

Conditions for the Preparation of the Complex Transport Infrastructure Investment Illustrated By the Lower Vistula River Revitalization¹

Bogusz Wiśnicki – Kasper Jędrzychowski – Hubert Jędrzychowski²

Abstract

The article presents results of research dedicated to the project of development of the logistics function in the river ports of the Lower Vistula River. Project has a strategic and complex character and aims to create an effective network of river logistics centres along the Lower Vistula River. The analysis includes the identification of investment tasks and the sources of their funding. The authors' present original investment benefits and risks analysis that identifies the most important efficiency factors for the project. The article ends with conclusions and recommendations of a general nature to be addressed to other such large infrastructure projects.

Key words

transport investments, logistic centres, inland shipping

JEL Classification: R42, R40

Introduction

The main goal of INWAPO project is to activate unused transport and logistics potential of waterways in Central Europe. Project analyses the possibilities of development of inland navigation using waterways between the Mediterranean Sea, Black Sea and Baltic Sea. INWAPO is focus on three main waterways systems: the ports of northern Adriatic ports on the Danube, as well as inland waterways in the Czech Republic and Poland.

This analysis, as one of the INWAPO elements, is dedicated to the development of inland waterways and inland ports on the Lower Vistula River, e.g. between Warsaw and Gdańsk. Poor condition of water engineering constructions, many years of neglect and lack of adequate funding for the ongoing maintenance, resulted in a significant deterioration of the waterway parameters. That was main reasons why Vistula River's transport function significantly limited.

There is a high disproportion in development of the infrastructure of inland waterways between Poland and Western Europe and Central Europe. Additionally, the lack of consistency European objectives of development strategies and the inability to create a common network of waterways TEN-T is observed (ECMT, 2006). Unfortunately, there is

¹INWAPO - Upgrading of Inland Waterway and Sea Ports, Project financed by the CENTRAL EUROPE Programme 2007-2013.

²Eng. Bogusz Wiśnicki, PhD., Maritime University of Szczecin, Faculty of Transport Engineering and Economics, Institute of Transport Engineering, Henryka Pobożnego 11, 70-507 Szczecin, Poland, b.wisnicki@am.szczecin.pl

Eng. Kasper Jędrzychowski, M.Sc., Maritime University of Szczecin, Faculty of Navigation, Wały Chrobrego 1/2, 70-500 Szczecin, Poland, jedrzychowski@gmail.com

Eng. Hubert Jędrzychowski, M.Sc., Maritime University of Szczecin, Faculty of Navigation, Wały Chrobrego 1/2, 70-500 Szczecin, Poland, hjedrzychowski@gmail.com

no realistic plan of action that could reverse this trend. The long term investment plan discussed in this paper represents an attempt to break the stalemate. It should allow not only for the restoration of the navigability of the waterway, but also the inclusion of the Vistula international river transport networks.

Innovative approach in proposed investment plan of Lower Vistula River revitalization is based on the purpose to create an effective network of river logistics centres along the river (Fechner, 2004). The waterway has to be connected with road and rail infrastructure in order to achieve the benefits of intermodal transport. Greater flexibility in the selection of routes and transportation will bring tangible economic benefits for logistics operators.

1 Methodology

The main objective of the article is to present a methodology of preparing large transport infrastructure investments. Investments of this type require the involvement of many actors, including public institutions and companies, and the involvement of large financial resources. Some of the most difficult transport infrastructure investment in scope of waterways, which are relatively long-lasting and inherently based on the extensive involvement of the governments and the international institutions. This specificity extends the investment preparatory process, which must be based on a multicriteria analysis taking into account the interests of many parties, which may be conflicting with each other.

The research study was based on the project of development of the logistics function in the river ports of the Lower Vistula River. Preparation process of that investment includes:

1. Identification of bottlenecks and infrastructure limitations,
2. Determination of multi-criteria investment objectives,
3. Description of the investments plan,
4. Analysis of the investment benefits and risks.

The research study used descriptive and comparative analysis based on multiple criteria of efficiency. Technical and operational determinants were taken into account. The scientific investigations included available literature sources mainly of strategic or analytical nature. Great importance had direct experience of the authors in the field of transport and logistic. At the final stage, method of synthesis was applied on gained results, as to present the theoretical knowledge in the field of investment process in the scope of waterways and ports infrastructure.

2 Results and Discussion

2.1 Characteristics of port investments

Investments in transport infrastructure have idiosyncrasies. Very costly and in the majority of non-profit investments in waterways are particularly difficult tasks. The number of specific factors must be taken into account during the preparation and realisation of the investment process. The most important factors influencing waterways and river ports investment process includes (UN Economic Commission for Europe, 1996) (European Commission, 2011):

- a) objective of an investment,
- b) spatial planning,
- c) environmental impact,
- d) water construction technologies,
- e) users and other beneficiaries,
- f) financing sources.

It is necessary to determine at the Government the level, the supposed result of the development process of the inland waterways and ports. The most important decision concerns the classification of the waterways. In the case of waterways of the international importance the goal achievement is lengthy and requires additional preparation works and realisation in stages.

It is necessary to include the potential investment plans related to the development of inland river and ports in local spatial plans. Analysis of port areas' ownership and the possibility of their obtaining for investments is needed. Additionally, the target ownership scheme of the new or upgraded terminals and ports should be determined. Planning and implementation of the investments should be in accordance with the needs of potential users of new or upgraded port terminals (e.g. ro-ro berth or container terminal operator).

Identification of the environmental risks arising from the investment is obligatory. It includes determination of the necessary measures for the protection of riverside areas in order to achieve the sustainable development.

2.2 Socio-economic characteristics of the Lower Vistula River

The analysis of the regional economic conditions is necessary to newly created transport system based on the waterways be consistent with the real market demand. Therefore the region along the Lower Vistula were analyzed for their socio-economic conditions. Synthetic data are given according to the following criteria (Woś, K. et al., 2014):

- a) demographic potential (the number of people living in the region),
- b) the economic potential (the volume of industrial production in the region),
- c) transport potential (the quality of transport infrastructure linking the river ports and their hinterland).

Geographical the Lower Vistula region, which is a potential hinterland of river ports covers about 10 million people. Nearly half of them live in the region of Warsaw which is also the fastest growing region in Poland. Projected demographic changes by year 2020 amount +2,54%.

The economic potential of the region is diversified economically. Far the largest production, calculated in GDP per capita is in the Warsaw region and amounts to 14371 EUR. Other regions have an average production of about 40-50% less. By 2020 economic developments trends are projected at about 2%. The most important business entitles in the Lower Vistula port's hinterland are: PKN Orlen, Boryszew, Technicolor Poland, CNH Poland, LG Electronics Mława, Man Track & Bus Poland, Tetra Park, Flextronics Interational Poland, Anwil Group, PESA Bydgoszcz, Lotos Group, Crist Shipyard, Energa, and International Paper Kwidzyn.

Most of the analysed ports provide access to roads and railways. In many ports directly on quays are railway sidings. Storage areas are paved and combined with asphalt

roads. There are no clear investment plans for port access infrastructure in perspective of 2020. Existing investment plans do not include the port as major transportation hubs.

2.3 Identification of bottlenecks and infrastructure limitations

The basis for determining the investment needs and the subsequent planning of investment tasks is proper identification of bottlenecks and transport infrastructure limitations. In the case of European transport and logistics systems, there are technical standards of infrastructure and recommendations for their use. Starting from the local development strategies and EU strategic guidelines, e.g. White Paper Roadmap to a Single European Transport Area. The proposed criteria for the analysis of in relation to the waterways of the Lower Vistula River include (UN Economic Commission for Europe, 1996):

- a) compliance with the AGN Agreement (European Agreement on Main Inland Waterways of International Importance),
- b) compliance with the TEN-T network (Trans-European Transport Network),
- c) capabilities to meet the transport needs of the ports' hinterland,
- d) capabilities to change ports into trimodal transport nodes.

Tab. 1 Lower Vistula River infrastructure discrepancies with European standards

Discrepancy	Type*	Description
Parameters of the waterway	A	The Vistula River does not meet the requirements of the AGN Agreement, which require min. IV class of navigable water. Infrastructure constraints effected that inland navigation on the Lower Vistula River is practically not functioning (0.5 million tons on the average distance 3 km were transported in 2012). At the same time it is observed growing need for efficient connections to seaports (Gdańsk, Gdynia, Elbląg) supported by the inland waterway transport.
Ratification of the AGN Agreement	D	European Agreement on Main Inland Waterways of International Importance (AGN) concluded in 1996, has not been ratified by the Polish Government. This situation is incompatible with the EU transport policy and makes it difficult to finance investments for the development of inland waterway transport from EU funds.
Environmental protection areas	D	The most parts of the Lower Vistula River, as in the case of the remaining Polish inland waterways declared navigable, are included in the environmental protection areas "Natura 2000". This situation makes very difficult implementation of any transport infrastructure investment.
Technical condition of ports infrastructure	B/C	Currently, infrastructure of these ports (handling equipment, quays, docks and inner port infrastructure) is depreciated and requires modernisation and upgrading to modern transport technology requirements.
Ports' access infrastructure	B/C	The existing infrastructure for road and rail access to inland ports requires modernisation and upgrading works. The current parameters of the most road and rail infrastructure allows limited local traffic.

* A - 'White spots' and bottlenecks on waterways; B - Limitations in ports developments; C - Limitations of access infrastructure; D - Organisation limitations

Source: own study

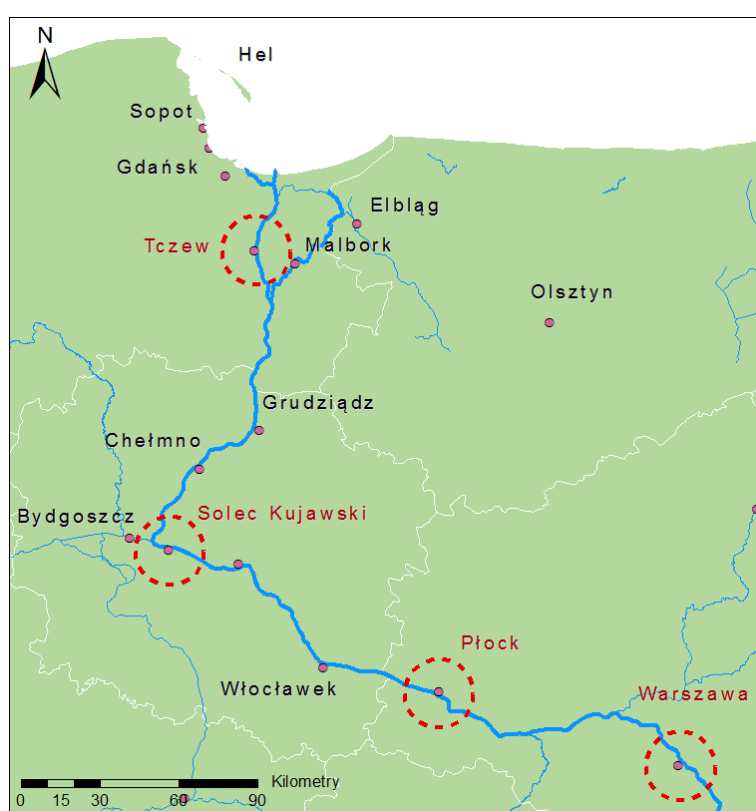
Table 1 shows the results of carried out the identification of the Lower Vistula River and ports infrastructure constraints. Three types of discrepancies were distinguished: 'white spots' and bottlenecks on waterways, limitations in ports developments; limitations

of access infrastructure; organisation limitations (complicated ownership of port infrastructure, disadvantageous long term contracts related to rent of port infrastructure, etc.).

2.4 Determination of multi-criteria investment objectives

Multi-criteria investment objectives relating to the development of water transport infrastructure should be defined and agreed. The proposed objectives for the Lower Vistula River take into account the existing plans and development strategies and enable elimination of bottlenecks, 'white spots', and other identified deficiencies in the development of transport infrastructure (tab. 2).

Fig. 1 Selected node ports of Lower Vistula River



Source: Woś, K. et al., 2014

Tab. 2 Investment objectives for the Lower Vistula River

No	Investment area	Investment objective	Time horizon
1	Waterways	The multiannual programme for the development of the Vistula River waterways, including reviving of the navigation along the Lower Vistula with minimum class IV	2050
2	Port facilities	Reviving river ports for the selected locations: <ul style="list-style-type: none"> • Tczew: container terminal, universal quay (bulk+ro-ro), • Solec: container terminal, universal terminal, • Płock: universal basin, shpyard basin • Warsaw: container terminal, terminal, bulk terminal, general cargo terminal. 	2030

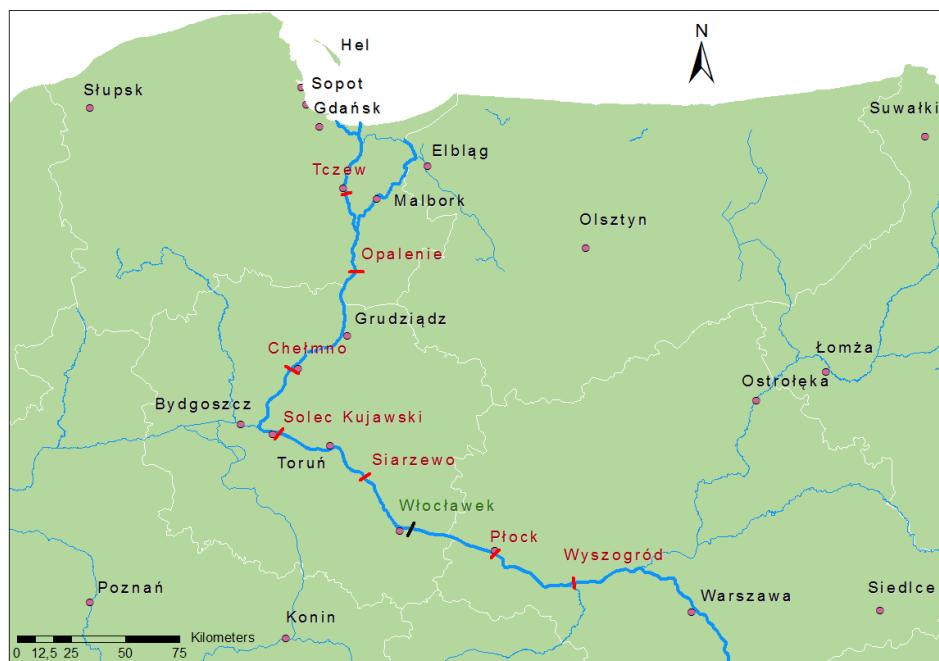
No	Investment area	Investment objective	Time horizon
3	Intermodal network	Tczew: railway connection with 'railway dry port' (new), road connection (modernisation)	2030
		Solec Kujawski: road and rail connections (new building), logistics centre (new)	2030
		Płock: road and rail connection (modernisation)	2030
		Warsaw: road and rail connection (modernisation)+ logistics centre (new)	2050
4	Other	Upgrading river banks with the purpose of flood protection	2025
		Acquisition of renewable energy (new power plants located at Lower Vistula Cascade)	2050

Source: own study

The most spectacular objective is to build intermodal logistics centers in the following river ports: Warsaw, Plock, Solec Kujawski and Tczew (fig. 1). These ports have the potential to serve such an important function in European transport and logistics system (Fechner I., 2004). However, the essential objective is the development of the Vistula River waterways, including reviving of the navigation. It should be the investment multiannual programme resulting in achievement of class IV waterway. Three implementation stages of that investment programme include:

- a) revitalization of the waterway to the parameters of the II waterway class,
- b) regulation works allowing to obtain the III waterway class,
- c) canalization of the river through the construction stages of fall with locks and hydroelectric power plants adapted to at least a IV waterway class.

Fig. 2 Lower Vistula Cascade project



Source: Woś, K. et al., 2014

2.5 Description of Lower Vistula River investments plan

The key result of transport investment preparations is investment plan, including description of all investment activities necessary to achieve defined multi-criteria investment objectives. The description includes: investment location, investment action, information about most probable investors and/or project coordinators and anticipated sources of their financing.

In case of the Lower Vistula River investment processes should be carried out by local authorities and/or institutions responsible for the management of waterways, hydro-technical facilities and areas adjacent to waterways. Interesting business partner could be entrepreneur invests in renewable energy. The most important possible waterways investors are: Regional Water Management Boards (RZGW), Drainage and Water Facilities Management Boards (ZMiUW), and Marshal Offices. In case of port facilities potential investors are: the County Districts, Offices of Commons, port enterprises in cooperation with external investors. Investments may be conducted in cooperation local governments with external investors, such as public-private partnerships, commercial and private companies. The main road and rail infrastructure connecting ports with hinterland should be developed by General Directorate for National Roads and Motorways (GDDKiA) and Polish State Railways (PKP PLK). Description of the Lower Vistula River investment plan, which contains the tabular coverage of the planned investment activities shows table 3.

Tab. 3 Lower Vistula River investments plan

Location	Investment action	Investor/Coordinator	Financing source
Lower Vistula	Revitalization the waterway to non-international parameters (Class II waterway)	National Water Management Authority (KZGW)	Public
	Regulation works of the waterway up to Class III waterway	National Water Management Authority (KZGW)	Public
	Construction of stages of fall with locks and hydroelectric power plants adjusted up to Class IV waterway	National Water Management Authority (KZGW) & electricity supply company	PPP
Warsaw	Construction of container quay, ro-ro berth and quay for general cargo handling. Revitalization of the port basins.	Port Authority	Public/Private/PPP
	Existing railway sidings connected directly to the quays.	Polish railway lines management authority	Public/Private
	Renovation of roads all over the port and adjusting storage areas for container, bulk and ro-ro transport.	Polish roads administration	Public/Private
	Repair banks, reconstruction and adaptation lock at least to a IV waterway class, deepening the entrance canal.	Regional Water Management Board of Warsaw (RZGW Warszawa)	Public
Plock	Construction of container quay, ro-ro berth and quay for general cargo handling.	Port Authority	Public/Private/PPP
	Renovation of existing railway sidings.	Polish railway lines management authority	Public/Private
	Renovation of roads all over the port and adjusting storage areas for container, bulk and ro-ro transport.	Polish roads administration	Public/Private

Location	Investment action	Investor/Coordinator	Financing source
	Repair quays and banks, reconstruction and adaptation of the flood gate at least to a IV waterway class, deepening the entrance canal and basins.	Port Authority	Public/Private/PPP
Solec Kujawski	Construction of a new port near Solec Kujawski. Port with a quays for handling: containers, bulk cargo and ro-ro.	Port Authority	Public/Private/PPP
	New rail connection of the planned port	Polish railway lines management authority	Public/Private
	New road connection of the planned port -	Polish roads administration	Public / Private
	New basins and quays.	Port Authority	Public/Private/PPP
Tczew	Expansion of container quay, ro-ro berth and quay for general cargo handling.	Port Authority	Public/Private/PPP
	Connection inland navigation port with the planned rail dry port	Polish railway lines management authority	Public/Private
	Renovation of roads all over the port and adjusting storage areas for container, bulk and ro-ro transport.	Polish roads administration	Public/Private
	Construction of a new port basin and new quays. Repair existing quays and banks, deepening the entrance canal and basin.	Port Authority	Public/Private/PPP
	Realising the potential of shipyards for ship repairs.	Owner of the shipyard	Private

Source: own study

The above table is as detailed as possible, taking into consideration lack of any strategic plans and projects. The key for ports' development are waterway projects. The common feature of the investments are the very long time perspective not determined costs, what is justified at this stage of investment plan.

2.6 Analysis of the investment benefits and risks

The additional part if the investment process preparation works is analysis of the impact of planned investments, e.g. direct and indirect benefits and risks. In case of Lower Vistula River investment process direct benefits include positive changes in: the volume of transshipment, the quantity of jobs, income, etc. Indirect benefits concern the development of additional functionalities of ports and waterways: production, logistics, city-creating, flood, tourist, etc. The investment risks may have economic nature or result in a negative environmental impact (tab. 4).

Tab. 4 Lower Vistula River investment benefits and risks

No	Investment	Direct benefits	Indirect benefits	Risks
1	Regulation and canalisation of the waterway up to class IV	<ul style="list-style-type: none"> • Increase of the vessels' permissible capacity • Extension of the navigation season (number of d navigableays) • Enhancement of the 	<ul style="list-style-type: none"> • Reduction of transport measures • Competitive position of inland shipping on the market • New jobs places, • Development of 	<ul style="list-style-type: none"> • Protests of the environmentalists • Lack of continuity in the financing of multiannual investment • Lack of symmetry in the development of

		<p>flood&ice safety for areas along the river</p> <ul style="list-style-type: none"> • New network of hydroelectric power plants 	<p>industrial areas along rivers,</p> <ul style="list-style-type: none"> • Reduction road congestion and exhaust emissions by shifting cargo from roads to the barges • Increasing water resources essential for industry, agriculture and forestry • Efficient and renewable source of energy, • Water tourism and fisheries development 	<p>transport potential along the river, e.g. ports' road and rail access infrastructure</p> <ul style="list-style-type: none"> • Missing links with the European TEN-T network of waterways • Weather anomalies limiting inland waterway transport • Extension of the transit time by lock transfers
2	Revitalization of river ports	<ul style="list-style-type: none"> • The utilisation of the areas currently not used 	<ul style="list-style-type: none"> • New jobs places • Eradication of poverty areas • Development of industrial areas along rivers, • Development of logistics centres in ports • Increase the regional and international tourist potential 	<ul style="list-style-type: none"> • Lack of interest of investors • Conflict with current development planning • Lack of trained and available workers

Source: own study

The investment benefits, direct and much more numerous indirect, are rather obvious. The most important identified risks result in lack of social awareness of the full benefits of planned investments which may result in protests of the environmentalists. Additionally, the identified important risks include lack of symmetry in the development of transport potential along the river and missing links with the European TEN-T network of waterways.

Conclusion

The research study resulted in a given methodology of preparing large transport infrastructure investments. The objective to build intermodal logistics centres in the chosen river ports required consideration of technological, organisational and economical issues. The presented methodology allows to analyse all important factors that could affect the efficiency of the new-built infrastructure. Of all the factors, two were very important are selected, although their role is underestimated.

Firstly, the greatest identified challenge is to restore relevant parameters to inland waterways. Regardless of the accepted variant of the waterway regulation, it is associated with a significant interference in the river's ecosystem. In accordance with the environmental directives and guidelines of the European Commission, the investments worsening environmental protection will be implemented only if three conditions are fulfilled at the same time:

1. the anticipated investment objective may not be achieved without harm to protected species and habitats,

2. the investment is justified by overriding public interest.
3. environmental loss will be offset by extending the protection of another area (corresponding to the surface area and quality of which as a result of the investment loses the favourable protected status).

Thus, the investment process on waterways will depend not only on the ability to ensure sufficient funds for this purpose, but above all from qualifying the investment as "overriding public interest".

Secondly, new-built waterways must be the part of uniform and coherent network of inland waterways in Europe. In case of Vistula River the missing links are connectors: Elbe-Oder-Danube and Danube-Adriatic Sea. The vision of the European network of waterways connecting three European seas, the Mediterranean Sea, the Baltic Sea and the Black Sea, was introduced as early as 1996 during the discussion on TEN-T. Unfortunately, there are no practical actions in order to implement this vision. These political aspects of infrastructure development have a great impact on the benefits to the waterways and ports users.

References

1. UN Economic Commission for Europe, Inland Transport Committee. (1996). *European Agreement on Main Inland Waterways of International Importance – AGN*. Geneva : United Nations.
2. ECMT. (2006). *Strengthening inland waterway transport - Pan-European co-operation for progress, European Conference of Ministers of Transport (ECMT)*. Paris : ECMT Publications.
3. European Commission. (2011). *White Paper : Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system*. Brussels : European Commission.
4. Fechner, I. (2004). *Centra logistyczne cel-realizacja-przyszłość*. Poznań : Biblioteka Logistyka.
5. Woś, K. et al. (2014). *WP 4.3 Ports Needs Assessment : the final report*. Retrieved September 10, 2015, from http://www.central2013.eu/fileadmin/user_upload/Downloads/outputlib/INWAPO_4.3.2_Needs_Assessment_Macro_update_version.pdf