*Source: Authors*

After completing the research analysis by means of descriptive statistics methods, we found out that logistic activity of Klaipeda State Seaport Authority partly complied with the character of sustainable logistics activity fig.1. Sustainable logistic activity was recorded at two levels – social and economic.

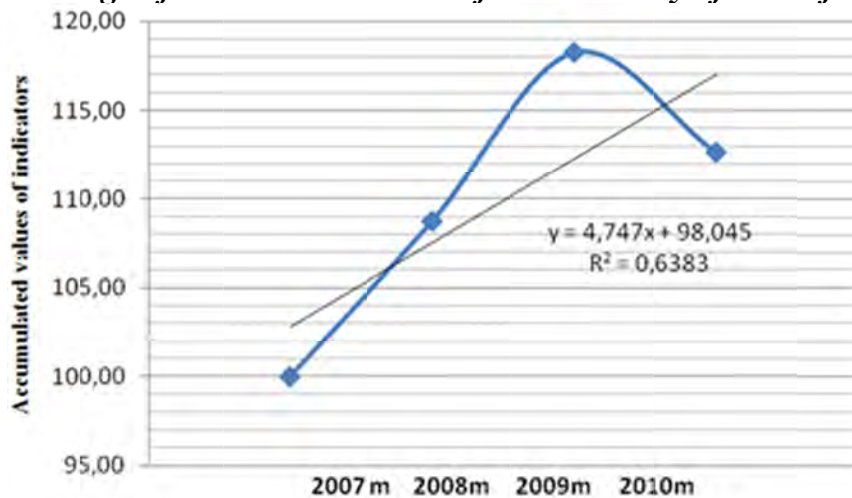
**Fig. 1: Change of sustainability indicators of Port of Klaipeda**



Source: Authors

During the logistic activity assessment in 2008 to 2010, the re-distribution of the logistics activity of Port of Klaipeda was recorded: the sustainability levels of logistic activity distributed themselves at the ecological and economic levels. The social level, developed especially fast at Port of Klaipeda, but was not related to the development of the ecological and economic levels. After calculating accumulated values of indicators of sustainable development of logistic activity in Port of Klaipeda (fig. 2), we can see that general development trends tend to decrease.

**Fig. 2: Change of accumulated index of sustainability of Port of Klaipeda**



Source: Authors

On the basis of the obtained outcomes of the empirical research the conclusion was drawn that the model of sustainability assessment of logistic activity in Port of Klaipeda was practically applicable as a measure that could help assess the sustainability of logistic activity in a port and provide opportunities of its development to get additional benefits. As an instrument of self-assessment of the port logistic activity aiming to identify the fields and areas of improvement, as a guideline for taking care of ecology and social environment, in creating added economic value, as a practical aid contributing to the image of the port logistic activity and as a subject of scientific discussion of further research in the identification of the trends and levels of sustainable development.

## **4 Discussion**

Port of Klaipeda has a clear vision of the development of its logistic activity, due to the specificity of the port geographical location, the uniqueness of the political environment, wide distribution of the types of transported cargoes, claims of increasing cargo flows, huge mutual competition, and unrestricted possibilities to organize international routes. Declared logistic activity standards of Port of Klaipeda can be a basis for the development of sustainable logistic activity with the ecological, economic, and social contexts. Sustainable development of logistics activity in ports of the eastern Baltic seacoast is promoted by regulated, planned, or spontaneous interventions emerging in the settings of an organization. To assure sustainability of logistics activity in seaports, we have to identify the sources of waste and pollution and their state, the indicators disclosing economic results, and the indices identifying social development.

In order to apply the model to organizations implementing other types of activities, it should be revised according to the contextual differences. The research was conducted to assess the logistic activity of Ports of Klaipeda; therefore, the sustainability assessment of seaport activity in other countries should be done by taking into account the national context of those countries and the measured indicators.

As identified in the research, nine sustainability indicators were significant for port logistic activity that had indices at each sustainability level. However, to the author's mind, other major criteria could be identified to define the port logistic activity in other ports.

To observe port development trends with respect to different levels of sustainability, we would consider reasonable to continue research and to analyze longer port development periods (a decade and more) and to compare them with other Baltic ports.

## **Conclusion**

The development of ports, as main logistic centers, is one of most important factors that affect major trends of regional development. The assessment of sustainability of development of logistic activity in seaports is important for determining current trends of development, to indicate problematic areas and to develop means of adjusting development according to predetermined goals.

During research we devised seven steps of determining sustainability of Port of Klaipeda logistic activity which let us to prepare a set of indicators for determining different levels of sustainability. After evaluating the change of those indicators during the period of three years, we could determine main trends of development of logistic activity of Port of Klaipeda.

Logistic activity of Port of Klaipeda partly complied with the character of sustainable logistic activity it was recorded at social and economic. During the logistic activity assessment from 2008 to 2010, the re-distribution of the logistic activity of Port of Klaipeda was recorded – the sustainability levels of logistic activity distributed themselves at ecological and economic levels. The social level, developed especially fast at Port of Klaipeda, but was not related to the development of the ecological and economic levels. After calculating accumulated values of indicators of sustainable development of logistic activity in Port of Klaipeda, we determined that general development trends tended to decrease.

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### **Contact Address**

**Audrius Kutkaitis, lect.dr.**

**Ligita Šimanskienė, prof. dr.**

**Darius Burgis, doctoral student.**

Klaipeda University, Faculty of Social Sciences, Department of Management.

Minijos st. 153, LT-93185, Klaipeda, Lithuania

Email: [ligita\\_simanskiene@yahoo.com](mailto:ligita_simanskiene@yahoo.com)

Phone number: +370 46 398666

Received: 03. 10. 2013

Reviewed: 21. 01. 2014, 31. 01. 2014

Approved for publication: 31. 03. 2014