Formal Cluster Formation in the Development of the Transport Sector in the Baltic Sea Macro-Region

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Formaalse klastri kujunemine Läänemere makroregiooni transpordisektori arengus

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CONTENTS

LIST OF PUBLICATIONS

The thesis is based on three original scientific publications, which are referred to in the text by Roman numbers:

I. **Nežerenko, O.,** Koppel, O. (2012). Some Implications of the EU Rail Transport Policy on Rail Business Environment in CEE Countries. *Baltic Journal of European Studies, 2,* 21-45. Tallinn University of Technology. (ETIS 1.2)

II. **Nežerenko, O.,** Koppel, O., Tuisk, T. (2015). Cluster approach in organization of transportation in the Baltic Sea Region. *Transport.* (Article in press). doi: 10.3846/16484142.2014.994225. (ETIS 1.1)

III. **Nežerenko, O.,** Koppel, O. (2015). Formal and informal macro-regional transport clusters as a primary step in the design and implementation of cluster-based strategies. *Transport and Telecommunication, 16(3),* 207 - 216. doi: 10.1515/ttj-2015-0019. (ETIS 1.1)

Other publications related to the topic:

• **Nežerenko, O.,** Koppel, O. (2012). Problems in International Transport Arising from the Unbundling of Railway Companies in the Baltic States. The 4th International Conference "Economic Challenges in Enlarged Europe", 17-19 June 2012, Tallinn: (Toim.) A. Hazak. Tallinn: Tallinn University of Technology, pp. 1 - 9.

• Kirch A., **Nežerenko, O.,** Mezentsev, V. (2011). Estonia and other countries of the Baltic Sea region as actors of development: conceptual approach. *European Integration Studies. Research and Topicalities, 5.* Journal of Kaunas University of Technology, pp. 199-204.

• **Nežerenko, O.,** Koppel, O. (2011). Rail Sector Restructuring in the EU: Implications for Rail Business Environment in CEE Countries. The 3rd International Conference „Economies of Central and Eastern Europe: Convergence, Opportunities and Challenges", 12 – 14 June 2011. Conference Proceedings. Tallinn: Tallinn University of Technology, pp. 1-16.

• **Nežerenko, O.** (2009). How can the EU Baltic Sea Strategy contribute to the recovery of cooperation in the field of transit (as exemplified by the cooperation of the Baltic States in the years 2004-2008)? *Proceedings of the Institute for European Studies, 6.* Tallinn: Tallinn University of Technology, pp.50-66.

The author's contribution to the Publications

Publication I. In this published paper, the author of the current thesis assisted her supervisor Prof. Ott Koppel in the part of analysis of the process of rail market liberalization which might lead to a creation of better conditions for the increase of competitiveness of this mode of transport. The author of the thesis analyzed the legal framework regulating rail business in the Baltic States and identified the main obstacles which prevent an efficient functioning of the Baltic Sea Region's railway system.

Publication II. In this published paper, the author of the current thesis was the primary author and principal contributor. The author analyzed the situation in the field of transportation in the Baltic Sea Region (BSR) in the period 2004–2011 by applying hierarchical cluster analysis method.

Publication III. The author of the current thesis was the primary author and the principal contributor of this jointly published paper. The author's practical contribution lies in identifying the development dynamics of the BSR transport sector towards a 'formal' macro-regional cluster with the help of hierarchical cluster analysis.

INTRODUCTION

The globalization of international trade and the expansion of multinational companies suggest unhindered movement of goods and resources provided by efficiently functioning transport system. Transport system is a supporting field of services, which provides trade relations with necessary infrastructure, means of transport, technical, legal, and administrative support. With the last global economic crisis in 2008–2009 leading to a degradation of economic and trade activities, the transport sector also experienced a significant drop in cargo (and passenger) flow. Considering that the recovery of the trading sector from the crisis was much faster than in global output (GDP), the transport sector boosts the recovery process further by servicing trade flows.

With the expansion of the multimodal transportation concept, the efficiency of a country's and region's transport system performance depends on synergy which occurs due to effective cooperation between different modes of transport on macro-regional level. In the framework of the present thesis, the author defines transport sector as a sector which includes industries providing transportation of cargo, distribution, warehousing and storage for goods, whose output is presented in tonnes or tonne-kilometres.

Many problems, which are obstructing better and faster development of the capacity of transport infrastructure and its full and balanced utilization, have emerged in the Baltic Sea Region (BSR). The BSR is studied in the thesis as a formal macro-region around the Baltic Sea, which consists of eight European countries and one non-EU country: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, and Norway. The BSR plays a strategic role as an international supply chain which serves trade flows passing via its physical infrastructure and helps to facilitate and intensify trade relations through macro-regional/international cooperation. Kirch *et al*. (2011) argue that contemporary international relations, which appear in the region, are attracted by two main forces – the Russian Federation and the European Union (EU). Researchers determine the EU as the main centre of attraction of the BSR, which set the rules and allocates resources within the region, mainly through its macro-regional strategy, projects and regulatory function. The second force of the BSR is the Russian Federation, which is considered to be a major regional power and the main supplier of energy resources and goods for the EU, which sometimes via the CIS represents also the interests of Central Asian countries (Kirch *et al.,* 2011, p. 200; Lumiste and Prause, 2011, p. 17).

International conflicts and crises reveal the importance and power of both forces. Thus, the recent crisis in Ukraine, which started in 2014, has demonstrated that transit cargo flows may be unstable. This, in turn, explains the need for alternative transport connections for the EU and the implementation of certain cooperation strategies and projects, which could unify the BSR countries' transport infrastructure. In this regard transportation investments are the life blood of economy and serve as engines that fuel

economic growth (Mačiulis et al., 2009; Lumiste and Prause, 2011; Kockelman *et al.*, 2013).

The Trans-European Transport Network (TEN-T) is a precondition for the proper functioning of the EU single market. Former president of the European Commission Jose Manuel Barroso pointed out the importance of the Rail Baltica project not only from the perspective of ensuring free movement of goods and people between the Baltic States, but also from the perspective of opening alternative routes to the dominant ones from Russia and Belarus (Poom, 2014).

A review of literature reveals that there is a lack of longitudinal interdisciplinary research, which would investigate the impact of the global economic and financial crisis on the BSR's transport sector as a whole and the role of macro-regional strategies in the sustainable economic development of countries within a region. In addition, the majority of short-run analyses focusing on the peculiarities and influence of a specific transport sector (transit, rail, shipping, etc.) on economic development in the latest economic crises are conducted on the national level (Litvinenko and Palšaitis, 2006; Mačiulis *et al.*, 2009; Bălan and Bălan, 2010; Grama, 2012). As a rule, such research papers are based on a weak theoretical platform which limits the implementation of system design in contemporary international transport logistics for determining a relevant approach to studying the effectiveness of the transport sector (Stock, 1997; Gubi *et al.*, 2003; Zachariassen and Arlbjørn, 2010; Bialasiewicz *et al.*, 2013; Karatas-Cetin and Denktas-Sakar, 2013). A solution to the problem of short-run coverage has been proposed by Tolli and Laving (2007) and Guerrero and Rodrigue (2014), who have studied the impact of economic cycles in long-run terms on a global scale, narrowing the focus specifically on containerized maritime transport.

The macro-regional pattern of the thesis was motivated by the importance of the geographical scope of the research and the need to discuss the concept of macro-region. The macro-regional initiatives of the EU since 2009 have encouraged the researcher to pay more attention to the practical issues in macro-regional strategies and trends in cluster development (Taina, 2012; Laaksonen and Mäkinen, 2012; Boronenko and Zeibote, 2011; and Zvirbule-Berzina, 2013a,b; Bialasiewicz *et al.*, 2013). Hettne and Söderbaum (2000), Dubois et al. (2009) and Bialasiewicz et al. (2013) see European macro-regional policies as a threshold between internal territorial cooperation and external cross-border cooperation. An analysis of published works related to regionalism (Wijnolst *et al.*, 2003; Boronenko and Zeibote, 2011; Karvonen, 2012; Laaksonen and Mäkinen, 2012; Garanti *et al.*, 2014 etc.) confirms the importance of the macro-regional clustering process in the development of the EU's transport and logistics sector, raising the urgent problem of heterogeneity within macro-regions, which could eliminate the input of transport activity into the economic growth of the region (Salines, 2010; Bialasiewicz et al., 2013). Inequalities between the EU micro-regions have been discussed at length by Hernández *et al.* (2009). Herrschel (2009) in his study has raised the question of the formal

and informal nature of regions and clustering process, highlighting the crucial importance of formal clustering process in the macro-region. The informal nature of the clustering process does not always help countries achieve a confident, competitive position mainly because of the heterogeneity which impedes the achievement of the synergy effect at a macro-regional level. This in turn leads to the generalized macro-regional view on the bottlenecks of the BSR transport sector, which could be specified by application of system analysis for the detection of formal macro-regional clusters formation's tendencies in a region (Herrschel, 2009; Zachariassen and Arlbjørn, 2010; Bengtsson, 2009; Mačiulis *et al*, 2009).

The BSR transport sector is examined on macro-regional level as a single formal transport cluster, in which groups of countries (micro-clusters) cooperate in order to achieve a certain strategic goal, such as a decrease of ecological issues, transportation costs, promotion to a more rational usage of countries' transport capacities, etc. The author defines formal transport macro-regional cluster as a geographical concentration of transport actors in the region, characterized by (1) the formal regulation on behalf of the EU within the European Union Strategy for the Baltic Sea Region (EUSBSR); (2) homogeneity in the development of physical infrastructure; (3) homogeneity in transport sector performance; and (4) similar behavioural pattern at different stages of the economic cycle. Within this context arises the problem of 'rational' involvement of the countries' transport capacities, which comes from the predominance of the informal/business aspect of macro-regional cooperation.

The author seeks to determine **how the BSR countries behave at different stages of the economic cycle (the economic crisis has a role of the intervention variable within the current study) and questions the superficiality of the concept of macro-regional development, which is regarded as a new approach in international relations** (Hettne and Söderbaum, 2000; Bialasiewicz *et al.*, 2013; Dubois *et al.*, 2009, Herrschel, 2009). This concept is identified with international cooperation policy, which is covered by numerous macro-regional projects and strategies, such as the EUSBSR, Northern Dimension, the Baltic Sea States Subregional Cooperation, Northern Dimension Environmental Partnership, Northern Dimension Partnership on Transport and Logistics, HELCOM, etc. Sometimes such projects and organizations set goals and priorities which overlap on the macro-regional level, as well as in sources of financial support.

The author of the thesis has set an aim **to emphasise the importance of the concept of macro-regional development of the BSR transport sector and to determine contribution of formal cluster approach to its development.** The central question discussed within the thesis is the following: **What determines the dynamics of the performance of the BSR transport sector in 2004-2012 and how can the concept of formal clustering contribute to its development?** In accordance with the aim and research question the author has set the following tasks:

1. To confirm the importance of the concept of macro-regional development for the BSR transport sector from the perspective of:
   a. macro-regional infrastructure development within the TEN-T system;
   b. macro-regional cluster collaboration in the BSR transport sector;
   c. the BSR's competitiveness in transhipment of cargo flow to/from Russia, the CIS countries, and China.
2. To identify the pattern of the BSR transport sectors' response to the fluctuations of global economy;
3. To determine the direction of further development of the BSR macro-regional policy.

The research approach and design of the thesis are based on the author's publications and their contribution to achieving the aim of the thesis by fulfilling the tasks referred to above. The tasks and sub-tasks of the thesis are covered in the following three scientific articles:

Article I. This research paper (I) is devoted to issues connected with macro-regional railway infrastructure development through the reorganisation process in order to ensure the sustainable development of railway business in the Nordic and Central and Eastern European Countries and their integration into the EU Single Railway Area (task 1c). The importance of the rail sector is confirmed by the fact that historically its' Baltic infrastructure has been engaged in servicing transit freight originating from Russia and others CIS countries.

Article II. Within the second research paper (II) hierarchical cluster analysis (HCA) of the BSR countries' cargo flows is conducted (tasks 1a, 2 and 3). The factors which led to appearance of similarities or discrepancies between countries are examined. HCA was tested as a method, which allows extracting countries, which react similarly to certain changes in the transport sector or in a whole economy. Applying correlation analysis, Bayesian analysis and Affinity analysis, factors which have led to the changes in the BSR cargo volumes were identified. Macro-regional cluster collaboration analysis resulted in two findings, namely: the tendency of formation of transport clusters on a national level predominates in the BSR and macro-regional clustering experience in railway, and road transport is negligible (task 1b).

Article III. This research paper explores problems arising from the macro-regional cooperation in the transport sector (tasks 1a and 3). The central approach of the study is based on two concepts: (1) the concept of formal and informal macro-regions, and (2) the concept of clustering. A formal macro-regional transport cluster (comprising distribution, maritime and transport and logistics cluster categories) has been identified using the HCA. The results of the study confirm the viability of the assumption that in order to provide the BSR a stable competitive position in the global transportation and logistics field, its formal and informal clusters must coincide, with the priority given to formal type of cluster.

The author conducted probabilistic (hierarchical cluster and correlation analyses) and non-probabilistic (Bayesian and affinity analysis) methods of analysis with the aim to: 1) determine changes in transport activity in response to changes in economy (article II); 2) evaluate correlation between the volume of cargo flows and economic indicators (article II); 3) identify the key factors influencing the performance of the BSR transport sector (article II) and 4) identify 'formal' micro-, meso- and single transport clusters (article III).

The **theoretical contribution** of the thesis lies in composition of theoretical platform for relevant interdisciplinary research in contemporary international logistics and working out of methodological frames for the system analysis on the formation tendencies of formal macro-regional clusters.

The **practical contribution** of the thesis to the literature lies in the application of the probalistic and non-probalistic analyses as a new measuring tool for an analysis of reasons and factors which lead to the emergence of clusters of countries within the macro-region and in determining the direction of further development focus of the BSR macro-regional policy.

The author sought to determine how the transport activity of the BSR countries changes at different stages of the economic cycle. Countries were clustered into groups (micro-clusters) according to similarity in the change of cargo volumes and cluster indicator 'Specialisation', which appeared as a result of fluctuation of economic indicators. Analyzing the BSR as a single transport cluster, which is formed due to its unique geopolitical location, the author conducted probabilistic analysis and determined the significant factors influencing the BSR transport system. The author also studied the dynamics of macro-regional development towards the formation of formal and informal transport clusters – this represents the core of the present thesis.

The thesis comprises a review article, a list of references, abstracts in English and Estonian, appendices, and the published articles. The review article is structured as follows: In the first chapter the theoretical framework of the thesis is presented. The author implies a systems view onto the transport sector, studying it as an open complex system which consists of a multitude of interconnected and interdependent elements, focusing on the importance of macro-regional and cluster cooperation. The second chapter describes the research methodology of the thesis, which is based on qualitative and quantitative analyses. In the third chapter, the results of the research are presented and the relevance of macro-regional transportation planning in the BSR is discussed.

1. THEORETICAL FRAMEWORK

1.1. Implications of systems theory for the transport sector

Logistics is a specific field of study which does not provide researchers with a unified theory. Issues connected with the foundation of a unified theory of logistics have been the focus of research interest since 1997. Stock (1997), Gubi *et al.* (2003), Zachariassen and Arlbjørn (2010) have analyzed applied theories and methodology in logistics-related publications (including doctoral theses) published between 1980 and 2008. Their analyses showed that the theoretical platform for studying logistics and transportation issues is usually borrowed from other disciplines such as accounting, management, geography, economics, philosophy, political science, computing, etc.

There are at least two diametral perspectives seen by scholars in respect of the evolution of logistics as a science. One of these focuses on the increasing need for a solid and unified theoretical basis for the future development of the logistics (Karatas-Cetin and Denktas-Sakar, 2013, p. 1). The other is based on a belief that future logistics research can benefit from further borrowing of theories from other disciplines (Stock, 1997).

The review of literature shows that logistics has a great potential in developing its unified theoretical basis, but considering the complex nature of logistics and the high level of interconnectedness with other disciplines, there is still room to test the borrowed theories and to analyze transport sector as an open system.

Bertalanffy (1968) points out the advantage of systems theory, which lies in its potential to provide a transdisciplinary framework for a simultaneously critical and normative exploration of the relationship between our perceptions and conceptions and the worlds they purport to represent. In the scope of this thesis, the term transport system is discussed from the perspective of transport geography and systems theory, thus the meaning of this term varies.

Transport geography studies transport sector as a complex spatial system, which consists of different transport modes, technologies, equipment and infrastructures. Their synergy provides the movement of material, information and financial flows. Transport system is usually conceptualized as a subsystem embedded in a larger socio-economic system (Dodder, 2000, p. 6).

The main contributor to the development of the transport system's theory, and often referred to in this thesis, is the Canadian scholar of transportation geography Jean-Paul Rodrigue. Rodrigue *et.al.* (2013, p. 7) distinguishes between three central concepts of transport system:

1. Transportation nodes, which serve as access points to a distribution system or as transhipment within a transport network. This function is mainly serviced by transport terminals where flows originate, end, or are being transhipped from one node to another.

2. Transportation networks, which form the spatial structure and organization of transport infrastructures and terminals.
3. Transportation demand (including demand for the modes used to support movements). Demand causes an interaction effect within a transport network.

From the perspective of systems theory, transport system is a socio-economic system which originally was regarded as an 'open' system. Here, openness means the existence of a connection with external environment.

Transport sector (internal systems) and external environment (external systems) influence each other, so that the border of a transport sector can expand or, conversely, narrow depending on the nature of their mutual influence (see Fig. 1).
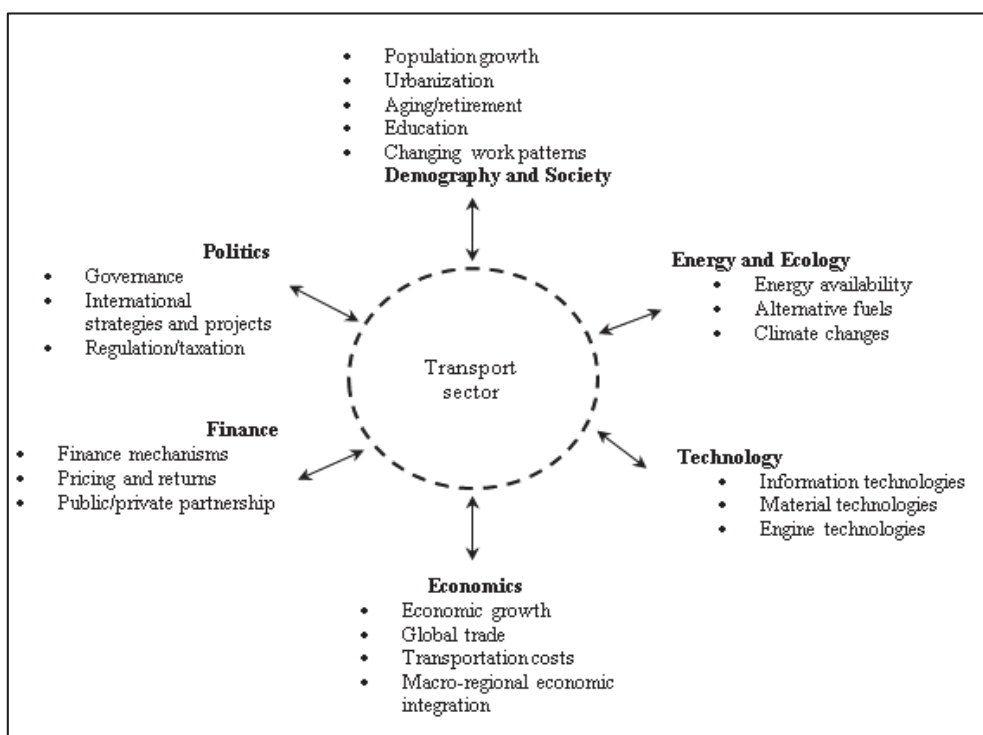
Figure 1. Interaction of the transport sector as an open system with other systems
Source: adapted by the author from Brodin, 2003, p. 27; Rodrigue *et.al*., 2013, p. 100

Each system presented in Figure 1 consists of a complex of subsystems which coevolves in mutual interaction (Bossel, 1999, p. 2). There is permanent change and evolution in it. According to the systems theory, a complex system is a system formed out of many components whose behaviour is emergent, i.e. the

behaviour of the system cannot be simply inferred from the behaviour of its components (Laszlo and Krippner, 1998).

The present thesis analyzes the interconnectedness between the transport sector and the economic and politics factors with which it interacts. The inherent difficulties in quantitative modelling complex linkages has led to the drawing of boundaries between the physical transportation structure and the broader socio-economic system in which that system is embedded (Dodder, 2000, p. 6).

On the basis of approaches for studying transport sector as a complex system, discussed in this part of the thesis, the author concludes that the efficiency of the transport sector depends on at least three sets of factors: technological, geographical and legal, which are presented in further detail in Figure 2.
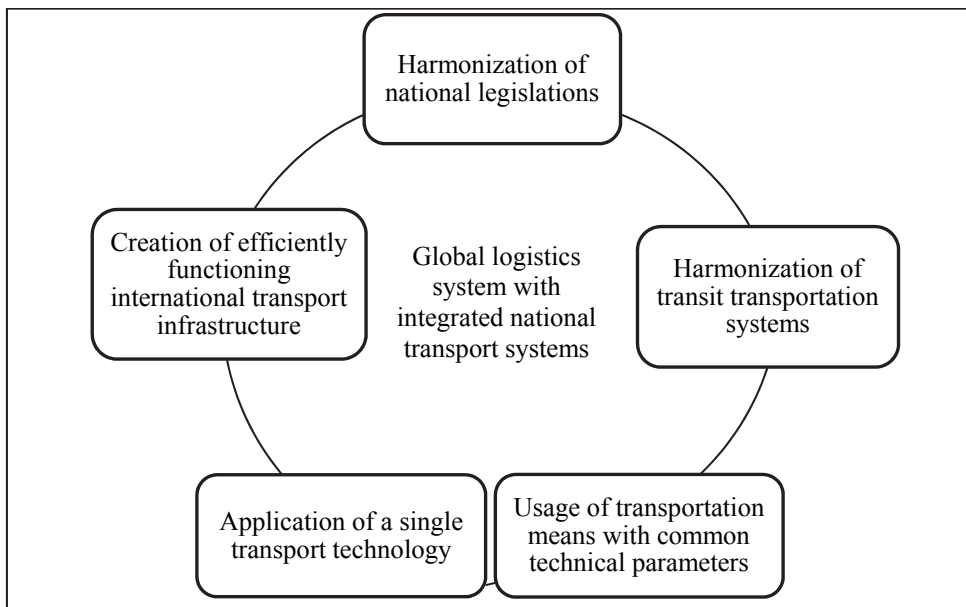
Figure 2. Efficient transport system
Source: constructed by the author

A convergence of these factors results in the creation of not only a competitive unified national transport system, but also an international one. International transport system is uniquely complex due to the coexistence of different national transport systems (geographically located in one region), which have differences in their capacities, technological and technical, including ITC, support, as well as in collaboration experience.

1.2. The concept of macro-regional development

Transportation is often referred to as an enabling factor, without the capacity and efficiency of which globalization could not have occurred (Rodrigue *et.al.*, 2013, p. 183). In the thesis, the BSR transport sector will be analyzed on the macro-regional level, thus it is necessary to discuss a new form of regionalism – the concept of macro-region.

The concept of macro-region was developed by the European Commission (EC) for the implementation of the EUSBSR in 2009. The strategy can be seen as an expression of the fact that the EU membership has shifted from a marginal to a dominant paradigm in the BSR since the 1990s, providing the members an opportunity to conduct regional cooperation within the EU context, rendering the cooperation more result-oriented and legally binding. One of the objectives of the strategy is to improve coordination of activities and, in a nutshell, coherence. The EUSBSR is seen as a tool which creates an opportunity for regional organizations and the EU to enhance their cooperation and to create synergies in order to tackle global economic challenges (Baltic Development…, 2012, p. 57).

The main task of identifying regions implies making judgments about the degree to which a particular area, in various respects, constitutes a distinct entity, which can be distinguished as a relatively coherent territorial subsystem from the rest of the global system (Hettne and Söderbaum, 2000, p. 461). Dubois *et al.* (2009, p. 17) note that the definition of a (macro-)region is related to the exercise of how to define a region regardless of the prefixes (macro, micro, meso, sub-national, etc.) used. The term 'region' can refer to anything from an administrative unit to a functional area. According to the EC definition, a macro-region is "an area including territory from a number of different countries or regions associated with one or more common features or challenges" (EC, 2009b, p. 1). However, Bialasiewicz *et al.* (2013, p. 62), in a discussion about the sceptical idea of creating trans-European macro-regions, argue that, in fact, the EU intends macro-regions as agglomerations of (micro-)regions. So that countries or their agglomerations, which form a macro-region (for example, the BSR), may demonstrate heterogeneity within the region in terms of their features and challenges.

In the thesis, a macro-region presents a political construction/space for the implementation of regional policy. The roots of macro-regionalism lie in the discipline of international relations, and it is often associated with implementation of a programme or strategy on the macro-regional level. Such strategies assume involvement of more than two countries and are aimed at sustainable development of the region through solving common problems and increasing its competitiveness on the global level. The concept 'macro-region' is central to the EU's political debates and has become a new style of territorial governance, which incorporates principles of integration, coordination, cooperation, and multilevel governance (CPMR General secretariat, 2012, p. 1; EC, 2013a, p. 3).

Recently, the macro-regional perspective has been projected by the EC from the BSR onto other European spaces: the Danube macro-region has been instituted, and other initiatives aimed at macro-regionalization have been envisaged, from the Adriatic to the Alps, to the western Mediterranean, the English Channel and the North Sea (Bialasiewicz *et al.*, 2013, p. 60). Hettne and Söderbaum (2000, p. 465) note that the process of macro-regionalism creates possibilities for smaller, economically dynamic sub-national or transnational regions to get direct access to the larger regional economic system, for example, the BSR to the "Blue Banana" area and the Mediterranean macro-region. From the perspective of geo-economy, the spatial location and transport potential of the BSR is of special importance in its mutual linkages with the so-called Blue Banana area, which is considered to be the major European economic development axis and "more or less homogeneous economic zone in the EU" (Hospers, G.J. 2003, p. 76).

In the case of the BSR, the EUSBSR offers better integration of the member states that joined the EU in 2004 into the EU single market. Some scholars (e.g., Hernandez *et al.*, 2009; Salines, 2010; Bialasiewicz *et al.*, 2013) focus in their studies on the problem of inequalities and heterogeneity within macro-regions. Thus micro-regions, which inevitably appear within a macro-region, can demonstrate differences not only in their development processes, but also in the nature of problems they tackle with and tools they use for solving them. In this respect, Herrschel (2009) has studied the formal and informal nature of regions, pointing out that in the EU, a 'region' is usually associated with a certain structure, distributed power or structural policy; consequently, it is of 'formal' nature (Ibid., p.280). However the problem of 'informal' region is of great importance – the dominance of cluster policy in regional strategies creates favourable conditions for shifting a region towards its 'informal' character (II, III).

Within the scope of the thesis the author investigates **the impact of the EUSBSR on the creation of an effectively functioning macro-regional transport system, which is the declared priority of the strategy**. This priority is very closely linked with integrated marine policy, maritime safety packages and the 2011 White Paper, which represents the view of the European transport policy, claims that divergent national priorities and the fragmentation of the transport market continue to negatively affect the quality of transport services in Europe (EC, 2013a, p. 14). Thus the problem of heterogeneity in transport sector is urgent.

1.3. The role of clusters in macro-regional cooperation

The structural transformation in transport, which started with the creation of the Single European Market in the early 1990s, in line with the further expansion of the EU to the west, has turned the Baltic Sea into a macro-regional transport cluster of the EU, increasing its role in international trade, economics and politics.

Clustering as a contemporary and widespread way to optimize business activity has been in the focus of researchers for decades. The evolution of clustering as a concept proceeds from its application to different fields of study, the most important of which are economics, geography and regionalism (Lazzeretti *et al.*, 2014).

Before the term 'cluster' came into use, researchers utilized the concept of 'industrial district', which was first described by Marshall in 1890 as the characteristic tendency of enterprises belonging to the same sector of economy to concentrate within certain geographic areas and was expanded into the concept of 'district' in 1920 (Marshall, 1920; Garanti, 2013; Lazzeretti *et al.*, 2014). 'The concept of 'district' has evolved over time under the influence of such theories as transaction cost theory, cluster theory, new economic geography theory, regional innovative system theory and regional cluster theory. Michael Porter (1998), the founder of the modern cluster concept, defines cluster as "a geographic concentration of interconnected companies and institutions in a particular field, suppliers of specialized inputs and providers of specialized infrastructure in a particular field, including governmental and other supporting institutions". Porter explains that the reasons for clustering grow directly out of the determinants of national advantage and are a manifestation of their systemic character. One competitive industry helps to create another in a mutually reinforcing process. (Porter, 1990, p. 148).

Within macro-regional cooperation, the cluster process is usually stimulated externally by intergovernmental authorities. Such clustering is of 'formal' character. Governments can nurture the development of innovative clusters primarily through regional and local policies and development programs, and by providing the appropriate policy frameworks in areas such as education, finance, competition and regulation (Rebitzer, 2007; Herrschel, 2009).

Garanti (2013, p. 26) defines regional cluster as an "informal form of cooperation and interaction between companies in the same industry, involving related and complementary businesses, scientific, educational and government and other related institutions in the same region". The researcher uses two contradicting constituents – namely, 'informal form of cooperation' and 'government'. Within the thesis, the formal nature (government involvement) of the cluster is a key precondition for the sustainable development of the macro-regional transport cluster. The dominance of informal clusters established on the basis of only business relations is dangerous for a region for three reasons: (1) business clusters have an informal character, which (2), as a rule, is time-limited, and (3) they tend to operate outside government hierarchy (Herrschel 2009, p. 276). Sheffi (2013, p. 485), who studies particular type of clusters - logistics-intensive clusters, which usually develop around transportation hubs also highlights a crucial part of government and natural environment (geographical location) in any logistics cluster's operation and success.

Thus, the concept of 'cluster' is tightly related to the concept of macro-region, which is based on similarities shared by the countries of the region. In the thesis, the BSR is approached as a formal macro-regional transport cluster

which is defined by the author as a geographical concentration of transport actors in the region, characterized by (1) the formal regulation on behalf of the EU within EUSBSR; (2) homogeneity in the development of physical infrastructure; (3) homogeneity in transport sector performance; and (4) similar behavioural pattern at different stages of the economic cycle. It would be a mistake to deny the importance of business clusters in macro-regional development, so the author is of the opinion that in order to provide a stable competitive position of the BSR in the global transport market, the formal and informal sides of a macro-region must coincide, whereas the former should predominate (III).

2. METHODOLOGY AND DATA

2.1. Research design

The focus of present thesis is studying the BSR transport sector as transport cluster, naturally formed on the macro-regional level. The author argues that the cluster concept is very closely linked with the concept of macro-region, which is based on homogeneous features of countries involved in it. In the present thesis the BSR is studied as a macro-regional transport cluster, consisting of micro-blocs which have similar economic power/potential, infrastructure development level and positioning relative to core national and international transport corridors.

Conclusions arrived at in the theoretical part allow setting up the following tasks:

1. To confirm the importance of the concept of macro-regional development for the BSR transport sector from the perspective of:
    a. macro-regional infrastructure development within the TEN-T system;
    b. macro-regional cluster collaboration in the BSR transport sector;
    c. the BSR's competitiveness in transhipment of cargo flow to/from Russia, the CIS countries, and China.
2. To identify the pattern of the BSR transport sectors' response to the fluctuations of global economy;
3. To determine the direction of further development of the BSR macro-regional policy.

To complete the tasks, the author used sequential mixed research design with the purpose of expanding the systems theory to the transport sector on a macro-regional level.

Publications I-II represent the qualitative phase of the research, which was conducted first. The most important findings from these publications were applied to drive the second, quantitative analysis phase (II-III). Qualitative analyses are predominant in the research. The overview of the research methodology is presented in Table 1. The databases used for finding relevant theoretical literature were: Google Scholar, EBSCOhost Web, Emerald, ScienceDirect, Scirus, and ebrary. The first three databases were also used for finding academic publications and dissertations published in the field of transport and, in addition, the Emerald and Blackwell databases were used.

Table 1. Research methodology

Research activity	Methods used	Article	Results
Study of literature	• Search terms in databases • Backward snowballing	II , III	• Interdisciplinary connections were set up • Theoretical framework for the research was identified 　• Systems theory 　• Regionalism 　• Cluster theory
Analysis of secondary studies	• Search terms in different databases • Forward and backward snowballing	I, II, III	• Elaboration on previous research results • Choice of methodology • Identification of the strengths and weaknesses of the BSR transport sector, incl. legislation issues • Factors influencing the transport activity of the region were identified
Quantitative data collection	• Textular method • Tabular method	II, III	The sample for further data analyses was formed: • In the period 2004–2012 • Included 17 attributes for 8 countries (cargo volume of road, rail and maritime transport modes, transit volumes, GDP; exports; imports; production change in industry; population; investments in road, rail and port infrastructure; gross value added in trade, communication and transport services, rail infrastructure density, Logistical Performance Index LPI, 'Specialisation' criterion)
Data analysis	• System analysis • Statistical analysis • Content analysis • Hierarchical cluster analysis • Correlation analysis • Bayesian analysis • Affinity analysis	II, III	• Display of results • Formation of clusters • Validating the interconnectedness between cargo flows and factors influencing them

Source: author's compilation

The World Bank online database, European Commission reports, EUR-Lex and International Transport Forum, Transbaltic and Cluster Observatory online databases were used as sources for gathering recent political papers, directives and project papers connected with the EU transport policy, mainly for conducting qualitative analyses.

2.2. Data collection

Quantitative data was collected mainly from the Eurostat, OECD, World Bank and Cluster Observatory databases. For gathering specific statistical data which was not included in the abovementioned databases the author used textular method to acquire data from the reports of International Transport Forum and OECD database, and separate political reports such as the State of the Region Report (2013).

In order to predict future changes in the economy in response to changes in transport activity, the author, applying the HCA, collected statistical data on two economic indicators for each BSR country: GDP and exports in the period 2004–2011.

To evaluate the correlation between the volumes of cargo flows and economic indicators, the author collected statistical data (in addition to GDP and export) on import volumes (million eur); production change in industry (%); population; investments in road infrastructure (million eur); investments in rail infrastructure (million eur); investments in port infrastructure (million eur); gross value added in trade, communication and transport services (%), road and rail infrastructure density (km/km^2) for each BSR in period 2004–2011. Export and import volumes include both intra- and extra-EU trade volumes.

The LPI 2012 obtained from the World Bank survey represents freight forwarders' estimation of a country's supply chain's efficiency in cost, time, and reliability. All in all, 155 countries participated in the survey. The ratings are based on 6,000 individual country assessments by nearly 1,000 international freight forwarders, who rated the eight foreign countries their companies serve most frequently (Arvis *et al*., 2012, p. 1). The author used LPI components as cluster-specific factors of the region.

To identify formal micro-, meso- and single transport clusters, the author collected statistical data on cluster indicator 'Specialisation' (known as Location Quotient, or LQ) for each BSR country's transport sector (including distribution, maritime and transport and logistics (T&L) cluster categories) in the period 2007–2011. The 'Specialisation' measure compares the proportion of employment in a cluster category in a region over the total employment in the same region, to the proportion of total European employment in that cluster category over total European employment (see Cluster Observatory). This metric could be calculated on the basis of different measures of economic activity (productivity, value added, etc.). Taking into account that statistical data is not available for some countries, the author followed the methodology of Cluster Observatory and use of employment for identifying regional clusters.

2.3. Data analysis

For the analysis of the BSR as an open system the author conducted qualitative (system and content analysis) and quantitative analyses (statistical, HCA, correlation, Bayesian and affinity analyses). The main tools used for data analysis as well as for the display of results were: Microsoft Excel, SPSS, B-Course, a web-based tool for Bayesian data processing, and data analysis software Weka. Microsoft Excel was used for (1) the display of initial data in the form of graphs and tables, and (2) the transformation of the initial data for its further use in SPSS, B-Course and Weka software.

The main tool for analysing the BSR transport activity was HCA, conducted by means of the SPSS software using Ward's method as a criterion that minimizes the total within-cluster variance (II, III). HCA is a statistical method for finding relatively homogeneous clusters of cases on the basis of measured characteristics. Cluster analysis is used as a tool of statistical analysis in many disciplines: biology, psychology, social science, regionalism, transport and logistics, machine learning, data mining, etc. (Tan *et al*., 2006, p. 487). The idea of hierarchical clustering lies in identification of each object initially as a single cluster (or, in this case, country). Then, in multiple iterations, the two nearest clusters are merged into a bigger one (micro-bloc/region). After a few iterations, the algorithm reaches the final cluster structure (macro-bloc/region/BSR).

The clustering method uses the dissimilarities or distances between objects when forming the clusters. A hierarchical tree diagram, called a dendrogram on SPSS, shows the linkage points, so that the clusters are linked at an increasing level of dissimilarity. The goal of the clustering algorithm is to join objects together into successively larger clusters, using some measure of similarity or distance. (Burns and Burns, 2008, p. 565)

In the scope of the HCA conducted in the thesis, transport activity is presented in cargo volumes handled by modes of rail (in tonne kms), maritime (in tonnes) and road transport between 2004 and 2011. The period was divided in three sub-periods: the period 2004–2007 reflects the economic growth stage of the economic cycle, 2008–2009 represents the crisis stage, and 2010–2011 the recovery stage (II). HCA was conducted also for the identification of employment-intensive transport clusters, the LQ indicator was analysed between 2007 and 2011 (III).

In order to analyse factors influencing the volume of cargo flows in the Baltic Sea Region across eight years, correlation analysis, Bayesian analysis and affinity analysis were applied.

Initially, the author chose 11 factors (independent variables), which may have had an impact on the BSR cargo flows (dependent variable). The total cargo flow for each country consists of cargo volumes handled by rail, maritime and road transport (in tonnes). After data reduction, only ten factors were included in the analyses: Gross Domestic Product at market prices; export volumes; import volumes; production change in industry; population; investments in road infrastructure; investments in rail infrastructure;

investments in port infrastructure; gross value added in trade, communication and transport services and rail infrastructure density. Due to the unavailability of statistical data about Latvia, motorways' density had to be excluded from the dataset. Thus, the sample for analysis was 72 country-years as cases (II).

2.4. Limitations

In the thesis, the BSR is studied as a formal macro-region around the Baltic Sea, which consists of eight European countries and one non-EU country: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, and Norway (EC, 2009a, p. 5). According to the EC definition of the region, only the northern parts of Germany and Poland are officially included in the BSR, whereas the statistical data (with the exception of LQ) used in the thesis covers the full territories of the countries. This limitation derives from the lack of accurate statistical data on the transport performance of the northern parts of the countries.

The second limitation concerns the statistical data on cluster indicator (LQ) which was not available for some countries, so the time frame of this part of analysis is the years 2007–2011. Despite the fact, this period still includes data on the stages of growth, crisis, and recovery of the economy, and allows clustering on the basis of LQ dynamics.

The third limitation is connected with two non-EU countries – Norway and the Russian Federation are of a great importance in terms of comprehensive implementation of the EU macro-regional policy. Both are the EU's trade partners and suppliers of energy resources, shipbuilders and fleet owners. Norway is included as part of the BSR in the scope of the thesis, while the inclusion of the Baltic Sea Russia in the geographical coverage of the BSR's definition has proved impossible in correlation, Bayesian and affinity, and partly HCA analyses, due to the unavailability of required statistical data (with the exception of LQ). However, the author does not exclude this country from the research scope.

The fourth limitation concerns the selection of transport modes for the analysis. Air and pipeline transport modes are excluded from the research. Despite the fact that cargo volumes transported worldwide by air transport are increasing every year, the performance of the BSR airports still remains relatively low. Pipeline transport (i.e. Nord Stream), in turn, services a limited range of products – namely, natural gas – and the use of its capacity and its development depends more on bilateral contracts between the EU and the Russian Federation.

3. RESULTS

3.1. The concept of macro-regional development as a key tool for ensuring sustainability of transport infrastructure

European Single Transport Policy became the official aim of the European Community in 1958, but cooperation in this field until the 1990s had been impeded by the unwillingness of the Member States to open their transport markets to develop a single transport policy. The European Union's Treaty was a meaningful step towards intergovernmental cooperation in transport policy, through the creation of a Single TEN-T.

Despite the fact that during the last two decades all national transport markets have been gradually opened for competition in road, maritime, inland water, air and rail sectors, Europe's transport system is currently viewed as an inefficient patchwork of different national networks, the major bottlenecks of which are the following (EC, 2011a):

1. Europe's railways currently have to use seven different gauge sizes;
2. Only 20 of the major airports are directly connected to the European rail network;
3. Only 35 of the major ports are well connected;
4. Weak organization of national border crossings.

Currently in accordance to the 2011 White Paper for the European transport policy, TEN-T is expected to contribute to a wide range of goals, including the sustainable mobility of persons and goods and the enhancement of both the internal market and the global competitiveness of the Community. Sustainable development of the TEN-T network is aimed at ensuring territorial, economic and social cohesion, social welfare, safety and security for European citizens, taking into account environmental aspects, such as climate change, pollution and protected areas. (Bothnian …, 2013, p. 5; EC, 2011c).

The 2011 White Paper for the European transport policy underlines that the connection of the TEN-T through regional transport network with the networks in Central Asia would respond to future traffic flows and facilitate alternative routes between Europe and Asia. Such networks should also include maritime-based intermodal freight transport connections with the neighbouring countries and between them. (Transbaltic Policy Report, 2011, p. 7).

In October 2011, the EC adopted a proposal to transform the existing patchwork of European roads, railways, airports and canals into a unified transport network. Its aim is to focus spending on a smaller number of projects where real EU added value can be realized. The new core network would remove above-mentioned bottlenecks, upgrade infrastructure and streamline cross-border transport operations for passengers and businesses throughout the EU, creating a Single European Area. It also aims to improve connections

between different modes of transport and contribute to the EU's climate change objectives. (EC, 2011a, p. 1)

In order to facilitate the implementation of the core network, the 'corridor approach' will be used. This instrument will help to coordinate and synchronize different projects ('formal' and 'informal'/business as well) on a macro-regional basis. Core network corridors shall provide for a coordinated approach with regard to infrastructure use and investments, so as to manage capacities in the most efficient way (EC, 2011b, p. 42).

In accordance to the EC, the core network corridors shall involve at least three modes of transport and at least three Member States. Each Member State participates in at least one corridor. The corridors cover the most important cross-border long-distance flows in the core network. In duly justified cases, the core network corridor may involve only two modes of transport. (*Ibid.*)

Currently, the BSR transport infrastructure is used to ship goods from the west to the east, as well as from the south to the north, and vice versa. In the following, the author brings out the major transportation corridors which cross the territory of the BSR and cover all modes of transport (rail, road, ports and air transport):

1. *The Baltic-Adriatic Corridor* is an intermodal development corridor, which runs from Scandinavia to the Mediterranean/Adriatic region. This corridor supports an integrated spatial, economic and infrastructural development in a country-crossing manner in the European context. Two Interreg-IV-B projects, SCANDRIA (in the northern part) and SoNorA (in the southern part), closely connected with each other, are being implemented within the Baltic-Adriatic Corridor. (Joint Spatial…, 2014). The corridor countries are Austria, the Czech Republic, Italy, **Poland**, and Slovakia.
2. *The North Sea-Baltic Corridor* stretches from the North Sea ports through Poland to the border of Belarus and to the Baltic countries as well as to Finland. The key project is Rail Baltica. The corridor countries are Belgium, Netherlands, **Germany, Poland, Lithuania, Latvia, Estonia and Finland**. (EC, 2014)
3. *The Scandinavian-Mediterranean Corridor* extends from the Finnish-Russian border, through southern Sweden, Norway, Denmark, Germany, Austria to Italy and Malta. The key projects are the Fehmarnbelt Fixed Link and the Brenner Base Tunnel.
4. *The Helsinki-Valletta Corridor* is the longest of the 10 TEN-T Core Network Corridors. It links major urban centres in Germany and Italy to Scandinavia and the Mediterranean whilst crossing seven different Member States – **Finland, Sweden, Denmark, Germany**, Austria, Italy, and Malta. (Trans-European Transport Networks, 2014)
5. *The Pan-European Transport Corridor I* runs from Poland to Finland. The corridor countries are **Finland, Estonia, Latvia, Lithuania and**

Poland. The major projects within the corridor are Via Baltica and Rail Baltica.

6. *The Pan-European Transport Corridor IX*, which provides the transportation of transit goods between ports located on the shores of the Baltic Sea, the Black Sea, and the Caspian Sea. This transport corridor provides external links for the EU, Russia and Turkey. Countries involved in the corridor are Greece, Romania, Moldova, **Finland, Lithuania, Russia**, Ukraine and Belarus.

7. *The East-West Transport Corridor II* (EWTC II) is a continued development of the successful East West Transport Corridor and it runs from Denmark to Belarus. This corridor has, due to its geographical location and the possibilities for clustering traffic volumes, great potential for developing cost-efficient services. Countries involved are Belarus, **Lithuania, Poland, Sweden, Germany, and Denmark**. (East West Transportation…, 2013)

Until 2007 the maritime infrastructure of the Eastern part of the BSR used to be a good and perspective object for foreign direct investments, especially from the Russian Federation, which as a main supplier of cargo to the EU and the main client of the Baltic transport system tended to effectively allocate its financial resources and its presence in the sector. On the one hand the favourable geographical location of the Baltic States and Poland is usually seen as the main contributing factor to the competitiveness of the transport business in these countries, but on the other hand, the countries' relatively narrow specialization and significant dependency on Russian cargo has decreased their competitiveness in the international market, especially during economically and politically unstable periods (Kirch *et al*., 2011, II). The direction of Russian transit flow depends on bilateral political relations between Russia and each BSR country. Since 2012, Russia has actively started to redirect its cargo flow from European Baltic ports to its own terminals, situated on the Baltic coast of Russia (Kirch *et al*., 2011). The increasing role of the existing customs union between Russia, Kazakhstan and Belarus, and the war in Ukraine influence not only international trade balances but also the transport sector, mainly maritime and railway transport, which remain the traditional modes of transport, fully operating in the world community for transporting oil, oil products, coal, and other resources of energy (Nežerenko, 2010, p. 53).

The increasing role of BRICS, especially of Russia and China, is widely discussed as a key symptom of the changing patterns in the global economy. Russia is the main supplier of energy resources for the EU. China is not only an increasingly central competitor for locations anywhere in the world, it is also a major market. The EU and China represent two indispensable anchors of international trade. Since external trade used to be the driver of economic growth in most countries (including China), there is a direct relationship between (sustainable) growth and (sustainable) export orientation (Inotai, 2011, p. 13).

In order to develop the BSR as a gateway for traffic between Asia and Russia on the one hand and Europe on the other hand, it is vital to optimize the present transport network in the BSR and the links to the neighbouring countries through a proper infrastructure's capacity enlargement. The fact that **transport network in different parts of the region varies in its quality** as well as capacity calls for special attention (I).

Every two years, the World Bank conducts Logistics Performance Index (LPI) surveys to measure the performance of on-the-ground trade logistics, providing feedback on the logistics 'friendliness' of the countries in which global freight forwarders and express carriers operate and those with which they trade. The LPI is an indicator of the quality of supply chain delivery and reflects the perspective of the global private sector on how countries are globally connected through their main trade gateways. The LPI consists of six components (Arvis *et al.*, 2012, p. 7):

1. The efficiency of customs and border management clearance (speed, simplicity, and predictability of formalities);
2. The quality of trade and transport infrastructure (ports, railroads, roads, information technology);
3. The ease of arranging competitively priced shipments;
4. The competence and quality of logistics services (transport operators, customs brokers);
5. The ability to track and trace consignments;
6. The frequency with which shipments reach the consignee within the scheduled or expected delivery time.

In Figure 3 the score results of each component of the LPI for the BSR countries are presented.
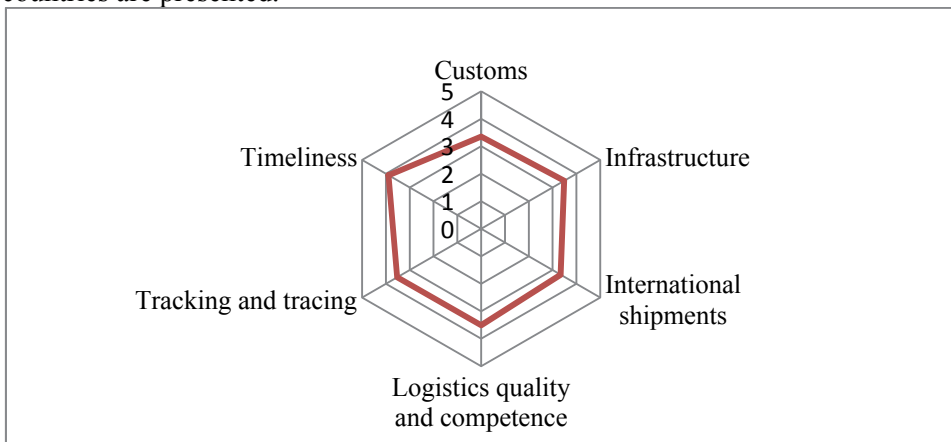

Figure 3. The BSR's overall LPI results in scores, 2012
Source: author's calculations based on Arvis *et al.*, 2012, p. 7

The score of the organization of international shipment (3.34 points) is the lowest in the region, while timeliness (3.89 points) yielded the best results. The overall delivery quality of the BSR as supply chain is 3.52. The low levels of infrastructure quality in Poland, Lithuania, Estonia and Latvia are confirmed by the EC in the 2011 White Paper, in which the problem of the eastern isolation of the BSR is the focus of the EU single transport policy (EC, 2011c, p. 14). Thus the reduction of the BSR transport network's bottlenecks, the development of its vital parts and updating its organizational approaches to an agreeable standard are of great importance. Support from all levels – macro-regional, regional, national, regional and local level – is needed to ensure that the development proceeds in the set direction of establishing an efficient and well-functioning transport network, whereby all modes of transport are utilized, each at their best capacity. Systems view on transport, discussed by the author in Chapter 1, identified the significant impact of political and legal factors (I) on the development of the international supply chain network.

Despite the fact that in the context of macro-regional programs it is common to speak about cooperation, a country's ability to capture a share of the international transport market (i.e. competitiveness) is often seen as vital to its sustained growth and solid position on the market. Lumiste and Prause (2010, p. 19) distinguish between two dimensions of competition in transport sector:

- competition for investment resources;
- competition for cargo or need to maximize the infrastructure utilization.

In terms of investment competition, all projects in transport sector compete with each other. For example, the Riga-Moscow fast train competes with Rail Baltica vision. As far as cargo is concerned, there are different existing and potential routes for delivering goods from Finland, Estonia, and Latvia to Germany, Central Europe, Mediterranean Sea ports, and the Black Sea. Well-developed port infrastructure in Finland, Estonia and Latvia allows easy transport to Rotterdam, Hamburg, Lübeck, Bremerhaven, and other ports. In addition to sea transport there also exist alternative routes by railway and roadway (*Ibid.*). Thus, competition for investment resources and cargo flows is accompanied by competition between different modes of transport and countries as well.

Considering the geopolitical location of the Baltic States and the concentration of rail freight traffic in this part of the BSR on the movement of Russian exports to seaports for further export, the political and economic decisions of the three main actors of the region (EU, Russia and China) may affect the region's railway sector, reducing the competitiveness (as well as quality) of the BSR transport system as an international supply chain, which is as strong as it's weakest link. (I, III)

The EU is aware of the creation of a Single European Railway Area, which assumes harmonization of conditions for access to the infrastructure and safety rules, standardization by means of technical specifications for interoperability, creation of freight corridors, and increase of investments into infrastructure

(Nežerenko and Koppel, 2012). **The problem of low levels of public and private investments into railway sector** is common for many EU Member States. In four countries of the BSR – Poland, Lithuania, Latvia and Estonia – infrastructure managers to finance their investments, maintenance and development needs use revenues from infrastructure charges.

The problem of these countries lies in insufficient investments volume which would be needed for implementing the projects and targets mentioned in the 2011 Transport White Paper (for example, Rail Baltica). The state budget of these countries may not have sufficient funds for financing railway infrastructure in the suggested volume, putting obstacles in the creation of the single EU transport cluster. Insufficient public funding results in reducing the attractiveness of railway sector both for incumbent and new operators. Thus, the competitiveness of certain freight corridors may be affected not only by external factors (such as politics or economics) but by ungrounded national decisions as well, for example, in implementing certain railway infrastructure pricing methods, as has been done in the Baltic States. To cover the needed investments in rail infrastructure, maintenance and development, these countries earn revenues from infrastructure charges imposed only on freight operators, leaving passenger operators in a privileged situation. (I)

3.2. Cooperation within international informal clusters

Cooperation in the BSR entered the stage of intensification at the beginning of 2009, when the EUSBSR was launched on the initiative of Sweden. Numerous projects and clusters dealing with regional growth helped to achieve a certain stage of coordination and complementarity crosswise countries around the Baltic Sea not only in transport, but also in research, technology and innovation. Within the strategy, the EU has developed an important system of political methods for reinforcing macro-regional cooperation in order to face economic challenges by working together as well as promoting a more balanced development in the area.

In this section, the author focuses on the 'informal' clustering element of this political system. Cluster policy has already shown positive results in creating the BSR macro-regional specialization in the ITC sector (II). Cluster policy as the approach for fuller integration of the BSR countries has great potential in the development and alignment of transport policies at various tiers of governance, but the transport sector is still facing some challenges.

The results of the analysis of transnational experience in the cluster policy of the BSR cooperation show that at least two main challenges deserve attention. One is connected with the **prevailing tendency to form transport and logistics clusters on a national level** (e.g., Estonian Logistics Cluster, Latvian Logistics Cluster, etc.), the so-called business clusters of informal character (III). These national clusters within the BSR are connected in many ways, although each has its own fields of specialization, production structures and other national cluster specifics. The advantage of informal cluster lies in the

presence of stakeholders from different modes of transport and related/supportive business sectors, as well as of public actors, bank, media and educational sectors. Its disadvantage lies in the absence of a proper/intensive transnational cooperation between national clusters, because competition predominates here. At the same time, those countries which have a relatively strong competitive position in the macro-region and bilateral linkages (Germany-Sweden, Sweden-Finland) tend to be significantly more actively involved in international projects/clusters, leaving behind countries that are less so (Latvia, Estonia). In this respect, public policy is an instrument designed by the authorities to stimulate the formal clustering process (Wijnolst *et al.*, 2003, p. 91).

Nevertheless, macro-regional business clusters have been successfully established in the maritime sector. One of the first books to discuss the need to create a continent-wide cluster in the EU maritime sector was by Wijnolst *et.al.* (2003), who assumed that the maritime sector in Europe might benefit from this organizational form. Such views on the further development of transport sector required intensification of national and international cooperation and integration on policy level and on the business level. Unfortunately, today the creation of a continent-wide cluster is too far from reality but the maritime sector in its development has already demonstrated cluster orientation (III).

Considering the fact that the BSR's maritime infrastructure is a core network of the region, the perspectives and issues of maritime clusters are in a special focus of governmental and non-governmental organizations, which conduct numerous studies and projects such as StarDust (MarChain) and SmartComp, etc. (II). According to the mapping made in the course of the MarChain project (at the end of 2013), the BSR's maritime cluster comprises the total of 11,900 companies with 211,500 employees (StarDust, 2013, p. 2). This is undoubtedly a positive outcome in a new way of cooperation on a macro-regional level. But here arises the second challenge – **the absence of macro-regional clustering experience in railway and road transport.**

In terms of rail sector, however, the Rail Baltica project can not be ignored in this discussion. Rail Baltica is the main and the most ambitious project launched in the region, which connects the three Baltic States and Poland in a north-south direction. The project clearly demonstrates genuine added value of regional cooperation supported by the EU budget (Barroso, 2014). Implementation of the project is impeded by organizational problems, which hinder participants from proceeding with coherent actions and sometimes puts the project's viability under the question. In the author's opinion, shifting the project to the level of cluster policy could prove to be a good solution to improve collaboration between the participants.

Despite the fact that the cluster model of cooperation is relatively new in the region, numerous international projects have been conducted in the transport sector in the period 2009–2014 such as Baltic Transport Outlook 2030, East West Transport Corridor II, Rail Baltica Growth Corridor, StarDust, SmartComp, SCANDRIA, TransBaltic, TransBaltic Extension and BSR

TransGovernance. These initiatives can be presented as umbrella projects which cover countries randomly, regardless of the countries' transport sector performances, LPI, and involvement in TEN-T corridors.

The transnational project TransBaltic and TransGovernance projects deserve a special attention. TransBaltic was led by the Swedish region of Skåne, devoted to transport and regional development and co-financed by the EUBSR program. TransBaltic was set up to tackle the issues of insufficient interoperability in robust transport networks and logistic patterns around the Baltic Sea, regarded as an important barrier to economic prosperity and growth in the Baltic Sea Region (TransBaltic, 2012a, p. 3). This, in line with growing transcontinental cargo flows bound for the region, makes the market players look forward to securing sufficient capacities.

According to the vision of TransBaltic, the future integrated transport system within the region will efficiently serve the trade exchange among its countries as well as between the BSR and the world. The idea behind this concept is to create corridors of excellence, carrying concentrated volumes of long distance international freight.

The BSR TransGovernance focuses on developing and testing joint planning and implementation frameworks for transport policies at levels which have witnessed a long process of cooperation across national borders with involvement of the public/private stakeholders, and/or which have contributed to the multilevel governance policy. The mentioned levels are Macro (the overall BSR area), Meso (cross-border integration areas), Corridor (transnational multimodal transport corridors) and Micro (intermodal transshipment nodes).

The author considers this model of international cooperation as a useful one for further explaining cluster approach in the organization of the BSR transport sector. In result of research (II, III) the author proposed a cluster approach, which is essentially the organization of macro-regional transport system on the basis of cross-border cluster cooperation, taking into account the real potential and threats of the region, which would provide a balanced use of the existing and potential capacity of national transport systems' infrastructure.

3.3. Dynamics for the macro-regional transport sector

Section 1.2 discussed the reciprocal influence of the transport system and its external environment. In theory, it is common to name the factors which may have either a positive or a negative effect on the transport system. In this section, the author presents the results of a statistical analysis which aimed to identify the factors which have had an impact on the BSR transport system performance, expressed in handled cargo volume. Tested by correlation analysis, Bayesian analysis and affinity analysis, these factors are presented in Table 2.

Table 2. Factors tested on the level of their influence on the overall cargo volume of the BSR

Internal system	External system
1. Investments in road infrastructure; 2. Investments in rail infrastructure; 3. Investments in port infrastructure; 4. Gross value added in trade, communication and transport services; 5. Rail infrastructure density.	1. Gross Domestic Product at market prices; 2. Population; 3. Export volumes; 4. Import volumes; 5. Production change in industry.

Source: compiled by the author

The correlation analysis showed that there are three factors which have significantly influenced cargo volumes handled in railway, maritime and road transportation sector of the Baltic Sea Region: export volumes, import volumes and production change in industry. All the three factors belong to the external environment of the transport system.

In the group of internal system (transport system) remain factors contributing to the capacity and quality of transport infrastructure – investments into rail, port and road infrastructure, which are considered by many countries as a tool to accelerate the economy (Lumiste and Prause, 2011, p. 16). The analysis showed the strongest correlation between 'cargo volumes' and 'road investments' and 'port investments'.

Systems view on the results allows determining the interrelation of independent variables. Thus, a strong correlation can be observed between 'GDP' and 'investments' into road and rail infrastructures, as well as between 'imports' and 'investments' into rail and road infrastructures. The latter two have led to the growth of macro-regional trade.

Despite the fact that maritime sector is considered to be one of the main EU transport priorities, the analysis demonstrates that investments into port infrastructure did not significantly affect 'exports' and 'imports' in the period 2004–2011. Thus it can be concluded that the level of rail and road infrastructure development has played a more important role in the BSR recovery process by supporting first of all the internal market of the region in contrast to maritime infrastructure, which specializes mainly on handling extra-EU cargo flows. It is also important to delve deeper into the nature of port investments. Firstly, investments into maritime infrastructure are of a long-term character; secondly, port terminals are more specialized in comparison to rail or road terminals, and require finding of a steady cargo flow for loading its capacity at a maximum level.

The output of Bayesian analysis is presented by the model of joint probability distribution, which was chosen as a more suitable one for validating the interconnectedness of the variables within the scope of the study (II). The analysis confirms the main finding of the correlation analysis and determines

extremely significant dependencies between 'imports' and 'GDP' and between 'imports' and 'exports' (see Fig. 4).
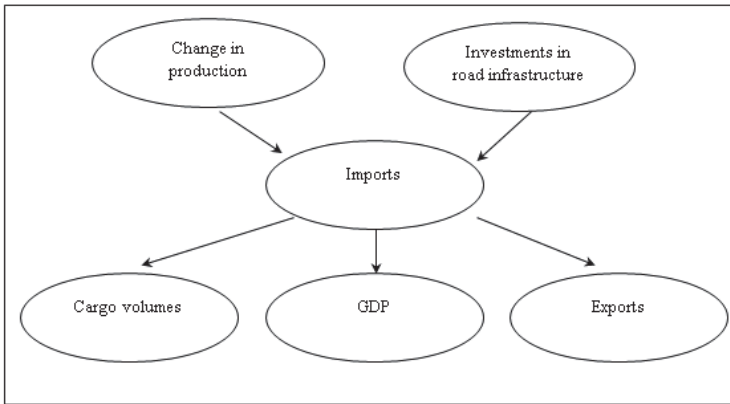
Figure 4. The model of joint probability distribution for the BSR in the period 2004–2011 (II)

The 'naïve model' constructed within the analysis demonstrates that there are latent variables outside the model, influencing simultaneously through 'changes in production' and 'investments in road infrastructure' also 'imports' (see dashed lines). Imports, in their turn, have a direct causal impact on 'cargo volumes' (see Fig. 5).
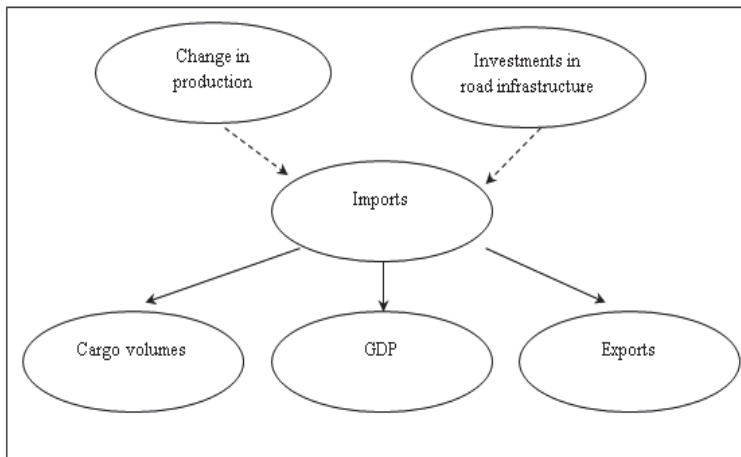
Figure 5. Naïve casual model for the BSR in the period 2004–2011 (II)

In the author's opinion, the latent variables may be connected with international policy, which remains outside the scope of this thesis. Economic sanctions against Russia affect the economies of contiguous countries through the main subsystems of national economies, such as industrial production, banking sector, transportation, etc. Thus the latent variable could be the dominant one in

the context of external environment influencing cargo volumes.

The output of the affinity analysis confirmed the results of both previous analyses – three independent variables ('GDP', 'imports', and 'exports') had the highest (non-probabilistic) frequencies based on the co-occurrences of their changes (II). Thus, correlation, Bayesian and affinity analyses showed that the BSR transport and its economic potential depend on international trade, production in industry, as well as on sufficient investments into road and rail infrastructure.

3.4. Towards formal clustering process

The problem of ignorance of the countries' diversity within a macro-region is confirmed by the fact that such approach has been criticized in a strategy for innovation for the BSR (Technopolis group, 2011, p. 5).

In this section the author presents results of HCA (II, III), used to identified the dynamics of the BSR countries' cargo turnover in order to find similarities in transport sector development (at different stages of the economic cycle as well). Below the author conceptualizes cluster approach implemented on the BSR transport sector (see Fig. 6).
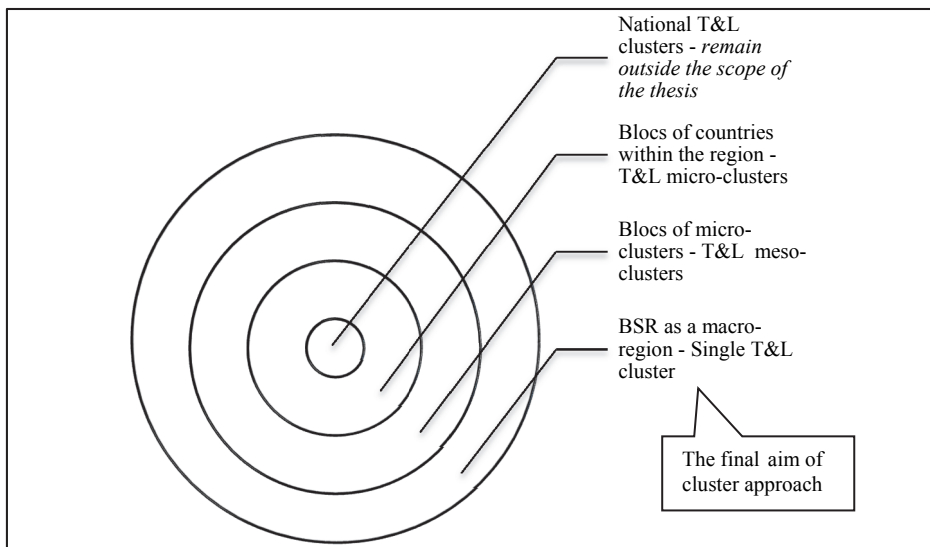

Figure 6. Conceptualization of cluster approach
Source: conducted by the author

HCA resulted in the formation of three levels of clusters: micro-, meso- and macro-regional clusters. Transport micro-clusters are agglomerations of the BSR countries with similar trends in transport sector. Two nearest micro-clusters merge sequentially into meso-clusters. The final or single transport

cluster consists of all micro-clusters within the region, thus this cluster was discussed as a macro-regional cluster.

The main significance of cluster analysis lies in its ability to divide countries into blocs/micro-clusters, which reveal the unequal conditions under which countries operate in the transport sector, delaying the creation of a single BSR transport sector.

In the following, the author presents the main findings of this empirical part of the study (II):

- Historical and geopolitical aspects prevail in the formation of micro-clusters in railway and maritime sectors.
- Germany and Poland have more dissimilarities compared to other BSR countries in all modes of transport.
- The railway and road transport of Latvia, Lithuania and Poland was the most vulnerable in the crisis period, demonstrating at the same the quickest recovery within the macro-region.
- Denmark, Finland and Norway form the most stable micro-cluster in terms of railway transport in all the three economic periods. The demonstrated stability is not only based on their similar geographical location and low share of international cargo in their rail freight transport.
- Clusters are more clearly formed in maritime transport. This is consistent with findings presented in earlier research papers which were mainly concerned with this type of transport.
- The railway sector remains to be very vulnerable in comparison to maritime and road transport, mainly because of its susceptibility to political decisions and financial instability of rail companies in Eastern Europe, many of which were hit hard in the economic crisis and their recovery took longer than in terms of other modes of transport.
- The maritime sector is the weakest transportation sector from the perspective of economic crisis**.**
- The macro-regional road sector is more adaptable to the market, as well as to economic and political changes in the region.

In order to identify the development potential for employment-intensive cluster of the transport sector, the author conducted the HCA on the 'Specialisation' criterion (LQ) in three cluster categories: Distribution, Maritime, and T&L (III**)**. The results of the analysis showed that the despite the fact that the BSR demonstrates positive dynamics in the formation of macro-regional cluster, having attributes of both formal and informal cluster, the disproportional development of cluster categories can be observed.

The distribution cluster category tends to be the weakest component of the BSR transport sector, mainly because of its specifics – it does not exceed beyond national borders. The driving force in this cluster category is Lithuania. The maritime cluster category shows a positive dynamics in macro-regional LQ

development, which is supported by intensive macro-regional business cooperation project. The Baltic Sea Poland is a leader in this cluster category. In contrast to maritime cluster category, the T&L holds the second place in terms of strong cluster formation, demonstrating two driving forces in its clustering process – Baltic Sea Poland and Norway. Table 3 shows the results of the HCA for the whole transport sector, which includes the cluster categories 'Distribution', 'Maritime' and 'T&L'.

Table 3. Results of HCA representing the formation of countries' clusters based on their 'Specialisation' criterion in transport sector in 2007–2011

Cluster nr.	The 1st stage of analysis	The 2nd stage of analysis	The 3rd stage of analysis	The 4th stage of analysis
1	Denmark, Sweden, Baltic Sea Germany	Denmark, Sweden, Baltic Sea Germany,	Denmark, Sweden, Baltic Sea Germany,	
2	Finland, Baltic Sea Russia	Finland, Baltic Sea Russia	Finland, Baltic Sea Russia,	Single cluster – the BSR
3	Estonia, Latvia, Lithuania	Estonia, Latvia, Lithuania,	Estonia, Latvia, Lithuania,	
4	Norway	Norway	Norway	
5	Baltic Sea Poland	Poland	Poland	

Source: compiled by the author on the basis of Appendix 3

The transport sector includes four micro-clusters which demonstrate different development dynamics. Cluster 1, comprising Denmark, Sweden and the Baltic part of Germany, demonstrates moderate growth during 2007-2011. Finland with its neighbour - Baltic Sea Russia (cluster 2) demonstrate slow rates of recovery process, as the employment rates of these countries were significantly hit by the crisis. The third cluster is formed by the Baltic States, whose employment in the transport sector was not affected by the crisis. These countries demonstrate a high level of cluster specialisation in this sector and demonstrate relatively high rates of growth during the period. Baltic Sea Poland and Norway are the driving forces of the BSR transport sector. These countries maintain leading positions in the sector owing to their high levels of LQ and its stable growth rates. Below the author outlines some findings regarding the mapping of the BSR's corridors as well (see Fig. 7).

Despite their relatively weak position in the region (in terms of cargo turnover dynamics and infrastructure dynamics), the Baltic States are overloaded with TEN-T and Core network corridors, which in most cases overlap with each other. This confirms the author's suggestion that there is no need to develop new corridors – the Pan-European transport corridors have lost their importance and, compared to other BSR countries, there has emerged the problem of high transport isolation of Estonia and Latvia with three corridors

crossing the countries' territories from the south to the north, isolating countries from the strategically important east-west direction.
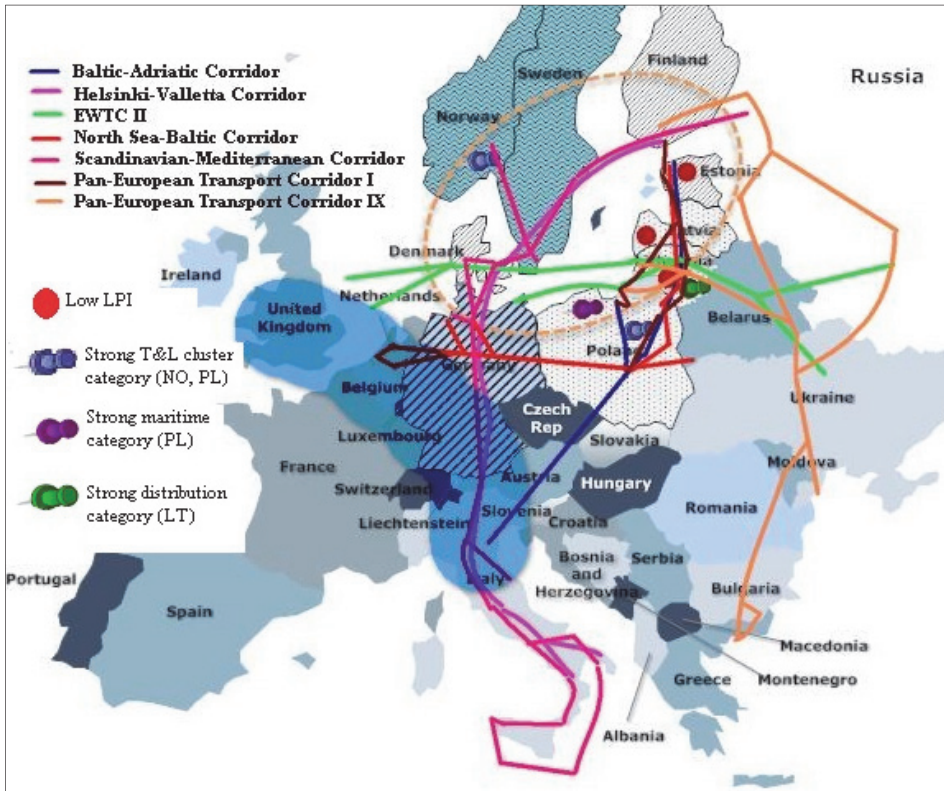
Figure 7. The BSR transport sector
Source: complemented by the author on the basis of Trans-European Transport Networks, 2014; EC, 2013b; II; III
Notes: dashed zones are micro-clusters formed by BSR's countries on the basis of the cargo handled by railway, maritime and road transport in 2011; blue area is "Blue banana area"

The cluster approach allows identifying homogeneous micro-clusters of countries in the transport sector. On the basis of the behavior of micro-clusters at different stages of the economic cycle (growth, crisis, recovery), it is possible to predict future trends in the development of the transport sector and recognize and eliminate potential bottlenecks in the sector that may hinder its sustainable development, thus unlocking the potential of the region. This, in turn, makes it possible to identify homogeneous transport micro-clusters. The intensification of cooperation between formal micro-clusters emphasizing the application advantages of each of them and spreading it onto macro-regional level will allow reducing heterogeneity within the BSR.

CONCLUSIONS

The author studied transport sector of the BSR as an open complex system which consists of a multitude of interconnected and interdependent elements and implied a systems view onto the transport sector.

The author of the thesis aimed to **emphasise the importance of the concept of macro-regional development of the BSR transport sector and to determine contribution of formal cluster approach to its development.** The research question of the thesis was the following: What determines the dynamics of the performance of the BSR transport sector and how can cluster approach contribute to its development?

The dynamics which determine the BSR transport sector performance were identified by means of correlation, Bayesian and affinity analyses. Thus, critical dynamics for the macro-regional transport sector are: international trade, production in industry, investments in road and rail infrastructures.

The author proposes a formal cluster cooperation which would facilitate the creation of a single BSR transport cluster. It was concluded that national and intergovernmental initiatives are the basis of macro-regional cooperation. But currently they do not provide formation of a Single macro-regional transport cluster – the BSR countries demonstrate a high level of heterogeneity in the development dynamics of transport field. The author identified five dimensions of a formal macro-regional transport cluster: (1) it is a geographical concentration of national states within one macro-region; (2) cooperation in the clusters is regulated on behalf of the EU and national governments; (3) it demonstrates homogeneity in the development dynamics of its physical infrastructure; (4) it demonstrates homogeneity in the dynamics of transport sector performance and (5) it has similar behavioural patterns at different stages of the economic cycle.

The author is of the opinion that formal cluster approach for the transport sector allows unlocking the potential of the region as it enables to identify homogeneous transport micro-clusters. The intensification of cooperation between formal micro-clusters emphasizing the application advantages of each of them and spreading it onto macro-regional level will allow reducing heterogeneity within the BSR.

The basis of formal cluster approach in the organization of the transport sector involves not only the promotion of cross-border cluster cooperation by intergovernmental institutions, but planning future projects and strategies in accordance to the BSR real strengths and weaknesses, determined by continuous monitoring of the regions' development process towards homogeneity in transport sector.

National and intergovernmental initiatives analyzed in the thesis cover countries 'randomly', regardless of the performances of the countries' transport sector, LPI, and involvement in TEN-T corridors. Cluster approach in organising the transport sector is based on the promotion of formal cross-border cluster cooperation by intergovernmental institutions. The factor that would

provide a balanced use of the existing and potential capacity of the infrastructure of national transport systems, is the intensification of cooperation within the international transport corridors in the region. Therefore, a single BSR transport cluster must be based on the corridor approach.

Considering the fact that the BSR is an important element of TEN-T, cluster approach may ensure continuous competitiveness of a regional transport system on a global level. As well as economic power/potential of a region, the level of regional infrastructure development and the region's positioning relative to core national and international transport corridors can contribute to the development of regional transport clusters.

The (macro-)regional cluster provides for a (macro-)region the same benefits as it does for a nation, but by involving more stakeholders in the process of international business cooperation, the scale of benefits expands, increasing its competitiveness in certain sectors on the global level. In the author's opinion this would provide a balanced utilization of the infrastructure's existing and potential capacity within the region. Considering the fact that infrastructure is the technical basis for the region's economy, cooperation must be intensified in its international corridors.

Theoretical and methodological contribution of the thesis

The primary theoretical and methodological contribution of the thesis is addressing two gaps in research thus far:

- establishing a relevant interdisciplinary theoretical platform for research in contemporary international logistics, based on based on the systems theory, new regionalism and the concept of regional cluster. The systems theory was tested on the macro-regional level on the example of transport sector, which was studied as an open complex system, interacting with external environment on a macro-regional level. Analysis of the regionalism-related publications showed that there is an urgent problem of heterogeneity within macro-regions, which can eliminate the input of transport activity into the economic growth of the region. The concept of formal macro-regional cluster is a core focus of the thesis. It was concluded that a macro-regional cluster provides the same benefits to a macro-region as it does to a nation, but due to involving more stakeholders in the process of international business cooperation, the scale of benefits expands, increasing its competitiveness in certain sectors on the global level. Whereas the formal nature of the such cluster is a key precondition for the sustainable development of the macro-regional transport cluster.
- developing a methodological framework for a system analysis (of the development dynamics of the field of macro-regional transport towards the formation of a formal cluster. The author used sequential mixed research design with the purpose of expanding the systems theory to the transport sector on a macro-regional level.

Practical contribution and implication

The practical contribution of the thesis lies in **determining a formal cluster approach for the sustainable development of the BSR** by applying macro-regional strategies. In results of empirical research the homogeneity of the BSR countries was identified on the basis of similar dynamics in cargo flows. The author developed an approach to estimate the level of impact of the components of economic cycles on the demand for rail, maritime and road transport services. Economic impact analysis, conducted by the author, unveils the impact of transportation facilities and systems on national economies.

The findings of the author could be used by macro-regional and intergovernmental authorities involved in the development of macro-regional strategies in order to even the collaboration in the transportation market at the macro-regional level, as proper identification of countries' natural comparative advantages and potential for development is needed at the stage of the policy-making process.

Limitations and future course of research

The next step is to acknowledge the limitations of the approach. The first limitation derives from the lack of accurate statistical data on the transport performance of the northern parts of the Poland and Germany. According to the EC definition of the region, the northern parts of Germany and Poland are officially included in the BSR, however the statistical data on cargo volumes and economic indicators used in the thesis covers the countries' whole territories. The second limitation concerned the statistical data on cluster indicator (LQ), which was not available for some countries in the period 2004–2007. The third limitation is connected with the exclusion of Baltic Sea Russia from correlation, Bayesian and affinity and partly HCA analyses because of the lack of required statistical data for its North-western Federal District, which has a direct exit to the Baltic Sea. The last limitation concerns the selection of transport modes for the analysis. Air and pipeline transport modes are excluded from the research due to their low performance in the region.

Further research could be conducted in three directions. The first arises from the main limitations that the author has tackled in the research – namely, solving the problem of the collection of the so far lacking macro-regional statistics on the transport field's performance indicators. The second could focus on the issue of macro-regional clustering in the railway and road sector of the BSR. And the third could be a more detailed evaluation of how international trade, production in industry and investments in transport infrastructure could reduce the problem of heterogeneity of macro-regional transport.

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ABSTRACT

Formal cluster formation in the development of the transport sector in the Baltic Sea macro-region

With the expansion of the multimodal transportation concept, the efficiency of a country's and region's transport system performance depends on synergy which occurs due to effective cooperation between countries' national transport sectors on macro-regional level. The focus of the present thesis is studying the Baltic Sea Region's (BSR) transport sector as a transport cluster, naturally formed on the macro-regional level by Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden, and Norway. Serving trade flows passing via its physical infrastructure, the BSR helps to facilitate and intensify trade relations through macro-regional cooperation and achieve the strategic goals set by the EC within the European Union Strategy for the Baltic Sea Region related to creating an effectively functioning transport system, promoting the increase of region's accessibility and attractiveness. The strategy, stressing the importance of macro-regional approach, which goes hand in hand with clustering process, has heightened the researchers' interest towards a new form of regionalism, raising the urgent problem of heterogeneity within macro-regions.

The doctoral thesis is based on three scientific publications by the author from 2011 to 2015. **The aim of the thesis is to emphasize the importance of the concept of macro-regional development of the BSR transport sector and to determine the contribution of formal cluster approach in its development. The central question discussed within the thesis is the following: What determines the dynamics of the performance of the BSR transport sector in 2004–2012 and how can the concept of formal clustering contribute to its development?** In accordance with the aim and research question, the author has set the following tasks:

1. To confirm the importance of the concept of macro-regional development for the BSR transport sector from the perspective of:
    a. Macro-regional infrastructure development within the TEN-T system (articles I, II and III);
    b. Macro-regional cluster collaboration in the BSR transport sector (article II);
    c. BSR's competitiveness in transhipment of cargo flow to/from Russia, the CIS countries, and China (articles I and II).
2. To identify the pattern of the BSR transport sectors' response to the fluctuations of global economy (article II);
3. To determine the direction of further development of the BSR macro-regional policy (article II and III).

The macro-regional transport system studied within the thesis represents a unique complex composed by different national transport systems, which are

different in their capacities, technological and technical, including ITC, support, as well as in collaboration experience. Within the scope of the thesis the author investigates the impact of the EUSBSR on the creation of an effectively functioning macro-regional transport system, which is the declared priority of the strategy. From this emerges the problem of 'rational' involvement of the countries' transport capacities in the transport system, which derives from the predominance of the informal/business aspect of macro-regional cooperation. The formal and informal nature of regions and clustering process are of crucial importance for a sustainable development of the macro-region, which could be achieved by their synergy effect.

The author clarifies the concept of formal macro-regional transport cluster and defines it within five dimensions:

1) it is a geographical concentration of national states within one macro-region;
2) cooperation in the clusters is regulated on behalf of the EU and national governments;
3) it demonstrates homogeneity in the development dynamics of its physical infrastructure;
4) it demonstrates homogeneity in the dynamics of transport sector performance, and
5) it has similar behavioural patterns at different stages of the economic cycle.

The author conducted probabilistic (hierarchical cluster and correlation analyses) and non-probabilistic (Bayesian and affinity analysis) methods of analysis with the aim to: 1) determine changes in transport activity in response to changes in economy (article II); 2) evaluate correlation between the volume of cargo flows and economic indicators (article II); 3) identify the key factors influencing the performance of the BSR transport sector (article II) and 4) identify 'formal' micro-, meso- and single transport clusters (article III).

The primary theoretical contribution is the establishing of a relevant interdisciplinary theoretical platform for research in contemporary international logistics, based on the systems theory, new regionalism and the concept of regional cluster; and developing a methodological framework for a system analysis. The systems theory was tested on the macro-regional level on the example of transport sector, which was studied as an open complex system, interacting with external environment on a macro-regional level. The concept of formal macro-regional cluster is a core focus of the thesis. It was concluded that a macro-regional cluster provides the same benefits to a macro-region as it does to a nation, but due to involving more stakeholders in the process of international business cooperation, the scale of benefits expands, increasing its competitiveness in certain sectors on the global level, whereas the formal nature of such a cluster is a key precondition for the sustainable development of the macro-regional transport cluster.

The methodological contribution of the thesis lies is developing the methodological framework of a system analysis, based on the use of sequential mixed research design with the purpose of expanding the systems theory to the transport sector on a macro-regional level. The justifiability of the methodological framework is confirmed by the practical contribution of the thesis, which lies in determining a formal cluster approach for the sustainable development of the BSR by applying macro-regional strategies.

In results of empirical research, the homogeneity of the BSR countries was identified on the basis of similar dynamics in cargo flows. The hierarchical cluster analysis as a key method used in the thesis enabled to divide the BSR's countries into micro-clusters and reveal the unequal conditions under which countries operate in the transport sector, delaying the creation of a single BSR transport sector.

Analyzing the macro-regional cluster collaboration in the BSR transport sector resulted in two crucial findings, namely: the tendency of formation of transport clusters on a national level predominates in the BSR and macro-regional clustering experience in railway, and road transport is negligible in the BSR. Of special importance are the patterns of formal micro-cluster formation process, which were identified by the author. Conducted analyses demonstrate that the BSR's countries split up into micro-clusters on the basis of historical, geopolitical and informal/business cooperation aspects (article II). The analysis defined that there are three driving forces/countries in the formal clustering process of the BSR transport sector's cluster categories: (1) Lithuania – in distribution; (2) Baltic Sea Poland – in maritime and Transport and Logistics; and (3) Norway – Transport and Logistics (article III). As the driving forces, these countries have a significant potential in formal promotion and spread of their success onto the macro-regional level. Thus, the intensification of cooperation between formal micro-clusters, emphasizing the application advantages of each of them and spreading it onto macro-regional level, will allow reducing heterogeneity within the BSR.

The author developed a conception to estimate the level of impact of the components of economic cycles on the demand for rail, maritime and road transport services, which help to determine similar behavioural patterns of transport sector at different stages of the economic cycle. This conception helps to predict future trends in the development of the transport sector and recognize and eliminate potential bottlenecks in the sector that may hinder its sustainable development, thus unlocking the potential of the region

Economic impact analysis, conducted by the author, unveils the impact of transportation facilities and systems on the BSR's national economies. The correlation, Bayesian and affinity analyses (article III) showed that there are four crucial factors which have significantly influenced cargo volumes handled in the Baltic Sea Region, namely international trade (export and import volumes), production in industry, investment in road and rail infrastructures.

To complement the concept of regional cross-border cooperation in the Baltic Sea region, developed by the governing bodies of the EU, the author has

presented in this doctoral thesis a principally new approach to transport sector clustering. Thus the findings of the research could be used by macro-regional and intergovernmental authorities involved in the development of macro-regional strategies in order to even the collaboration in the transportation market on the macro-regional level, as proper identification of countries' natural comparative advantages and potential for development is needed at the stage of the policy-making process. The author suggests three directions for further research:

- working out the system of collection of macro-regional statistics on transport field performance' indicators;
- detailed analysis of issues, which prevent macro-regional clustering process in the railway and road sector of the BSR;
- evaluation of how international trade, production in industry and investments in transport infrastructure could reduce the problem of heterogeneity of macro-regional transport.

Key words: transportation, cluster analysis, Baltic Sea Region, macro-region, international cooperation, transport network

KOKKUVÕTE

**Formaalse klastri kujunemine Läänemere makroregiooni
transpordisektori arengus**

Riikide ja piirkondade transpordivõrkude tulemuslikkus multimodaalse transpordi mõiste avardumisel sõltub sellest, kui tõhusalt suudavad eri riikide transpordisektorid teha koostööd makroregionaalsel tasandil. Käesolev doktoritöö keskendus Läänemere makroregiooni transpordisektori uurimisele makroregionaalsel tasandil moodustuva klastrina, kuhu kuuluvad Taani, Eesti, Soome, Saksamaa, Läti, Leedu, Poola, Rootsi ja Norra. Füüsilise taristu kaudu liikuvaid kaubavooge hallates aitab Läänemere regioon hõlbustada ja edendada makroregionaalse koostöö abil kaubandussuhteid ja saavutada Euroopa Komisjoni seatud strateegilisi eesmärke Euroopa Liidu Läänemere strateegia raames, et luua tõhusalt toimiv transpordivõrk, mis omakorda edendaks piirkonna ligipääsetavust ja atraktiivsust. Nimetatud strateegia, mis rõhutab makroregionaalse lähenemise tähtsust ning on tihedalt seotud klasterdamisega, on juhtinud teadlaste tähelepanu uuele regionalismile, tõstatades sellega pakilise küsimuse makroregioonide heterogeensuse kohta.

Doktoritöö aluseks olid autori kolm teaduspublikatsiooni, mis avaldati aastatel 2011–2015 ja on valminud koos kaasautoritega. **Töö eesmärgiks oli rõhutada makroregionaalsuse olulisust Läänemere transpordisektori arengus ja hinnata formaalsete klastrite loomise mõju selle arengusse. Uurimus keskendus küsimusele, mis on need tegurid, mis määrasid Läänemere regiooni transpordisektori tulemuslikkust aastatel 2004–2012 ning kuidas võib formaalsete klastrite loomine seda mõjutada.**

Doktoritöö eesmärgi ja keskse küsimusega seonduvalt seadis autor endale järgmised ülesanded.

1. Tõestada makroregionaalse arengu tähtsust Läänemere transpordisektoris järgmistest vaatenurkadest:
   a. Makroregionaalse taristu arendamine üle-euroopalise transpordivõrgu (TEN-T) raames (artiklid I, II ja III);
   b. Makroregionaalsete klastrite koostöö Läänemere transpordisektoris (artikkel II);
   c. Läänemere regiooni tulemuslikkus Venemaalt, teistest SRÜ riikidest ning Hiinast lähtuvate ja sinna suunduvate kaubavoogude teenindamisel (artiklid I ja II).
2. Teha kindlaks, kuidas Läänemere transpordisektorid reageerivad muutustele globaalses majanduses (artikkel II);
3. Sõnastada Läänemere regiooni makroregionaalse poliitika edasise arengusuunad (artiklid II ja III).

Käesolevas töös käsitletav makroregionaalne transpordivõrk kujutab endast erinevate riikide transpordivõrkude ainulaadset süsteemi, mille üksikosad

erinevad üksteisest mahtudelt, tehnilistelt parameetritelt, infotehnoloogilise toest ning koostöökogemusest. Autor uuris töös Euroopa Liidu Läänemere strateegia mõju tõhusa makroregionaalse transpordivõrgu loomisele, mis on nimetatud strateegia peamiseks eesmärgiks. Sellega seoses tekkis küsimus ratsionaalsusest riigi transpordivõimekuse osas transpordivõrgus osalemises, kuna see tuleneb peamiselt makroregionaalse koostöö mitteametlikust ehk majanduslikust aspektist.

Piirkondade ja klastrite loomise formaalsus ja mitteformaalsus on määrava tähtsusega makroregiooni jätkusuutliku arengu seisukohalt, ning seda on võimalik saavutada koostoime abil. Autor selgitas formaalse makroregionaalse transpordiklastri mõistet ja defineeris seda viie mõõtme kaudu:

1) makroregionaalne klaster on rahvusriikide geograafiline koondumine ühe makroregiooni alla;
2) klastritesisest koostööd reguleeritakse Euroopa Liidu ja liikmesriikide valitsuste kaudu;
3) makroregionaalse transpordiklastri füüsilise taristu arengudünaamika on homogeenne;
4) klastri transpordisektori tulemuslikkuse dünaamika on homogeenne, ja
5) klastrite käitumismustrid majandustsükli erinevates faasides on sarnased.

Autor kasutas tõenäosuslikke (hierarhilise klaster- ja korrelatsioonianalüüsi) ning mittetõenäosuslikke (Bayesi ja afiinsusanalüüsi) meetodeid eesmärgiga: 1) määrata kindlaks muutused transporditegevuses, mille toovad kaasa muutused majanduses (artikkel II); 2) hinnata veovoogude mahu ja majandusnäitajate korrelatsiooni (artikkel II); 3) tuua välja peamised tegurid, mis mõjutavad Läänemere regiooni transpordisektori tulemuslikkust (artikkel II); ja 4) määratleda formaalsed mikro-, meso- ja üksikud klastrid (artikkel III).

Teoreetiliseks panuseks on üldise süsteemiteooria rakendamine autori poolt transpordisektori makroregionaalsel hindamisel, mille käigus loodi asjaomane interdistsiplinaarne platvorm kaasaegse rahvusvahelise logistika uurimiseks, mis põhineb süsteemiteooria, uue regionalismi ja regionaalse klasterdumise kontseptsiooni sümbioosil. Süsteemiteooriat testiti makroregionaalsel tasandil transpordisektori näitel, mida käsitleti avatud süsteemina, mis makroregionaalsel tasandil sõltub välisest keskkonnast. Formaalse makroregionaalse klastri mõiste oli doktoritöö keskne uurimisküsimus. Uurimusest järeldus, et makroregionaalne klaster toob võrdselt kasu nii makroregioonile kui riigile, ent kuna rahvusvahelises majanduskoostöös osaleb rohkem sidusrühmi, siis selle kasu skaala on avaram ja nii on üleilmsel tasandil teatud sektorite konkurentsivõime suurem. Samuti on klastri formaalne olemus makroregionaalse transpordiklastri jätkusuutliku arengu peamiseks eelduseks.

Doktoritöö metodoloogiliseks väljundiks on kindla järgnevusega segauurimisstrateegiatel põhinevate süsteemianalüüsi meetodite väljatöötamine, mille eesmärgiks on rakendada süsteemiteooriat makroregionaalse tasandi

transpordisektori uurimisel. Selle metoodilise raamistiku valikut õigustab doktoritöö praktiline panus, mis seisneb formaalsete ehk ametlike klastrite rakendamisel Läänemere regiooni jätkusuutlikus arengus kasutades makroregionaalseid strateegiaid.

Empiirilise uurimuse tulemusena määrati kindlaks Läänemere regiooni riikide homogeensus kaubaveovoogude dünaamika sarnasuse osas. Hierarhilise klasteranalüüsi kasutamine doktoritöö põhilise uurimismeetodina võimaldas autoril jagada Läänemere riigid mikroklastritesse ja tuua esile ebaühtlased tingimused nende riikide transpordisektorite toimimises, mis omakorda ei võimalda ühtse Läänemere regiooni transpordivõrgustiku kiiret loomist.

Läänemere regiooni transpordisektori makroregionaalsete klastrite koostöö analüüsimisel ilmnes kaks väga olulist tulemust – Läänemere regioonis on ülekaalus transpordiklastrite moodustumine riiklikul tasandil, samas kui makroregionaalse klasterdumise kogemus Läänemere regiooni raudtee- ja maanteetranspordisektoris on tühine. Olulisel kohal on ka autori poolt määratud formaalsete mikroklastrite moodustamise mudelid. Teostatud analüüsid näitasid, et Läänemere regiooni riigid jagunesid mikroklastriteks ajalooliste, geopoliitiliste ja mitteformaalsete/majanduskoostöö tegurite mõjul (artikkel II). Lähemal analüüsil ilmnes, et Läänemere regiooni transpordiklastrite kategooriate formaalne klasterdumine toimus kolme juhtiva jõu/riigi mõjul (artikkel III): 1) Leedu – jaotustegevuses; 2) Poola Läänemereäärses osas – merekaubanduses ning transpordis ja logistikas; ja 3) Norra – transpordis ja logistikas. Juhtivate jõududena on neil riikidel tugev potentsiaal oma edukuse ametlikul edendamisel ja jagamisel makroregionaalsel tasandil. Formaalsete mikroklastrite vahelise koostöö intensiivistumine, mille käigus rõhutatakse iga klastri eeliseid rakendamisel ja makroregionaalsel levitamisel, võimaldab vähendada heterogeensust Läänemere piirkonnas.

Autor töötas välja kontseptsiooni, kuidas hinnata majandustsüklite komponentide mõju nõudlusele raudtee-, mere- ja maanteetranspordi teenuste järgi. See aga aitaks leida sarnaseid käitumismustreid transpordisektoris majandustsükli erinevates faasides. Samuti võimaldaks kontspetsioon ka ennustada sektori arengu tulevikusuundi, et tunda ära ja kõrvaldada võimalikud kitsaskohad, mis võiksid takistada sektori jätkusuutlikku arengut ja seeläbi rakendada piirkonna potentsiaali.

Autori teostatud majandusliku mõju analüüs tõi välja transpordivahendite ja – võrkude mõju Läänemere regiooni riikide majandustele. Korrelatsiooni, Bayesi ja afiinsusanalüüsid (artikkel II) näitasid, et Läänemere regioonis käsitsetud kaubamahte on oluliselt mõjutanud neli kriitilist tegurit – rahvusvaheline kaubandus (ekspordi- ja impordimahud), tööstustoodang, investeeringud maantee- ja raudteetaristutesse.

Et täiendada EL juhtorganite poolt välja töötatud regionaalse piiriülese koostöö mõistet Läänemere regioonis, on käesolevas doktoritöös esitatud põhimõtteliselt uudne kontseptsioon transpordisektori klasterdumisele. Selleks, et ühtlustada transporditurul koostööd, võivad autori tulemused osutuda kasulikuks makroregionaalsete strateegiate arendamisega seotud regiooniüleste

ja valitsusvaheliste organisatsioonide jaoks. Selle alast uurimistööd näeb autor kolmes võimalikus suunas:

- makroregionaalsete võtmemõõdikute andmebaasi loomises Läänemere transpordisektori järjepidevaks hindamiseks;
- põhjaliku analüüsi läbiviimises raudtee- ja maanteetranspordi makroregionaalse klasterdamise protsessi takistavate asjaoludest;
- mõju kindlaksmääramisel, kuidas rahvusvaheline kaubandus, töötlev tööstus ja investeeringud transporditaristusse aitavad vähendada heterogeensust makroregionaalse transpordi valdkonnas.

Võtmesõnad: kaubavedu, klasteranalüüs, Läänemere regioon, makroregioon, riikidevaheline koostöö, transpordivõrk

Publications

I. **Nežerenko, O.,** Koppel, O. (2012). Some Implications of the EU Rail Transport Policy on Rail Business Environment in CEE Countries. *Baltic Journal of European Studies, 2,* 21-45. Tallinn University of Technology. (ETIS 1.2)

II. **Nežerenko, O.,** Koppel, O., Tuisk, T. (2015). Cluster approach in organization of transportation in the Baltic Sea Region. *Transport.* (Article in press). doi: 10.3846/16484142.2014.994225. (ETIS 1.1)

III. **Nežerenko, O.,** Koppel, O. (2015). Formal and informal macro-regional transport clusters as a primary step in the design and implementation of cluster-based strategies. *Transport and Telecommunication, 16(3),* 207 - 216. doi: 10.1515/ttj-2015-0019. (ETIS 1.1)

Appendix 1.

Research paper I

Nežerenko, O., Koppel, O. (2012). Some Implications of the EU Rail Transport Policy on Rail Business Environment in CEE Countries. *Baltic Journal of European Studies, 2,* 21-45. Tallinn University of Technology. (ETIS 1.2)

Some Implications of the EU Rail Transport Policy on Rail Business Environment in CEE Countries

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Abstract: *The development of rail transport is the key to the integral development of the entire European transport system. In 2010, consultations were started to discuss the proposal of the European Commission for merging various EU directives relating to railway transport. In 2011, the European Transport White Paper was published; the paper lays down the transport policy for the current decade with a perspective up until the years 2030/2050. The principles of the White Paper are compliant with the general ideas of the Commission. Both of these documents see the strengthening of supervision at the national level as the key issue for improving the competitiveness of the rail sector; require the separation of ownership and using the first best infrastructure pricing solutions. The authors find that the following questions must be answered in order to implement these ideas: 1) how to allocate supervisory functions between the state and infrastructure manager; 2) which would be the best way for realising the unbundling of rail activities; 3) how can the sustainability of railways be ensured while using marginal cost pricing in the situation where formal transport policy does not allow state support for rail transport. The authors seek answers to these questions by comparing the situation in the Nordic and Baltic countries, as these two groups of countries illustrate two diametrically different approaches to the possible solutions.*

Keywords: *access charging, infrastructure investments, rail transport, transport policy*

1. Introduction

The transport system has always been playing an important role for the European Union and its member countries. The effective and integrated transportation links are the most important prerequisite for ensuring coordinated work of the EU's Single market. The transport sector accounts for about 5 per cent of the EU's GDP and it is considered to be an important tool against unemployment, as it directly employs around 10 million people (EU, 2011). The sustainable development of the EU transport system needs a set of appropriate law regulations. Economic, social and environmental dimensions of the transport policy are set up by the 2011 White Paper (*White Paper*, 2011), which stems from the earlier White Paper approved in 2001 (*White Paper*, 2001). A vision for a competitive and sustainable transport system needs considerable collaboration of all allied groups, whose activity predetermine the viability of the intention to create a single European transport area. The Baltic Sea strategy holds an important place among the EU strategies stressing the integration of various interest groups. It is an initiative of the EU, aiming to find solutions to the main bottlenecks of the region hindering the development of the area. The Baltic Sea strategy consists of two parts: a strategy document and an action plan accompanying the strategy paper (*Communication from...*, 2009). These documents define four strategic areas—environmental sustainability, prosperity, accessibility and attractiveness, safety and security.

Based on these areas, the action plan for the strategy is divided into 15 political fields, each of which contains particular projects that will be implemented within the framework of the action plan. From the point of view of the present article the most important one is political area No. 11 of the Baltic Sea strategy—To improve internal and external transport links. Among the flagship projects listed in the horizontal dimension of the vertical dimension "accessibility and attractiveness" (Complete the agreed priority transport infrastructures, Northern Dimension Partnership on Transport and Logistics, Develop the Baltic Motorways of the Seas Network, Shorter Plane Routes, Cooperate for Smarter Transport) should be pointed out prioritised investments in transport infrastructure, for example the Rail Baltic project. Meanwhile, the overall experience of certain countries (first and foremost in the Baltic states) in the implementation of international projects is so far insignificant. The competition is still a stumbling block, forcing

the countries to concentrate purely on the national transport market and to forget about developing the coherence between the national transport networks and to neglect building partner relations (Nežerenko, 2009). This is illustrated by the delays in implementing the Rail Baltic project mentioned above.

The EU development-oriented documents described above stress the importance of preferring the environmentally sustainable modes of transport, mostly waterways and railways, both from transport and regional policy aspects. The task of this article is to investigate some of the problems that have to be resolved in the CEE countries of the Baltic Sea region and Poland in order to achieve the targets laid down in the Transport White Paper and the Baltic Sea Strategy of the European Union. In the following part some of the postulates of the EU's transport policy that are significant from the point of view of achieving the set goals will be described.

2.   Background

The process of rail market liberalisation started in 1991. The legislation is based on a distinction between infrastructure managers who run the network and the railway companies that use it for transporting passengers or goods. Different organisational entities must be set up for transport operations on the one hand and infrastructure management on the other. Essential functions such as allocation of rail capacity (the train paths that companies need to be able to operate trains on the network), infrastructure charging and licensing must be separated from the operation of transport services and performed in a neutral fashion to give new rail operators fair access to the market. The process of opening up the railway services market to cross-border competition is presented below. During the past decade, the following packages of railway directives were adopted:

*   "The first railway package" of 2001, which enabled rail operators to have access to the trans-European network on a non-discriminatory basis, implemented a common licensing of the railway operators and guaranteed operators' rights for the use of railway infrastructure capacity;
*   "The second railway package" of 2004. In the framework of this package the set of measures to revitalise railway transport was adopted. The rail freight market was fully opened to competition from the 1st of January 2007. Due to the implementation of the first two packages the decline in railway sector was temporarily stopped by 2007;

- "The third railway package" of 2007 aimed on completing the European regulatory framework for the rail transport, including the introduction of the European train driver license and strengthening rail passengers' rights. The package provided for opening up the international passenger transport market by the 1st of January 2010.

Despite the fact that the packages of liberalisation's measures are implemented (excluding market opening to domestic passenger rail services, which is going to be realised by the year 2012) there are still problems that need to be resolved, for instance:

- Inadequate regulatory oversight by national authorities, often with insufficient independence, competences and powers;
- A low level of competition due to market access conditions which are not sufficiently precise and therefore still biased in favour of the incumbents;
- Low levels of public and private investment, as the quality of infrastructure is declining in many Member States because of insufficient funding, investment in railway services becomes less attractive both for incumbent and new operators.

The European Commission set up proposals for adopting a new directive (*Communication from…*, 2010), which is focused on the resolving the abovementioned bottlenecks of the Single European Railway Area. The main solutions mentioned in the proposal are:

- In order to monitor competition situation on the rail transport service market, an independent surveillance body not subject to any of the ministries must be established;
- In addition to railway infrastructure managers, also transport undertakings or even third persons possessing infrastructure necessary for the provision of rail transport service can be natural monopolies;
- Rail infrastructure user fee must be based on the first best solution, i.e. marginal cost pricing with the possibility to apply mark-ups in the condition that market can bear it.

Thus, the proposal of the European Commission focuses on three main areas: supervision in the field of competition in railway transport, defining of companies in market dominant position and explaining them their obligations, and railway infrastructure access pricing.
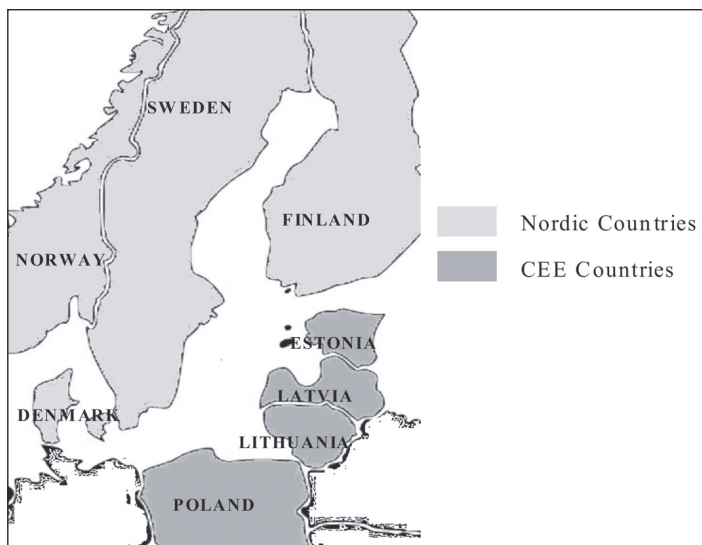
3.   Method and Data

The authors are of the opinion that in the set of the circumstances mentioned above, the following questions need to be answered:

•   How to allocate supervisory functions between the state and infrastructure manager if the organisational structure of rail transport has been made compliant with the EU legislation;

•   Which would be the best way for realising both the horizontal and vertical separation of rail transport in compliance with the EU requirements;

•   How can the financing of railway undertakings be ensured whilst using marginal cost pricing in the situation where formal transport policy does not allow supporting rail freight transport from the state budget?

The scope of the data used for the purposes of this article was defined on the basis of the following considerations. The Baltic Sea region includes the Baltic countries (Estonia, Latvia, and Lithuania), Denmark, Finland, Sweden, northern Germany, northern Poland, and part of Russia's Northwestern Federal District. Considering the importance of the Baltic Sea region in the transport links of Northern Europe, the EU has involved also Iceland, Norway and Belarus in implementing its Baltic Sea strategy. CIA World Factbook (2011) defines Estonia, Latvia, Lithuania, Poland, Belarus and Germany as CEE countries, whereas Norway, Finland, Sweden, Denmark and Iceland are defined as Nordic countries. Thus, the group of selected countries in this article includes the Baltic States and Poland from CEE countries, and the Nordic countries (excl. Iceland). The geographical position of the countries is depicted in Figure 1.

The paper uses the comparative analysis method.

Figure 1.   Selected countries

Source: Authors' illustration

The analysis is based on secondary source information provided by the railway infrastructure managers, rail transport undertakings of the region, national statistics authorities and international professional associations. In presenting conclusions and recommendations the specific features of rail transport in particular regions are taken into account: for example, in the Baltic States railway companies are mostly engaged in servicing transit freight originating from third countries.

4.   Study

4.1.   Institutions

According to Directives 2001/12/EC and 2001/14/EC of the EU, each member requires an independent regulatory body (though not necessarily of the government) whose task is to ensure a fair and non-discriminatory access to the rail network and services.

The regulators are usually established to carry out complex technical tasks which the government is unable or unwilling to do, partly because the government wishes to distance itself from responsibility for some decisions, but, having invested regulatory authorities with sometimes considerable powers which are more detailed and intrusive than any possessed by government over state-owned entities or industries, political or bureaucratic impatience or intolerance of that power sometimes takes over, and undue governmental pressure or interventions follow.

As a result, many countries are not able to completely withdraw from the elements of oligopoly or monopoly (see also below) in railway services—it is difficult for governments to give up control of their domestic railway sector and to abandon their basic rights in the formation of transport policy and oversight of railroad operators and service enterprises. Previously, a common idea that natural state monopoly on the market of railway services is a guarantee of the development of, at least, the railway infrastructure, has lost its relevance. Market liberalisation and the creation of independent institutions are the necessary prerequisites for the formation of long-term competitiveness of railways, including improving the quality of services provided by operators (Winsor, 2010).

The level of independence of national authorities can seriously vary within the EU because the current EU legislation requires regulators to be independent of the infrastructure manager, but not necessarily of government. Therefore, the regulatory bodies in Europe can be divided into three categories:

•   special regulatory bodies;

- regulatory bodies within a railway authority;
- regulatory bodies within a ministry.

While the model of the special regulatory body is the strongest form in terms of its powers and independence from the state and the infrastructure manager, regulatory bodies within a ministry can be considered the weakest form (IBM, 2011). Finland, Norway, Latvia and Sweden according to the presented classification have Regulatory Body within a Railway Authority. This model deals primarily with licences, safety and other railway-specific administrative tasks, although Finnish and Swedish railway sector are governed by the cross-sectoral transport authority (Finnish Transport Safety Agency and Swedish Transport Agency, respectively). Denmark is the only one among the countries under consideration that has established a special Regulatory Body, whereas in Estonia and Lithuania such agencies have been established within the administrative area of governing ministries (see Fig. 2).

Figure 2. Organisation of regulatory bodies for rail transport in selected countries
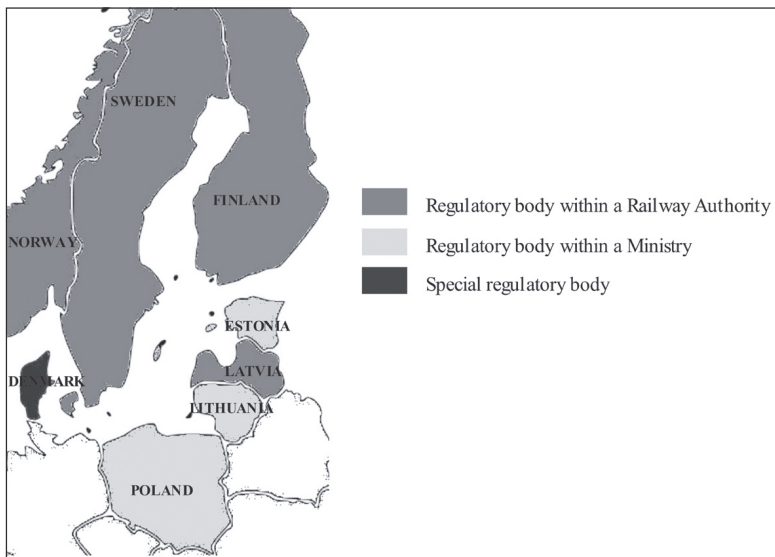
Source: IBM, 2011

A rail regulator independent of direct political control, with clearly specified powers and responsibilities and adequate resources, offers many advantages. It may offer the infrastructure manager the guarantee that the required level and quality of infrastructure will be consistent with the funding provided, and protect new entrants from arbitrary or discriminatory regulatory measures designed to protect the existing operator. Indeed, this degree of independence is even more

important when there remains a major state-owned incumbent operator, and particularly when this operator is part of the same organisation as the infrastructure manager. Given the existence of such a regulator, it is doubtful whether the right of appeal to a separate competition authority is either necessary or helpful; of course, recourse to the courts on matters of process (rather than substance) should be possible. At the same time it is important that general competition authorities have a strong role in developing government policy for the railways, for example in relation to the structural organisation of the sector, not least in order to guard against the dangers of regulatory capture (ECMT, 2005).

Therefore, considering the positions expressed in the EU transport policy documents and related studies, it would be necessary to reorganise competition supervision both in CEE and most of the Nordic countries. Based on the Estonian example, such reorganisation should involve establishing an independent supervisory body dealing with competition in railway. The position of such agency in the hierarchy of Estonian state institutions should be similar to that of the Legal Chancellor or the Auditor General.

4.2. Organisation of rail transport

The issues and approaches to regulation are directly affected by vertical and horizontal separation (Thompson, 2009). Rail transport is a part of national economy from which it obtains its input and to which it gives its output. Therefore we cannot treat railway undertakings as subsystems of the system of rail transport in isolation from the context.

The most important sub-system of railway transport is the sub-system of railway infrastructure. Table 1 presents the parameters of the railway networks of the selected countries as of 2005 and in perspective until the year 2020. For historical reasons, these countries have two different track gauges, which is one of the factors hindering interregional cooperation. The table also indicates that there are no significant conventional and high-speed railway projects envisaged for the next decade (this does not include different routes for the Rail Baltic project).

Train traffic analysis for CEE and Nordic countries (see Fig. 3) shows that passenger trains prevail in most of the countries. This sets stricter requirements for the technical condition and safety of railway networks. There are also railway sections in the Baltic countries where the density of passenger trains is higher than the density of the freight trains but there are also many sections (e.g., Valga-Koidula in Estonia) for which under normal conditions exist no demand whatsoever.

Figure 3.   Traffic-mix in selected countries 2007
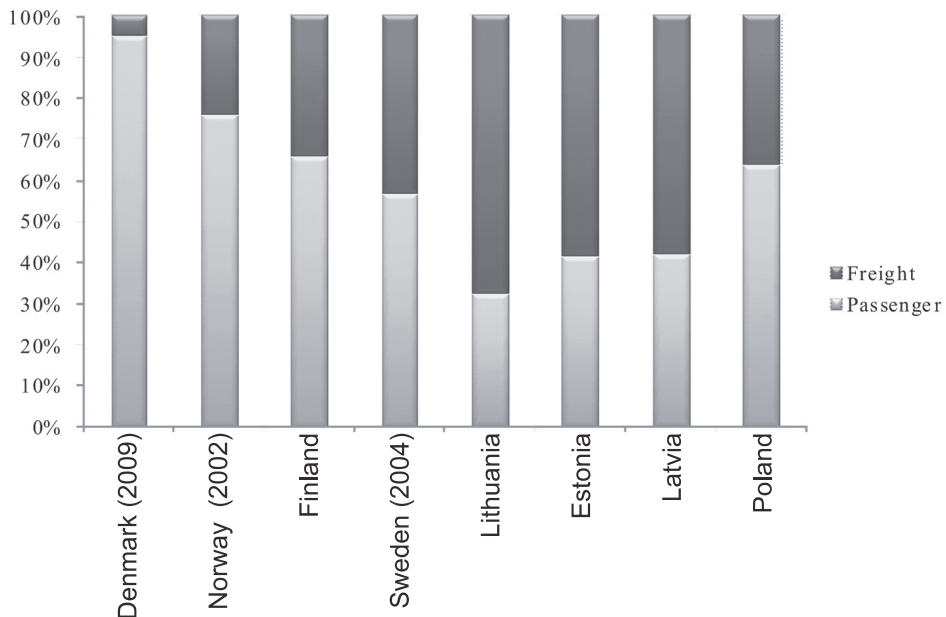
Table 1.   Length and link type of TEN-T railways in selected countries

Country	Type (track gauge)	Length (km-s)		
		2005	**2013**	**2020**
Nordic countries				
Denmark	conventional (1,435 mm)	928	928	944
Finland	conventional (1,524 mm)	3,492	3,576	3,594
Norway	conventional (1,435 mm)	4,087	4,159	N/A
Sweden	conventional (1,435 mm)	3,181	3,181	3,181
	high-speed (1,435 mm)	1,600	1,600	1,600
	Total	4,781	4,781	4,781
CEE countries				
Estonia	conventional (1,524/1,520)	962	962	962
Latvia	conventional (1,520 mm)	1,340	1,340	1,340
Lithuania	conventional (1,520/1,435)	933	1,036	1,036
Poland	conventional (1,435 mm)	5,187	4,888	4,888
	high-speed (1,435 mm)	0	337	337
	Total	5,187	5,225	5,225

Among the CEE countries under discussion, the share of rail passengers in the overall passenger turnover (incl. passenger cars) is the highest in Poland (6% in 2009) and the lowest in Lithuania (1%). This rate is considerably higher in the Nordic countries, reaching almost 10% in Denmark and Sweden.

In most of the countries, passenger transport by rail has not been affected by the economic crises as much as the other areas of economy, as there has occurred no significant reduction in rail passenger turnover (see Fig. 4).

Figure 4.   Passenger turnover by rail in selected countries
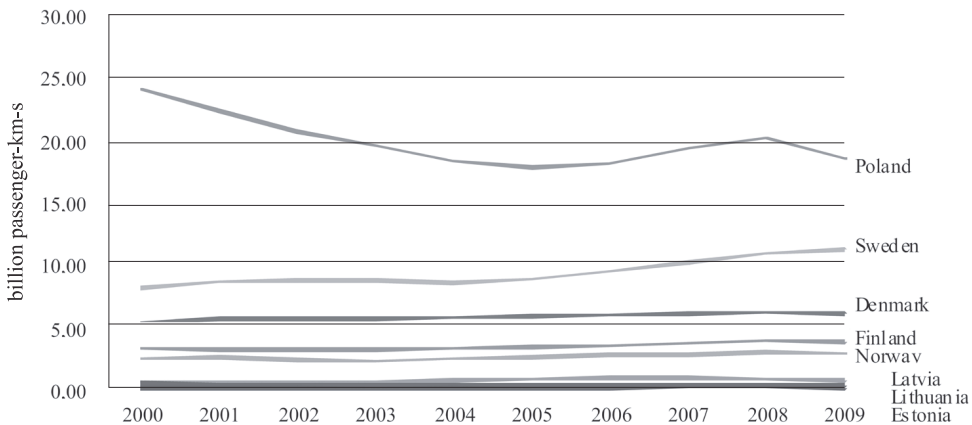
Source: EU, 2011

The share of rail transport in the overall freight turnover among the CEE countries of the Baltic Sea region has been the largest in Estonia (70% in 2007) and the smallest in Poland (37%). In the Nordic countries this indicator remains between 8 per cent (Denmark) and 34 per cent (Sweden) (EU, 2011).

During the economic crisis, a significant reduction of rail freight volume occurred in Poland and Estonia (see Fig. 5), whereas there was no such obvious reduction in the other countries under discussion. According to data provided by the Statistics Working Committee of the International Union of Railways (UIC) such reduction was of temporary nature, as rail freight volumes started to grow at the beginning of 2010.

Meanwhile, leaving aside the Baltic countries, the share of rail transport in the freight turnover of the European Union has not reached the set target—15 per cent share by the year 2010 (*European Transport...*, 2001). In order to improve the situation, the European Commission has made among many of its proposals the proposal for the endorsement of a new railway directive that

carries the idea of establishing a single European railway area. The main tool foreseen for achieving this objective is the unbundling of the currently vertically and horizontally integrated railway companies in order to ensure sufficient separation of railway infrastructure managers from freight and passenger transport undertakings. Such restructuring of railway companies is necessary for several reasons.

Figure 5. Freight turnover by rail in selected countries
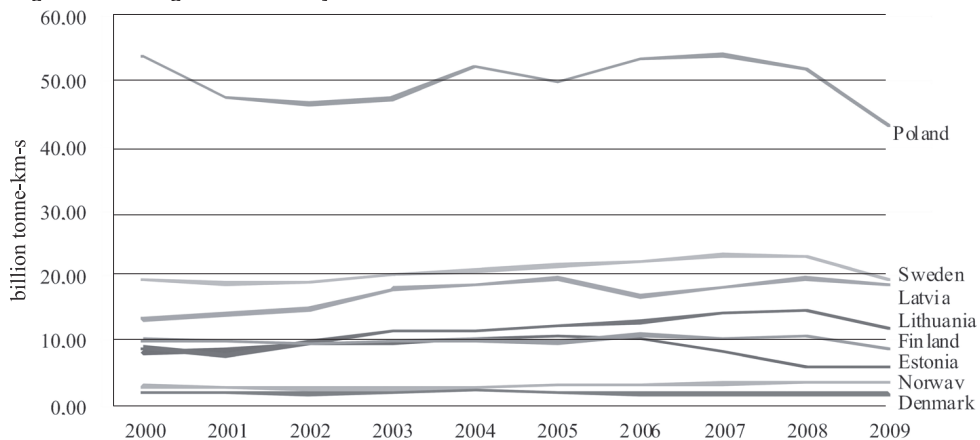
Source: EU, 2011

Firstly, infrastructure managers working in a regulated business environment must be separated from freight and passenger transport service providers working on competitive market so that the infrastructure managers would treat all freight and passenger transport operators (including those belonging to a same group of companies) equally. So the companies would have more trust, new companies could enter the market more easily and there would be more competition. All that could have positive influence on freight transport charges.

Secondly, such separation of railway companies would prevent subsidising freight transport service on the account of regulated infrastructure service provision (or *vice versa*—*Authors' note*), which could affect freight transport charges in a way that would prevent freight transport undertakings from coming to the market.

Thirdly, in case of separation, the infrastructure managers can focus on their main activity—provision of services ensuring access to infrastructure (*Communication from…*, 2010).

There are several ways how to separate infrastructure managers from freight transport undertakings.

1) Recording revenue, expenses, assets and liabilities separately for different activities, i.e. the so-called accounting separation;

2) Functional separation of infrastructure manager, passenger and freight transport undertakings, i.e. the independence of infrastructure managers in groups of companies is ensured (separate organisation, independent decision-making system, independence of management, right to determine investments into network and keeping of confidential information);

3) Legal separation of infrastructure managers, passenger and freight transport undertakings in the course of which a separate undertaking dealing with infrastructure management is established inside a group of companies.

4) Ownership separation—the most radical way of separation, meaning that a railway company must fully or partially give up its ownership in freight transport undertaking (Kukke, 2011).

In broad terms, railways are organised as Ministries, state-owned enterprises and as independent corporations (though some or all of the equity may be owned by the state) (Thompson, 2009). The degree of separation in rail transport sector extends in the Nordic and CEE countries from functional separation to a complete ownership separation of infrastructure and operations (RGL Forensics, 2009). Within the geographical scope of the paper, there is a full vertical and horizontal ownership separation in the areas of infrastructure and operations in the Nordic countries like Norway and Sweden. In CEE countries, that is in Estonia, Latvia, Lithuania and Poland, there is functional, legal and accounting separation (see Fig. 6) of various forms that will be analysed in the present article using the example of Estonian Railways.

Estonian Railways, Ltd (EVR) is according to the OSJD (2002) the main railway undertaking in Estonia. EVR was a vertically integrated freight transport railway that was also the owner of the largest public railway network in Estonia. In the years 2001–2007, private investors owned 66 per cent of EVR's share capital, whereas today 100 per cent of the company's shares are back in government ownership. On 14 January 2009 EVR split into two new companies: AS EVR Infra dealing with railway infrastructure management and AS EVR Cargo providing freight transport and rolling stock services. Similar vertical separation has taken place in Poland and Latvia.

At the end of November 2010, the European Commission initiated legal actions against 13 Member States, incl. Poland, in the European Court of Justice, claiming that these countries have not implemented the First Railway Package of 2001 at a sufficient level. The main complaints of the Commission are as follows:

- The integration of infrastructure managers in the group of companies, the model selected by many countries, incl. CEE states in the Baltic, infringes the provisions of EU unbundling legislation.

- Member States do not ensure that their infrastructure charges pay sufficient attention to the market viability of individual market segments.

- There are no incentives for infrastructure managers to reduce costs and lower infrastructure charges.

- The regulatory authority does not have sufficient powers to conduct market polls (Deutsche Bahn, 2011).

The Government of the Republic of Estonia has passed a resolution about conducting the ownership separation of railway companies already in 2012 (see Fig. 7). The holding company Estonian Railways, Ltd was divided on 4 September 2012 into two separate companies, whereas the business name of Estonian Railways remains with the infrastructure manager AS EVR Infra.

Figure 6. Models of separation between operations and infrastructure in selected countries
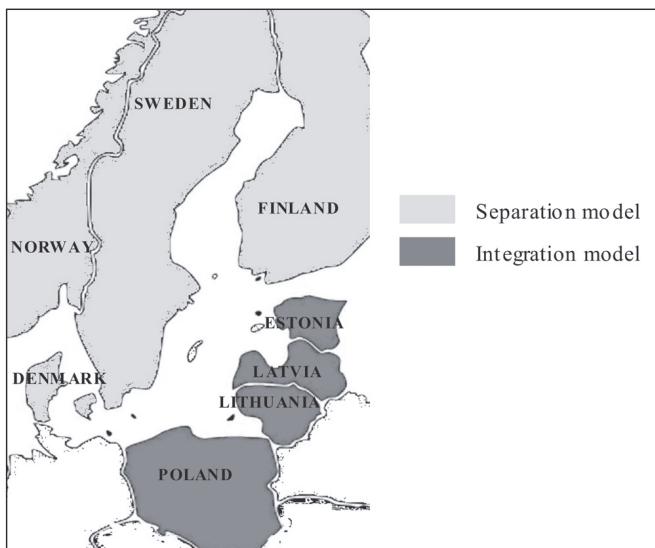
Source: IBM, 2011

Differently from Estonia, many European governments have stated publicly that their regulations were transposed in conformity with the Directives and are in line with the objectives of the railway packages. It has also been claimed that criticism can be levied as regards the Commission's procedures in that it is attempting to enforce its own ideas of regulatory legislation not by means

of parliamentary legislative proceedings, but in the form of extensive legal interpretation (Deutsche Bahn, 2011).

Figure 7.   Model of organising rail transport in Estonia considering EU regulations
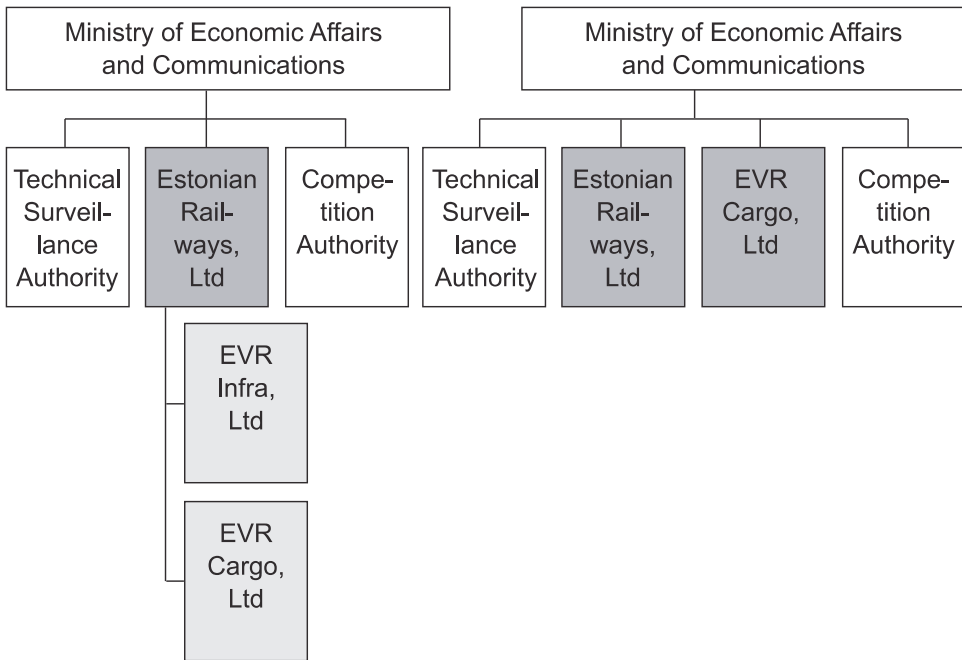
Source: Nežerenko and Koppel, 2012

The authors are of the opinion that this position is justified, as the Council of Ministers and the European Parliament had agreed that the first railway package was to grant the Member States a certain degree of freedom in transposition of the measures. This also refers in particular to the form of corporate structure, infrastructure charging and the decision on whether the incentive to reduce costs is to be designed as a performance regime, in the form of multiannual contracts or in some other way. Therefore, the reorganisation process in Estonia could prove to be unnecessary.

4.3.   Rail infrastructure charging issues

In the previous section it was mentioned that the European Commission has complaints regarding infrastructure pricing mechanisms against many Member States. Therefore, the authors analyse the details of infrastructure pricing in the Nordic and Baltic countries.

Pricing theory is based on the perfect market, that is a market where the supply and demand are always in balance. As any other goods market, the rail transport service market is not a perfect one—market failures occur. In the context of this study, market failures mainly manifest themselves in the form of natural monopolies. A natural monopoly is defined as an undertaking who owns essential facilities, such as an infrastructure or other, which other persons cannot duplicate or for whom it is economically inexpedient to duplicate, and the access to which is essential in order to operate on the goods market. In order to regulate the activities of undertakings in a dominant position, the state can use different price regulation methods (Baumstark & Bonnafous, 1998).

In case of the best solution, a price is effective (optimal) when it equals both the marginal cost and consumer marginal surplus. Marginal cost is an extra cost incurred to produce a product or service unit, that is a change in total cost which equals a change in the volume of production by one output unit. Special methods for marginal cost pricing are: social marginal cost pricing (SMC); short-run marginal cost pricing (SRMC); short-run marginal social cost pricing (SRMSC); long-run marginal cost pricing (LRMC); long-run marginal social cost pricing (LRMSC); Ramsey pricing; cost-plus pricing (MC+).

The typology of special methods of marginal cost calculation universal methodology is based on the fact that if the time horizon is sufficiently long, all infrastructure management costs are variable costs. According to literature, in the case of SRMC-method a price is effective if capacity is limited or excessive, and in the case of LRMC-method if the capacity and demand are exactly the same. In the case of SMC-methods, all transportation system costs, both regarding the consumer and society in general, are included in price formation (Koppel, 2006).

Maximum efficiency obtained by marginal cost pricing in sectors with increased returns, for example in railway infrastructure management, is a decisive conclusion contributed by the theory of welfare economics. However, this theoretical result presents a number of problems (Baumstark & Bonnafous, 1998). The authors of this article find that such problems are manifested in the large investment need of railway infrastructure, competition for freight trains originating from third countries and cross-subsidising between freight and passenger transport taking place in the selected countries. Table 2 presents information about railway infrastructure pricing methods used in the countries under discussion. It can be seen that the Nordic countries use exclusively the marginal cost pricing method and the Baltic countries use the fully distributed costs (FDC) method. Finland can be considered a special case, as the Finnish

infrastructure pricing method is based on the long-term marginal costs of the infrastructure.

Table 2.   Use of pricing methods in selected countries

Country	Pricing principle	Two- or multi-part tariff	Charges per		
			gross tonne-km	train-km	path-km
Denmark	SRSMC+			*V*	
Finland	LRSMC+		*V*		
Sweden	SRSMC+		*V*		
Norway	SRSMC+		*V (freight)*		
Estonia	FDC	*V*	*V*	*V*	
Latvia	FDC			*V*	
Lithuania	FDC	*V*	*V*	*V*	*V*
Poland	FDC			*V*	*V*

Note: SRSMC – short-run marginal social cost pricing, LRSMC – long-run marginal social cost pricing, FDC – fully distributed cost pricing.

Source: ECMT, 2005

Estonia has chosen to use two-part tariff method where the fixed component is theoretically meant for covering the costs related to train control. The external marginal cost of transport system is partially included in the railway infrastructure pricing model of all the Nordic countries, including costs such as those related to congestion, railway accidents or negative environmental impact (noise, vibration, air pollution) (see Table 3).

Table 3.   Cost items included in variable infrastructure charges in selected countries

Country	Cost items					
	Maintenance	Renewals	Traffic management	Congestion	Accidents	Environment impacts
Denmark	*V*			*V*		
Norway	*V*				*V*	*V*
Sweden	*V*				*V*	*V*
Finland	*V*	*V*				*V*
Estonia	*V*	*V*	*V*			
Latvia	*V*	*V*	*V*			
Lithuania	*V*	*V*	*V*			
Poland	*V*	*V*	*V*			

Source: ECMT, 2005

In the relevant literature (Baumstark & Bonnafous, 1998) two main principles of railway infrastructure pricing have been mentioned. One of them involves relating pricing to the difficult question of covering the fixed costs which within

the rail system, as many other networks, represent a large proportion of the total costs. The European Commission's proposal (*Communication from…*, 2010) sets the maximum of 35 per cent for direct costs to be included in infrastructure charge. It implies that the remaining part of the costs should be covered by the state budget. While this practice is prevailing in certain Member States (where railway freight share is around 10%, this share focuses on containerised cargo, and subsidies to rail operations and infrastructure are significant), it is not the case in other Member States. For example, in the Baltic States (Lithuania, Latvia, and Estonia) infrastructure managers are not significantly subsidised by governments (see Fig. 8). They earn revenues from infra-structure charges to cover the needed investments in rail infrastructure, maintenance and development.

Figure 8.   Target per cent of the total cost covered by infrastructure charges
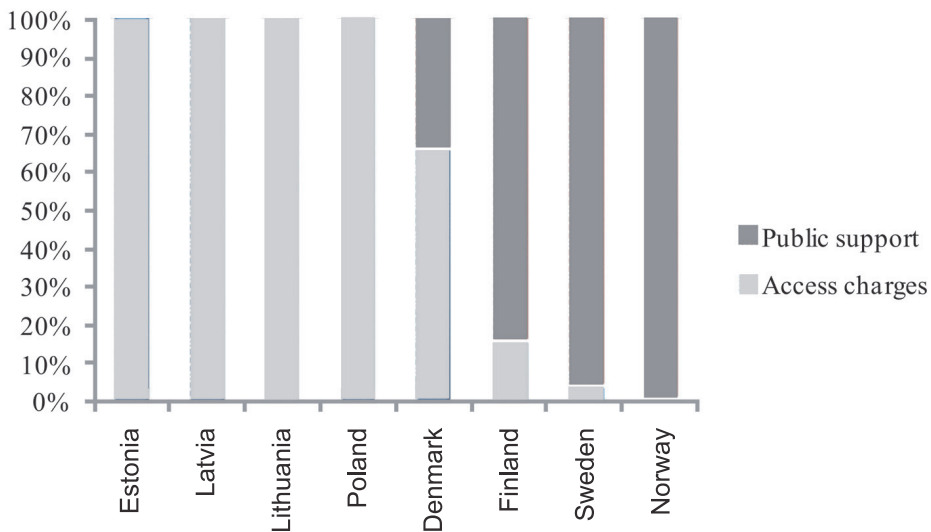
Source: Thompson, 2008

The railway undertakings of the Baltic countries can be characterised by a vast need for investment that would be necessary for implementing the projects and targets mentioned in the Transport White Paper and the Baltic Sea Strategy of the EU. It is also not certain whether the state budgets of these countries would have sufficient funds for financing railway infrastructure in the suggested volume.

The aforementioned is substantiated by the fact that the rail infrastructure investment and maintenance costs per one kilometre (see Tables 4 and 5) are substantially higher in the Nordic countries than in the selected CEE countries (apart from Lithuania).

Table 4.   Investments per km of track in selected countries (current prices and exchange rates, million euros)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Nordic countries											
Norway	86.8	47.7	46.5	49.1	54.4	47.3	63.1	68.9	69.9	87.2	n.a.
Finland	39.8	34.8	38.4	47.0	57.2	49.1	39.6	35.8	55.2	57.1	61.3
Sweden	53.6	52.7	73.9	67.4	71.9	77.5	82.8	102.2	119.6	118.4	128.7
Denmark	204.5	166.0	172.7	121.5	122.5	91.0	67.3	87.7	141.0	134.8	149.8
CEE countries											
Estonia	20.7	15.3	18.6	16.7	22.8	21.5	22.9	33.6	23.2	32.1	37.3
Latvia	16.1	13.2	15.9	17.9	14.6	17.7	14.6	16.5	27.0	33.8	41.2
Lithuania	9.3	14.5	32.4	48.2	39.5	38.4	28.5	42.6	48.4	38.0	60.6
Poland	8.6	5.6	5.3	9.4	10.8	12.1	18.2	33.3	46.1	32.9	34.9

Source: ITF, 2012

Table 5.   Maintenance expenditure per km of track in selected countries (current prices and exchange rates), million euros)

Country	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Nordic countries										
Norway	80.4	91.5	102.7	95.3	86.6	88.1	98.8	101.3	108.8	130.1
Finland	19.6	21.3	23.0	23.4	27.1	27.3	26.4	28.3	30.4	33.1
Sweden	32.0	31.1	40.2	48.2	70.2	51.4	53.4	55.7	54.2	53.0
Denmark	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
CEE countries										
Estonia	22.6	18.9	15.1	12.6	11.9	13.6	18.5	20.8	n.a.	n.a.
Latvia	20.7	21.7	23.5	18.6	24.5	26.6	31.0	39.3	55.9	73.2
Lithuania	25.0	29.1	42.2	52.2	53.6	59.5	59.5	64.9	65.0	93.8
Poland	2.6	2.2	1.9	3.3	3.8	4.2	3.4	5.2	1.8	7.9

Source: ITF, 2012

In order to achieve the targets set in the EU transport policy (high-quality transport connections), the total investments into infrastructure and maintenance costs in the CEE countries should increase 5–20 times. It is highly probable that such situation cannot be achieved without subsidies from the state budget (as is the case in Norway, Sweden and Poland) or the EU structural funds (the Baltic countries) (ECMT, 2005).

Therefore, the second principle of railway infrastructure pricing is based on the acknowledgement that rail infrastructure pricing cannot be separated from investment choices. The example of Estonian Railways (former EVR Infra, Ltd) shows that in order to satisfy the investment need of a company through access fee's capital cost component based on the full infrastructure costs (considering that the weighted average useful life of railway infrastructure components is

ca 30 years), a cumulative sum of more than half a million euros should be covered annually. As Estonian Railways is a business undertaking, the so-called reasonable business profit should be added. The Estonian legislation stipulates that such profit is the product of weighted average capital cost and the residual value of non-current assets. It has also been considered that according to the accounting rules applicable in Estonia, the investments made with the assistance of the EU structural funds are not depreciated.

Rail freight traffic in the Baltic States is essentially devoted to shipping exports of Russian commodities to seaports for further exports (i.e. these are re-exports) or to shipping commodities from Russia into the Russian enclave of Kaliningrad (i.e. these are re-imports of the Russian Federation). This unique case requires special treatment. It does not make sense to use public funds from the EU Member States to effectively lower track access charges in this particular case, since this would be a transfer of public funds to undertakings from a third country.

Figure 9. Average annual investments of Estonian Railways in railway infrastructure and sources of funding
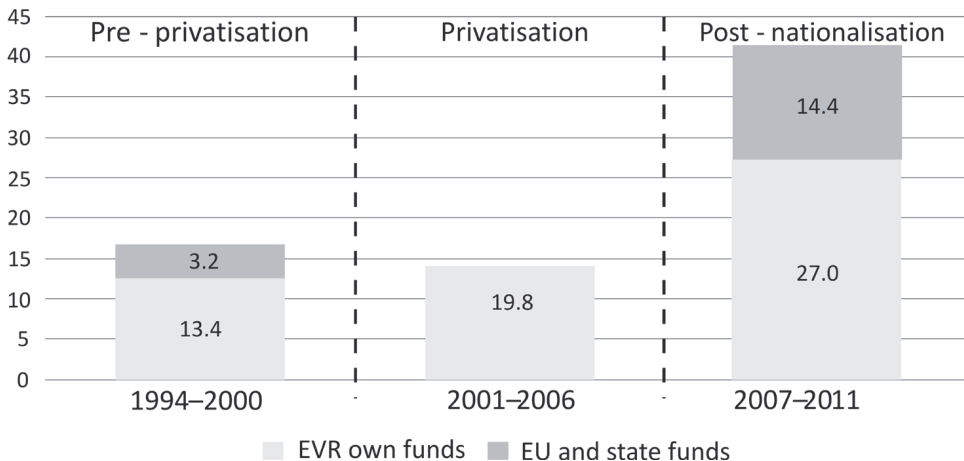
Source: Koppel & Archer, 2006; Communication with Estonian Railways, 2012

The aforementioned shows that the market in case of railway infrastructure management is seen as an oligopoly rather than a monopoly, that is a market where a limited number of sellers sell their products practically to an unlimited number of buyers (Koppel, 2006). To illustrate the above-said, let us view the Baltic rail transport market as one integral whole where infrastructure managers Estonian Railways (Estonia), LDz Infrastruktūra (Latvia) and LG Railway Infrastructure Directorate (Lithuania) compete with each other. As

is shown in Figure 10, the volume of internationally moving freight hauled by the Baltic railways in 2006–2010 has varied by approximately 15 per cent and a significant role in the distribution of freight between the countries is played by the economic policy considerations of Russia, whereas in short-term perspective the volume of freight going through the Baltic countries has been stable.

Figure 10. Volume of freight hauled by Baltic railways in 2006–2011

	EVR 2006	EVR 2007	EVR 2008	EVR 2009	EVR 2010	EVR 2011	LDZ 2006	LDZ 2007	LDZ 2008	LDZ 2009	LDZ 2010	LDZ 2011	LG 2006	LG 2007	LG 2008	LG 2009	LG 2010	LG 2011
Domestic	3,247	4,911	4,0565	2,82	4,248	5,42	2,4	2	1,687	1,299	1,262	1,19	13,411	12,33	15,377	12,932	14,117	15,05
International	41,136	31,8	22,01	22,539	25,384	25,09	46,326	50,16	54,37	52,38	47,902	58,19	36,888	41,136	39,592	29,737	33,943	37,28
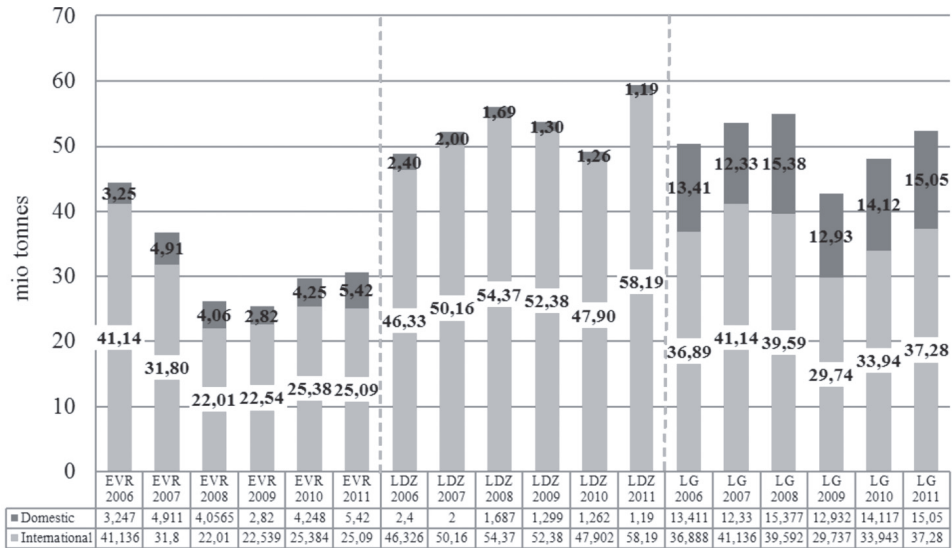
*Source: Authors' illustration based on the information of Baltic railway undertakings*

There are also opinions that the new railway directive aims at establishing more precise infrastructure charging rules in order to end the forced subsidising of passenger transport by freight transport in the CEE countries. For example, the railway infrastructure access fee calculation method employed in Estonia is known from the theory of economics as fully distributed costs (FDC) pricing method (see above).

Access fee is calculated as two-part tariff, using, in the authors' opinion, unjustifiably the assumption that 30 per cent of railway infrastructure management costs are fixed and 70 per cent are variable. Fixed costs are distributed between freight operators in accordance with the share of capacity allocated to a company (measured in train kilometres) and variable costs based on the mutual proportion of companies' rolling stock works (measured in gross tonne kilometres). The distinctive character of the Estonian system is that the companies providing public passenger transport services are exempt from

paying the fixed cost component of railway infrastructure access fee that causes legitimate doubts about the existence of cross-subsidies (Koppel, 2006).

The element of cross-subsidising is present also in the infrastructure pricing mechanisms of other countries (see Figs. 11 and 12), whereas in Norway the passenger trains using railway infrastructure pay no fee whatsoever. There exists a rational explanation for that, as the pricing of road transport competing with railway infrastructure does not include full infrastructure and environmental costs. Meanwhile, there also exist cases where freight transport is cross-subsidised by passenger transport. This is mostly happening in some Nordic countries where the governments want to shift freight from road to rail. It is peculiar that freight transport subsidising by rail passenger transport funded from state budget is also happening in Estonia—on the railway infrastructure belonging to Edelaraudtee Infrastruktuuri AS (South-West Railway Infrastructure, Ltd).

Figure 11. Infrastructure access charges for freight and passenger trains in selected countries
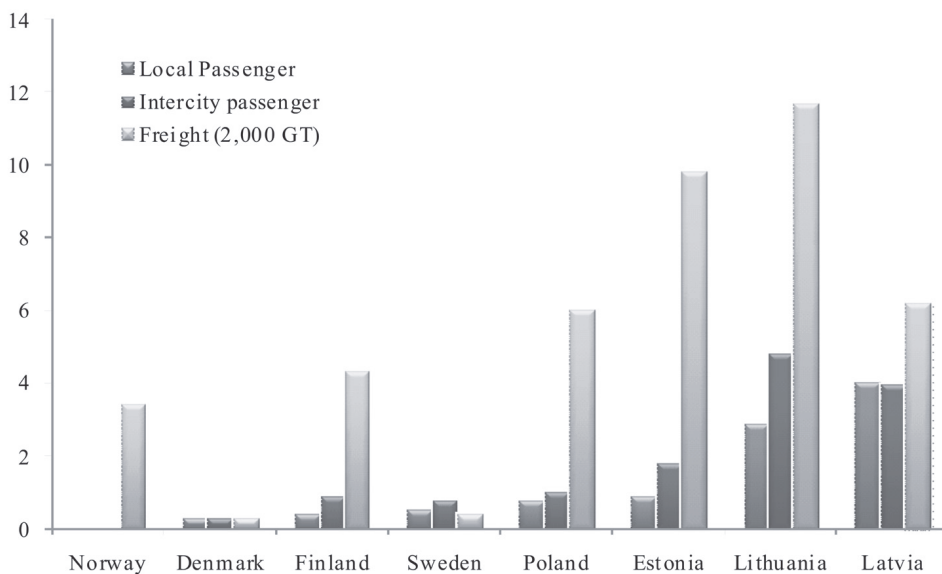
Source: Thompson, 2008

Based on the foregoing statements, the following conclusions can be drawn. The increasing volumes of rail freight transportation in the Baltic CEECs signify that "the market can bear the applied charges", as it is mentioned in the proposed new directive (*Communication from…*, 2010). Moreover, a specific feature of railway market in the Baltic States is that more than 70 per cent of freight traffic

comes/goes from/to third countries (Russia, Belarus, etc.) and raw materials are the dominant type of freight. If the possibilities for the mentioned countries to recover total costs are to be limited then it would signify: a) unbearable burden for national budgets to invest in railways, and b) unjustified outcome of subsidising third countries. On the other hand, the market failures in unfair pricing of passenger and freight transport have to be eliminated.

Figure 12. Ratio of the access charge per a typical 2,000 gross tonne freight train to charge per a 590 gross tonne intercity passenger train
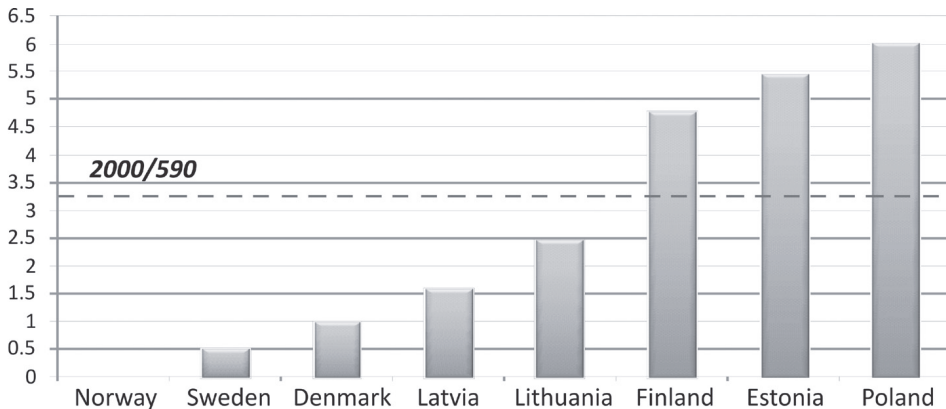
Source: Authors' calculation

5. Conclusions

The results of the research indicate that the organisation of rail transport in any CEE country located in the Baltic Sea region is not compliant with the respective legislation of the European Union and the compliance with those legislative acts would require certain reorganisation at the government agencies' level. The authors still doubt whether the establishment of an independent body only for the purpose of supervising competition on railways would be reasonable considering the small size of the Baltic States. Among other things it might appear necessary to transfer the shares of rail transport undertakings from holding companies to the governments or privatisation of companies. In other aspects, good reorganisation examples can be seen in the Nordic countries, particularly Denmark, where the legal (but not ownership) separation has already been completed.

Meanwhile, the Baltic States and Poland acceded to the EU in 2004. As such, neither Estonia, nor any other acceding Member State, had an opportunity to

influence the First Railway Package, issued in 2001. Nevertheless, necessary exemptions were applied for and received by Finland. Now, during the recast of new railway directive there is an opportunity to make necessary amendments taking into account the particularities of the Baltic States. Possible solutions to the problem could comprise one or several of the following steps:

1) Apply for an exemption for the Baltic countries for using the fully distributed cost method for railway infrastructure pricing until the companies working on the rail transport market are able to pay it;

2) Stipulate that the requirements of the new EU railway directive will not apply to international rail transport from third countries;

3) Stipulate that the requirements of the new EU railway directive will not apply to international rail transport to the seaports of the Baltic countries.

4) Considering what has been said above, the authors are of the opinion that the recommendations given would ensure the sustainable development of railway business in the CEE countries located in the Baltic Sea region. These recommendations would actually facilitate and not hinder the achievement of the goals laid down in the EU documents dealing with development. This statement is also supported by the fact that at the time of writing the present article such ideas are being discussed also in the European Parliament (Serracchiani, 2011).

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Appendix 2.

Research paper II

Nežerenko, O., Koppel, O., Tuisk, T. (2015). Cluster approach in organization of transportation in the Baltic Sea Region. *Transport.* (Article in press). doi: 10.3846/16484142.2014.994225. (ETIS 1.1)

CLUSTER APPROACH IN ORGANIZATION OF TRANSPORTATION IN THE BALTIC SEA REGION

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Abstract. The urgency of the issues discussed in this paper stems from the fact that cross-border collaboration is an essential part of commercial transportation today. With the extension of multimodal transportation concept, the efficiency and performance of not only national but also of regional transport systems depend on a synergy which occurs as a result of cooperation between transport enterprises and different modes of transport. The present study analyses the situation of transportation field in the Baltic Sea Region (BSR) in the period 2004–2011. The methodology used is based on Hierarchical Cluster Analysis (HCA), correlation analysis, Bayesian analysis and affinity analysis, which help to identify countries with similar trends in the field of transportation and the common reasons and factors which have led to the emergence of these clusters.

Keywords: transportation; cluster analysis; cargo volumes; Baltic Sea Region; infrastructure; co-operation; competition.

Introduction

The transportation sector has been considered a supporting field of services, which provides trade relations with required infrastructure and means of transport, involving technical, legal and administrative support. While the last global economic crisis in 2008–2009 led to a degradation of economic and trade activities, the transport sector also experienced a significant drop in cargo (and also in passenger) flow.

Moreover, the dependency of the transportation sector on political events and decisions should not be underestimated, especially in the case of the Baltic States the transport activity of which relies on bilateral rather than on multilateral relations with Russia. For the coming years, business activity has taken the course of internationalization.

Amidst one of the most complicated global economic crisis, the business sector (including transportation) faced new challenges. The authors share a view that the new context requires a new way for a strategic approach – namely, a cluster approach.

The urgency of the present paper is confirmed by the following facts:
 – the competitiveness of transportation corridors goes beyond the boundaries of a group of enterprises;
 – Baltic transportation corridors can be presented as links within an international supply chain;
 – cooperation of all transportation chain links (including all modes of transport) allows not only to minimize ecological issues, but also to decrease transportation costs, and promote more rational involvement of transit countries' transport capacities;
 – formation of a single regional transportation system would allow the Baltic Sea Region (BSR) to achieve a new quantitative transportation field.

This, in its turn, proves that for the creation of competitive business environment and transportation corridors cooperation between enterprises and the public sector is of great importance (MoEAaC 2011).

Being an essential part of the Trans-European Transport Network (TEN-T), the BSR links East and

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West, and North and South. Environmental issues, differences in economic development and in infrastructural accessibility, and throughput of the latter in the region require the efficiency of existing BSR transport corridors to increase in order to spread the load on transport infrastructure in the BSR more evenly.

The European Commission (EC) in its White Paper (EC 2011) states that one of the issues that the European Union (EU) has to tackle is a competition on the global transport market. Logistics clusters in the Far East are the main competitors for the European ones. With the extension of multimodal transportation concept, the efficiency of a region's transportation system performance depends on a synergy which occurs as a result of efficient cooperation between countries.

In order to develop the BSR as a gateway for traffic between Asia and Russia, on the one hand, and Europe, on the other, it is vital to develop the present transport network in the BSR and the links to the neighbouring countries, such as Russia, Ukraine, and Belarus. The condition of the network varies in different parts of the region and in the neighbouring countries and calls for special attention to reduce the bottlenecks and develop the vital parts of the network into an agreeable standard that could handle future transport volumes in a satisfactory manner.

Support from all levels – trans-national, national, regional and local level – is needed in order to ensure that the development goes in the set direction of establishing an efficient and smoothly functioning network of infrastructure, whereby all modes of transport are utilized each within their best capacity. According to the foresights, the future of freight corridors depends on politics – and the political agenda in China, Kazakhstan and Russia will set the rules. Eastern Europe will continue to grow and thereby consume and produce more. The flows will depend on the market (TransBaltic 2010).

The aim of the present paper is to analyse the current situation of the field of transportation in the BSR by means of Hierarchical Cluster Analysis (HCA) and to identify reasons and factors contributing to the formation clusters of countries with similar trends in the field of transportation.

The hypothesis of the study is the following: dynamics and responsiveness of country's transport performance during the period from 2004 to 2011 as modelled by HCA will enable to predict the country's recovery from the crisis. Each of the three fields of transportation – rail, sea and road – will be individually tested and managed with negative results of Economic Crisis in Europe.

The geographical coverage of the study complies with the definition of the BSR given by the EC (EC 2009). The BSR consists of eight European countries and one non-European country: Denmark, Estonia, Finland, Germany, Latvia, Lithuania, Poland, Sweden and Norway.

1. Previous Studies

The presence of clusters, that is, regional agglomerations of companies and other institutions in industries connected through different types of linkages and spillovers, are associated with higher levels of overall regional economic performance in the Baltic Sea Macro-Region of the EU (Ketels *et al.* 2012). The reasons for clustering grow directly out of the determinants of national advantage and are a manifestation of their systemic character (Porter 2011).

Garanti and Zvirbule-Berzina (2013) have explored in their paper benefits of regional cluster initiatives at micro (enterprise) and macro (region) a levels and presented the theoretical framework of regional cluster effect on regions' growth and development (Fig. 1).

The researchers conclude that the regional cluster presence has a positive impact on the growth and development of the region.

The urgency of this fact is especially high in terms of variable nature of the world economic system. Authors are of the opinion that development of the BSR transportation field can be achieved by creating a single regional transport cluster. As a result, an increase in efficiency and in a level of business formations, activation of innovation in the field would create a favourable environment for the business sector and activate economic growth and development in the BSR.

Review of the literature shows that the number of research papers investigating the influence of the global economic and financial crisis on different modes of transport is limited. Grama (2011) in her study examines developments of the liner shipping market and freight rates in 2009 and 2010 and concludes that the impact of
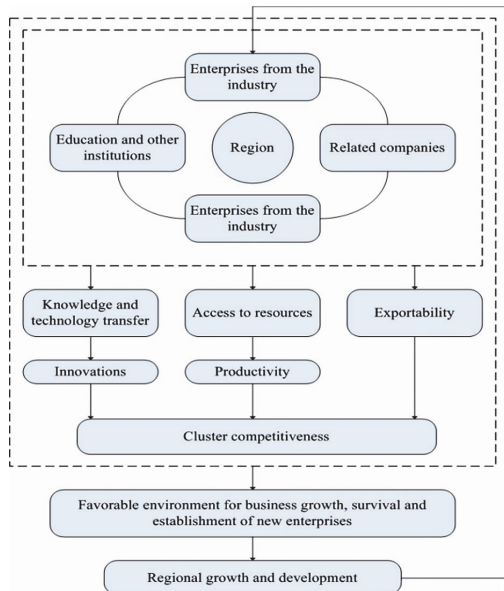

Fig. 1. Regional Cluster Effect on Regional Growth and Development (Garanti, Zvirbule-Berzina 2013)

the crisis on freight rates was very dramatic – prices for vessels declined by 50–70% compared to the year 2008. Decline in demand forced ship-owners to adopt a number of measures, such as cutting the size of their fleet by returning unwanted chartered tonnage to ship-owners, sending some ships to demolition and laying up others.

Development of rail passengers and freight transportation in the EU in the period of 2006–2009 is the focus of the paper by Bălan, G.-S. and Bălan, M. (2010). The authors express the view that railway transport presents less risk factors than other modes of transport, but at the same time their analysis shows that decline in rail freight transportation in 2009 was more significant in Central and Eastern Europe (24%), where revenue loss has been more severe compared to the Western Europe, and in contrast with other modes of transport, tonne-kilometres were already declining in early 2008 and the financial situation of rail companies has been critical for years. As a consequence, some railways in Eastern Europe have been unable to pay their staff in full, suppliers are not being paid and are charging penalties.

The study of Wiskulski and Bar-Kołelis (2012) examines the BSR's tourism potential on the basis of statistics of eight EU countries in 2000–2009 and prospects for 2010–2011. The pattern of factors influencing the transportation of passengers and freight is different. But some, such as expansion of low-cost airlines, economic crisis, increase of operating costs, the 2004 EU Enlargement, growth in fuel prices, historically well-developed connections between certain countries are valid for the freight transport market.

The problem of cooperation between different modes of transport was discussed at length by Rigas *et al.* (2011). Authors attempted to identify the circumstances under which air and maritime transport could develop a competitive relationship. Authors point out that a new operational environment led to market consolidation, though the condition of either markets can be regarded as fluid and under transition, and its final form will depend on the intensity and the duration of the crisis, which can even lead to oligopoly or even monopoly.

The works published by Guerrero and Rodrigue (2014) look at economic cycles as components of the derived demand of containerized maritime transport at the global level with the usage of cluster analysis, shift-share analysis and technical analysis. The researchers have expressed the view that future expectations about the growth of containerization need to be assessed within an economic cycle perspective instead of the rather linear perspectives in which containerization is generally considered.

Based on the analysis of literature on the subject it could be argued that there is a very wide range of factors influencing the development processes of transportation field. The conceptual relation between these factors (Brodin 2003) has been identified in Fig. 2.

It is not possible to cover in detail some factors, especially 'qualitative factors' such as political ones, mainly because political processes can be interpreted in various
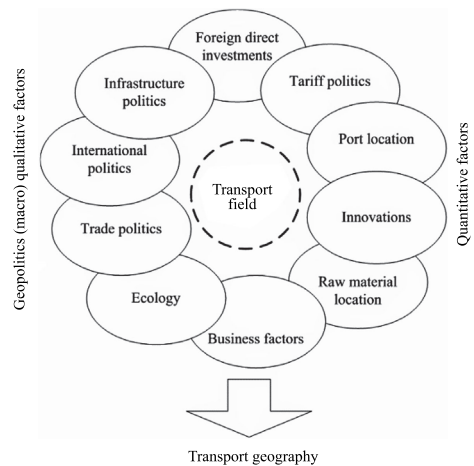

Fig. 2. Conceptual relation between factors influencing the analysis of a field of transportation (Brodin 2003)

ways. Transported cargo volumes, international trade volumes, development level and capacity of transport infrastructure, investments and business activities are the quantitative factors that have been more frequently analysed in research papers.

Taking into account that transportation field is on the edge of economics and politics, there is a continuous interaction between all the above-mentioned factors. As a result of political decisions, such as not allocating additional funding to state railways, and thus, possibly, increasing railway efficiency, the competitiveness among national ports may be indirectly decreased (Brodin 2003).

Both groups of factors also interact with each other. Thus the imposition of protectionist infrastructure tariffs, trade barriers and administrative obstacles may limit the business activity in a sector and have a negative influence on the competitiveness of the whole transport corridor.

International projects in the field of transport on regional level may increase business activity. Within the BSR, cooperation in or implementation of international projects implies the participation of the third countries, which are the suppliers of cargos – in the given case this primarily concerns Russia and China.

2. Methodology

The methodology applied in analysing the BSR transport sector in 2004–2011 makes use of four types of analysis:

1. HCA, using Ward's method as a criterion that minimizes the total within-cluster variance;
2. Correlation analysis;
3. Bayesian analysis carried out using B-course, the web-based tool for Bayesian data processing;
4. Affinity analysis carried out using *Weka* – data mining software (Hall *et al.* 2009).

HCA is the main tool for analysing the BSR transport activity within the scope of this paper. There are two main types of empirical studies which can be carried out using the HCA. One type simulates clusters in data of a particular type and then assesses the characteristics and recovery of clusters. The first is based on real data from a particular subject matter, the criterion in the second usually being the interpretability of clusters.

Examples of former researches include a review by Milligan (1981) and a study reported by Milligan and Cooper (1987). The latter concluded that Ward's method performed very well when the data contained clusters with approximately the same numbers of points, but poorly when the clusters were of different sizes.

Cunningham and Ogilvie (1972) and Blashfield (1976) also concluded that for clusters with equal numbers of points Ward's method is successful (Everitt *et al.* 2011). In addition to the HCA, other statistical data and indices provided by Eurostat (2013) and OECD (2013) will be used in the discussion part (Appendixes 1 and 2). Despite the fact that only the northern part of Germany is officially included in the BSR, statistical data used for HCA covers the whole country. Ward's method allows forming clusters on the basis of cargo flow dynamics, not on the basis of absolute values (i.e. Z-scores of the real values were used within the HCA).

HCA is a statistical method commonly used for finding relatively homogeneous clusters of observations based on their measured attributes. From a dataset, HCA finds groups (clusters) that minimize their endogenous dissimilarity according to a set number of groups. Initially it places each observation in a separate cluster and then combines the clusters sequentially, reducing the number of clusters at each step until only one cluster is left. When there are N cases, this involves N-1 clustering steps (Guerrero, Rodrigue 2014). Hierarchical classifications may be presented in a two-dimensional diagram, known as a dendrogram, which illustrates the fusions or divisions made at each stage of the analysis (Everitt *et al.* 2011).

Cluster analysis has limited application in papers on transportation research and it has mainly been used in maritime sector to classify ports according to their function and performance level (e.g. Tongzon 1995). The main idea of cluster approach in the organization of transport activities at a macro-regional level consists in the increasing of efficiency of transportation process due to the links between identified clusters. On the basis of statistical data (cargo volumes) and observed cargo turnover dynamics in the course of eight years (2004–2011) it is possible to see which countries form single clusters. Each country's 'conduct' and its belonging to the cluster allow to forecast the given country's or cluster's recovery after global economic crisis. The latter event has a role of the intervention variable within the current study. Besides, we have empirical data reflecting also the situation during the crisis period.

The following three methods of analysis are carried out with the purpose of explaining changes in cargo volumes across 8 years for the 9 countries and determine factors that influence cargo volumes in the BSR. Ten factors were tested: Gross Domestic Product (GDP) at market prices; export volumes; import volumes; production change in industry; population; investments in road infrastructure; investments in rail infrastructure; investments in port infrastructure; gross value added in trade, communication and transport services and rail infrastructure density. The sample for analysis was 72 country-years as cases.

3. Results of Empirical Research – the BSR Countries' Performance According to Modes of Transport

3.1. Rail Transport

During the pre-crisis period, in 2004–2007, and the post-crisis period, in 2010–2011 (Figs 3 and 4), Denmark, Norway and Finland (who form the first cluster) seem to demonstrate similarity in dynamics of their performance.

Estonia, Sweden, Lithuania, Latvia with Poland form the second cluster within the hierarchy of railway transport clusters. The most dissimilar country within the region in 2004–2011 is Germany.

There had been changes in the clusters' structure during the crisis period in 2008–2009 (Fig. 4). Estonia and Sweden left their initial cluster and joined the group of Nordic countries – Denmark, Norway and Finland.

That was the reason for Latvia, Lithuania and Poland to lose 21–40% of cargo turnover.

All the rest of countries showed less significant drop (10–20%), with the exception of Estonia and Sweden – these countries even increased their performance by 20% and 1%, respectively.

Despite the fact that Fig. 5 demonstrates that in the post-crisis period participants of clusters remain the same, HCA shows that economic recovery has reduced the step of cluster formation at the second stage – dissimilarity between the two biggest clusters in cargo turnover dynamics has been reduced.

In the period 2010–2011, Latvia and Lithuania demonstrated in their cargo turnover growth by 63% and 16%, respectively. Meanwhile Estonia and Sweden showed negative dynamics. Within the second cluster, the countries' turnover dynamics varied.

Sweden lost 3.6% of cargo turnover, Norway's absolute values remained stable, and Finland had a drop of 9%. Germany, in the post-crisis period, improved its railway performance by 2.9%. It is interesting to note that in the post-crisis period the biggest increase in cargo turnover by railway was demonstrated by the countries whose economies in the crisis period were significantly weakened – Latvia and Lithuania.

Estonia's performance had already dropped during the pre-crisis period as a result of political events, e.g. the Bronze Night of 2007 (Koppel 2008) and followed by blocking of oil products and coal transit flow by railway through Estonian ports. Starting from 2008, international cargo flow in Estonia had demonstrated relatively minor fluctuations despite the economic crisis.
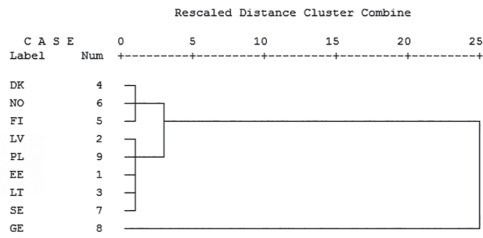
Fig. 3. Dendrogram representing the formation of countries' clusters based on their railway transport flows during 2004–2007
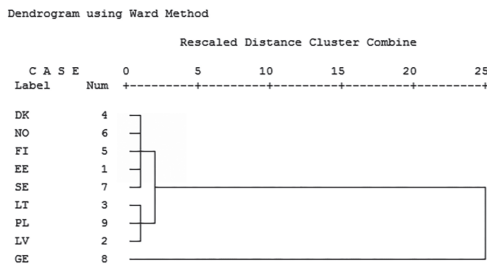

Fig. 4. Dendrogram representing the formation of countries' clusters based on their railway transport flows during 2008–2009
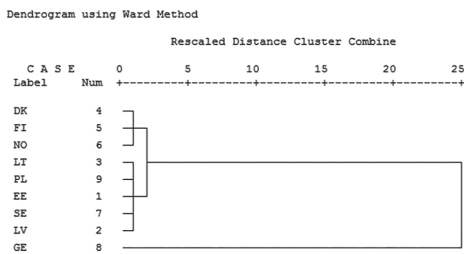

Fig. 5. Dendrogram representing the formation of countries' clusters based on their railway transport flows during 2010–2011

Bălan, G.-S. and Bălan, M. (2010) state that the financial situation of rail companies in Eastern Europe has been critical for years and many rail companies have been hit hard in the economic crisis and are expected to take longer than other modes of transport to recover. The researchers stress the fact that many rail and infrastructure companies in Central and Eastern Europe are chronically underfinanced. Public sector contributions to expenditure in rail infrastructure have been insufficient to allow infrastructure managers to meet the costs of maintenance and renewal, and rail operators are not sufficiently compensated for public service obligations.

Denmark, Finland and Norway form a single cluster in all the three periods. On their example it is possible to highlight the importance of a country's geographical position within a region. From this perspective the share of international rail freight transport in the abovementioned countries is low and on the contrary – Germany, Sweden, Poland and the Baltic States are located in the key international transport corridors.

3.2. Maritime Transport

In the very first stage of all the analysed periods, three clusters were formed:
 – the cluster of Denmark and Finland;
 – the cluster of Estonia, Poland, Latvia and Lithuania;
 – the cluster of Norway and Sweden, while Germany remains stand-alone (Fig. 6).

In few clustering stages it is possible to notice the emergence of two larger clusters, while the step of their formation in the pre-crisis and the crisis period remains the same (Fig. 7).

The first cluster encompasses all southern Baltic countries, Denmark, Finland and Poland, and the latter includes Sweden, Norway and Germany.

This clustering result is based largely on two different groups in terms of total sea cargo throughput. Up to 2004 Estonia, Latvia, Lithuania and Poland used to be the main transit corridor for cargo flow from East to West and from West to East.

Important geopolitical changes for this region took place in 2004 when the countries joined the EU, and the position of Baltic ports was transformed from 'former' Soviet to European ones. Baltic Ports became a good and perspective object for Foreign Direct Investments (FDI). But their relatively narrow specialization and dependency on Russian cargo decreased their competitiveness on the international market.

Potential risks for the countries whose port sectors significantly depend on Russia have been discussed in

Fig. 6. Dendrogram representing the formation of countries' clusters based on their maritime transport flows during 2004–2007

Fig. 7. Dendrogram representing the formation of countries' clusters based on their maritime transport flows during 2008–2009

a studies by Kirch *et al.* (2011) and Rijkure and Sare (2013). The first one of abovementioned studies presents three negative scenarios: the first points out the direction of Russian transit flow, which usually depends on bilateral political relations between Russia and each Baltic State. Rijkure and Sare (2013) stress that Latvia managed to attract considerable amounts of Russian cargos to its transit corridor in time of unfavourable relations between Estonia and Russia. The second scenario suggested by Kirch *et al.* (2011) could be witnessed in 2012, when cargo flow was redirected from European Baltic ports to Russian terminals at the Baltic Sea. And the latter takes into account the increasing role of existing custom union between Russia, Kazakhstan and Belarus. Rijkure and Sare (2013) point out the need to expand the cooperation with Russia and the countries of the Commonwealth of Independent States (CIS) and Central Asia in order to develop the sector of continental shipment.

The tendency of recent years suggests that average vessel size is increasing (Ducruet, Notteboom 2012), and the countries offering deep-sea service are more active in the market's new condition. Fig. 8 demonstrates, as was the case in rail transport, that in the post-crisis period clusters' compositions remained the same.

HCA shows that economic recovery has reduced the rate of cluster formation in the second stage, which means that dissimilarity between Latvia, Poland, Estonia and Lithuania on one side, and Denmark and Finland on another has been reduced.

3.3. Road Transport

Within the BSR's international road transport sector three clusters were formed in a very early stage of each analysed period. However their structure has not been stable.

In the pre-crisis period (Fig. 9) the first and the biggest cluster consisted of five countries – Finland, Sweden, Norway, Estonia and Latvia. Lithuania, Poland and Denmark formed the second cluster – these countries have a high level of similarity in the dynamics of cargo turnover.

Germany formed a cluster on its own and joined others in the final, third stage.

In the crisis period, Denmark left the cluster of Lithuania and Poland (Fig. 10).

In the post-crisis period, Latvia joined Poland and Lithuania, forming a new cluster (Fig. 11).

Compared to other modes of transport, international road transport is more adaptable to market and economy's changes. As a result, the biggest fluctuations could be observed in road transport during the crisis period. Sweden lost 35% of its road cargo turnover; Estonia and Latvia – 27% and 38%, respectively. Within another cluster, Lithuania lost 16% and Poland 39%. Despite the fact that the abovementioned countries experienced the biggest drop in their cargo turnover, in the post-crisis period they showed the quickest recovery in this transportation sector.
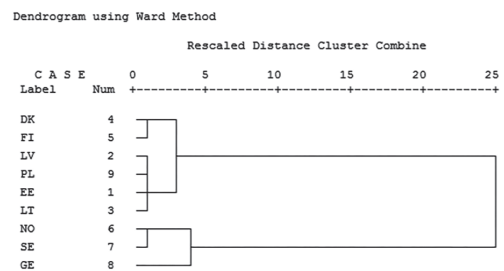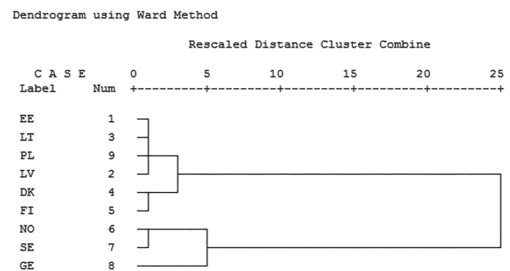

Fig. 8. Dendrogram representing the formation of countries' clusters based on their maritime transport flows during 2010–2011

Fig. 9. Dendrogram representing the formation of countries' clusters based on their road transport flow during 2004–2007

Fig. 10. Dendrogram representing the formation of countries' clusters based on their road transport flow during 2008–2009
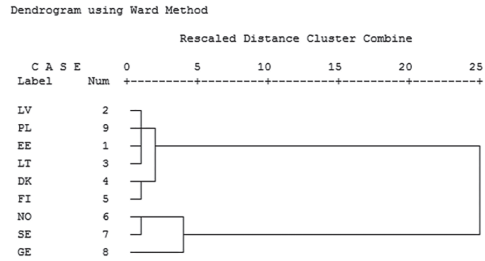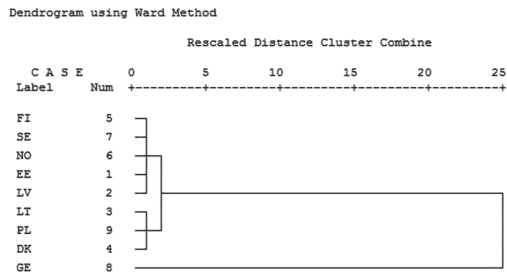

Fig. 11. Dendrogram representing the formation of countries' clusters based on their road transport flow during 2010–2011
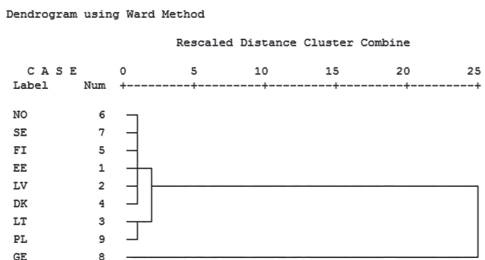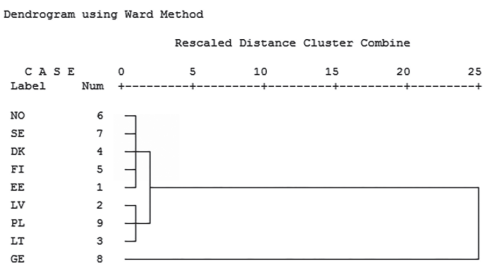
Meersman and Van de Voorde (2013) also suggested that the worldwide economic crisis and the Europe's debt crisis have hit road freight more seriously than GDP, and that recovery might bring the road freight in-

tensities back to pre-crisis levels. At the same time, the issue of border throughput still has to be in a focus. The low throughput of Finnish–Russian and Estonian–Russian borders has an extremely negative impact on the competitiveness of the West–East road corridor. Political factors are making the problem more complicated, and in the case of Estonia the problem is still far from being solved.

HCA gave the authors an opportunity to identify smaller clusters of countries of the BSR which had followed similar patterns in their transportation flows during shorter periods of time from 2004 to 2011. This has enabled us to understand the reasons and factors which effectively contribute to the formation of such clusters of countries that have similar trends according to modes of transportation. Although these factors vary significantly, most of them are still connected either with transport geography or with politics.

4. Economic Recovery and Transport Activity of the Region

4.1. Analysis of the Development Trends Describing Relationship between Economy and Transport Sector

There are several main indicators of economic activity which are used to understand the relationship between different sectors of economy and for forecasting a sector's development trends. One of them is GDP – a widely used indicator, a universal but too general one to be used in most of the aggregate freight models because it largely consists of value generated in this sector.

Engel and Wang (2011) demonstrate that in OECD countries both trade flows – import and export – are about three times more volatile than GDP. This finding can be extended to apply to the recent crisis. Levchenko *et al.* (2010) suggest that imports and exports fell so much relative to GDP because their composition is different from the composition of GDP.

Meersman and Van de Voorde (2013) in their research paper investigate a number of alternatives and prove that GDP is not the best indicator for measuring the relationship between economy and the transport sector, because its composition changed, and is

still changing, and as a result the link between freight transport and economic activity itself has been changed. The researchers suggest that manufacturing production index, export performance and import penetration rate are more relevant indicators.

This issue becomes even more urgent in the light of the fact that the BSR, located in the periphery of the economic centre of Europe, depends strongly on foreign trade in goods and needs a well-functioning transport infrastructure for its economic growth (EC 2012).

During the economic crisis national governments traditionally set a goal to increase national export volumes. However, a country's export activity is not only the tool for the country's post-crisis recovery process, but it is also a sector of national economy, which provides the transportation sector with additional potential for growth. Table 1 shows the development of export volumes in the BSR countries.

The dynamics of export volume growth in the pre-crisis period was more active in the EU's new Member States – Estonia, Latvia, Lithuania and Poland, showing great economic potential, got a perfect impulse for their economic and social developments due to joining the EU. At the same time these countries were hit harder by the economic crisis. Lithuania, Finland and Norway experienced the biggest drop in export volume in the crisis period.

In 2010 Estonia, Latvia and Sweden demonstrated faster recovery (with the average growth of 30%) not only in export volumes, but also in all transport modes analysed within the paper. Finland, Norway, Germany and Poland had relatively the modest growth in export volumes (15% in average) and in freight transport.

In October 2013, the EU announced its new priorities in transport policy. In the focus of the EC are TEN-T value added projects, which provide environmentally sustainable development of the field of transport. The EC gives preferences to TEN-T international projects. In the case of the BSR, such projects promote the development of transportation corridors, such as Rail Baltica or the Twin-Port development project, on which agreement between the Port of Helsinki and the Port of Tallinn was signed in October 2013.

Table 1. Comparison of export volumes in the BSR countries in 2004–2011, % to a previous year (Eurostat 2013; OECD 2013)

Country	Pre-crisis			Crisis		Post-crisis	
	2005/2004	2006/2005	2007/2006	2008/2007	2009/2008	2010/2009	2011/2010
Estonia	1.30	1.24	1.04	1.05	0.76	1.34	1.37
Latvia	1.29	1.18	1.23	1.14	0.80	1.30	1.31
Lithuania	1.27	1.18	1.11	1.29	0.73	1.32	1.28
Denmark	1.10	1.07	1.02	1.06	0.84	1.07	1.10
Finland	1.06	1.16	1.06	1.00	0.68	1.16	1.08
Norway	1.20	1.17	1.01	1.17	0.71	1.17	1.16
Sweden	1.06	1.11	1.04	1.01	0.75	1.27	1.12
Germany	1.06	1.13	1.09	1.02	0.81	1.18	1.11
Poland	1.19	1.22	1.15	1.13	0.84	1.23	1.12

4.2. Statistical Analysis of Factors Influencing the BSR Cargo Volumes in 2004–2011

In order to determine factors that have influenced the BSR transport activity, the authors tested 10 independent variables by using correlation analysis, Bayesian analysis and affinity analysis.

The results of analyses proved that there are three main attributes which significantly affected the cargo volume handled in the BSR countries in 2004–2011, namely imports, exports and production change in industry.

A strong correlation between 'GDP' and 'investments' into road and rail infrastructures ($r = 0.671$, $p = 0.000$ and $r = 0.365$, $p = 0.002$, respectively) can be observed, as well as between 'imports' and 'investments' into rail and road infrastructure. The latter two have led to the growth in import and export volume (Appendix 3). The correlation analysis demonstrates that investments into sea port infrastructure did not affect significantly the cargo volume and international trade. Thus, it can be concluded that the level of rail and road infrastructure development has played a more important role in the BSR recovery process by supporting the internal market of the Region in contrast to maritime infrastructure. As far as a port sector is concerned, it is known that investments are made with a long-term perspective and finding steady cargo flow for a brand new terminal may prove complicated.

Within B-course web-based Bayesian data processing environment the dependency modelling of joint probability distribution (Myllymäki *et al.* 2002) was carried out. The resulting model consisted of 6 variables out of 11, with 5 indicators not included in the model (Fig. 12).

The obtained model can be considered as suitable for validating the interconnectedness of the variables. For the sake of clarity, omitted variables are not presented in Fig. 12. At the same time, output of the Bayesian analysis reveals that the dependencies between 'imports' and 'GDP' and between 'imports' and 'exports' are extremely significant.

Naïve causal model, built as a result of dependency modelling, is considered less realistic because there are no latent variables in the domain that causes the dependencies between variables (Fig. 13).

Although in Bayesian 'naïve model' the directed arcs signify causal influence, the model also demonstrates that there are latent variables outside the model, influencing simultaneously through 'changes in production' and 'investments in road infrastructure' also 'imports'. The latter has a direct causal impact on 'cargo volumes'.

Bayesian classification modelling was subsequently applied first in order to learn about dependencies between cargo volumes as the dependent variable and all other variables that are considered independent. The resulting model consisted of merely three variables whereas only 'imports' and 'change in industrial production' were used in the model. This finding is validated
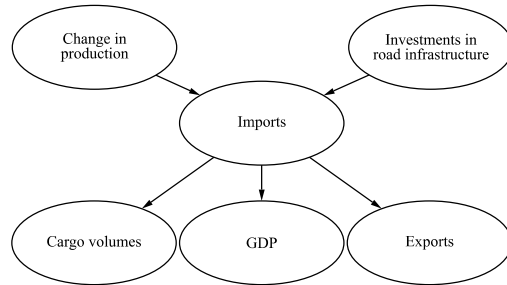
Fig. 12. The Bayesian analysis model proposed for the BSR in the period 2004–2011
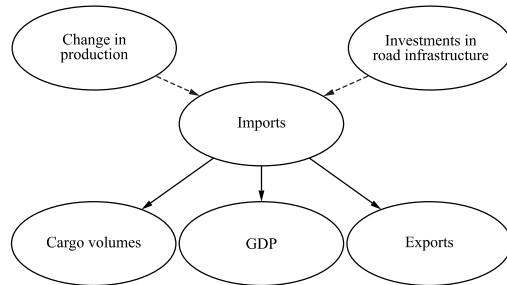
Fig. 13. Naïve casual model for the BSR in the period 2004–2011

by earlier significant correlations between 'cargo volume' and 'imports' ($r = 0.495$, $p = 0.000$) and between 'cargo volume' and 'industrial change' ($r = 0.395$, $p = 0.001$).

The third type of analysis conducted by the authors for testing the dependent variable was the affinity analysis, carried out using the *Weka* – data mining software (*http://www.cs.waikato.ac.nz/ml/weka*). The results of this analysis validated the findings by correlation and Bayesian analyses: there are three main associations between the analysed attributes – 'GDP', 'imports', and 'exports'. (That is, association rules found by *Weka* proved that these three independent variables had the highest (non-probabilistic) frequencies based on the co-occurrences of their changes).

The BSR transport as well as economic potential depends on international trade, production in industry and on sufficient investments in road and rail infrastructure. These three attributes are the strengths of the region which in the light of new EU priorities prepare the ground for a significant jump in its development in the nearest three to ten years.

5. Discussion

Business sector has faced various challenges in recent years. Efficient adaptation to market and economy's changes demonstrates a proper business strategy of companies. Despite the fact that politics assigns the development course of transportation sector, business actors' estimations and expectations are vital.

The World Bank conducts the Logistical Performance Index (LPI) survey every two years to measure on-the-ground trade logistics performance, providing feedback on the logistics 'friendliness' of the countries in which global freight forwarders and express carriers operate and those with which they trade. The LPI reflects the perspective of the global private sector on how countries are globally connected through their main trade gateways (Arvis *et al.*, 2012).

The survey is built up on six logistics issues:
– customs clearance efficiency;
– infrastructure quality;
– the ease of arranging competitively priced shipments;
– the competence and quality of logistics services;
– the ability to track cargo;
– the frequency with which shipments reach the consignee within the scheduled or expected delivery time.

Freight forwarders rate countries on these logistics issues on a scale of 1 (worst) to 5 (best). The overall logistical index represents the qualitative estimation of trade logistics efficiency of a country from the perspective of freight operators (Appendix 4).

In the authors' opinion, a comparison of the transport clusters formed during the post-crisis period and the clusters formed on the basis of the 2012 LPI survey may reveal whether the results of HCA coincide with the assessments of respondents.

The results demonstrate that the formation of transport clusters (based only on cargo turnover dynamics) does not reflect freight forwarders' estimation of a country's supply chain efficiency in cost, time, and reliability (Fig. 14). Estonia, Latvia and Lithuania form a single cluster with a high level of dissimilarity relative to other countries (Fig. 14b). Thus, LPI as an expert's estimation rather demonstrates a possibility to classify countries on the basis of their logistics performance and does not reflect real clusters, which were formed on the basis of cargo flows.

In order to strengthen and improve the efficiency of marine transport and competitiveness of the region, several projects have been launched. MarChain as a pilot program within the StarDust project aims at mapping the content of the national clusters and identifying their current main advantages and the key challenges these clusters are facing (Karvonen, Heikkilä 2013). SmartComp project, carried out in 2012–2013 aimed to unite the maritime clusters of the region and to strengthen existing networks by creating new ones in order to improve competitiveness of the sector and thus enable sustainable growth possibilities for the sector (SmartComp 2013).

Within both projects a number of studies has been conducted – these are aimed to detect differences appearing between clusters, which can either contribute or hinder not only the cluster's competitiveness, but also inter-cluster cooperation in such factors as structure and activity base, innovative capacity, government policy towards clustering, and so on.
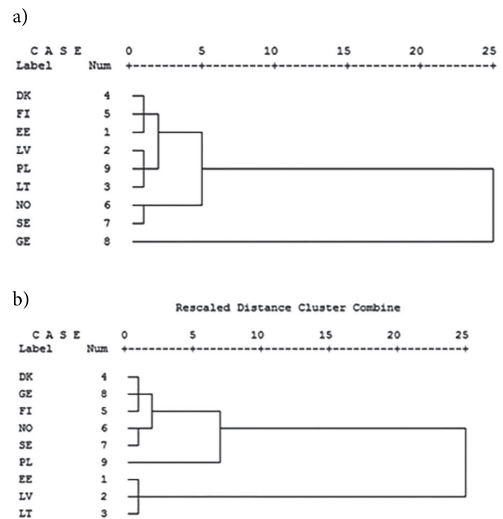
Fig. 14. Dendrograms for the cargo handled in the BSR countries by railway, maritime and road transport in 2012 (a) and LPI 2012 (b)

The transportation process efficiency depends to a higher degree on the Information and Communication Technologies (ICT) sector, in which the BSR has a strong performance. It can been proved by the total share of employment in ICT sectors in the BSR, which is close to 2.7%, compared to 2.6% in EU-27 and 2.4% in Europe as a whole, suggesting a slightly higher level of ICT specialisation in the BSR (Sölvell, Protsiv 2013). The existence of this cluster shows that the BSR has a potential for its sustainable growth, because the micro and macro competence is growing. Undoubtedly, the intensity of growth can vary within different fields of economics. Thus, IT field had exhibited relatively intensive development process, and there are other fields which may exhibit more measured or even slow tempos. Each cluster's characteristics are unique in terms of cluster formation and their contribution to economic growth (Sheffi 2013).

ICT, innovation and R&D sectors' development level varies within BSR clusters. Thus, in accordance with SmartComp (2013) and StarDust (Karvonen, Heikkilä 2013) reports, innovative capacity of Estonia, Finland and Germany can contribute to the creation of a single BSR cluster. Finland's experience may prove, through the involvement of government authorities in the innovation activities, a good example for other BSR countries. The cluster competitiveness and growth potential also depends on the involvement of educational sector. Finland, Sweden, and Germany more actively cooperate with university industry, while Poland's and Lithuania's link of sciences and business as a facilitator in stimulating innovation, knowledge and technology transfer into the business is relatively weak.

At the same time, Estonia and Latvia hinder inter-cluster cooperation because of their clusters' structure,

which was formed due to their geopolitical location and transit orientation model, in which the role of large companies is too dominant. As a result, cluster performance depends on the limited amount of enterprises, which can be non-profit ones and in state ownership. As opposed to such structural problems, Finland, Sweden, Lithuania, Poland and Germany are based on diversified structures, which undoubtedly is a facilitating factor contributing to an inter-cluster cooperation (Smart-Comp 2013; Karvonen, Heikkilä 2013).

Taking into account the specificity of transportation field, there is a complexity in the formation of international supply chain, which would be efficient in terms of ecological, economic and infrastructural issues of the region. Further development approach must be strategic. The results of the research showed that 'natural' clusters have been already formed, thus there is a basis for a single transport cluster formation. Authors suggest that in the nearest future the transport field could be the next one to demonstrate positive tendencies in the formation of the macro-regional transport cluster.

Conclusions

The application of HCA method enabled the authors to identify homogeneous clusters of the BSR's countries based on the evolution of handled cargo volume by railway, maritime and road transport between 2004 and 2011.

The hypothesis, presented in the study that the dynamics and responsiveness of a country's transport flows during the period 2004–2011 as modelled by HCA, will enable to forecast the country's recovery from the crisis was confirmed. Ten attributes were analysed from the perspective of their influence on transport activity, and the most important of these are the following three: international trade, production in industry and investments in road and rail infrastructure. In addition to economic factors, there are also political events (these can be seen as the 'latent variables') which, while not a focus of this paper, have a great influence on prediction accuracy and on expectations based on quantitative factors.

The results of the analysis could be presented from two perspectives:
1. The first is focused on the level of similarities between the BSR countries. Cluster analysis showed that Germany and Poland had more dissimilarities compared to other BSR countries in all modes of transport. Due to historical and geopolitical aspects, the southern BSR countries' transport field development trends share more similarities. In the authors' opinion, it is necessary to take into account the level of similarity between countries for more efficient implementation of intraregional projects in the field of transportation, because, as a rule, political factors predominate in such decisions.
2. The second is focused on the application level of the cluster approach for the analysis of different transport modes. In the present analysis, clusters were more clearly formed in terms of maritime transport. This is consistent with findings presented in earlier research papers which were mainly concerned with maritime transport.

The authors share the opinion that the present topic has potential for further research that would rely on the results of HCA, as presented in the current study. It is essential to analyse business logistics clusters formed in the field of transportation on a national level and in the BSR.

The BSR has shown a number of ingredients for the evolution of dynamic clusters, but continues to rank relatively low on the level of actual cluster development and within-cluster collaboration. Here also emerges the question about the dominant role of political decisions in the formation of such clusters compared to 'naturally' formed transport environment in the BSR countries. So, the relevance of a long-term forecast is doubtful. Setting time limits would lead to a mid-term period (4–5 years), which does not provide us with precise estimations, considering that the field of transportation most strongly depends on the external environment.

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APPENDIX 1

The BSR Countries' Railway, Maritime and Road Transport Performance, 2004–2011

Country	2004	2005	2006	2007	2008	2009	2010	2011
Railway transport – international transport of goods [billion tonne-kms]								
Estonia	10.0	9.9	9.7	7.3	5.2	5.4	5.9	5.5
Latvia	16.4	17.4	14.8	16.4	17.4	14.4	12.9	21.1
Lithuania	10.2	9.0	9.7	11.4	11.1	8.8	10.1	11.4
Denmark	1.6	1.5	1.6	1.6	1.7	1.6	2.1	2.4
Finland	2.9	3.1	3.7	2.9	3.2	2.7	2.8	2.6
Norway	0.8	0.9	0.9	0.9	0.9	0.8	0.8	0.7
Sweden	7.7	7.6	7.4	7.6	7.1	7.2	8.6	8.4
Germany	46.5	46.9	56.5	60.8	62.4	47.0	52.8	54.3
Poland	15.5	14.0	16.1	16.9	15.7	9.6	11.7	12.9
Maritime transport [million tonnes]								
Estonia	45	47	50	45	36	39	46	48
Latvia	55	60	57	61	61	60	59	67
Lithuania	26	26	27	29	36	34	38	43
Denmark	100	100	108	110	106	91	87	93
Finland	107	100	111	115	115	93	109	115
Norway	198	202	197	199	193	183	195	199
Sweden	167	178	181	185	188	162	180	182
Germany	272	285	303	315	321	263	276	296
Poland	52	55	53	52	49	45	60	58
Road transport – international transport of goods and cabotage [billion tonne-kms]								
Estonia	4.8	5.8	6.8	8.2	6.5	4.8	4.6	5.2
Latvia	5.0	5.8	8.2	10.2	9.8	6.1	8.0	9.0
Lithuania	10.1	13.8	15.9	17.6	17.9	15.1	17.1	19.2
Denmark	12.6	12.2	9.8	9.2	8.8	6.9	4.4	4.1
Finland	5.0	4.0	4.3	3.9	3.4	3.4	4.4	3.1
Norway	3.0	2.9	4.1	4.0	4.0	3.2	3.4	3.1
Sweden	4.3	3.9	4.4	4.2	4.4	2.9	3.5	3.5
Germany	65.8	66.0	72.0	74.4	70.0	56.7	55.3	53.5
Poland	15.5	14.0	16.1	17.0	15.7	9.6	11.7	12.9

APPENDIX 2

Export Volumes of the BSR Countries, 2004–2011 [Billion Euros]

Country	2004	2005	2006	2007	2008	2009	2010	2011
Estonia	4.7	6.2	7.7	8.0	8.4	6.4	8.7	12.0
Latvia	3.2	4.1	4.9	6.0	6.9	5.5	7.1	9.4
Lithuania	7.4	9.4	11.2	12.5	16.0	11.8	15.6	20.1
Denmark	61.9	68.4	73.7	75.2	79.4	67.3	72.7	80.3
Finland	49.4	52.6	61.4	65.6	65.5	45.0	52.4	56.8
Norway	69.3	83.5	97.8	99.4	116.8	83.7	98.5	114.4
Sweden	99.0	105.2	117.7	123.1	124.6	93.7	119.5	134.3
Germany	731.4	780.4	882.5	964.0	983.2	803.0	949.6	1058.0
Poland	60.3	71.8	88.2	102.2	115.8	97.8	120.4	135.5

APPENDIX 3

Bivariate Correlations (Pearson *R*, *p*-value), *N* = 72 for all Cases

	cargvol	gdp	imp	exp	chg	pop	invrail	invse	invrd	gval
cargvol	1									
gdp	0.366**	1								
	0.002									
imp	0.495**	0.908**	1							
	0.000	0.000								
exp	0.532**	0.866**	0.911**	1						
	0.000	0.000	0.000							
chg	0.395**	0.093	0.231	0.295*	1					
	0.001	0.439	0.051	0.012						
pop	−0.197	0.038	−0.011	−0.117	−0.035	1				
	0.097	0.754	0.924	0.329	0.768					
invrail	0.049	0.365**	0.341**	0.370**	−0.117	0.146	1			
	0.680	0.002	0.003	0.001	0.326	0.221				
invsea	0.171	0.180	0.173	0.191	−0.049	−0.152	−0.134	1		
	0.151	0.131	0.145	0.107	0.685	0.201	0.261			
invrd	0.194	0.671**	0.652**	0.501**	−0.203	0.072	0.334**	0.139	1	
	0.102	0.000	0.000	0.000	0.087	0.548	0.004	0.245		
grval	0.216	−0.383**	−0.297*	−0.285*	0.129	−0.016	−0.175	−0.130	−0.263*	1
	0.068	0.001	0.011	0.015	0.281	0.891	0.141	0.275	0.026	
railden	−0.025	−0.047	0.043	−0.079	−0.157	0.214	0.144	−0.075	0.219	0.105
	0.833	0.697	0.718	0.511	0.187	0.072	0.226	0.530	0.064	0.379

Notes: * Correlation is significant at the 0.05 level (2-tailed); ** Correlation is significant at the 0.01 level (2-tailed).

APPENDIX 4

Logistics Indices of the BSR Countries

Country	2007	2010	2012
Estonia	2.95	3.16	2.86
Latvia	3.02	3.25	2.78
Lithuania	2.78	3.13	2.95
Denmark	3.86	3.85	4.02
Finland	3.82	3.89	4.05
Norway	3.81	3.93	3.68
Sweden	4.08	4.08	3.85
Germany	4.10	4.11	4.03
Poland	3.04	3.44	3.43

Appendix 3.

Research paper III

Nežerenko, O., Koppel, O. (2015). Formal and informal macro-regional transport clusters as a primary step in the design and implementation of cluster-based strategies. *Transport and Telecommunication, 16(3),* 207 - 216. doi: 10.1515/ttj-2015-0019. (ETIS 1.1)

FORMAL AND INFORMAL MACRO-REGIONAL TRANSPORT CLUSTERS AS A PRIMARY STEP IN THE DESIGN AND IMPLEMENTATION OF CLUSTER-BASED STRATEGIES

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The aim of the study is the identification of a formal macro-regional transport and logistics cluster and its development trends on a macro-regional level in 2007-2011 by means of the hierarchical cluster analysis. The central approach of the study is based on two concepts: 1) the concept of formal and informal macro-regions, and 2) the concept of clustering which is based on the similarities shared by the countries of a macro-region and tightly related to the concept of macro-region. The authors seek to answer the question whether the formation of a formal transport cluster could provide the BSR a stable competitive position in the global transportation and logistics market.

Keywords: Baltic Sea Region (BSR), hierarchical cluster analysis (statistics), location quotient, macro-region, transport and logistics

1. Introduction

Regionalisation and globalisation tendencies have brought about the expansion of new forms of active economic integration on the macro-regional level, among these new forms there is also the macro-regional concept for regional development (EC, 2013, 2).

The intensification of international cooperation within the Baltic Sea Region (BSR) started with the launching of the European Union Strategy for the Baltic Sea Region in early 2009. Numerous projects and clusters (StarDust, SmartComp, Transbaltic, etc.) dealing with regional growth helped to achieve a certain level of coordination and complementarity across the countries around the Baltic Sea.

The purpose of this paper is to examine the potential of the BSR for formal cluster development in distribution, maritime and transport and logistics sectors (transport and logistics field) on the macro-regional level. The urgency of the topic is conditioned by the fact that the driven clustering process within macro-regional cooperation shifts the BSR towards becoming a virtual macro-region formation. Macro-regional policy, in its turn, tends to be associated with the identification of macro-regional clusters, which provide a basis for the development of informal forms of cooperation (Herrschel, 2009, 280). Thus, the central approach of the study is based on two concepts.

- The concept of formal (bounded) and informal (virtual) macro-regions.
- The concept of cluster, which is based on the similarities shared by the countries of a macro-region and tightly related to the concept of macro-region.

The authors examine the BSR as a virtual macro-region (which is informal and non-institutionalized), established through the shared cluster policy objectives, and try to answer the main question of the research – can the formation of a formal transport cluster provide the BSR a stable competitive position in the global transport and logistics market? Kabashkin (2014) points out that in order to establish a region as a key component in global logistics networks, it is necessary to envision the strategic positioning of the region within the context of the overall global logistics networks.

The study is based on the cluster approach as an analytical tool of the BSR macro-regional policy for the transport and logistics (T&L) field for the identification of its formal and informal nature. In the authors' opinion, the process of informal clustering prevails in today's macro-regional cooperation. Informal clustering implies realisation of macro-regional projects on the level of collaboration only among business partners. On the one hand, this applied strategic clustering approach contributes to the creation of

a competitive business environment, while on the other hand, it may affect the competitiveness (as well as quality) of the macro-regional T&L system as an international supply chain – the supply chain is as strong as its weakest link. The involvement of countries in international projects varies within the region (Finland, Sweden and Baltic Sea Germany are the most active countries in contrast to Norway and Baltic Sea Russia). Thus, one of the problems of cluster approach is concentration on well-performing regions (Dümmler and Thierstein, 2002, 11). Another tendency is the formation of new clusters, which eliminates the use of present regional resources.

As it can be seen, the concept of "cluster" is tightly related to the concept of "macro-region", which is based on the similarities shared by the countries of the region. Below, the authors provide a brief review of literature on clusters and establish some general concepts.

2. Previous studies

In recent years, regional economic integration has been given a fresh impetus in specialised literature and academic publications. Numerous papers are devoted to the outcomes of the "two-dimensional" regional economic policy, namely to (1) regional economic integration at the national level (Boronenko and Zaibote, 2011; Ivanov, 2009; Magomedov, 2011 *et al.*); and (2) regional economic integration at the international (macro-regional) level (Bialasiewicz *et al.*, 2013; Garanti *et al.*, 2014; Hettne and Söderbaum, 2000; Dubois *et al.*, 2009 and others). The particularity of the macro-region lies in the character of international cooperation, which can be simplified, for example, through the countries' membership in a certain regional grouping or, *vice versa*, it can be complicated in case of its absence (i.e. the Baltic Sea, the Danube, the Adriatic and Ionian regions). The quality of engagement in the collaboration process may vary significantly as, according to the gravity model of trade, the presence of physical border can significantly limit the international business activity.

Bialasiewicz *et al.* (2013) examine European macro-regional policies as a threshold in between internal territorial cooperation and external cross-border cooperation, which goes beyond the EU external borders and engages its closest neighbourhood. The authors of the paper have adopted some basic principles of regional cooperation and applied these to macro-regional cooperation.

Herrschel (2009) studies the formal and informal nature of regions and highlights that business clusterings are informal because they are largely a personality-based form of cooperation, which may be potentially dangerous. Herrschel names at least three reasons why it may be so: (1) it has an informal character, which (2) as a rule is time-limited, and (3) it tends to be outside the government hierarchy.

On the basis of these approaches, the BSR's active business clustering policy is of informal character. The region relies on the distribution of the network participants within numerous clusters, which are often episodic in character (StarDust, SmartComp, Transbaltic, etc.). The regions based on this type of clustering policy can be considered non-institutionalised or informal; they are brought together through the shared policy objectives.

A formal region (as well as cluster) is based on a state's rigid regulation; it has a fixed structure and territory. In the authors' opinion, a formal T&L macro-cluster is of major importance in the creation of a competitive macro-regional cluster of formal character. Herrschel (2009) has shown that formal and informal regions can produce negotiated, relatively stable and effective relationships.

Macro-regional/international clusters have been successfully established in the maritime sector. Wijnolst *et al.* (2003) discuss the need of creating a continent-wide cluster in the EU maritime sector, assuming that the maritime sector in Europe might benefit from this organisational form. Macro-regional maritime clusters are in many respects forerunners, especially in environmental technologies. These clusters also share common challenges, such as increasing production and labour costs, a combination of which could bring competitive advantage for the whole region in the future (Karvonen, 2012;Laaksonen and Mäkinen, 2012, 101). Contrary to the maritime sector, railway (due to territorial and infrastructural limitations) and especially road transport lack macro-regional clustering experience – the cluster policy in road transport and logistics is mainly implemented at the national level (Taina, 2012; Laaksonen and Mäkinen, 2012; Nežerenko *et al.*, 2015).

As to Russian research experience, Ivanov (2009) has examined macro-regions as a functional area of the international economic integration at the macro- and mega-regional levels of the global economic system, which contributes to the formation of countries into aggregation and/or international clusters, which share common geo-economic and geo-strategic interests as well as resources, which lead to a favourable development of the international trade and business. Logistics cluster holds a special place in the cluster structures. Magomedov (2014) has sought to study the nature of the logistics cluster and compared it with the logistics system. The analysis shows that the signs of the cluster and the logistics system are almost

identical. Magomedov has pointed out that the formation of other clusters depends on the logistics cluster development and that in regional clustering (logistic integration of territories), the development of transport infrastructure is determinative.

Analysis of the literature shows that regional economies (implemented at national or international levels) can achieve practical benefits by employing the concept of clusters (Boronenko and Zaibote, 2011; Garanti *et al.*, 2014). The authors suggest that in order to provide a stable competitive position of the BSR in the global T&L market, the formal and informal character of macro-region must coincide.

3. Methodology

The geographical coverage of the study is the BSR, which consists of eight EU countries and two non-EU countries: Denmark, Estonia, Finland, Baltic Sea Germany (BSG), Latvia, Lithuania, Baltic Sea Poland (BSP), Sweden, Norway and Baltic Sea Russia (BSR).

The methodological and practical contribution of the research lies in identifying the development dynamics of the BSR's T&L field towards a formal macro-regional cluster with the help of HCA on the basis of a 'Specialisation' criterion. The authors suggest that identification of formal clusters of countries may increase the efficiency of the policy-making process in T&L and give further macro-regional development a proper direction. The research structure is presented below (Fig. 1).
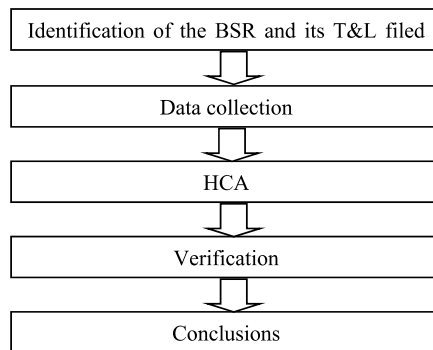
Identification of the BSR and its T&L filed

Data collection

HCA

Verification

Conclusions

Figure 1. Research structure

Within the paper the authors use the term "clustering" in two meanings: (1) clustering as a way of collaboration in macro-regional projects and (2) clustering as a statistical technique.

Jucevicius and Puidokas (2007), Stejskal (2011), Danjko and Kuzenko (2012), Garanti and Zvirbule-Bērzina (2013) analyse the application of methods for cluster identification. The most widespread method is the input-output analysis, which due to the limited statistical data turns out to be unsuitable for current research. In practice, the measurement of the clusters' performance is a very complicated task because the data necessary for the analysis of the various variables influencing the performance of a cluster are not always available (Prause, 2014).

The methodology used for the analysis of the BSR as a macro-regional cluster is based on quantitative methods (statistical analysis, hierarchical cluster analysis).Statistical data on the cluster indicator "Specialisation" (known as Location Quotient, or LQ) have been collected from Cluster Observatory databases. LQ, can be calculated on the basis of different measures of economic activity. Cluster Observatory uses employment data for identifying regional clusters, comparing the proportion of employment in a cluster category of a region/country to the total employment in the same region/country to the proportion of the total European employment in the given cluster category to the total European employment. Thus LQ says that if a region is more specialised in a specific cluster category than the overall economy across all regions is likely to indicate that the economic effects of the regional cluster have been strong enough to attract related economic activity from other regions to this location, and that spill-overs and linkages will be stronger. (European Cluster Observatory)

There is considerable disagreement in scientific literature about the minimum LQ necessary to identify the specialisation of a region in the particular industry (Garanti and Zvirbule-Bērzina, 2013, 96).

The authors follow the methodology of Cluster Observatory, according to which the measure needs to be at least 2 to conclude that the region/country is specialised in a certain sector.

The analysis covers the BSR's T&L field, which consists of (1) distribution sector (wholesale and retail sale), (2) maritime sector (fishing, aquaculture, manufacture of cordages, tanks, containers, etc.), and (3) T&L sector (land and water transport, shipbuilding, warehousing and storage, etc.). Taking into account that statistical data were not available for some countries, the time frame of the research are the years 2007–2011.

For the identification of formal micro-, meso- and single T&L clusters, hierarchical cluster analysis (HCA) has been applied. The analysis was conducted by means of the SPSS software using Ward's method, which allows forming clusters on the basis of LQ dynamics (Z-scores of the real values were used within the HCA) as a criterion that minimises the total within-cluster variance.

Clustering is a widespread technique of analysis in regional studies, which helps to identify inequalities within macro-regions (Humphries, 2007, Hernández *et al.*, 2009; Mimis, 2013; Nežerenko *et al.*, 2015).The idea of hierarchical clustering lies in the identification of each object initially as a single cluster (or, in this case, country). Then, in multiple iterations, the two nearest clusters are merged into a bigger one – a T&L micro-cluster. Meso-clusters emerge at the second stage of HCA, when two adjacent micro-clusters merge into a bigger one. After a few iterations, the algorithm reaches the final cluster structure – a single T&L cluster. Dissimilarities between countries are shown as dendrograms according to the number of steps in cluster formation.

The overlapping of the formal and the informal natures of the BSR has been determined by using comparative analysis.

4. Findings

The current research is partly based on a previous study by Nežerenko *et al.* (2015), which showed that "formal" clusters can be formed on the basis of handled cargo volumes by the BSR within road, rail and maritime sectors. In the present study, the authors expand the formal cluster formation technique on the indicator LQ used by the European Cluster Observatory (see Appendix) for ranking the regions' potential in the formation of clusters.

The figure below (Fig. 2) presents the average LQ in three sectors for 10 countries of the BSR in the period 2007–2011.
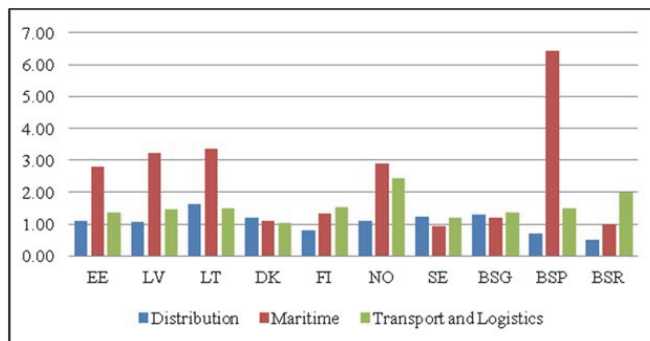

Figure 2. Average LQ in distribution, maritime and T&L sectors for 10 countries of the BSR, 2007–2011
Source: European Cluster Observatory database

From the macro-regional perspective, the BSR demonstrates significant specialisation in maritime sector due to Baltic Sea Poland, Lithuania, Latvia, Norway and Estonia (their average LQ is 2.43). According to the mapping carried out in the course of the MarChain project, the maritime cluster of the BSR comprises the total of 11,900 companies with 211,500 employees (Karvonen and Heikkilä, 2013, 2). The second and the third places belong to T&L and distribution sectors (with LQ of1.54 and 1.07, respectively).

The economic base theory argues that if the LQ for an industry is greater than 1, it is assumed that the region exports the products from that industry. Distribution, maritime and T&L sectors, in that respect, support the international trade of the BSR countries, which, in turn, can activate or, vice versa, restrain the

BSR's transport and economic activity (Nežerenko et al., 2015). Considering that the T&L field demonstrates the highest total number of employees, which is 2 million (Cluster Observatory) within all fields of economy in the region, it can be argued that it forms the economic basis of the BSR.

Further, the authors carry out HCA for mapping the dynamics of micro- and meso-clusters within T&L field sectors.

4.1. Distribution sector

The distribution sector within and among micro-clusters formed at the first stage of HCA by Estonia, Norway and Latvia on the one hand, and Denmark, Sweden and Baltic Sea Germany on the other, demonstrates similarities in the dynamics of their development. These micro-clusters are separated by relatively high LQ and moderate tendencies of its fluctuations during the analysed period (Fig. 3).
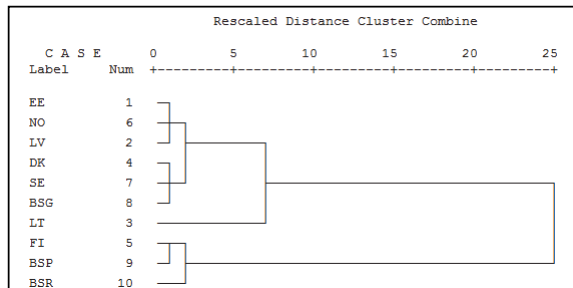

Figure 3. Dendrogram for the average LQ of the BSR distribution sector, 2007–2011(Transform values: Z-scores by case)
Source: The authors' calculations based on the European Cluster Observatory data

Lithuania does not compose any cluster at the earlier stages of the HCA. As shown in Figure 2, Lithuania demonstrates not only the highest LQ, but the highest rate of its positive dynamics in the BSR. The LQ of Finland and Baltic Sea Poland is too low, varying between 0.69 and 0.82. At the first stage, Baltic Sea Russia becomes detached from all other countries with its LQ and also development dynamics, and joins the second weakest micro-cluster of Finland and Baltic Sea Poland at the second stage. In terms of meso-clusters, these countries show the modest potential of the sector development towards cluster specialisation.

4.2. Maritime sector

At the very first stage three clusters were formed (Fig. 4).
- The cluster of Sweden, Baltic Sea Russia, Denmark, Baltic Sea Germany and Finland.
- The cluster of Estonia, Norway, Latvia and Lithuania.
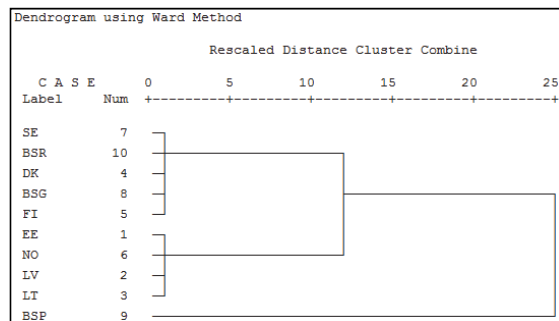- The micro-cluster of Baltic Sea Poland.

Figure 4. Dendrogram for average LQ of the BSR maritime sector, during 2007–2011 (Transform values: Z-scores by case)
Source: The authors' calculations based on the European Cluster Observatory data

A comparison of all three micro-clusters reveals that they demonstrate significant dissimilarities. Countries of the first micro-cluster have a relatively stable employment level during the periods of the crisis (2008–2009) and the post-crisis (2010–2011). In contrast, the second micro-cluster is more vulnerable, experiencing sharp falls and growth. Among the micro-cluster's countries, Lithuania and Estonia achieved better positions at the end of the analysed period, compared to their performance before the crisis. Despite the fact that Baltic Sea Poland has the highest LQ in the BSR, 6.43 (Fig. 2), it is dissimilar from other micro-clusters in that it is caused by the negative tendency in the employment sector up to 2010 (the loss is about 1 point). Only in 2011 did the positive dynamics lead to a negligible growth in LQ.

4.3. Transport &Logistics sector

In terms of the transport and logistics sector, four micro-clusters have been formed (Fig.5).
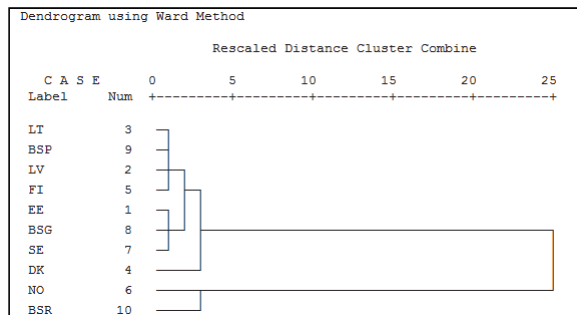

Figure 5. Dendrogram for average LQ of the BSR T&L sector, 2007–2011(Transform values: Z-scores by case)
Source: The authors' calculations based on the European Cluster Observatory data

Countries of the first micro-cluster (Lithuania, Baltic Sea Poland, Latvia and Finland) demonstrate moderate grow of LQ, with the exception of Baltic Sea Poland, whose employment market was hit hard during the crisis. Despite the fact that Estonia, Baltic Sea Germany and Sweden comprise one micro-cluster, some differences in their LQ dynamics can be noticed. Namely, Estonia's LQ was growing during 2007– 2011, leaving behind Sweden and Baltic Sea Germany, which could not improve their LQ after achieving the minimum meaning in 2010. Denmark formed a cluster on its own and joined two first-mentioned micro-clusters at the third stage of HCA, demonstrating confident stability. Two non-EU members – Norway and Baltic Sea Russia – form the fourth micro-cluster with a high level of dissimilarity relative to other micro-clusters due to the fact that starting from 2008 the dynamics of LQ was positive, thus the proportion of employment in the cluster category remained at the same level.

4.4. Potential for the development of the Transport &Logistics field

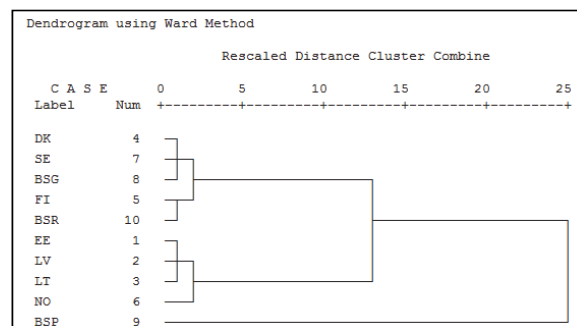Next, the authors examined the potential for the development of T&L field (Fig.6).

Figure 6. Dynamics for average LQ of the BSR's T&L field, 2007–2011 (Transform values: Z-scores by case)
Source: The authors' calculations based on the European Cluster Observatory data

As a result of the HCA, four micro-clusters emerged featuring the following development dynamics of T&L field.

- Denmark, Sweden and Baltic Sea Germany demonstrate moderate growth rates with average LQ of 1.18 in the analysed period.
- Finland and Baltic Sea Russia were significantly hit by the crisis and demonstrate slow rates of the recovery process. Average LQ in the analysed period was 1.20.
- Estonia, Latvia and Lithuania were not affected by the crisis and demonstrate relatively high rates of growth during the period. Average LQ in the analysed period was 1.95.
- Norway was the strongest micro-cluster with moderate, but stable growth rates. Average LQ in the analysed period was 2.1.

5. Verification of the Baltic Sea Region's potential toward formation of a formal single Transport & Logistics macro-cluster

National and intergovernmental initiatives are the basis of macro-regional cooperation and can be presented as umbrella projects which cover countries randomly, regardless of the countries' transport sector performances, LQ, and involvement in TEN-T corridors. Next, the authors take a look at the involvement of the BSR countries in eight transport projects, recently launched within the macro-regional T&L policy (Fig. 7).
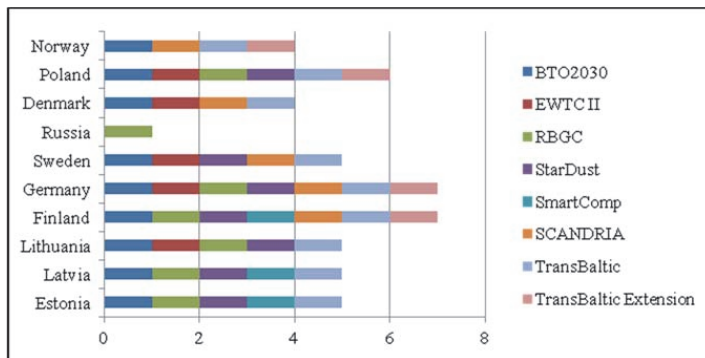

Figure 7. The BSR engagement in "informal" macro-regional cooperation in 2009–2013
Source: Compiled by the authors based on the Baltic Sea Region Programme 2007–2013 database

Baltic Sea Germany and Finland are most actively involved in the macro-regional cooperation. Baltic Sea Poland holds the second place; the third place is shared by Latvia, Lithuania and Sweden. Norway was involved only in two macro-regional projects, Russia only in one project – RBGC launched on the basis of TEN-T development. EWTC II and SCANDRIA are also TEN-T corridors, all together they cover practically the whole macro-region, and these projects tend to be formal. Other projects are informal business clusters initiated mainly in the maritime sector in the case of which the involvement of countries is lower.

The BSR transport field depends on three factors: (1) international trade; (2) production in industry and (3) sufficient investments in road and rail infrastructure (Neženenko *et al.*, 2015). These three attributes must be the focus of the macro-regional cluster-policy priorities. At the moment the maritime sector driven by Baltic Sea Poland, Lithuania, Latvia, Norway and Estonia has shown significant LQ–2.43.T&L sector driven by Norway, Baltic Sea Russia and Finland has the LQ of 1.54. Road and rail transport, warehousing and storages and other components need an impulse to ensure diversified development towards a single T&L cluster.

6. Conclusions

In this study, the authors have sought to make a theoretical contribution to the literature by continuing Herrschel's (2009) discussion concerning the concepts of formal and informal regions and

clusters. The authors consider that the formal BSR is already bounded and demonstrates potential for the development of its T&L field on the basis of its natural/formal comparative advantages, the accumulation and effective use of which is of great importance for providing the sustainable development of the region in the global context.

In the study three components of the BSR T&L field (distribution, maritime and T&L sectors) has been analysed from the perspective of formal macro-regional cluster formation on the bases of specialisation criterion. The results of the study confirm the viability of the assumption that the formal and informal clusters can coincide.

The maritime sector of the BSR has attributes of both formal and informal clusters. The high macro-regional specialisation ratio coupled with intensive macro-regional business-cooperation form a stable competitive position of the BSR in the global maritime sector. In contrast to the maritime sector, the distribution sector tends to be the weakest component of the BSR T&L field. Its development depends mainly on the business projects of a national character, but still it does not provide the required potential for national and macro-cluster formation as well (with the exception of Lithuania). In its turn, the T&L sector goes beyond national borders, covering all transport modes, warehousing and storage. The BSR demonstrates positive dynamics in the formation of macro-regional cluster, but more intensive macro-regional collaboration is required – the clustering experience varies significantly not only between national countries but between modes of transport and national transport systems unified into international transport corridors.

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Appendix

"Specialisation" criterions of the BSR countries in Distribution, Maritime and Transport & Logistics sectors

Country	2007	2008	2009	2010	2011
Distribution					
Estonia	1.17	1.23	1.07	1.07	1.07
Latvia	1.11	1.06	1.06	1.09	1.10
Lithuania	1.47	1.49	1.70	1.73	1.73
Baltic Sea Poland	0.74	0.73	0.69	0.71	0.71
Baltic Sea Germany	1.41	1.30	1.31	1.27	1.29
Denmark	1.20	1.17	1.18	1.18	1.25
Norway	0.75	1.21	1.20	1.22	1.22
Sweden	1.20	1.17	1.20	1.34	1.34
Finland	0.82	0.76	0.78	0.81	0.81
Baltic Sea Russia	0.46	0.50	0.50	0.51	0.51
Maritime					
Estonia	2.62	2.43	2.59	3.15	3.18
Latvia	3.49	3.17	2.98	3.24	3.27
Lithuania	3.18	2.94	3.23	3.68	3.71
Baltic Sea Poland	6.99	6.41	6.38	6.15	6.20
Baltic Sea Germany	1.23	1.25	1.21	1.20	1.18
Denmark	1.36	1.14	1.00	1.01	1.02
Norway	3.15	2.72	2.79	2.90	2.92
Sweden	1.01	0.93	0.89	0.93	0.94
Finland	1.62	1.43	1.21	1.20	1.21
Baltic Sea Russia	1.08	1.03	0.99	1.00	1.01
Transport & Logistics					
Estonia	1.25	1.24	1.37	1.48	1.48
Latvia	1.05	1.46	1.58	1.66	1.66
Lithuania	1.18	1.45	1.68	1.57	1.57
Baltic Sea Poland	1.95	1.92	1.30	1.14	1.14
Baltic Sea Germany	1.23	1.46	1.48	1.38	1.35
Denmark	1.04	1.03	1.03	1.04	1.04
Norway	3.15	2.72	2.79	2.90	2.92
Sweden	1.33	1.16	1.21	1.20	1.20
Finland	1.50	1.56	1.52	1.58	1.58
Baltic Sea Russia	2.16	1.93	1.95	1.97	1.97

ELULOOKIRJELDUS

1. Isikuandmed

Ees- ja perekonnanimi	Olga Nežerenko
Sünniaeg ja -koht	09.06.1982, Tallinn, Eesti
Kodakondsus	Eesti
E-posti aadress	olga.nezerenko@gmail.com

2. Hariduskäik

Õppeasutus (nimetus lõpetamise ajal)	Lõpetamise aeg	Haridus (eriala/kraad)
Audentese Ülikool	2006	Ärijuhtimine/ magistrikraad
Audentese Ülikool	2004	Ärijuhtimine/ bakalaureusekraad

3. Keelteoskus (alg-, kesk- või kõrgtase)

Keel	Tase
Vene	Emakeel
Eesti	Kõrgtase
Inglise	Kõrgtase
Hispaania	Kesktase

4. Täiendusõpe

Õppimise aeg	Täiendusõppe läbiviija nimetus
2014 (18.02-6.05)	Õppimine ja õpetamine kõrgkoolis. Tallinna Ülikool.
2014 (10.04-09.05)	Kombineeritud uuringudisainid. Tallinna Ülikool.
2014 (13.03-28.03)	Eesti teaduskeel. Akadeemiline kirjutamine. Tallinna Ülikool.
2014 (20.02-29.05)	Akadeemiline inglise keel II: akadeemiline kirjutamine. Tallinna Ülikool.
2014 (04.02-28.05)	Akadeemiline inglise keel I: suuline eneseväljendus. Tallinna Ülikool.
2013 (28.11-12.12)	Andmeallikate kriitiline kasutamine. Tallinna Ülikool.
2013 (8.05-9.05)	Hindamis- ja tagasisidemeetodid. Tallinna Ülikool.
2012 (04.10-18.12)	Akadeemiline inglise keel. Tallinna Tehnikaülikool.
2011 (15.11-16.11)	Study design and writing Scientific Report. Tallinna Tehnikaülikool.

5. Teenistuskäik

Töötamise aeg	Tööandja nimetus	Ametikoht
2015 - …	Valgamaa Kutseõppekeskus	õpetaja
2014 - …	Eesti Ettevõtluskõrgkool Mainor	Logistika erialajuht
2013 - …	Tallinna Tehnikakõrgkool	lektor
2008 - …	Tallinna Tehnikaülikool	lektor
2007-2008	Audentese Ülikool	lektor
2006 - …	Eesti Ettevõtluskõrgkool Mainor	lektor
2005-2006	OÜ Maxima	ostujuht
2002-2004	OÜ FTC Raudtee	ökonomist

6. Teadustegevus

- Nežerenko, O., Koppel, O. (2015). Formal and informal macro-regional transport clusters as a primary step in the design and implementation of cluster-based strategies. *Transport and Telecommunication*, *16(3),* pp. 207-216. Doi: 10.1515/ttj-2015-0019

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- Nežerenko, O., Koppel, O. (2012). Problems in International Transport Arising from the Unbundling of Railway Companies in the Baltic States. The 4th International Conference "Economic Challenges in Enlarged Europe", 17-19 June 2012, Tallinn: (Toim.) A. Hazak. Tallinn: Tallinn University of Technology, pp. 1 – 9.

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- Kirch A., Nežerenko, O., Mezentsev, V. (2011). Estonia and other countries of the Baltic Sea region as actors of development: conceptual

approach. *European Integration Studies. Research and Topicalities,* 5. Journal of Kaunas University of Technology, pp. 199-204.

- Nežerenko, O., Koppel, O. (2011). Rail Sector Restructuring in the EU: Implications for Rail Business Environment in CEE Countries. The 3rd International Conference „Economies of Central and Eastern Europe: Convergence, Opportunities and Challenges", 12 – 14 June 2011. Conference Proceedings. Tallinn: Tallinn University of Technology, pp. 1-16.

- Nežerenko, O. (2009). How can the EU Baltic Sea Strategy contribute to the recovery of cooperation in the field of transit (as exemplified by the cooperation of the Baltic States in the years 2004-2008)? *Proceedings of the Institute for European Studies, 6.* Tallinn: Tallinn University of Technology, pp.50-66.

- Nežerenko, O. (2008). Is there a place for problems of energy resource transit in EU's Baltic Sea Strategy? *Proceedings of the Institute for European Studies, 4.* Tallinn: International University of Audentes, Tallinn University of Technology, pp.48-56.

7. Kaitstud lõputööd

- Magistritöö:
  Nežerenko, O. *Eesti kaudu toimuva naftatoodete transiit: analüüs ja arengu perspektiivid.* Juhendaja: Dr. Mihhail Bronštein. Audentese Ülikool, Tallinn, 2006.

8. Teadustöö põhisuunad

Euroopa integratsioon, Läänemere äärise riikide macro-regiooni transpordi- ja energiaalased probleemid.

CURRICULUM VITAE

1. Personal data

Name	Olga Nežerenko
Date and Place of birth	09.06.1982, Tallinn, Estonia
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2. Education

Educational institution	Graduation year	Education (field of study/degree)
International University Audentes	2006	Master of Business Administration
International University Audentes	2004	Bachelor of Business Administration

3. Language competence/skills (fluent; average, basic skills)

Language	Level
Russian	Native
Estonian	Fluent
English	Fluent
Spanish	Average

4. Special Courses

Study Period	Educational or other organization
2014 (18.02-6.05)	Studying and Teaching in Institutes. Tallinn University.
2014 (10.04-09.05)	Mixed Methods Research Designs. Tallinn University.
2014 (13.03-28.03)	Scientific Estonian: Academic writing. Tallinn University.
2014 (20.02-29.05)	Academic English II: Academic Writing. Tallinn University.
2014 (04.02-28.05)	Academic English I: Speaking. Tallinn University.
2013 (28.11-12.12)	Critical use of Sources. Tallinna Ülikool.
2013 (8.05-9.05)	Evaluation and Feed Back Methods. Tallinn University.
2012 (04.10-18.12)	Academic English. Tallinn University of Technology.
2011 (15.11-16.11)	Study design and writing Scientific Report. Tallinn University of Technology.

5. Professional Employment

Period	Organisation	Position
2015 - …	Valga County Vocational Training Centre	Teacher
2014-…	Estonian Entrepreneurship University of Applied Sciences	Head of Logistics specialty
2013-2014	TTK University of Applied Sciences	Lecturer
2008 - …	Tallinn University of Technology	Lecturer
2007-2008	International University Audentes	Lecturer
2006 - …	Estonian Entrepreneurship University of Applied Sciences	Lecturer
2005-2006	OÜ Maxima Eesti	Purchase manager
2002-2004	OÜ FTC Raudtee	Economist

6. Scientific work

- Nežerenko, O., Koppel, O. (2015). Formal and informal macro-regional transport clusters as a primary step in the design and implementation of cluster-based strategies. *Transport and Telecommunication, 16(3),* pp. 207-216. doi: 10.1515/ttj-2015-0019

- Nežerenko, O., Koppel, O. (2015). Formal and Informal Macro-Regional Transport Clusters as Primary Tools for Ensuring Stable Competitiveness of the Baltic Sea Region. *Research and Technology - Step into the Future*, *10(1),* pp. 12 - 14.

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- Kirch A., Nežerenko, O., Mezentsev, V. (2011). Estonia and other countries of the Baltic Sea region as actors of development: conceptual approach. *European Integration Studies. Research and Topicalities, 5.* Journal of Kaunas University of Technology, pp. 199-204.

- Nežerenko, O., Koppel, O. (2011). Rail Sector Restructuring in the EU: Implications for Rail Business Environment in CEE Countries. The 3rd International Conference „Economies of Central and Eastern Europe: Convergence, Opportunities and Challenges", 12 – 14 June 2011. Conference Proceedings. Tallinn: Tallinn University of Technology, pp. 1-16.

- Nežerenko, O. (2009). How can the EU Baltic Sea Strategy contribute to the recovery of cooperation in the field of transit (as exemplified by the cooperation of the Baltic States in the years 2004-2008)? *Proceedings of the Institute for European Studies, 6.* Tallinn: Tallinn University of Technology, pp.50-66.

- Nežerenko, O. (2008). Is there a place for problems of energy resource transit in EU's Baltic Sea Strategy? *Proceedings of the Institute for European Studies, 4.* Tallinn: International University of Audentes, Tallinn University of Technology, pp.48-56.

7. Defended theses

- Master thesis:
  Nežerenko, O. *Oil products transit across the territory of Estonia: the analysis and development prospects.* Supervisor: Dr. Mihhail Bronštein. International University Audentes, Tallinn, 2006.

8. Main areas of scientific work/ Current research topics

European Integration, Transport and Energy issues in the Baltic Sea Macro-Region's countries

DISSERTATIONS DEFENDED AT
TALLINN UNIVERSITY OF TECHNOLOGY ON
ECONOMICS AND BUSINESS ADMINISTRATION

1. **August Aarma**. Segmented Analysis of Bank Customers and Banking Information: Estonian Case. 2001.

2. **Enn Listra**. The Development and Structure of Banking Sector: Retail Banking in Estonia. 2001.

3. **Tatyana Põlajeva**. The Comparative Analysis of Market's Attractiveness. 2001.

4. **Tuuli Tammeraid**. Modeling Flow of Funds for Estonia. 2002.

5. **Ivo Karilaid**. The Choice in General Method for Investment and Performance Evaluation. 2002.

6. **Hele Hammer**. Strategic Investment Decisions: Evidence from Survey and Field Research in Estonia. 2003.

7. **Viljar Jaamu**. The Methods and Instruments for Solving the Banking Crisis and Development of the Banking Sector in Estonia. 2003.

8. **Katri Kerem**. From Adoption to Relationships: Internet Banking in Estonia. 2003.

9. **Ly Kirikal**. Productivity, the Malmquist Index and the Empirical Study of Banks in Estonia. 2005.

10. **Jaanus Raim**. The PPP Deviations between Estonia and Non-Transitional Countries. 2006.

11. **Jochen Sebastian Heubischl**. European Network Governance – Corporate Network Systematic in Germany, the United Kingdom and France: an Empirical Investigation. 2006.

12. **Enno Lend**. Transpordiühenduse ja logistikasüsteemi interaktsioon (Saaremaa ja Hiiumaa näitel). 2007.

13. **Ivar Soone**. Interrelations between Retail Service Satisfaction and Customer Loyalty: A Holistic Perspective. 2007.

14. **Aaro Hazak**. Capital Structure and Dividend Decisions under Distributed Profit Taxation. 2008.

15. **Laivi Laidroo**. Public Announcements' Relevance, Quality and Determinants on Tallinn, Riga, and Vilnius Stock Exchanges. 2008.

16. **Martti Randveer**. Monetary Policy Transmission Channels, Flexibility of the Economy and Future Prospects of the Estonian Monetary System. 2009.

17. **Kaire Põder**. Structural Solutions to Social Traps: Formal and Informal Institutions. 2010.

18. **Tõnn Talpsepp**. Investor Behavior and Volatility Asymmetry. 2010.

19. **Tarmo Kadak**. Creation of a Supportive Model for Designing and Improving the Performance Management System of an Organisation. 2011.

20. **Jüri Kleesmaa**. Economic Instruments as Tools for Environmental Regulation of Electricity Production in Estonia. 2011.

21. **Oliver Parts**. The Effects of Cosmopolitanism on Estonian and Slovenian Consumer Choice Behavior of Foreign *versus* Domestic Products. 2011.

22. **Mart Nutt**. Eesti parlamendi pädevuse kujunemine ja rakendamine välissuhetes. 2011.

23. **Igor Novikov**. Credit Risk Determinants in the Banking Sectors of the Baltic States. 2011.

24. **Mike Franz Wahl**. Kapitaliühingute lõppomanike alusväärtuste ja tahte uurimine ning omanikkonna tüpoloogia konstrueerimine. 2011.

25. **Tobias Wiebelt**. Impact of Lease Capitalization on the Development of Accounting Standards: A Theoretical Research. 2012.

26. **Sirje Pädam**. Economic Perspectives on Environmental Policies: The Costs and Benefits of Environmental Regulation in Estonia. 2012.

27. **Juhan Värk**. Venemaa positiivse hõlvamise poliitika ja teiste välispoliitiliste liinide mõjud Eesti-Vene suhetele aastail 1991–2011. 2012.

28. **Mari Avarmaa**. Implications of Capital Structure and Credit Constraints for Company Performance: A Comparative Study of Local and Multinational Companies in the Baltics. 2012.

29. **Fabio Filipozzi**. The Efficiency of Interest Rate and Foreign Exchange Markets in the Euro Area and Central and Eastern Europe. 2012.

30. **Aleksei Netšunajev**. Developments and Determinants of Intra-Industry Trade in the Baltic States. 2012.

31. **Aleksandr Miina**. Critical Success Factors of Lean Thinking Implementation in Estonian Manufacturing Companies. 2012.

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37. **Aleksandr Michelson**. Destination Branding and Constructing Symbolic Capital in the Reproduction of Heritage Space: the Case of UNESCO Designated Hanseatic Old Towns. 2014.

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40. **Riina Koris**. Customer Orientation at a Higher Educational Institution: The Perspective of Undergraduate Business Students in Estonia. 2014.

41. **Merle Rihma**. Ethics Audit: A Management Tool for Assessing of Corporate Social Responsibility and Preventing Ethical Risks. 2014.

42. **Anu Virovere**. The Role of Management Values, Knowledge Management and Conflict Management for Improvement of Organisational Sustainability. 2015.

43. **Kristina Hunke**. Conceptualisation and Management of Green Transport Corridors. 2015.

44. **Eneken Titov**. Management Paradigm Values in Real and Propagated Level as Prerequisites of Organisational Success. 2015.

45. **Siiri Same**. Conceptualization of Experience Marketing and Country Branding from a Marketing Management Perspective. 2015.

46. **Helbe Põdder**. Combining Work and Family Life – A Comparative Perspective on Changes in Parental Roles in Estonia, Finland and Sweden. 2015.

47. **Katrin Toompuu**. The Full Costing Model and Its Implementation at Universities: The Case of Tallinn University of Technology. 2015.

48. **Õnnela Paas**. Development of the Safety Management System at Enterprises. 2015.

49. **Iivi Riivits-Arkonsuo**. Consumer's Journey as Ambassador of Brand Experiences. 2015.