SCIENTIFIC SUPPORT PLAN FOR A SUSTAINABLE DEVELOPMENT POLICY

Intermediary report - January 2003

FOUNDATIONS OF INTERMODAL TRANSPORT GROWTH IN BELGIUM: AN INVESTIGATION OF «MISSING LINKS»

CP-44

ULg - VUB

SPSD II

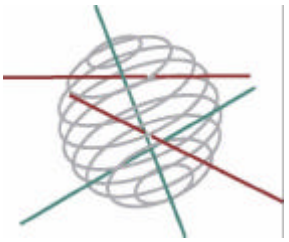
PART 1

SUSTAINABLE PRODUCTION AND CONSUMPTION PATTERNS

- GENERAL ISSUES
- AGRO-FOOD
- ENERGY
- TRANSPORT

This research project is realised within the framework of the Scientific support plan for a sustainable developmentpolicy (SPSD II)

Part I "Sustainable production and consumption patterns"



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INTERMEDIARY SCIENTIFIC REPORT

OF THE

SSTC PROJECT IN NETWORK:

BASES OF A GROWTH OF THE INTERMODAL TRANSPORT IN BELGIUM: THE SEARCH OF ‘‘MISSING LINKS’’

JANUARY 2003

Structure of the report

I. INTRODUCTION

I.1. CONTEXT AND SUMMARY

The project named "Bases of a growth of the intermodal transport in Belgium: the search of missing links" is a coherent set of tasks realized by two research teams which constitute a multidisciplinary thematic NETWORK.

The common search team Brussels-Liège is at present the main group of Belgian research in the field of the intermodal transport. The present research project in network is based on previous different research projects realized by the two research centres.

These previous researches led to the conclusion that the practitioners as well as the public decision-makers should concentrate on specific elements to stimulate a better growth of the intermodal transport in Belgium.

The team has identified four elements which constitute real "missing links", not enough taken into account by the public policy and the administrators of the intermodal transport. These four elements are:

1. A tool to follow the prices of the intermodal transport ;
2. An analysis of the most critical services with added value which should be supplied by the intermodal terminal operators ;
3. A series of directives to optimize the packaging of the goods to stimulate the intermodal transport ;
4. An instrument of follow-up of "modal scan".

These four elements should be considered as bases of a new policy of approach of the intermodal transport which will allow the government to concentrate on the "missing links" of a transport policy to favor an environment more attractive, transparent and cooperative for the different actors of the market of the transport rather than to try to develop an important global intermodal masterplan which would seem good on paper but which would be difficult to implement in an effective way.

I.2. OBJECTIVES

The present project in network aims to integrate the knowledge of bases acquired by both research groups and to pursue the search for development of a real intermodal plan which will focus on the "missing links" of the public policy and which will include the specific strategic implications for the different actors concerned, more specifically the national and regional governments, the transport companies and the users of the transport.

The philosophy of the project is that a real modal shift from the road network to an intermodal transport will be possible only if the economic actors of the offer and the demand begin themselves specific actions or identify new opportunities at the micro level by which the modal transfer would engender profits at the level of companies.

The research teams reunited in this project have identified elements requiring a detailed study. Two of these elements relate to the demand, namely:

- The lack of exercises of modal integration which prevents from considering the intermodal transport as valid alternative;

- The lack of transparency at the level of the costs of the intermodal transport.

Concerning the offer, the two main subjects to be examined are:

- The services with added value necessary to present an attractive logistic alternative to the conventional users of the road transport;
- The problem of grouping of the small volumes of traffic. Until now, the lack of groupage prevents many small and medium-sized companies from using the intermodal alternative.

I.3.EXPECTED OUTCOMES

The main outcomes the team wishes to obtain ensue from the missing links related to the intermodal transport. So this project hopes:

1. To set up a tool to follow the prices of the intermodal transport ;
2. To make a deep analysis of the most critical services with added value which should be supplied by the intermodal terminal operators in order to make the intermodal transport more competitive as regard the road transport ;
3. To propose a series of directives to optimize the packaging of the goods to stimulate the intermodal transport ;
4. To quantify the potential of transfer between the road and the intermodal transport mode using the "modal scan" methodology.

II. Description of the scientific methodology

The present research project in network proposes a deepened study of the four elements constituting missing links being able to favor the growth of the intermodal transport in Belgium.

Two of the four elements which constitute real missing links, have been examined in this first part of the project. These elements are :

- The study of a tool to follow the prices of the intermodal transport ;
- The study of procedures to implement directives to optimize the packaging of the goods to stimulate the intermodal transport.

These elements have been examined on the basis of these four constituents:

1. The international academic research on the subject ;
2. The previous research results obtained by the team ;
3. The current efforts (or the lack of efforts) of different professional organisations and public agencies on the subject concerned as in Belgium as in the other countries of the European Union ;
4. The coherence with the Belgian and regional governments transport policy objectives.

III. Detailed description of the intermediary results, preliminary conclusions and recommandations

At the present stage of the search, some preliminary conclusions have been drawn concerning the first two points analysed.

III.1. TOOLS FOR TRANSPORT COST ANALYSIS IN GENERAL

III.1.1. Methodology

The global transport chain has been described and its different actors identified. This description of the intermodal transport chain highlights cost posts (shipper, consignee, pre/post haulage, transshipment point, main haulage) which put together give the cost of the intermodal transport. This description allowed the definition of different intermodal transport scenarios. Two main scenarios are considered. :

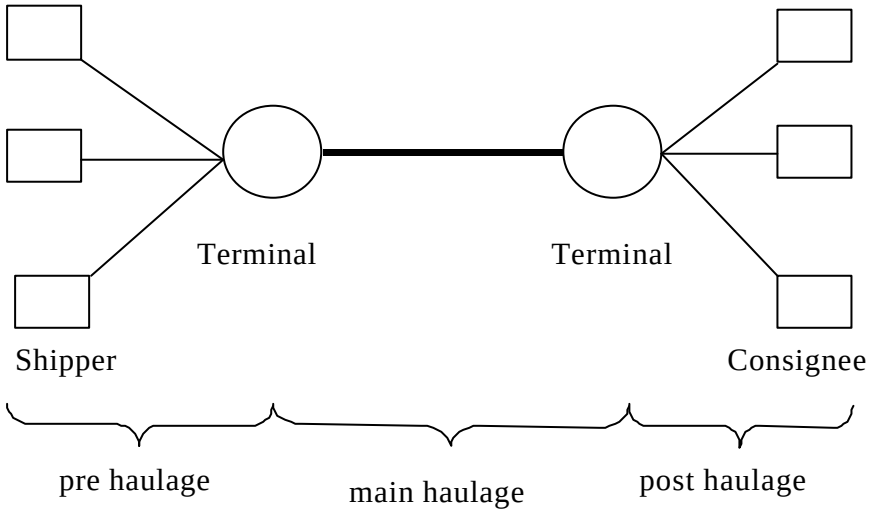
1° The intermodal rail scenario which can be summarised like this :

Shipper – pre haulage – terminal – train - maritime terminal

2° The river intermodal scenario which can be summarised like this :

Shipper – pre haulage – river terminal – barges - maritime terminal.

The chain of intermodal transport can be schematized in the following way:



The intermodal chain shows that the intermodal transport cost can easily be obtained if the cost at the level of each actor intervening in the transport chain is known. From the above general scheme, the particular case of the belgian intermodal transport chain has been derived.

Generally speaking, the Belgian intermodal transport chain is composed of the following actors (see annex I):

- The shipper (for the export) or the consignee (for the import) ;

- The terminal operator ;
- The road transport operator for the pre/post haulage transport ;
- The main haulage which is done by train or by barges. This is to say that the cases of main haulage by short sea shipping and by ferroutage are not considered .

This description shows that the belgian intermodal transport cost is the sum of :

- The pre/post haulage cost ;
- The terminal cost ;
- The main haulage cost.

Information provided by road carriers, terminal and intermodal operators and other specialists in transport lead to consider that the price for the handling of one container (TEU[1] or FEU[2]) is of 50 euros and the price for the pre/post haulage road transport in Belgium varies from 100 euros to 125 euros in a radius of 20 to 40 km around a transshipment point. The calculations are made here considering 100 euros as the pre/post haulage price. This is to say that the intermodal tariffs given here are the cheapest ones.

III.1.2. Intermediary results

The description of the intermodal chain allowed the elaboration of a global intermodal costs structure (see annex II). This table has been drawn with the objective to be as general as possible in order to allow each one to calculate easily his global transport costs. It is to be noted that the global cost table established here is related to the intermodal transport of one container of twenty or forty feet equivalent unit (TEU or FEU). However, not all the cost items are needed for the calculation of the global cost. Each one has to adapt this methodology to his real case and to the scenario he deals with. This means that not all the cost items have to appear clearly in the table serving to the calculation of the costs. Many costs can be included inside other costs.

The methodology has been used to calculate the intermodal transport cost of one container (TEU or FEU) between the Liège region and the Antwerp port. The calculation are done for the two scenarios listed here above.

1- Calculation in the case of the rail intermodal scenario

For this scenario, the intermodal cost has been determined thanks to information got from the IFB and B-cargo operators for the rail part. The rail operator gave us only the price for the transport of containers on the considered road and not the different costs it faces as those costs are listed in the global cost table.

2- Calculation in the case of the river intermodal scenario

The intermodal cost has been determined for this scenario in two manners. First, the global intermodal chain has been described, all the actors of the chain identified. Then, the price applied by each actor has been collected. The global intermodal cost on the considered corridor is obtained by adding all the prices provided by the different actors.

This way of proceeding gives the real price the user has to pay but it doesn't show the different costs each actor supports. As it was not possible to obtain the real costs for each actor because of professional secrecy, we have proceeded in another way. We made the

[1] Twenty Equivalent feet Unit
[2] Forty Equivalent feet Unit

calculation according to the real cost an intermodal operator faces when he uses a new or old ship of 1350 tons or the one of 2000 tons of loading capacity. The ship can belong to the operator or be taken in leasing. These cases lead to other results. (See annex III.).

III.1.3. Preliminary conclusions and recommandations

The calculation of intermodal transport cost between Liège and the port of Antwerp has shown that there is a very small difference between the intermodal and the all road transport prices.

Price for one TEU

Scenario	Transport cost
Rail scenario	224 €
River scenario	250€
All road solution	260 €

Comparison of cost by scenario for one container (TEU)

Price for one FEU

Scenario	Transport cost
Rail scenario	240 €
River scenario	260€
All road solution	260 €

Comparison of cost by scenario for one container (FEU)

The price for the transport of one FEU is the same for the all road solution and the river intermodal scenario. In the present state of the intermodality, there is no reason for one user to prefer the intermodal solution compared to the all road solution. However, the calculation carried out on the basis of real costs (ships of 1350 and 2000 tons) shows that the intermodal price decreases when the quantity transported increases. This fact means that the intermodal solution can be cheaper than the all road solution only if the quantity of containers transported by rail or by river reaches a given level that one can consider as a critical level. This is illustrated by the graph in the annex IV showing the influence of the transported quantity on the river and intermodal costs. The graph has been drawn for the case of the new ship of 1350 tons belonging to the intermodal operator. This graph proves that groupage and added value services are very important for the competitiveness of the intermodal transport.

Nevertheless, the growth of the intermodal transport is favoured by the road congestion. One can thus consider that the road congestion is an important ally for intermodal transport because it supports its growth.

III.1.4. The price structure of the intermodal transport for the Liège–Antwerp road

The price structure of intermodal transport on the road Liège-Anvers shows a too great influence of the price of the road transport as well as that of handling on the global price of intermodal transport. (See annex V). In order to try to give some advantage to intermodal transport comparatively to the road transport as regards the tariff applied by both transport modes, it is necessary that the intermodal operators integrate all the operations of transport from the shipper to the port of Antwerp. This way, they will be able to control the prices of the transport of pre/post routing as well as the price of handling.

This calls for an increased collaboration between the road conveyors, the river terminal operators and the intermodal operators to allow a harmonious development of the intermodality by the control of the costs. The constitution of an association for the development of the intermodality which would gather all the actors intervening in intermodal transport is to be wished. Such an association would be charged to study all the problems which slow down the growth of the intermodality and will try to find effective solutions to solve them.

This association should also have as task to maintain the contact with the shippers to keep them informed with the progress made by the intermodality (increase of the number of the services to the major maritime ports (Antwerp and Rotterdam), reduction of the tariffs, etc) and to continue to collect their opinions for an even more attractive intermodality.

III.2. The introduction of "groupage" in Belgian intermodal transport

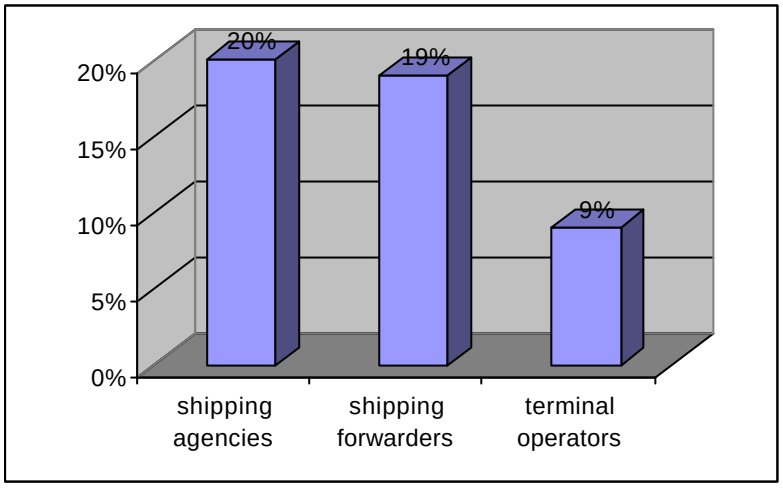
III.2.1. Methodology

Most intermodal transport terminal operators in Belgium presently are engaged in the "bundling" of containers in order to fill trains or inland navigation vessels in an efficient manner, but "groupage" services are not provided systematically, i.e., the collection of small freight flows to fill the load units themselves. However, such groupage services in many cases are provided in other European Union countries, where terminal operators view such services as an important source of value added. We analysed the reasons for the lack of groupage activities in Belgium by conducting a survey among terminal operators, shipping agents and shipping forwarders in Belgium. Forty-seven shipping agencies indicated their willingness to participate in the survey, but only 15 of these firms (32%) appeared to make use of intermodal terminals at present. As regards the intermodal terminals themselves, 11 of the 20 Belgian terminals operators participated in the survey. About 50 of the 80 randomly contacted shipping forwarders located in Belgium, were willing to participate in the survey. This survey allowed the identification of the main barriers hindering the introduction of groupage, as well as the perceived advantages of this practice that may lead to its introduction in the near future.

III.2.2. Intermediary results

The first step of the survey consisted of finding out to which extend groupage is offered to the clients. The figure below illustrates the results.

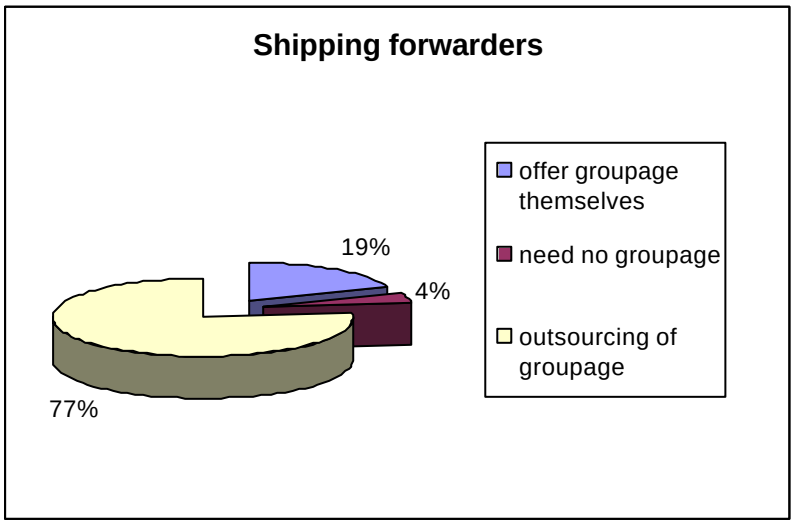
Figure 1 Percentage of actors who offer groupage.



We notice that shipping agencies and forwarders play a more important role in groupage than terminal operators. In fact only 1 Belgian terminal operator (9%) recently decided to offer this service to his clients.

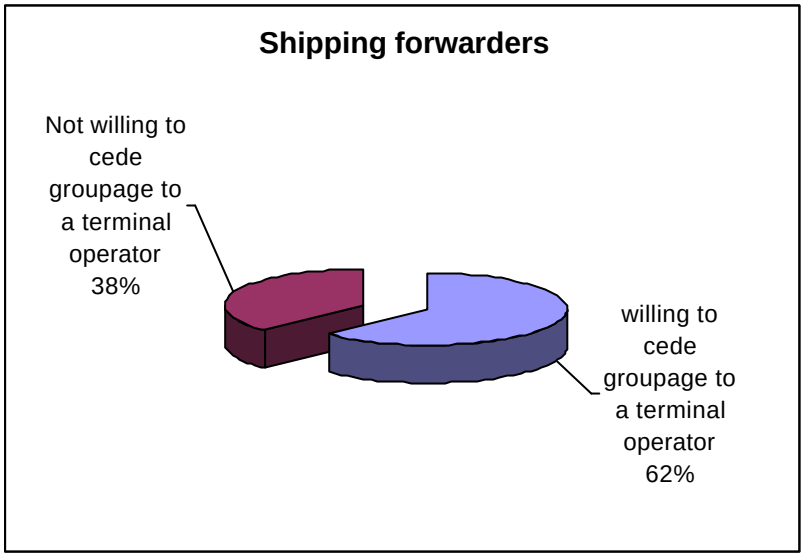
As shipping agencies mostly work under direct instructions of shipping forwarders, it is obvious that the latter has the power to decide where groupage will take place. He can do it himself or leave it to the shipping agent or terminal operator.

Figure 2 Percentage of shipping forwarders that (do not) offer groupage or sourced it out.



About 77% of the shipping forwarders source out the groupage activity. Since this is an important percentage, it seemed interesting to discover under which circumstances they would be willing to leave groupage in hands of terminal operators instead of specialised groupage companies that are not directly connected to a terminal.

Figure 3 Percentage of shipping forwarders (not) willing to leave groupage in hands of a terminal operator.



About 62% of all the interviewed shipping forwarders, is prepared to (partially) replace the contracts with specialised groupage companies by contracts with terminal operators. The condition to realise this shift, is that terminal operators should guarantee a lower price and a service as good (or even better) as what shipping forwarders can expect with their current contracts.

Even shipping forwarders who never make use of intermodal terminals (about 1/3th of the entire interviewed population) are prepared to leave groupage in hands of terminal operators (90%).

Still, about 38% of the shipping forwarders prefer not to entrust the activity to terminal operators. The primary reason (56%) is that they offer groupage themselves and don't want to loose their profit margins. The second most important reason (44%) is that they are convinced of the lack of know-how of terminal operators. The third most important reason (28%) is that shipping forwarders desire to maintain the good relation with the groupage companies they are currently working with, which proves that some forwarders are still very conservative minded.

III.2.3. Advantages and disadvantages of groupage

The main advantage of groupage identified by shipping agents and terminal operators is that, if organised by large, specialised companies, economies of scale can be created. According to the respondents this would result in a financial benefit to the companies providing this service.

In contrast, the rather obvious potential impact on the cost per transported unit inside each container is not considered a benefit. In addition, potential environmental benefits are also neglected, although groupage should in principle not only reduce the number of semi-empty trips but also the overall distances travelled in tonkilometers, thereby resulting in lower emissions. (European Commission, (2001))

Furthermore, groupage could create a form of customer loyalty. By offering this value added service, customers are not obligated to group elsewhere before turning to the terminal for the transport of the goods. By offering not only transhipment possibilities, but also groupage, the terminal operator simplifies the transport chain and creates a higher customer loyalty.

Groupage systems also have a number of disadvantages. One of the main disadvantages is that groupage implies more transhipment, and other operations at the nodes. This results in higher costs and lead times (Kreutzberger et al., 1997).

The second disadvantage of groupage is related to the detours required if the groupage warehouse is not located on or close to the terminal. Some door-to-door transport routes will thus be faced with large detours and will suffer a substantial disadvantage vis-à-vis direct unimodal transport. The presence of detours means that time costs, as well as energy- and environmental costs are increased (Kreutzberger et al., 2000). The implementation of a groupage service on the terminal site may be instrumental to reducing transport times, by cutting back the time necessary to transport the goods between the sorting centre and the terminal (Rossera et al. 1999). By offering the possibility of groupage (on the terminal site), the intermodal terminal is likely to increase its attractiveness as well as its potential to provide value added to customers. It has been estimated that for short distances between 100km and 500km, the time needed to transport freight door-to-door, using an intermodal system, is 5 times longer than with unimodal road transport. This is mainly due to the long waiting times at the terminals and the pre and post road haulage (Rutten, 1995). Without pre- and post- road haulage, the average delivery time to transport 80,000 tons of freight over 450km amounts to 10 days for unimodal barge transport, while it takes a mere 2.95 days for unimodal rail transport and 1.43 days for unimodal road transport. (Blauwens et al., 2001). Although groupage is time consuming, it is important to note that without groupage, several origin to destination relations would not have barge or rail transport at their disposal (Kreutzberger et al., 1997).

III.2.4. Obstacles to groupage adoption

A number of underlying obstacles can explain why terminal operators and shipping agents are reluctant to offer a groupage service. We asked them why they currently do not offer the service and, where relevant, why they do not intend to do so in the near future. The answers to these questions are re-interpreted in this section.

This section examines the groupage system. Most of the terminal operators and shipping agents see more obstacles for groupage than for bundling. The main problem they encounter with bundling is one of organisation. More specifically, in the context of rail transport the locomotive of shunted trains is not permitted to leave the national territory. This means that when a shunted train needs to go from Belgium to Spain, three locomotives are used; a Belgian one, a French one and a Spanish one. Direct international trains do not face this problem as they are permitted by the regulatory system to use a single locomotive.

In contrast, the key obstacle for a terminal operator to offer groupage is that it is very difficult to stay neutral. If for example a client wishes to group his goods at the terminal, but has not yet decided upon which shipping agency he will rely, it is strongly recommended to the terminal operator not decide in his place. The choice of the shipping agency should stay the task of the shipping forwarder. In this situation staying neutral is a matter of surviving. If the terminaloperator goes beyond his task of groupage, the shipping forwarder becomes superfluous and a conflictual situation arises. Finally shipping forwarders will decide to leave the terminal.

Another problem of neutrality is faced by the terminaloperator if he decides to attract a specialised groupage company to the terminalsite. By doing so, he shows his preference for that one company. Other groupage companies might react negatively and reconsider using the terminal, just as well as some shipping forwarders.

To avoid conflictual situations and loss of clients it is vital for the terminal operator to maintain a neutral relationship with shipping agents, shipping forwarders and business companies.

Only few terminal operators succeeded to offer a profitable groupage activity on a neutral basis. In foreign countries indeed, groupage on terminal sites is almost always offered by a specialised groupage company and is not operated independently by the terminal operator. In many cases, when public instances are involved (in one way or the other) with the groupage, subsidies can be granted to outweigh eventual losses caused by conflictual situations.

The next obstacle to groupage is that it is not suitable for all types of goods. Some goods, such as "dangerous loads" are subject to severe regulations. One of these regulations dictates a required minimum distance between loads that must be respected when storing these goods. In some cases, the required distance is such that the goods cannot be placed together in the same container.

It is not only "dangerous goods" that are subject to regulations. Shipping agents/terminal operators, who collect small packages, store them in containers and distribute them afterwards, need to be familiar with the rapidly changing regulations concerning import, customs, health and sanitary inspections, etc. Given that groupage requires specialised staff, who constantly follow up the changes in regulations, it has become an activity that cannot be conducted by just any shipping agent/terminal operator.

From a financial perspective, groupage usually cannot be offered by small agents or operators. For groupage to be a profitable activity, a minimum efficient size is necessary. If a shipping agent/terminal operator has to deliver a few small packages that do not fill an entire container, it may cost much more per unit than if a sufficient volume were available to fully load a container. Furthermore, if a shipping agent is too small to benefit from scale economies, he will not be able to collect enough packages in a short period of time. This will result in long lead times and dissatisfied customers.

Another obstacle is the labour intensive nature of groupage. The groupage and de-groupage of goods is a labour-intensive activity. This means, of course, that the labour costs will be relatively high. On maritime terminals the labour costs are usually higher than on inland terminals, which favours the implementation of groupage on inland terminals. In the starting up phase, it is sometimes possible to restrain labour costs by executing groupage with the current labour forces, without hiring more employees.

Besides labour costs, groupage also requires special cranes and forklifts, which represents a significant investment cost.

From a financial point of view, it can take as long as half a decade for groupage to be profitable. During the first years the costs are heavily exceeding the profits. But after a few years and depending on the magnitude of the terminal, it is possible that groupage develops into a lucrative activity.

From an organisational point of view, groupage requires careful, integrated logistical planning, especially when intermodal transport is considered. Indeed, if groupage is done at the point of origin, de-groupage will be required at the point of destination. This means that sufficient skilled labour and infrastructure, such as warehouses and cranes, must be present at

both the origin and destination points. Furthermore, the use of trucks, barges and trains needs to be harmonised both during the collection phase and the distribution phase.

In addition to organisational problems, there are also some technical problems. The most important of these concern objects that simply will not fit in the containers, i.e., objects that are too large.

In order to incite forwarders to group their goods and to use intermodal transport, often a cognitive change is required. Numerous forwarders exhibit a conservative mindset and do not really want to change their transport strategies. Once they have established a system whereby they move their (often small volumes of) goods by truck, it is difficult to convince them to group the goods and to transport them using an intermodal system.

The figures below summarise the most substantial obstacles, according to the survey, that keep shipping agents and terminals operators from offering a groupage activity.

FIGURE 5

Obstacles faced by shipping agents.

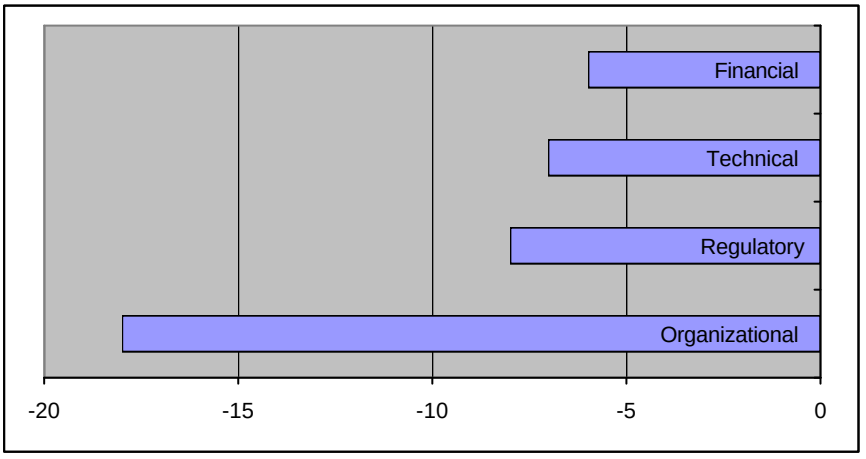
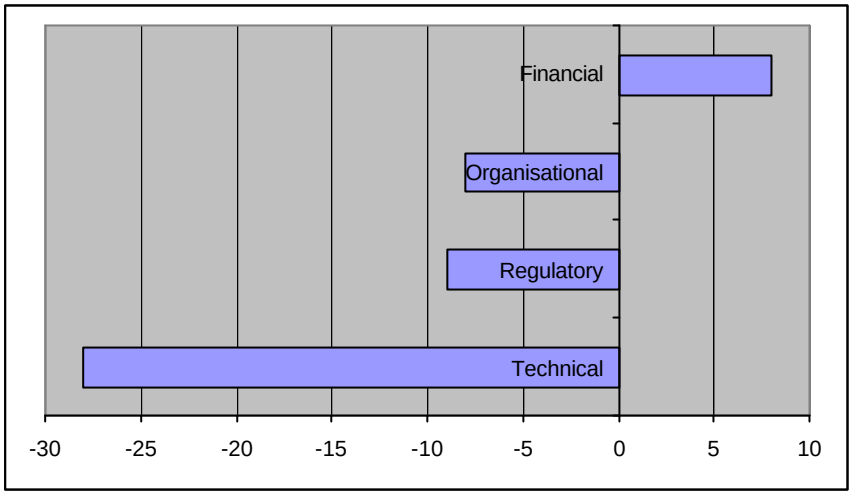


Figure 5 suggests that the main obstacle is an organisational one. Approximately 71% of the shipping agents believe that organising a groupage/de-groupage activity will encounter many difficulties. All the other types of obstacles have approximately the same importance, although regulatory barriers are viewed as somewhat more important than the financial and the technical aspects.

FIGURE 6

Obstacles faced by terminals



At the level of the terminal operators, the main obstacle appears to be a technical one, followed by regulatory and organisational factors. Financial factors are not considered an obstacle by terminal operators. On the contrary, they perceive groupage as instrumental to financial gains.

III.2.5. Conclusion

In a majority of cases, terminal operators and shipping agents active in Belgium offer to bundle containers and to transport them using a combination of truck, barge and train. They favour the bundling system because this may lead to financial gains. Moving a fully loaded train/barge is obviously more profitable than moving a partly loaded train/barge.

Terminal operators appear reluctant to group small freight flows into a single container. Several obstacles hinder the adoption of groupage; as a result, shippers with small volumes of goods turn to specialised groupage agencies, which currently have a preference to transport the goods by truck.

However, terminal operators could still benefit from the groupage activity, namely if they were to provide this service themselves. Indeed, groupage opens a new market for intermodal transport. The main reason is that groupage results in a lower overall cost of the main transport mode due to smaller unit costs. This means that adoption of groupage may reduce the barriers to a modal shift towards intermodal transport.

In order to convince forwarders to use groupage services, these actors must first be made to understand the advantages offered by this practice, such as, possible scale economies, a higher loading degree and resulting from this, a reduction of the transported goods' unit costs. In most cases, however, these actors presently focus on the disadvantages of groupage such as an increased number of transhipment operations, detours and long lead times. In addition to these intrinsic disadvantages of groupage, a number of obstacles presently contribute to preventing many shipping agents/forwarders from grouping goods. The financial, organizational, technical and regulatory problems associated with the groupage activity explain why this practice simply cannot be adopted by every agent.

Not all terminal operators are faced to the same extent with the problem of small freight flows. Hence, a contingency perspective is necessary to identify the terminals that may benefit most from offering groupage services. Further research to evaluate the market potential of these services for the various Belgian terminal operators is thus required. Here, the issues of automation and innovation in groupage provision should be analysed carefully.

IV Future prospects and future planning

The clarification of the cost of intermodal transport in Belgium is an element which will contribute to attract tonnage towards the intermodal transport mode. However, this element alone is not enough to obtain a more consequent modal shift between road and intermodal transport. Thus in the continuation of this work, we will consider the added value services that one can introduce in the terminals in order to improve the quality and the attractivity of the intermodal transport. So, two tasks will be carried out in the future: inventory of added value services and the modal scan.

For the first task, we will first make an inventory of added value services that terminals can offer and, secondly we will study the influence of the introduction of these services on the intermodal transport behavior. We are convinced that the introduction of those services will be beneficial for this mode of routing.

For the second task, i.e. the modal scan, we will first update a database containing information about services offered by intermodal terminals. Before starting the modal scan, it is necessary to get an idea of what terminals offer to their clients.

Next, we will analyse the traffic flows of a certain number of large companies in order to detect their potential to realise a modal shift from road transport towards intermodal transport. We will effectuate the modal scan in 10 companies, from which 5 are situated in Flanders and 5 in Wallonia. Each research team will chose 5 companies belonging to different sectors of the industry.

ANNEX

I. Belgian intermodal transport chain

Belgian intermodal transport chain

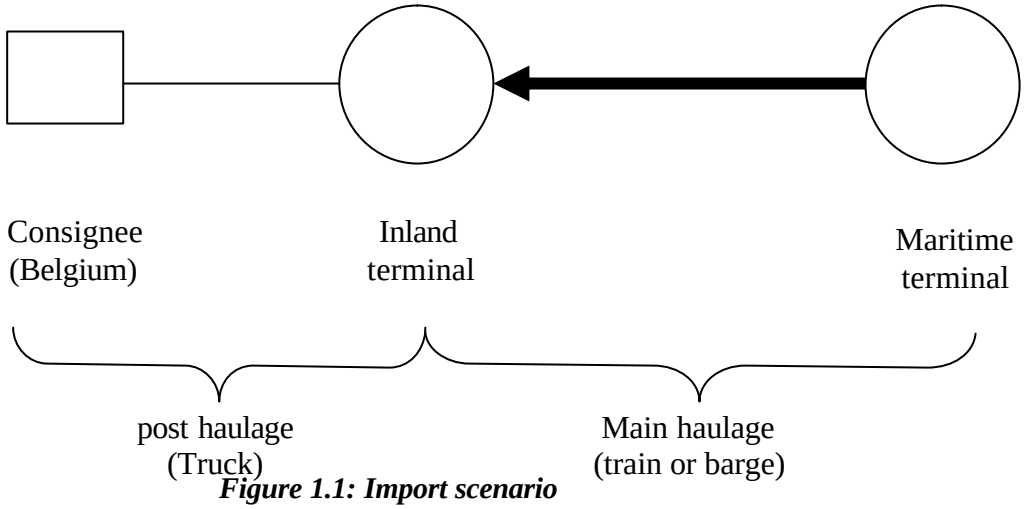


Figure 1.1: Import scenario

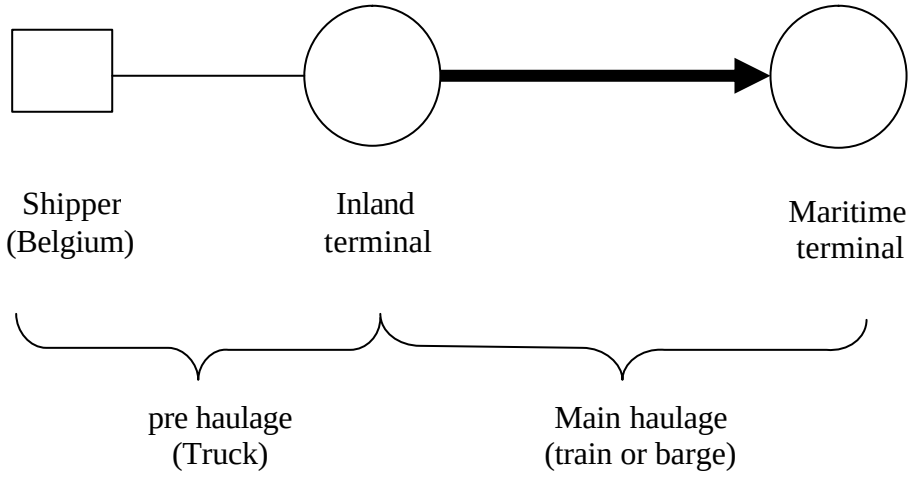


Figure 1.2: Export scenario

II. Intermodal costs: Global structure

Personnel	S	PH	T	TP	MY	HR	HT	HW	HM
Gross wage/salary of driver		X			X	X	X	X	X
Gross wage/salary of worker	X		X	X	X				
Expenses incurred by the driver		X				X	X	X	X
Social security									
Overhead									
Administration									
Profit /opportunity									
Advertising, PR									
Advocating/Consulting									

Fixed assets / Maintenance of assets	S	PH	T	TP	MY	HR	HT	HW	HM
Container investment	X	X	X	X		X	X	X	X
Container-repair	X	X	X	X		X	X	X	X
Depreciation and interest	X	X	X	X		X	X	X	X
Container maintenance		X				X	X	X	X
Means of transport inv.: deprec.+ interest		X				X	X	X	X
Means of transport-maintenance		X				X	X	X	X
Means of transport-repair			X	X	X				
Technical asset-maintenance and repair			X	X	X				
Building invetment: depreciation and interest	X		X	X	X				
Building-maintenance and repair	X		X	X	X				
Property/site/development-inv.	X		X	X	X				
Infrastructure- invetment: depreciation and interest		X	X	X	X	X	X		
Infrastructure-maintenance and repair		X	X	X	X	X	X	X	X

Energy, other consumption materials / telephone, telecommunication and radio	S	PH	T	TP	MY	HR	HT	HW	HM
Fuel, diesel		X			X	X	X	X	X
Electricity									
Oil, fat, additional variable cost									
Tyres									
Telephone, telecommunication, radio									

Stock turn	S	PH	T	TP	MY	HR	HT	HW	HM
Loading/Unloading									
Transhipment									
Shunting, marshalling, rearrangement									
Storage of goods									

Time	S	PH	T	TP	MY	HR	HT	HW	HM
Waiting time									
Rest time for driver									
Parking, port liner terms charge									

Organisation costs	S	PH	T	TP	MY	HR	HT	HW	HM
Monitoring	X	X	X	X	X	X	X	X	X
Safety test	X	X	X	X	X	X	X	X	X
Disposition of wagon/vehicle fleet Additional keeping ready of wagons and means of transport	X	X	X	X	X	X	X	X	X
Disposition of cargo/good-dispatching, conducting, co-ordination	X								
Operational cost for the network (rail/waterway - signalling, station and network management			X		X		X	X	X
Management / Transaction	X	X	X	X	X	X	X	X	X

Insurance / Taxes / Charges	S	PH	T	TP	MY	HR	HT	HW	HM
Insurance of cargo/good	X								
Insurance for the risk of the enterprise	X								
Insurance for vehicle and loading units		X	X	X	X	X	X	X	X
Third party motor vehicle insurance		X				X		X	X
Tax, Sales tax	X								
Vehicle tax		X				X			
Duty	X								
Tolls, road-pricing		X				X			
Fixed road charges, truck vignette		X				X			
Rail track user charges					X		X		
Lock charge								X	

Costs with internal and external parts	S	PH	T	TP	MY	HR	HT	HW	HM
Congestion		X				X		X	
Scarcity, Slot allocation			X	X	X		X	X	X
Specific road bottleneck, go round						X			

External costs	S	PH	T	TP	MY	HR	HT	HW	HM
Accident									
Air pollution									
Climate Change									
Noise nuisance									

(*X means that the cost is not supported by the concerned actor*.)

S : Shipper
PH : Pre and post Haulage

T : Terminal
TP : Transhipment Point
MY : Marshalling Yard
HR : main Haulage Road
HT : main Haulage Train
HW : main haulage Inland Waterways
HM : main Haulage Maritime

III. Comparison of costs for the transport of one conteneur : river intermodal scenario

Rate of use: 100%

Ship capacity : 1350 tons

State of the ship	*Operating system*	*River cost*	*Intermodal cost*
Old boat	Own	42.66	192.66
	Rental	60.07	210.07
New boat	Own	53.1	203.1

Ship capacity : 2000 tons

State of the ship	*Operating system*	*River cost*	*Intermodal cost*
Old boat	Own	37.64	187.64
	Rental	51.08	201.08
New boat	Own	47.24	197.24

Rate of use : 75%

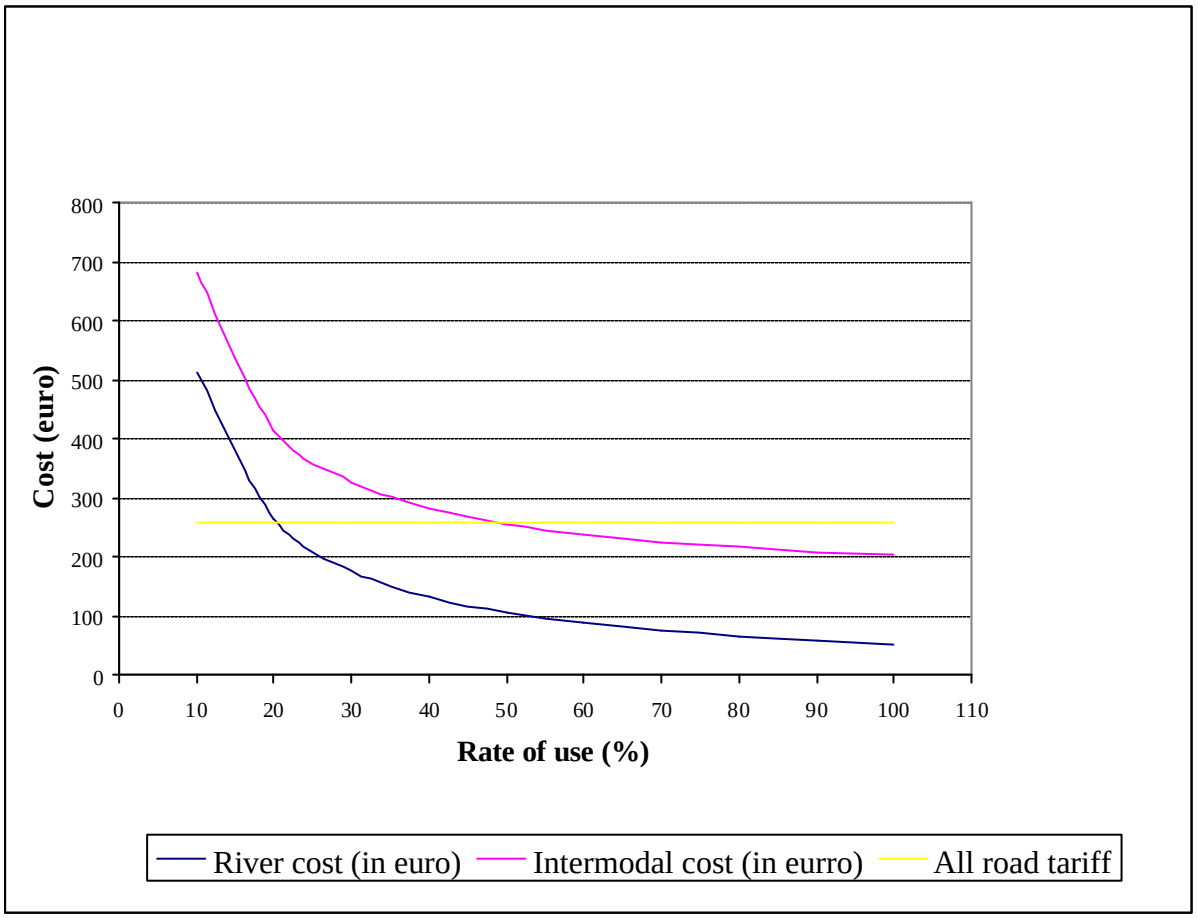
Ship capacity : 1350 tons

State of the ship	*Operating system*	*River cost*	*Intermodal cost*
Old boat	Own	56.88	206.88
	Rental	80.1	230.1
New boat	Own	70.8	220.8

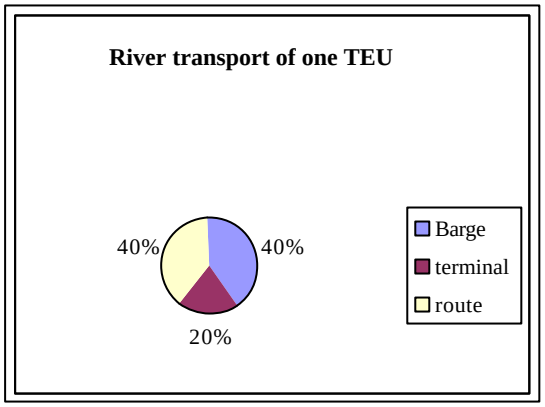
Ship capacity : 2000 tons

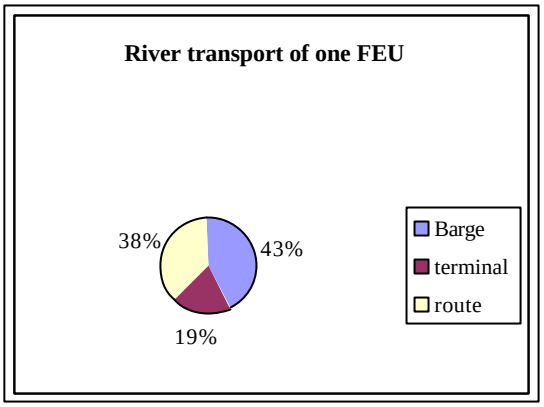
State of the ship	*Operating system*	*River cost*	*Intermodal cost*
Old boat	Own	50.2	200.2
	Rental	68.11	218.11
New boat	Own	62.99	212.99

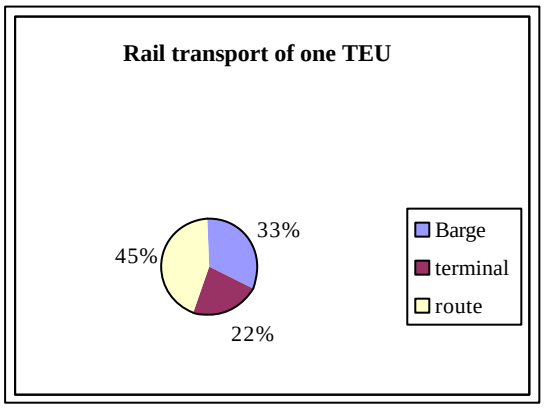
IV. Influence of the rate of use on the river and intermodal transport costs using a new ship of 1350 tons

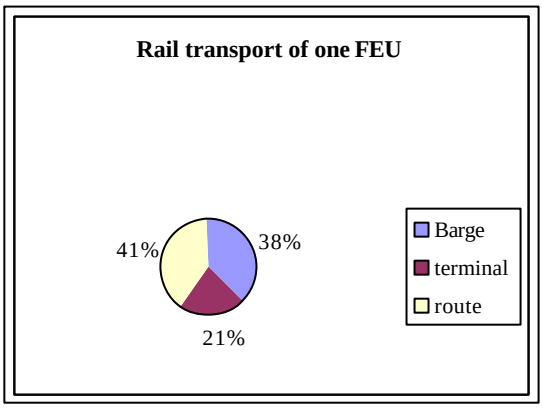


V. *Structure of the intermodal transport cost on the road Liège-Antwerp*









REFERENCES

1. Journal ''Le Lloyd'', édition du 7/juin/2002, page 2.
2. Patrick COUDIJZER : Calcul du coût de transport par voie d'eau intérieure, mémoire de fin d'études, Université de Liège, 1993.
3. Bart A. M. JOURQUIN : Un outil d'analyse économique des transports de marchandises sur des réseaux multi-modaux et multi-produits : LE RESEAU VIRTUEL, concept, méthodes et applications ; Thèse de doctorat, 1996.
4. Rafael SANCHEZ : L'intermodalité au Québec : entre le mythe et la réalité. Article paru dans la révue : Routes et Transports, vol. 25, N°4, Hiver 1995-1996.
5. Michel MARQUIS : Deux nouveaux systèmes intermodaux pour le transport de marchandises à courte et moyenne distances au Québec. Article paru dans la révue : Routes et Transports, vol. 25, N°4, Hiver 1995-1996.
6. RECORDIT : Real Cost Reduction of door-to-door intermodal transport. European study on the calculation of the intermodal transport cost. February 2002.
7. Policy options for intermodal freight transportation, transportation research board, Washington D.C. , 1998.
8. Blauwens G., Janssens S., Vernimmen B., Witlox F., 2001, De keuze tussen vervoerswijzen op basis van het 'total cost concept', *Connektie magazine/tijdschrift vervoerswetenschappen, volume 10,* 28-32, September
9. Bontekoning Y.M., 2000, The importance of new-generation freight terminals for intermodal transport, *Journal of advanced transportation, Volume 34,* 391-413.
10. Bontekoning Y.M., Priemus H., Dekker R., 2000, A jump forward in intermodal freight transport: are hub-terminals an alternative for shunting? In: 6th TRAIL PhD-congress Scheveningen, 12-12-2000, (Delft University Press, Delft), 13-37, December.
11. Bontekoning Y.M., 2001, Will shunting Yards be replaced by new-generation intermodal hub-terminals?, May. In: Nectar Conference nr 6, 16-18 mei (Helsinki), 1-1
12. Bontekoning, Y.M., Macharis, C., Trip, J.J., forthcoming. Is a new applied transportation research field emerging? – A review of intermodal rail-truck freight transport literature. Transportation Research A.
13. Delft University of Technology, 1999, Promising innovative intermodal networks with new-generation terminals, TERMINET deliverable D7, May
14. European Commission, 2001, IDIOMA; Innovative Distribution with Intermodal Freight Operation in Metropolitan Areas. Best Practice Handbook.
15. Janic M., Reggiani A., Nijkamp P., 1999, Sustainability of the European freight transport system: evaluation of innovative bundling networks. *Transportation Planning and Technology*, Vol. 23, No. 2, 129-156, August
16. Kreutzberger E., Priemus H., Bovy P.H.L., 1997, New generation terminal and node concepts in relation to the innovation of bundling concepts in intermodal freight transport. Identification of promising developments, Transport, Infrastructure and logistics. 3rd TRAIL Year Congress. October

17. Kreutzberger E., Priemus H., Bovy P.H.L., 1998, The performance of new-generation terminal concepts for hub terminals and collection and distribution terminals. Balancing between effectivity and feasibility. (Delft University Press, Delft). October

18. Kreutzberger E., Priemus H., Bovy P.H.L., 1999, Innovative networks and new-generation terminals for intermodal transport. Improving the cost-quality ratio by bundling of flows, TRAIL Research School, Delft, December.

19. Kreutzberger E.D., Priemus H., Bovy P.H.L., 2000, New generation terminal concepts and innovative bundling concepts for combined transport. TRAIL Research School, Delft, December.

20. Macharis C.and Verbeke A., 1999, Intermodaal vervoer; economische en strategische aspecten van het intermodaal vervoer in Vlaanderen. (Garant, Leuven/Apeldoorn)

21. Marchal J., Nzengu F., 2000, Développement d'un outil de modélisation du calcul du coût global du transport fluvial, Editions ANAST, rapport final pour le compte du Ministère de l'Equipement et des Transports de la Région Wallonne (Direction des Voies Navigables), 39 pages, December

22. Marchal J., Zhang Z., Marchal J.C., 2000, related to «les potentialités du transport fluvial en Wallonie », Research report realized with the group LEPUR-ANAST (CPDT, Administration de l'Aménagement du Territoire, Région Wallonne), Liège, September.

23. Marchal J., Marchal J.C., 2001, related to « politique ferroviaire en Wallonie », Research report realized with the group LEPUR-ANAST (CPDT, Administration de l'Aménagement du Territoire, Région Wallonne), Liège, September.

24. Notteboom T., Winkelmans W., 1998, Bundeling van containerstromen in het Europese havensysteem en netwerkontwikkeling in het achterland, *Tijdschrift vervoerswetenschap, 4/98*, 379-398.

25. Rossera F., Rudel R., Bern, 1999, The supply of combined transport services, *Materials of NRP*, Vol M7.

26. Rutten, B.J.C.M., 1995. On medium distance intermodal rail transport. PhD-thesis, Delft University of Technology, Delft.

27. Trip J.J. and Kreutzberger E., 2001, Complex bundling networks and new-generation terminals: a synthesis. The Netherlands Research School for Transport, Infrastructure and Logistics, Delft.

28. Vleugel J., Kreutzberger E., Bontekoning Y.M. (eds.), 2001, Concepts of innovative bundling networks. TRAIL Reports in transportation planning n°R 2001/03, Delft.