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RELATIONSHIP BETWEEN TRANSPORT AND ECONOMIC DEVELOPMENT

Addendum 3

WATERWAY TRANSPORTATION AND ITS SUSTAINABLE DEVELOPMENT MARKET AND STRATEGY ANALYSIS

Report Summary

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Waterway Transportation and Its sustainable Development --Market and strategy Analysis --

Report Summary
Contract MD/12/035

Executive Report

December 2000
Liege

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1. Introduction - Objectives

The present study, 'Waterway Transport and Its sustainable Development — Market Analysis and Development strategy" is sponsored by the Belgian Prime Minister's service for Scientific, Technic and Cultural Affairs, SSTC *(Service du Premier Ministre, Affaires Scientifiques, Techniques, et Culturelles)* under the programme "Transport and Mobility, Part II, sustainable Development". It was carried out by ANAST, the Naval Architecture & Transportation systems Department of the University of Liege.

It was scheduled for three years (1.12. 1997-30. 11.2000).

The global objective assigned to this study is to give a substantial contribution to the emergence of a sustainable transport system through the definition and detailed analysis of the key factors that can enhance the intensive use of the waterway transport mode.

The specific objectives are:

1. to analyse the possibility of shifting cargo traffic to inland waterways;
2. to identify obstacles that hinder the intensive use of the waterway transport mode;
3. to define the pre-requisites for a successful integration of the waterway transport system into intermodal transport chains;
4. to elaborate the concepts and strategies for the future actions.

2. Working approach and exploitation of the results

The basic area of the study is the Belgian freight transport market. However, the relations with and the trends of the overall European freight transport market are taken into account as well.

The results and findings obtained in the study are based mainly on a demand analysis realized by the mean of questionnaires and interviews. They have been conceptually and practically designed having in mind the market optimisation from the technical and organisational points of view.

The results of the study are addressed to (1) the waterway transport suppliers and (2) to the decision-makers (i.e. the Public Authority). They constitute a solid basis for the setting-up of:

- sector plans for sustainable development;
- infrastructure planning;
- decisions on executive actions;
- guidelines for the integration of the waterway transport into logistical chain;
- policies for a congestion free and environmental friendly mobility.

3. Research Activities and Results

3.1 shifting Possibilities

3.1.1 Strategic Position of Belgiun Inland Waterways

Located in the centre of the West Europe corridor, the Belgian inland waterways have an important position in the Trans-European Transport Network (TEN).

West Corridor of TEN (Waterways)

The West corridor comprises regions of France, Belgium, the Netherlands, and part of Germany. Its overall appearance is a vertical strip, which runs from the North to the South. Excepted for the relations with the Rhine corridor, the inland waterways' network in the West corridor supply mainly the North South accesses. In this corridor, many waterways (in France), that have not yet reached ECE IV, class have already been planed for an upgrade. Once these connections are accomplished, Belgian waterways will play a more important role in offering the North-South accesses. Many E-labeled waterways pass through Belgium. In comparison with the other European countries, Belgium has the second highest density of European inland waterways. Apparently, the Belgian inland waterways are in the core of this West corridor.

Belgian Inland Waterways

The Belgian waterways network is very well canalized and classified according to the EMET standard of waterway dimensions normalization. The total length of the navigable waterways in Belgium is 1514 km (860 km of which are canals and *654* km natural waterway).

It consists of seven river systems well canalized and linked together. There are more than 199 locks and 449 ports. It is well connected to the West European waterway network and this constitutes a substantial advantage for the development of inland waterway transportation services.

Based on the analysis of the waterway infrastructure and transport demands, four axes are identified. They are:

- North-East Axis (Albert Canal)
- South-East Axis (Meuse, sambre)
- 1° South-North Axis (Scheld)
- 2° South-North Axis (Brussels-Charleroi, Rupel)

3.1.2 Traffic Analysis

StatisticalAnalysis

It is based on the statistical indices (realized tons and ton.km), on the modal shares and transport distances. This analysis consists of two parts:

- Domestic Statistics: traffic within Belgium.
- International statistics: traffic for import/export and transit

Traffic on the waterway network

Through the application of traffic assignment tools, the traffic pattern on Belgian waterways network has been defined in several categories:

(1) traffic for domestic transport, (2) traffic for import/export transport, and (3) traffic for transit transportation.

It appears that the North-East axis is a very important line for the domestic transportation. Concretely, the transport between Liege *and* Antwerp districts, through the Albert canal jointed to the lower section of river Meuse, represents the main domestic market for IWT. The next ones are the transport between Gent and Antwerp (by using the Dutch Waterways), between Charleroi and Antwerp (2° North-South axis).

The main import/export points are: Antwerpen, Lanaye locks and Gent. Completely different from the traffic pattern for domestic transportation, the traffic of import/export transportation has a more uniform distribution on the different waterways. Although the North-East axis remains the primary route for the exportation of the industries along Meuse river to the Netherlands (through Rhine-schelde connection), the 1° and 2° North-South axes are also very important for Belgian import/export activities.

The 1º North-South axis is very important for the transit transportation with a direct connection between France and The Netherlands. The South-East axis also plays a role of link between France and The Netherlands. However, the Albert Canal, which is the key waterway for domestic and import/export transport, has very little functions for the transit transportation.

3.1.3 Demand Prognosis

It is not sufficient to specify the transport demand by its quantity. Its quality requirements are also important, especially in relation with modal choices. The quantity, which indicates the amount of cargo to be transported, is most widely used by statistics as an index to measure the level of the transport demand. The quality however indicates the specific transport requirements (consignment size, time requirement, reliability, etc.) and should be taken into account. The accuracy of the forecast is determined by two factors: (1) availability of data; (2) suitability of methodologies. The results of the demand prognosis are expressed in O-D matrix of cargo flows, categorized by product type.

3.1.4 Main results

The main observations are as followings:

- Over years, road transportation experienced a rapid development while the waterway transport kept nearly the same traffic volume (regarding the transport performance). This fact does not appear only in Belgium but in the other West European countries as well. This shows that the waterway mode is still mainly concerned with the traditional bulk freight market

- From the point of view of market shares, waterway transport decreased in recent years due to the expansion of the road share. How to improve the waterway transport system to match the increasing transport demand will be an important topic to be tackled by the waterway transport sector.

- For Belgium, as well as for the whole West Corridor, waterway transport does not take a high share in the domestic transport market but is keeping a significant position in the international transport market. This is a special characteristic determined by the demand, the IWW network, and the waterway transport specificities. The single market policy of EC brings a good chance to promote waterway transport between the member countries where is the dominant market space for waterway transport.

- Regional links by IWW can be identified and proved by the traffic pattern analysis. Relations between the specific demands and the respective infrastructures can be established, allowing hence a more clear insight into the potential contributions of individual infrastructures to economic development.

3.2 Shifting Potentials

3.2.1 Cargo Traffic in Multi-Modal Network

Integrated Multi-Modal Network concept was suggested by ANAST to explain the physical traffic switches between modes. It refers to the network, which describes the transport infrastructure connections (nodes and links) of different single mode networks as well as the transhipment connections between modes.

Multi-modal network could be imaged as a three-dimensions network. Each transport mode takes for one layer. When analysing criss-cross transport network covering a studied region, the physical network can be abstracted into different layers basing on the mode attribute. Then, imaged links are added to connect the nodes between layers. These are transit links, through which transshipment from one mode to the others can happen. Similarly to a single mode network, traffic through the multi-modal network will take paths that are composed of sequences of adjoined links. Appearance difference of the path in a multi-modal network is that it jumps to the other layer (or mode) for the minimal transport cost. Transshipment resistance between modes (layers) could be simply represented by the transshipment links. Through the implementation of the concept, traffic shifts between modes can be well presented and computed.

Utilization of the mode split can generate very reasonable mode shares. Many case studies showed satisfactory results. However, it lacks of capacity to present cargo's transshipment, which is looked as a hot point, as well as a weak point of 'intermodality'. Many investigations show that most of mode shifts are accompanied with the transshipment because the industries are not always located along inland waterways. In this point of view, the modal split has its intrinsic weakness and limitation. The integrated multi-modal network supplies the possibility to represent the transshipment because the transit resistance can be presented in the network by the links' cost. From this point of view, the multi-modal network is more convenient for the mode shift studies.

3.2.2 Shifting Concepts

Definitions

Cargo traffic can be understood as the movement of the freight from an origin to a destination through the transport network, which is composed by the networks of different modes and the transhipment between them. if there is traffic that leaves its original transport mode to another before reaching its destination, the traffic **shift (or shifting) is said** to occur. Typically, the traffic shifting between modes happens in two ways. The first one is that the traffic switches directly from one mode to the other if the origin and destination are reachable by both modes. The second one is that the transshipment, through which the traffic shifts from the original mode to a new one, happens somewhere in the network.

Conventionally, the traffic shifting occurs when the new mode or path has less cost (generalized) than the original one so that the cheaper routes are taken.

Traffic in a transport network is a result of a natural equilibrium of demand and supply under the social, economic and the market conditions. Changes of the traffic pattern can happen only after modifications of the factors (infrastructure, regulations, costs, etc.) that determinate the present status of the studied system.

Sometimes, barriers or obstacles situated in the right position can constitute an important factor which prevent the full use of a mode. This results in unreasonable overall market share of some modes. To generate the shifting effects, it is necessary to have special measures that can change the existing balance of the system toward a direction in favour of one transport mode. Especially, the measures that can delete the obstacles are highly desired. If the existent mode share is not in a reasonable level because of the obstacles, the *system's tendency* to reach a new balance status *(mode shifts automatically)* after the removal of the hindrances is looked as **shifting potentials.**

Concretely, shifting potentials from mode m_1 to mode m_o could be defined as the volume of traffic that is available to mode from mode m_o with the framework of cost, infrastructure and cargo characteristics. The total shifting potentials in favour of mode m_o is the sum of the potentials from all the other modes to mode m_o. Realization of shifting potentials is done by the way of applying measures that can remove the obstacles in term of cost, time, reliability and cargo characteristics. In another word, the measures could be looked as means to release the shifting potentials that were blocked by the obstacles. From this point of view, shifting potentials indicates the up-limit that could be realized by different efforts. The shifting potential is always associated with the obstacles and its level is measured by the difference between the existing level and the up-limit. Namely, the shifting potentials are always counted in comparison of the existing situation with a reference situation. From this definition, it is clear that the shifting potentials are closely relative to the terms:

- Obstacles, which hinders the release of the shifting potentials
- Measures, which can remove the obstacles to the realization of shifting potentials
- References, which are used to count the level of potentials in relation to the existing situation.

- Automation: After the removal of the obstacles, shifting potentials should automatically be released.

Based on the definitions of the shifting potentials, an attached concept, **Benefit Ratio of generating mode shifts**, can be introduced. It can be defined as the ratio between benefits of releasing potentials and the cost of taking related appropriate measures. **Possibility** indicates the degree of chance to realize the shifting potentials under the constraints of social, economic, and technical conditions. Theoretically, once the obstacles are removed, all the shifting potentials can be realized. Practically, the obstacles are impossible to be removed completely, i.e. the shifting potentials cannot be realized at a 100% level. The ratio between the "practically realisable" shifts and the "theoretical potentials" shifts represents the Shifting possibility. It reflects the level of clearance of the obstacles that block the release of shifting potentials. It reflects also somehow, the effects of the measures taken in order to remove the obstacles. From a statistical point of view, the shifting possibility could be looked as the ratio between shifted traffic against the shifting potentials. Removal of one or more obstacles cannot clean all the hindrances in order to release the total potentials. In this sense, the shifting possibility is very useful to describe the practical problems and the difference between the shifting potentials and the shifted traffic.

Shifting Criteria

Many factors can influence the mode choice and shifts. Conventionally, the transport cost and time are the two main decisive factors in choosing transport modes as well as the paths. However, it was founded that cargo traffic does not always follow the cheapest mode and route. In this study, it has been particularly established that the following criteria, besides the transport cost and time, are also decisive factors for the traffic shifting:

Affinity

It describes the 'preferences' of each category of cargo to the different transport modes. The affinities are determined by the characteristics (packages, values, size of consignment, time requirement, etc.) of the cargo.

Reliability

Modern production and logistical concepts require a reliable transport system. In many cases, it is more important than transport time. Reliability refers to two aspects. The first one is the punctuality and the second is the security. It should be emphasized that the overall path's reliability is derived from the multiplication of the reliabilities of the links that compose the path. Therefore, if only one link has a low reliability, the whole path's reliability will dramatically decrease.

Possibility

Regulations, policies and market environments have influences and sometimes are decisive factors in the mode choice. These facts relative to the market environments could be considered as the possibility.

Shifting Potential vs. Shifted Traffic

According to the definitions, shifted traffic refers to the part of potentials *realized* after the application of specific measures. Depending on the degree of overcoming the obstacles, shifted traffic will be in proportion with the strength of the applied measures. The criteria suggested in the previous sections can be used to evaluate or measure the shifted traffic. Shifting potentials are relative to the obstacles and measured by the difference between the present traffic and the reference one. However, how the reference should be determined? Theoretically, the reference should be a new balance when the obstacles are completely removed. So, the reference should be in an ideal (perfect) balance.

Experiential Estimations

The present study deploys an experiential formula, which is based on the investigations on Danube corridor, to calculate the potentials on Belgian network. After an assignment of the transport volumes, the potential traffic in each segment of the waterways was obtained.

Waterway Capacity

Traffic resistance in waterways is identified as coming from: (1) fairway, (2) locks and other hydrostructures, and (3) bridges. In fact, the waterway capacity is mainly determined by the fairways and locks. Basing on the theoretical capacity calculation method, Belgian waterways' capacity was assessed.

Comparisons & Analysis:

After comparisons between the waterway capacity and the potential traffic, it was found that:

- Most parts of Belgian waterways have plenty of free capacity. They have sufficient capacity to handle the potential traffic.

- There will be possible congestion (different degree) if the shifting potentials are completely realized. They are identified as:

Lock Wijnegem in Albert Canal
Canal Bruxelles-Charleroi (section between Bruxelles and Feluy)

3.3 Shifting Obstacles

Obstacles are the hindrances that prevent the realization of mode shifts (potentials). They may comes from:

. Technical impediments
. Organizational inconsistency
. Market conditions.

This present study found that the obstacles may be configured in different structures showed as resistance. The blockage of shifting may be due to interactions of different obstacles. The only practical way to find out the obstacles is in-situ investigation, which consists of two actions:

Questionnaires and Interviews.

3.3.1 Questionnaires

Target Groups

In the waterway transport market, the players can be classified into the following groups:

- Shippers
- Forwarder agents (Charters)
- Shipping operators
- Other service suppliers (administrators, ports, etc.)

Shippers are the users of IWT services. They are the sources of transport demand. To satisfy their logistical requirements, normally, they may choose means and modes from many alternatives. Shipping operators are those who transport cargoes on inland waterways, normally referred to as the shipping companies. They are the main IWT suppliers. Forwarder agents are the people who stand between the shippers and the shipping operators to bridge the business links. In one aspect, they organize cargo for the shipping operators while in the other aspect, they represent the shippers and their need to realize the logistical services. such a role makes them key players in the waterway transport market.

In the present study, the shippers and the forwarders are the key targets groups of the survey.

Design

The questionnaires were designed as to allow a quantitative and a logic link analysis of the answers. In that sense, the questions were formulated in a concise, simple, short and anonymous way

Executions

550 questionnaires were distributed to the shippers and to the forwarding agencies. However, the return rate is not so high as it was expected.

Results

The responses reflect the general images of waterway transport service and the main obstacles of shifting. It was found that the shifting potential represents more than 35 millions tons of transport demand and covers all major categories of products. The results from the survey helped in finding out the shifting obstacles but also they provided the image of the sector, and the general ideas about shifting potentials. The main findings are the following.

A. New characteristics of transport demand

- Changes in consignment sizes. Most consignments are concentrated on the small size (<l00 tons) and large size (>800 tons)

- Transport distance. Basing on the consignment size, the transport distance presents a large variance. However, most of the transport demand requires a displacement of about 200-400 km (middle distance)

- Time requirement. For large consignment, requirement on transport time is not so strict (1 week). However, most of the small consignments are requested to be delivered within 24 hours.

B. Shippers transport mode choice

• Mode choice criteria: Lots of criteria were proposed as essential for the choice of the transport mode. It appears from the survey that shippers rank the criteria in the following order: Transport Cost, Transport punctuality, Service quality, Service flexibility, Transport time

• Personal preferences: Investigation confirms that there are shippers who prefer to use road transport mode.

• Enterprise Locations: A strong relation was found between the location of enterprises in relation to ports and their rate of using waterway transport mode.

• Intermodality: At present, direct single mode traffic takes a very high share. Intermodal transport is not yet well developed.

C. Main Obstacles

• Generally, shippers consider the fact ‘difficult to operate’ as the main reason for not using waterway transport mode.

• The first category of obstacles relates to the operating difficulties and the high cost of port handling. The second category of problems concerns the relatively high transport time, the limited waterway network and the location of ports (too far away). The third category of obstacles is related to the consignment sizes, usually too small to ask for a waterway transport service.

D. Most effective measures

• Evaluation: Shippers consider that the most effective measures are on two aspects. The first one is related to the operations. The second one focuses on market. They look forward to a real promotion of waterway transport what would increase its attractiveness and competitiveness.

• suggestions: (1) small vessels (200-250 tons) should be available in order to suit to the usual shippers consignment size. (2) The abolition of ‘Tour de Role’ regime in France would help reaching a fair level of competition.

In addition to the above, important relations between system indices and variables were found:

- Reliability Evaluation of transport modes and transshipments
- Transport cost vs. product prices

- Shifting potentials vs. transport cost
- Shifting potentials vs. transport time
- Transport cost vs. transport time.

3.3.2 Interviews

Direct interviews are complementary to the questionnaires. They can help in having a better idea about the source of the problems.

Interview Targets Groups

Different from the questionnaires, whose target groups are the shippers and forwarding agencies, the interview address all the actors (shippers, forward agents, administrators, operators, and the other service suppliers) in waterway transport market. Naturally, the shippers and forwarding agents are the main targets of the interview actions.

Concerned Topics

The interviews concentrate on the following topics.

- ➢ Obstacles and Their structures
- ➢ Impacts of Abolition of 'Tour de Rǒle' system
- ➢ Technical, managerial, and Logistical Innovations
- ➢ Proposals and suggestions.

Interview Actions and Results

25 interviews were carried out. In addition to shippers and forwarders, a considerable amount of service suppliers (ports, ship operators) and administrations were visited. The results of the interviews confirm the results obtained by the mean of questionnaires. However, the detailed answers have helped in a better understanding of the obstacles.

The most interesting findings are related to the impacts of the abolition of the 'Tour de Role' system in Belgium. The reactions showed that positive effects were brought into the waterway transport market. The significance is in:

- Increased level of competition resulting in better services
- Close co-operation between shippers and ship operators as a result of free market
- Slight decrease of Transport prices
- Improvement of Transport reliability.

3.4 Shifting Pre-Requisites

The definition of the shifting pre-requisites is based on the optimisation of: (1) Techniques, (2) Organisational & operational aspects, and (3) Market and policy aspects. Briefly, the relate to the following:

A. *Technical Optimisation:*

- Infrastructure conditions: Waterway bottlenecks and multi-modal plateforms
- Ships: Design and operational techniques
- Handling: equipment and operations
- Intermodal connections: techniques and standards

B. *Organisational Optimisation*

- Infrastructure operations: locks, bridges operations
- Application of Information technologies: Telematic systems
- Ports operations: new techniques and operations.

C. Market Optimisation

- Policy framework on the European level
- Promotion of waterway transportation
- Fair competitions.
