SCENARIOS FOR THE DEVELOPMENT OF INLAND WATERWAYS TRANSPORT IN POLAND

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Abstract

The development of inland waterways transport in Poland is a great chance to relieve road transport, which currently accounts for 86 % of transport in Poland, with only 0.4 % for water transport. This is important primarily due to the obligations of the so-called White Paper (Roadmap to a Single European Transport Area issued in 2011 by the European Commission). The article presents the results of research carried out under the TRANS TRITIA project, implemented in an international consortium consisting of cross-border regions of three countries: Poland, the Czech Republic and the Slovak Republic. The research concerned the construction of scenarios for the development of inland waterways in Poland, taking into account not only the requirements of the White Paper, but also the needs arising from the growing needs for the implementation of international freight with a significant share of inland waterways.

Keywords: Inland waterways, structural analysis of development factors, development scenarios

1. INTRODUCTION

As a result of many years of investment neglect, Polish inland waterways have lost its importance and practically does not exist as part of the transport system. It has been said for a long time that on the map of European inland waterways, Polish waterways are so-called "Bottleneck". However, it should be emphasized that Polish water routes have great potential from the point of view of international connections and are considered for inclusion in the trans-European transport network. To this end, the Act on the ratification of the European agreement on the main inland waterways of international importance (AGN) has recently entered into force in Poland. The AGN Convention obliges Poland to adapt the main waterways to at least class IV navigability. The agreement also indicates ten locations of inland ports of international importance. Currently, waterways in Poland, except for short sections on the lower Oder, do not meet the minimum international navigability conditions set out in the AGN Convention. Due to the next revision of the TEN-T network in 2023, it is necessary to develop and adopt programs for the reconstruction of waterways intended for inclusion in the network. The development of such documents requires a broader view and consideration of potential changes that may occur in the environment of the country's transport system. The article attempts to develop scenarios for the development of inland navigation in Poland in the context of incorporating the main inland waterways into the TEN-T network.

2. METHODOLOGY FOR BUILDING INLAND WATERWAYS DEVELOPMENT SCENARIOS

Contemporary applications of the scenario method appeared simultaneously in two countries: in the USA and France. Two schools have developed in the American centre, i.e. the school of intuitive logics and probabilistic modified trends school, while French practice in the field of research on the future allowed to shape the school La prospective. The experience of such companies as Shell, SRI, GBN and SAMI Consulting constituted the basis for the development of the intuitive logic school [1]. The scenario construction model promoted by this school is intuitive in the sense that it is based on the subjective assessment of uncertainty and its possible results by recognized experts, but is also logical, formal and requires a structured approach to the construction of scenarios [2,3].

Scenario analysis, as part of the methodological toolkit of science-policy interfaces [4], has grown significantly over the last two decades [5]. In the opinion of A. Kononiuk [6] in recent years - i.e. since 2003 - the development of the scenario method was influenced by, among others publications of such authors as: P van Notten et al. [7], R. Bradfield et al. [1], L. Borjeson et al. [8], E. Hiltunen [9], P. Bishop et al. [10], C. Stewart [11], O. Saritas and Y. Nugroho [12]. Works of P. van Notten et al., L. Borjeson et al. were mainly devoted to establishing the typology and classification of scenarios. R. Bradfield et al. conducted a comparative analysis of three main schools of scenario construction. The idea of E. Hiltunen's work was to establish a relationship between weak signals, wild cards and scenarios. The purpose of the work of P. Bishop, A. Hines and T. Collins was to present all possible script construction techniques that appeared in the literature until 2007. The authors presented the usefulness, strengths and weaknesses of the identified 23 techniques, which were then grouped into 8 categories. The work of O. Saritas and Y. Nugroho is a proposition of an evolutionary approach to the construction of scenarios consisting in mapping the dynamics of variables at a given time [6]. The process of creating scenarios is shown in **Figure 1**.

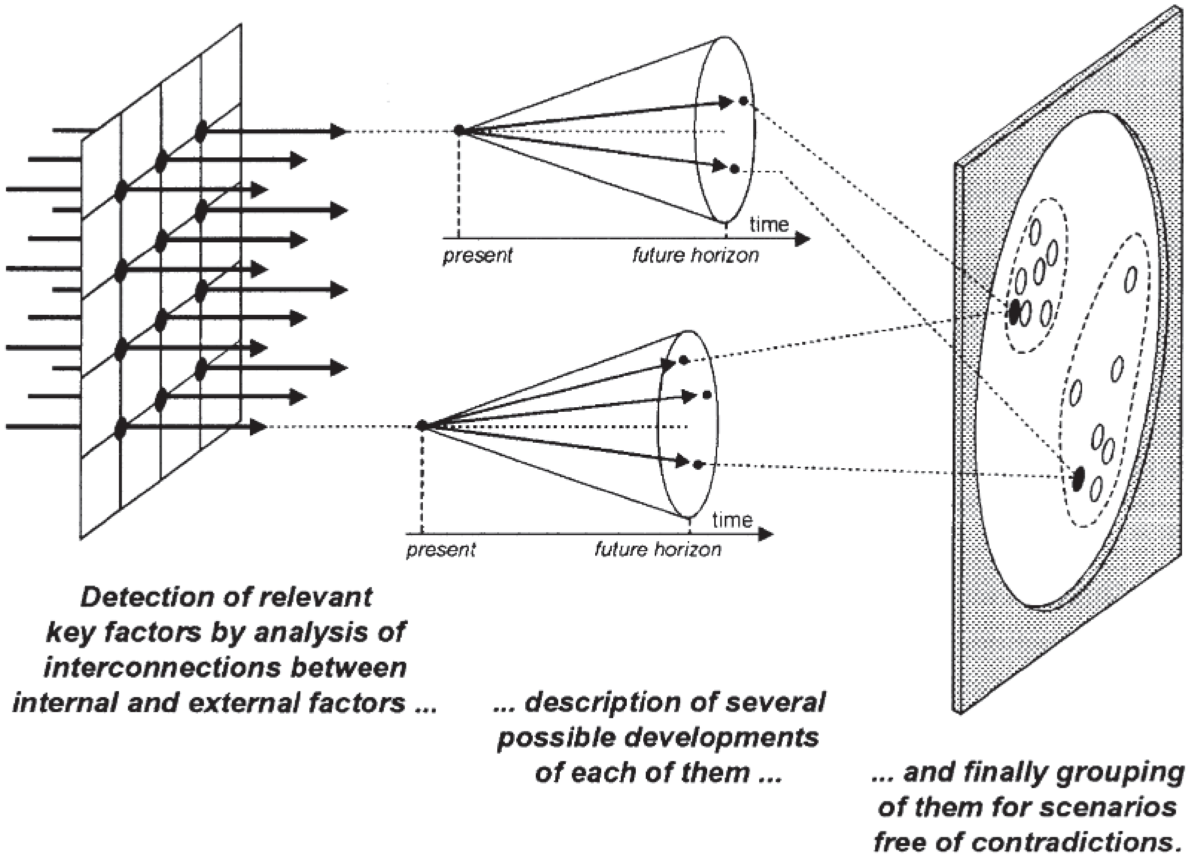

Figure 1 The process of scenario creation [13]

Taking into account different approaches to building scenarios, the authors of the article adopted a methodology consisting of five stages:

1) Preparatory stage - at this stage the current state of inland waterways in Poland and the potential for its future development have been presented; at this stage, key actors (stakeholders) were also identified in the area under study;
2) Identification of factors determining variants of environmental behaviour - at this stage, factors affecting the development of inland waterways in Poland were identified; to check the interactions between the identified factors, an interaction matrix was used to assess them on a network; this approach has

identified factors that can be used as levers for the development of inland waterways; at this stage, IWT experts were involved in identifying interactions between different impact factors;

3) Identification of key factors and the strength of their impact on the development of inland waterways - at this stage, statistical processing using the MICMAC program was used to identify key factors.;

4) Scenario development - at this stage, the identified factors recognized as levers for the development of inland waterways were compiled with the behaviour of stakeholders, obtaining consistent scenarios for the development of inland transport.

3. SCENARIO ANALYSIS

Scenarios for the development of inland waterways in Poland were prepared on the basis of the methodology presented in point 2. The preparatory stage regarding the determination of the current state of inland navigation is presented in the article [14]. The next stages of scenario construction are presented in sections 3.1. up to 3.3. of this article.

3.1. Identification of factors determining environment behaviour variants

Based on extensive literature studies and research conducted as part of the TRANS TRITIA project, carried out in three countries and four regions: The Moravian-Silesian Region, the Opole Voivodeship, the Silesian Voivodeship and the Žilina Region, **Table 1** presents a list of 20 factors that have potential impact on the development of inland navigation in Poland.

Table 1 Factors affecting the development of inland waterway transport in Poland [own study]

Factor No.	Name of the factor
1	Shaping the integrated transport structure in the country
2	Financing transport development from national and European Union funds
3	Increasing demand for transport services
4	Having active production potential in the industry of modern means of transport and ITS
5	Decapitalization of infrastructure fragments in inland waterway transport
6	Fragmentation of activities in the field of inland waterway transport development and lack of support for initiatives in this respect undertaken by national and local authorities
7	Weak position of the country in obtaining EU funds for organizational and infrastructure solutions in the field of inland navigation
8	Decapitalization of assets of inland waterway transport operators
9	Expenditure on R & D, the effect of which will lower costs of development of transport systems and their services
10	Energy-saving technologies in transport, causing a technological breakthrough and changing the market: alternative fuels, hybrid drives, hydrogen engines

11	Adaptation of waterways to international navigability classes
12	Favourable arrangement of waterways from the point of view of the flow of freight streams (connection with Western Europe waterways and seaports)
13	Implementation of the river information system
14	Complementarity of the level of development of inland waterways infrastructure with the development of flood protection investments; production of energy from renewable sources; improvement of water relations (agriculture, industry, population)
15	Increase in congestion; environment pollution; high accident rate in freight and passenger transport
16	Implementation of the system of preferential subsidies strengthening the position of inland waterway transport in freight and passenger transport
17	Policy promoting water and intermodal transport
18	Formulated programs for the development of inland waterways and the degree of their implementation
19	The river with railway infrastructure connection
20	Increase in expenditures on transhipment infrastructure and improvement of port warehouse facilities (including the planned Terminal in Szczecin and Świnoujście; Logistics centre in Gorzyczki, etc.)

The factors listed in **Table 1** were evaluated by 15 experts who are members of the project steering committee and also responsible for inland waterway management. Each factor was scored on the following scale: "0" meant no effect, "1" weak effect, "2" medium effect, "3" strong effect between two factors. **Table 2** shows the median rating values for each factor. Calculations related to the structural analysis of factor influences were made using MICMAC software. The program is available for free download on the "La Prospective" website edited by M. Godet [15]. The results of the program help to group variables and identify those with the greatest impact - key factors that exert a strong influence on other factors and at the same time strongly depend on other factors.

In addition, structural analysis allowed the isolation of the following groups of factors: objective factors, result factors, auxiliary factors, decisive factors (motors and brakes), external factors, regulating factors and autonomous factors.

3.2. Identification of key factors and the strength of their impact on the development of inland waterways

Key factors combine high impact with a high degree of dependence. The "goals" factors are those that change more by themselves than others. They represent the possible goals of the examined system. Dependent factors / results are characterized by low impact and high dependence on other factors. They are particularly susceptible to changes in critical and key factors. The decisive factors (determinants) are those that exert a very strong influence on the system, i.e. driving and braking factors, but are difficult to control. Regulatory / ancillary factors have little impact on the system, but may be helpful in achieving strategic goals. Autonomous factors show the least impact on changes occurring in the system as a whole, and external factors are characterized by a less significant impact on the system than the impact of determinants, but more than the impact of autonomous variables. At the same time, the impact of the system on these variables is small [16].

The conducted structural analysis, which was based on a matrix of direct influences, allowed the identification of six key factors: shaping the integrated transport structure in the country (1), decapitalization of infrastructure fragments in inland waterway transport (5), expenditure on R&D, which will result in lower costs of shaping systems transport services and their services (9), a policy promoting water and intermodal transport (17), formulated programs for the development of inland navigation and the degree of their implementation (18), linking river infrastructure with rail infrastructure (19). The results of the analysis are presented in **Figure 2**.

Table 2 Matrix of Direct Influences (MDI) [own study]

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1	0	0	1	3	3	0	1	0	0	3	3	3	0	3	1	3	2	3	1	2
2	3	0	1	2	2	3	3	0	3	3	3	2	3	3	3	2	2	0	3	1
3	2	2	0	3	3	3	2	3	0	3	3	3	2	2	3	1	1	3	0	1
4	2	0	2	2	2	0	1	0	0	2	2	2	3	3	0	0	2	1	0	0
5	2	1	1	3	3	0	0	3	1	3	1	3	3	2	0	0	1	3	0	2
6	2	1	0	3	3	0	3	0	3	3	3	2	3	0	2	0	3	3	3	3
7	3	3	0	1	3	1	3	3	0	3	0	3	3	2	3	0	0	3	0	0
8	2	0	0	0	3	0	3	3	3	3	2	0	0	0	0	0	0	3	1	3
9	3	0	2	3	1	3	0	1	0	3	3	0	0	3	2	2	2	0	2	0
10	2	2	1	2	2	3	2	0	0	2	2	1	3	0	0	0	0	0	2	2
11	3	0	3	3	3	2	0	1	0	3	3	2	2	1	0	3	3	0	1	3
12	3	0	3	3	3	2	0	0	0	3	3	0	2	3	3	0	3	0	3	2
13	2	0	1	1	0	2	0	0	0	2	0	0	2	1	0	0	0	0	0	0
14	0	2	1	3	3	0	2	2	0	0	0	1	2	3	0	1	0	0	0	0
15	3	2	0	3	3	3	0	0	0	3	1	0	2	2	1	0	0	0	0	1
16	1	0	3	3	3	2	2	2	1	2	3	2	1	1	0	0	1	0	0	0
17	3	2	3	0	3	2	3	2	0	3	3	0	2	3	3	3	3	0	3	3
18	3	3	2	3	0	2	3	1	0	3	3	0	3	3	3	3	3	0	3	3
19	3	1	3	3	3	2	2	1	0	0	3	1	2	2	0	3	2	0	1	2
20	1	0	0	2	2	2	2	0	0	3	0	1	2	2	0	2	2	1	2	0

Figure 2 System grid to visualize the interaction pattern of relevant influence factors [own study]

3.3. Preparation of scenarios for the inland waterways development

The key factors identified in the structural analysis became the basis for determining the following variants of inland waterways development scenarios: optimistic scenario, realistic scenario, stagnation scenario, pessimistic scenario. **Table 3** presents an assessment of the behaviour of key factors in individual scenarios.

Table 2 Assessment of the behaviour of key factors in individual scenarios for the development of inland waterways [own study]

Scenario/ Key factor (change trend)	Dynamic growth (optimistic scenario)	Stable/ sustainable growth (realistic scenario)	No changes (stagnation scenario)	Divergence of needs and possibilities (pessimistic scenario)
Shaping the integrated transport structure in the country	↑	↔	↔	↓
Decapitalization of infrastructure fragments in inland waterway transport	↓	↔	↑	↑
Expenditure on R & D, the effect of which will lower costs of development of transport systems and their services	↑	↑	↔	↓
Policy promoting water and intermodal transport	↑	↑	↔	↓
Formulated programs for the development of inland waterways and the degree of their implementation	↑	↑	↔	↓
The river with railway infrastructure connection	↑	↔	↔	↓
↑ increase ; ↔ unchanged; ↓ decrease				

The optimistic scenario assumes an increase in factors related to shaping the integrated transport structure of the country, with simultaneous increase in R&D expenditure, which will result in lower costs of shaping transport systems and their services. In addition, the optimistic scenario assumes an increased focus on shaping policies that promote water and intermodal transport as the implementation of inland waterway development programs increases. In addition, there is a need to increase links in river infrastructure with rail infrastructure.

In the realistic scenario, with the unchanged integrated transport structure in the country and the lack of changes in the scope of links between river and rail infrastructure, there will be an increase in R&D expenditure, which may result in lower costs of shaping transport systems and their services. Political and economic conditions conducive to the development of shipping are also assumed, and new inland navigation programs will be formulated, increasing the degree of implementation of infrastructure and organizational projects in this area.

The stagnation scenario assumes that the country does not keep up with the opportunities created by the state and European Union institutions for financing the development of inland navigation; the result of this situation, e.g. the lack of projects, may be insufficient application for financial support for inland waterway transport projects. The effect of this state of affairs may be an increase in the decapitalization of infrastructure fragments in inland waterway transport.

In the pessimistic scenario, assuming slow economic development, small investments in transport infrastructure, poor policy promoting inland waterway transport and the lack of programs for inland waterway transport, there will be a decrease in R&D expenditure and a significant increase in decapitalization of infrastructure fragments in inland waterway transport, which will further reduce the share of shipping inland freight transport in Poland.

4. CONCLUSION

Many problems of the development of inland waterway transport in Poland result from the fact that the low share of this branch of transport in servicing transport needs is identified with its marginal significance in the Polish transport system. The rank of this branch in Poland is often underestimated, while the specificity of inland waterway transport means that its development opportunities are related to natural conditions, which often results in the lack of a relationship between the share of this branch in servicing transport needs and its actual role on individual markets. It should be strongly emphasized that in Poland, inland waterway transport, regardless of the low share in servicing the total transport needs, can play a very important role in selected market segments.

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