SCENARIOS OF THE RAILWAY TRANSPORT DEVELOPMENT IN POLAND

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Abstract

Railway transport is a key branch for the development of intermodal transport. In 2016, intermodal transport in Poland had an 8.8 % share in transport performance and was higher by over 1.4 percentage point than in 2015. In 2017, further increase in intermodal railway transport was recorded. The average in EU countries has been stable at around 16 % since 2009. The year 2018 in Poland in intermodal transport was characterized by an increase in all parameters compared to 2017. Although the share of intermodal transport in total freight is steadily increasing, it is still insufficient. The freight transport structure in Poland is dominated by road transport, which generates the highest external costs. The current structure of flows in the freight transport network is unfavorable given the sustainable development. The purpose of the article is to indicate the scenario of railway freight transport development in Poland by 2030. Factors affecting the development of railway transport are very diverse. Therefore, in assessing the development of railway transport, we proposed one of the heuristic methods of scenario analysis. The scenario analysis allowed to examine the phenomena affecting the development of railway freight transport in the long term. According to her methodology, we generated the most probable scenario, which we compared with the optimistic and pessimistic scenario.

Keywords: Scenario analysis, intermodal network, railway transport, determinants

1. INTRODUCTION

Development of the railway freight transport is especially important at the age of shaping the intermodal transport network both in Poland and the whole Europe. Construction of the intermodal network and development within this sector of freight transport, implemented by various branches of transport is not a single operation or investment, it is first and foremost a long-term answer to problems resulting from high external costs of transport. During this process, it is necessary to implement such planning forms that would completely consider all factors (both positive and negative) that might affect the development of intermodal freight transport network. The answer to the needs is the adoption of scenario-based methods, proposed in the paper, to create the railway transport strategy within a long period of time. In this context, the objective of the paper is to present scenarios for the development of the railway intermodal freight transport. Based on the adopted transport policy of Poland, the time perspective reaches 2030. The scenario-based analysis has been preceded with the identification of key determinants of the railway transport development in Poland. The results of the studies are presented in a separate paper.

2. THE IDEA OF THE SCENARIO-BASED ANALYSIS TO EVALUATE THE DIRECTIONS OF DEVELOPMENT OF THE RAILWAY FREIGHT TRANSPORT

The development of the intermodal network is determined by a series of economic, legal, social technological and environmental factors. At the same time, it depends on the decisions and attitudes of various stakeholders, both these with direct impact (first plan stakeholders) and these who have indirect impact but may severely notice the effects of the development of intermodal transport network. These very differentiated stakeholders, such as: local and regional authorities, production and trade organizations, logistic operators, forwarders, infrastructure managers, face many problems related to significant uncertainty. The factors that affect the development of intermodal railway transport must be considered in the context of uncertainty affecting the planning and making the decisions. A very good strategic management tool under conditions of significant

uncertainty is the scenario-based approach to the planning operations [1]. The scenarios are most useful when the external environment is complicated and unsure, and the key decisions are related to major investments or may have long-term consequences. These assumptions are satisfied by the problematic aspects of development of the intermodal freight transport, including railway transport.

The scenario-based planning is especially useful in situations when the external analysis is important. Generally, it applies to developing innovative but probable variants of detailed events and then designing strategic operations in order to meet these variants. P. Schoemaker [1995, p. 28] describes the scenario-based planning as a "disciplined way of imagining possible variants of the future" [2]. The scenario-based planning perceived this way is coupled with turbulence, uncertainty and complexity [3]. The scenario-based planning is thus a method designed to analyse possible future conditions and paths of development [2]. Its purpose is not to predict the future in detail but rather to better understand the logical steps that lead to various scenarios and assistance in developing more complex strategies [1]. As opposed to traditional methods, the scenario-based planning develops different goals that are possible to achieve in the future, ensuring this way the grounds for generating strategies that collide with unexpected situations [4]. Considering the uncertainty allows the strategists to more effectively cope with the complexity and variability leading to better responding capabilities and alertness to a change of market conditions. In the context of intermodal transport network, it may be perceived as positive impact on the network immunity to disturbances. The scenarios may have a very wide space, time and material range or be characterized by significant concentration on a selected issue. Moreover, they may have descriptive or normative character. However, notwithstanding the above, the scenario-based approach has the following common features [5]:

- many perspectives: scenarios will always include more than one perspective of the future. This is their explicit goal. One perspective is a prognosis,
- qualitative change: scenarios are the most appropriate when considering complex, highly unsure situations, where immeasurable and qualitative forces are present (e.g. social and technological values, regulations, etc.),
- objective: scenarios describe the things that may happen not the things we want to be happening. Objectivity requires that the scenarios are inherently cohesive and feasible. If they are perceived as impossible or unfeasible, they are rejected. The challenge is the widening of thinking and staying reliable at the same time,
- openness: scenarios are some sort of stories. They do not provide accurate data. The allow the reader to add details that make the scenarios more dynamic,
- focus and accuracy: scenarios must be appropriate for the situation, they should focus on driving forces and critical uncertainties related to the considered strategic decisions.

Event though there are many definitions of scenarios, one must underline that in the broadest context, the scenarios are to explain possible visions of the future, showing general directions of the development for the decision making purposes (political, business, military) [6]. K. Johnson et al. [2012] define the scenarios as "detailed and reliable outlook at the way the business environment of the organization may develop in the future based on key environmental elements and the catalyst of changes that are accompanied by high level of uncertainty". The European Environment Agency defines the scenarios as "common and reliable image of the possible alternative of the future, by delivering information on the main topic in the public debate". B. Radzikowska [8] defines the scenarios as "system of events linked into logical, most often chronological, sequence".

These different definitions presented in the literature show very differentiated approach not only to interpretation of this concept but also to the method the scenarios are created. Considering the variety of contexts of applying the scenario-based analysis, different complexity of considered issues, it is difficult to show one versatile methodology of the scenario-based analysis. Effectiveness of this approach for strategic

planning makes that many experts does not publish the stages and tools used to create a scenario, since they do not want to disclose the whole methodology of studies [9].

Among the research approaches, comprehensively described in the literature, one may indicate the scenarios of the environment states, processes scenarios or the maps of the future. The deductive method useful to create and describe the scenarios under varying and uncertain situations has been described in 2005 by K. van der Heiden, matrix of scenarios. The deductive scenario-bases methods are perceived as the most analytical and exhaustive ways to construct scenarios from the perspective "from outside to inside" [van der Heijden, 2005, p. 131]. The scenarios matrix constructs and visualizes four scenarios based on two key factors of uncertainty. The number of four scenarios is considered as the maximum that the decision makers are able to manage [4]. The matrix is complemented by two other tools that are important for creation of the scenarios: fact sheets and impacts diagram.

The methodology adopted in the studies is based on the approach proposed by K. van der Heidena assuming the steps given in **Figure 1**.

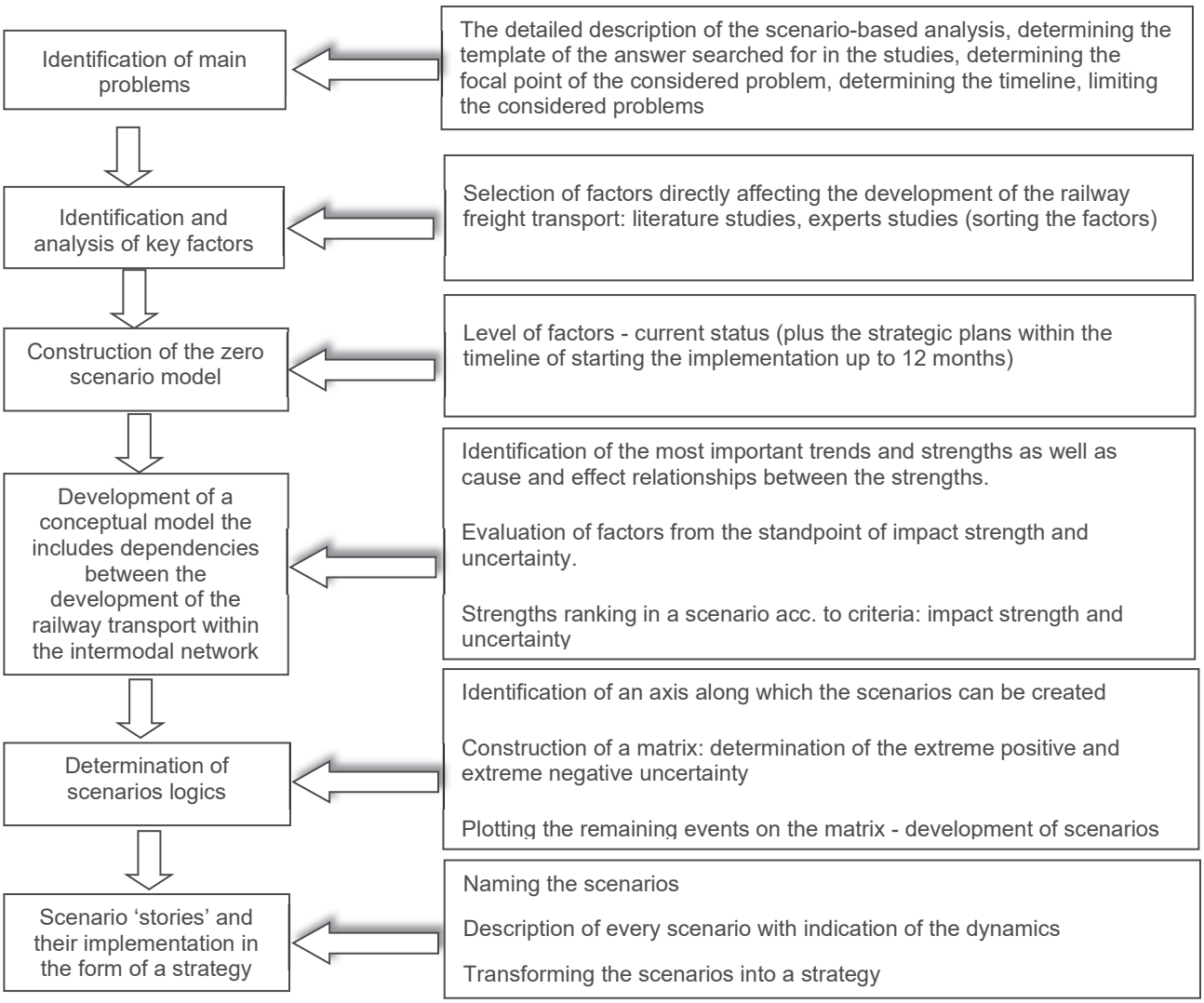

Figure 1 Stages of scenario development [own study]

Such procedure causes that the scenarios focus on the factors of: high significance / low uncertainty - there are relative axioms of the future in case of which current plan must be prepared; as well as of high significance / high uncertainty - these are potential "creators" of different variants of the future in case of which long-term plants should be prepared.

3. SCENARIONS OF THE RAILWAY FREIGHT TRANSPORT DEVELOPMENT WITHIN THE INTERMODAL NETWORK - STUDIES RESULTS

The identified key factors of development of the intermodal railway transport in Poland were evaluated according to the adopted methodology from the standpoint of probability of occurrence of individual trends (growth, stabilization and regression) and their impact strength. The strength was evaluated in the scale from -3 to +3 considering positive and negative impact on development of the railway freight transport. At first, the "0" scenario was created that combines factors evaluated by the experts from the standpoint of their actual strength of impact on development of the intermodal railway transport. The "0" scenario is the basis to evaluate the direction of changes - stabilization of a factor. Next, the probability and effect of the growth and regression of each factor was evaluated. The most probable scenario is compared to an optimistic and pessimistic scenario. The optimistic scenario more accurately corresponds to the most probable scenario and that is why **Table 1** compares the pessimistic scenario with the most probable scenario.

Table 1/1 Comparing the most probable scenario with the pessimistic one concerning development of the railway freight transport within the intermodal network [own study]

Probability	Power of influence	Direction of change	Factor	Direction of change	Power of influence	Probability
0.2	-1		Expenditure on the TEN-T program by railways		2	0.6
0.1	-1		Flows as part of the New Silk Road		1	0.6
0.1	-2		Restrictions on the movement of goods by road		-1	0.5
0.2	-3		Railway programs and the degree of their implementation		1	0.4
0.1	-1		Access to railway infrastructure		1	0.6
0.1	-2		Focusing European transport policy on the development of intermodal transport		3	0.6
0	-2		Quality of international relations of countries and infrastructure managers		2	0.6
0.1	-3		Focusing the state transport policy on railway and intermodal transport		3	0.5
0	-3		Access of railways to inland / sea ports		3	0.5
0	-2		Expenditure on infrastructure adjustment - 750m trains		2	0.6

Table 1/2 Continue Comparing the most probable scenario with the pessimistic one concerning development of the railway freight transport within the intermodal network [own study]

Probability	Power of influence	Direction of change	Factor	Direction of change	Power of influence	Probability
0.1	-2	↘	Expenditure on separating the freight line infrastructure	→	-1.5	0.5
0	-3	↘	Quality (parameters) of transhipment terminals	↗	3	0.7
0	-2	↘	Density of intermodal terminal networks	↗	3	0.8
0.3	-1	↘	Expenditure on technology development ro-la	→	-1	0.7
0.1	-3	↘	Expenditure on technology development lo-lo	↗	2.5	0.7
0.1	-1	↘	Expenditure on the development of intermodal loading units	→	1	0.6
0.3	-1	↘	Expenditure on technology development ro- ro	→	-1	0.4
0.1	-3	↘	Interoperability of railway systems	↗	3	0.5
0.1	-2	↘	Transit transport through Poland	↗	3	0.6
0.1	-2.5	↘	Price level of competing transport modes	↗	3	0.6
0.2	-3	↘	Demand for rail transport	↗	3	0.4
0.2	-3	↘	Intermodal relief	→	1	0.5
0.2	-2	↘	Stability of procedures in intermodal transport	→	-1	0.6
0.3	-3	↗	Charges for access to line infrastructure	→	1	0.5
0.2	-3	↘	State expenditure on linear infrastructure	↗	3	0.5
pessimistic scenario				**most likely scenario**		

The most likely scenario is created by the factors that mostly positively affect the development of the national intermodal transport and their direction of impact is stabilization or growth. Average strength of the factors impact in this scenario is 1.56 which shows a clear growth in relation to the"0" scenario, wherein the impact strength was (-0.4). This means that in the experts' opinion, the most probable is the moderately favouring impact of factors on development of the railway transport within the intermodal network. The factor that would negatively affect further development of the railway freight transport with high probability (0.5) and strength (-1.5) is the problem related to separation of the linear infrastructure for the freight transport. This mostly results

from the fact that the most probable trend identified by experts is stabilization of operations within this scope. Unfortunately, at the moment, there are no solid assumptions and decisions to separate the linear infrastructure for the passenger and freight transport.

High probability is assigned by the experts to the growing tendencies within the scope of considering the intermodal railway transport within European, national and regional policies. The decisions at the strategic level of a country within this scope are necessary for smooth development and modernization of infrastructure, improvement of communication between branches of transport and development of incentives for the participants of the delivery chain to use the railway intermodal transport.

The optimistic scenario shows positive impact of growth of most of the factors with average probability 0.44. The exception is the factor - fees for the access to the railway infrastructure - drop of which positively affects the development of the railway intermodal transport. Average probability of positive impact of determinants on development of the intermodal transport is much higher comparing to the pessimistic scenario, wherein the average probability is at the level of 0.13 with average impact strength (-2.18).

Despite the low average probability of the pessimistic scenario, it is still necessary to monitor it by the decision makers due to potential high strength of impact, identified in this scenario. This especially applies to factors that would strongly inhibit development of the railway intermodal transport in case the dropping tendency occurs. Therefore, they represent potential risk factors including: drop of demand for railway transport, reduction of pressure in the European and national programmes and strategies on the railway intermodal transport, reduction of interest and lack of investments that would allow for including the railway transport into the inland waterway and sea transport system idea - abandoning the strive to construct trimodal nodes, impairment of qualitative parameters of the intermodal terminals, reduction of expenditures on construction and modernization of the linear railway infrastructure and on the development of modern reloading systems, mostly in the lo-lo technology, rising the fees for access to the railway infrastructure as well as reduction of the intermodal relief and deterioration of the interoperability level in the system of railway freight transport. The mentioned factors, due to their significance, must be closely monitored and one must look for solutions that limit negative impact on the level and direction of development of the national freight transport within the intermodal network.

4. CONCLUSION

The paper considers the important issue of development of the railway freight transport within the intermodal network. This idea fully matches the current assumptions of the strategic policy of the EU and Poland. The railway intermodal transport within the past years can be characterized by a gradual growth, however its share in the total railway transport is still small. Therefore, the paper analysed 25 key factors identified as these that are considered the most important for the future development of railway freight transport. They represent three major areas of the surrounding: political and legal, economic and technological (within the social and environmental area, there were no key determinants identified). Based on the analysed determinants, one created scenarios that present pessimistic, optimistic and most probable occurrence of events related to development of the railway transport. The performed scenario-based analysis allowed for noticing many concurrences between the optimistic and the most probable scenario. This is a positive aspect that promises good future for the railway transport. Moreover, when analysing the pessimistic scenario, one noticed the occurrence of potential risk factors that may inhibit the transport development. Therefore, it is necessary to observe them in order to limit their occurrence probability or to minimize the effects of such event. It is also necessary to underline that due to average probability of the pessimistic scenario amounting 0.13, it may be considered as low probable. Therefore, it is clear how significant the chance is for the railway freight transport within the intermodal network in Poland.

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