TransBaltic

Towards an integrated transport system in the Baltic Sea Region

Deployment of the ICT Tools for Optimisation of the Modal Choice.

Final Report

TransBaltic
Work Package : WP5.3.

Edited by:
Institute of Logistics and Warehousing, Poznan, Poland

Team:
Leszek Andrzejewski - Task Leader & Editor
Dr Marcin Hajdul
Dr Olgierd Dziamski
Tomasz Dębicki

Poznan, July 2012

Project part-financed
by the European Union
(European Regional Development Fund)

Baltic Sea Region
Programme 2007–2013

Instytut Logistyki i Magazynowania

SKANE

Contents

Contents 2
List of Figures 3
List of Tables 4
Glossary 5
Executive summary 6
1. General description of tools for planning intermodal supply chains 6
2. Functionality of the LogIT4SEE Application 7
2.1. Specification of tool's functionalities 7
2.2. Target groups 9
2.3. Technical description 9
2.4. Benefits 10
3. Demonstration of tool's support in the modal choice – Case Study 10
3.1. Comparative analysis of transit time 12
3.2. Comparative analysis of transport costs 13
3.2.1. Analysis assumptions 13
3.2.2. Main trends recognized 14
3.2.2.1. CIF Hamburg / CIF Rotterdam 15
3.2.2.2. FOB Shanghai via Hamburg or Rotterdam 17
3.2.2.3. Direct deliveries Shanghai - Gdansk 17
3.2.2.4. Deliveries via port of Koper 19
4. Pros and cons of "Journey Planner" type applications 22
5. Proposed improvements in tool's functionalities 24
5.1. General architecture of improved version of the tool. 24
5.2 . Processes supported by Intermodal Transport Planning System 26
5.2.1. Search for transport offers 26
5.2.2. Negotiation of the offer 27
5.2.3.Transport planning and execution process 28
5.3. Concept of intermodal planning 29
5.3.1. Resources 29
5.3.2. System architecture of intermodal planning 30
5.3.3. User profiles 32
5.3.4. System modules of the Intermodal Planning System 33
5.3.5. Management of Network Resources 34
5.3.6. Location management 35
5.3.7. Network Structure Definition 35
5.4. Calculation intermodal transport plan 38
5.5. Planning of intermodal transport services 38
5.6. Electronic communication module 40
5.7. Consolidation of loads 47
5.7.1. Need for consolidation of loads 48
5.7.2. Shared Supply Chain Concept 48
5.7.3. How the Shared Supply Chain concept may be used in the containerized transport sector. 51

Project part-financed by the European Union (European Regional Development Fund)
Baltic Sea Region Programme 2007–2013
Instytut Logistyki i Magazynowania
SKANE

5.7.4. Concept of joint organisation of intermodal transport processes 53
5.7.5. T-Scale platform as a tool supporting consolidation of containerized cargo 54
5.7.6. Lessons learned 59
6. Deployment plan 61
6.1. Basic implementation variants 61
6.2. Tool's data base building issues 62
6.2.1. Geographical scope of data bases 63
6.2.2. Registration of locations 63
6.2.3. Registration of logistics service providers 64
6.2.4. Registration of the transport offers. 67
6.2.5. Conclusions and recommendations concerning data base creation 70
6.2.6. Deployment plan milestones 71
7. Key Performance Indicators 72
7.1. Indicators evaluating quality of the tool 73
7.1.1. Scope of tool's functionalities 73
7.1.2. Quality of data base 75
7.1.3. Market acceptance 76
7.1.4. Contribution to sustained development of transport system 76
7.2. Indicators evaluating benefits obtained by the actors of the tool 77
7.2.1. Customer using application as an in-house tool to manage its supply chain 77
7.2.2. Ad hoc transport user 77
7.2.3. Transport user – member of consortium of SME enterprises 78
7.2.4. Transport service provider (freight forwarder or carrier) 78
7.2.5. Transport service provider (freight forwarder) 78
8. Conclusions 78
Bibliography 81

List of Figures

Fig. 2-1 Visualization and collaboration with existing systems for end-to-end status 7
Fig. 2-2 LogIT 4SEE standard services and data exchange 9
Fig. 3-1 Container transport route from the Far East to Poland with the alternative use of gateway ports of Rotterdam, Hamburg or Gdansk 11
Fig. 3-2 Alternative modal solutions in on-carriage of containers from ports of Hamburg and Rotterdam to Poland 12
Fig. 3-3 Comparison of cost of different modal solutions in on-carriage of 40FT containers from ports of Hamburg and Rotterdam to Poland 15
Fig. 3-4 Comparison of cost of different modal solutions in on-carriage of 20FT containers from ports of Hamburg and Rotterdam to Poland 16
Fig. 3-5 Comparison of cost of different modal solutions in on-carriage of 40FT containers from Shanghai to Poland 17
Fig. 3-6 Comparison of cost of different modal solutions in on-carriage of 40FT containers from Shanghai to Poland 18
Fig. 3-7 Comparison of cost of different modal solutions in on-carriage of 20FT containers from Shanghai to Poland 19
Fig. 3-8 Spheres of competitive influence of different modal solutions in transport of 40FT containers from Shanghai to Poland. 20
Fig. 3-9 Spheres of competitive influence of different modal solutions in transport of 20FT containers from Shanghai to Poland. 21
Fig. 3-10 Europe wide intermodal network utilized in imports of sea containers ex the Far East to Poland. 22
Fig. 5-1 The architecture of a target ICT tool supporting stakeholders in their modal choice. 24

Fig. 5-2 Search transport services on freight exchange 27
Fig. 5-3 Negotiations of an offer. 27
Fig. 5-4 Simplified Transport Process with one LSP 28
Fig. 5-5 Architecture of the Intermodal Transport Planning System. 31
Fig. 5-6 Three types of transport resources in intermodal transport system planning concept....34
Fig. 5-7 Example of transport network from Hamburg to Poznan....36
Fig. 5-8 Flexible resources - zones of services 37
Fig. 5-9 Flexible resources - service area....38
Fig. 5-10 The concept of the intermodal transport planning 40
Fig. 5-11 A range of processes supported by GS1 Logistics Interoperability Model. Source (GS1/LIM)....41
Fig. 5-12 Electronic messages exchanged in Transport process. Source (GS1/LIM). 42
Fig. 5-13 Structure of transport instruction. Source (Freightwise). 44
Fig. 5-14 Transport Execution Status. Source (Freightwise). 44
Fig. 5-15 Transport Service Description. Source (Freightwise). 45
Fig. 5-16 Goods Item Itinerary. Source (Freightwise). 46
Fig. 5-17 Single Transport Document. Source (Freightwise)....46
Fig. 5-18 Common Framework information exchange (Source: Discwise Project)....47
Fig. 5-19 Benefits for the transport users from participation in the Shared Supply Chains....49
Fig. 5-20 Benefits for the transport service providers from participation in the Shared Supply Chains 49
Fig. 5-21 Traditional way of organizing transport process 50
Fig. 5-22 Comparison of 40-foot container transport costs on selected routes 51
Fig. 5-23 Roles within the new transport processes organisation model....53
Fig. 5-24 Overview of the information flow on the T-Scale platform 55
Fig. 5-25 Basic data structure describing transport needs on the platform....56
Fig. 5-26 General overview of the transport request on the platform....56
Fig. 5-27 Visualisation of the possible routes on the platform 57
Fig. 5-28 Visualisation of the possible routes on the platform 58
Fig. 5-29 Comparison of transport costs for individual transport requests....59
Fig. 5-30 Practical results of implementing Common Framework and T-Scale platform in selected group of small, medium and big companies from ECR Poland....60
Fig. 6-1 Questionnaire results 66

List of Tables

Tab. 3-1 Delivery time of container deliveries ex the Far East to Warsaw depending on transport modal solution....13
Tab. 3-2 Transport expenses on the route Hamburg – Warsaw per 20FT container....16
Tab. 3-3 Delivery time of container deliveries ex the Far East to Warsaw depending on transport modal solution....20
Tab. 6-1 Comparison of data base building process in in-house and public versions of the tool 69
Tab. 6-2 Deployment plan milestones 72

Glossary

4PL	4th Party Logistics
AEO	Authorised Economic Operator
CIF	Cost, Insurance and Freight , INCOTERMS trade term
d2d	Door-to-door
ECR	Efficient Consumer Response
EDI	Electronic Data Interchange
FOB	Free On Board, INCOTERMS trade term
FTL	Full Truck Load
GII	Goods Item Itinerary
GPS	Global Positioning System
GS1	International non-profit association for development of global standards
ICT	Information and Communication Technologies
ISO	International Organization for Standardization
LSC	Logistics Service Client
LSP	Logistics Service Provider
LTL	Less than full Truck Load
KPI	Key Performance Indicators
NVOOC	Non Vessel Owning Ocean Carrier
POD	Proof of delivery
RFR	Request for Resources
SME	Small and Medium sized Enterprise
SSC	Shared Supply Chains
STD	Single Transport Document
TEP	Transport Execution Plan
TES	Transport Execution Status
TEU	Twenty-foot Equivalent Unit
THC	Terminal Handling Charge
TNM	Transport Network Manager
TMA	Transport Manager – Administration
TSD	Transport Service Description
TSP	Transport Services Provider
UBL	Universal Business Language
XML	Extensible Markup Language

Project part-financed
by the European Union
(European Regional Development Fund)
Baltic Sea Region
Programme 2007–2013
Instytut Logistyki i Magazynowania
SKANE

Executive summary

The ICT tools enabling optimal modal decisions of freight market stakeholders may be helpful in restructuring multinational transport networks into more sustainable according to the co-modality concept. The main idea behind - is supplying shippers with objective market information concerning all possible transport opportunities along multimodal corridors. With on-line access to time schedules and tariffs of carriers and freight forwarders the decision makers may fully exploit modal advantages. Such optimising tools may be used either as dedicated solution for specific supply chains being managed by a shipper or freight forwarder or as open Web based tool accessible for any enterprise looking for transport expertise. This latter type of tool is subject to the further analysis. The works were focused on the selected exemplary application.

The data base of the tool was filled with time schedules and freight rates obtained from a few transport services providers representing different modes of transport as road, rail and maritime, being active in the selected transport corridors. The comparative analysis of transit times and transport costs within alternative intermodal supply chains were presented to the audience of shippers and transport service providers in a series of workshops to show the modal advantages The same time at the meetings functionality of the tool was confronted with the stakeholders needs. It was the base for drawing up the list of recommended improvements. The need to make improvements of the present tool's functionality were detailed explained as well as necessity to provide new functionalities in order to better adjust to user needs.

The study ends with the tool deployment plan and proposal for a set of Key Performance Indicators measuring the quality of the application during implementation process. The same time indicators measuring the benefits obtainable by the actors of the transport process were proposed.

1. General description of tools for planning intermodal supply chains

There are generally two groups of the ICT tools supporting choice of transport service provider. The first group – **transport exchange** widespread in the road transport sector as an open internet platform being a contact place for transport users presenting their inquiries as well as carriers and freight forwarders providing their offers. Main motivation of the exchange users is negotiating freight rates, transit times or payment conditions and searching for reliable carriers. For transport service providers in turn the exchange is a source of additional orders, especially for the back loads increasing efficiency of the core carriages.

The other group of tools follows the idea of so called **"Journey planners"** quite popular among tourists who may plan their trips taking use of time schedules and tariffs of the passenger carriers, namely airlines, railways, bus operators or ferry lines e.t.c. There are attempts to transfer this idea into the freight transport. The core issue here, opposite to freight transport exchanges, is supporting intermodality and planning optimal supply chains as a combination of different modes according to the criterion of minimal transit time or expense. Companies developing this kind of tool propose also carbon dioxide emissions

calculator as well as historically analysed Key Performance Indicators obtained by carriers as additional criterions.

This study will focus on multimodal supply chain planners in freight transport to allow decision makers to take rational decisions as far as choice of transport service providers is concerned.

2. Functionality of the LogIT4SEE Application

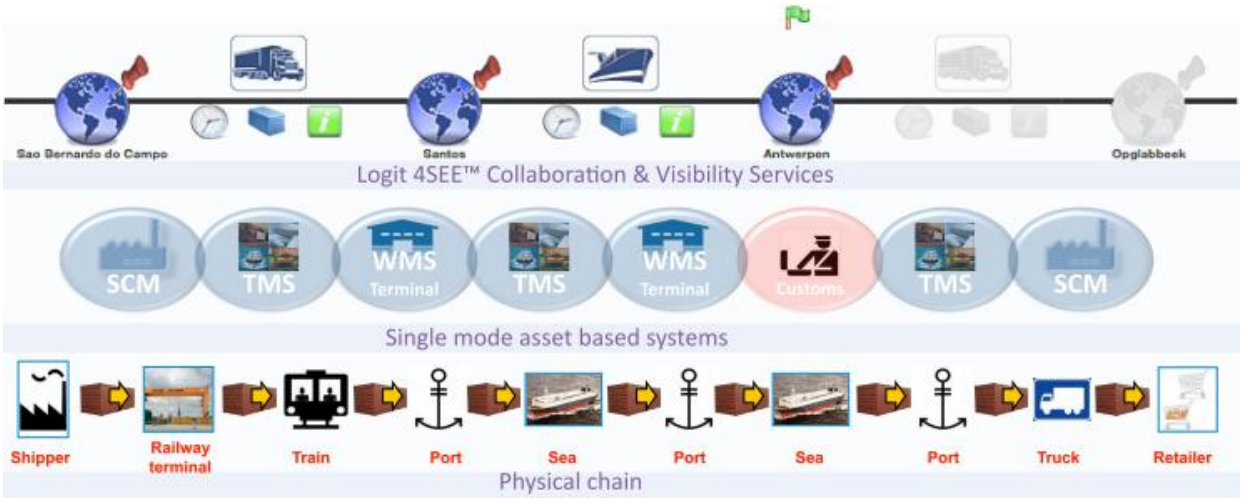
2.1. Specification of tool's functionalities

An application called LogIT4SEE of LogIT Systems A/S, Norway is a subject of deeper analysis.

The objective of the tool is planning intermodal chains is to deliver to transport users the possibility to choose the best transport alternative across all possible modes by providing the cost and time calculation and thus enabling the door to door transports with the use of optimal modal solution.

Transport decision makers may be supported not only in optimal modal choice but also in executing transport services obtaining full visibility along the whole transport chain in cooperation with existing systems of particular logistics service providers during the transport process.

Fig. 2-1 Visualization and collaboration with existing systems for end-to-end status



Source: Logit 4See

The main focus of the tool is optimization of a multimodal supply chain according to the following basic logistics processes:

- Operational Planning – selecting the optimal transport chain according to delivery time or cost criterions and booking loading surface with them.

- Transport execution - after acceptance of transport order system allows to monitor transport progress. In case of deviations chain may be rescheduled

- Freight transaction completion – after accepting POD (Proof of Delivery) by a receiver there is time for possible claims settling , invoicing and payment.

Logit4See supports wide set for functionalities in two modules (planning and execution).

The next chapters provide more details of it architecture and functionality.

Specification of functionalities:

- Set up logistics services - Logistics service providers need to register their offers in the system. They can provide the data through the website user interface or using the electronic message sent from their home system. They also provide and update time schedules or duration of their transport services.

- Providing transport request - The transport requests are inquiries from customers for transport and logistics services containing transport instructions. They may be sent through an interface to Logit4SEE system. Customers must be first registered in the system to be able to provide transport requests.

- Transport planning - The planning in Logit 4 SEE system might be generally carried out in two ways. The planning can be done automatically by the system while user only points the priorities for planning as transit time, costs or CO_2 emission.[1] The other way is to use the predefined chain templates which are very useful for transport chain managers in planning delivery leg by leg. The last step of transport planning is booking services at the service providers.

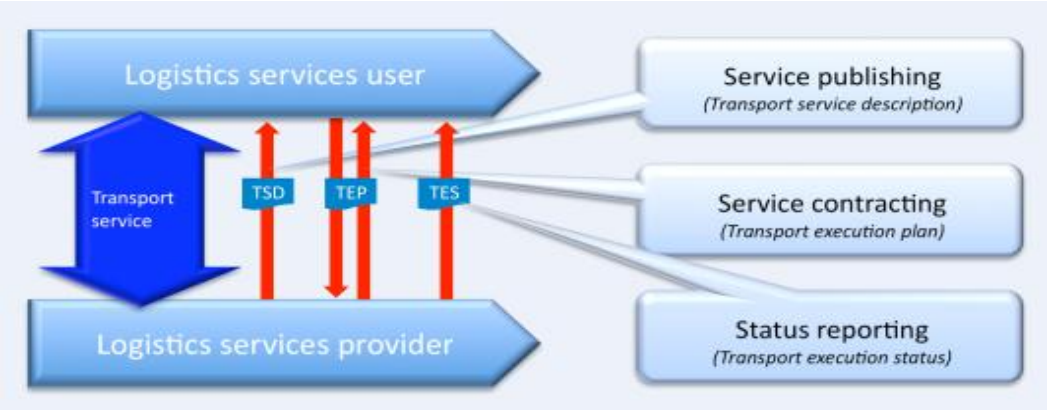
- Transport execution and monitoring – When the actual transport starts, Logit system allows to monitor what is happening with the goods along transport chain. It allows to receive a status information about actual or estimated times of start or end of the service. It can also receive statuses from active equipment which may control temperature, humidity or intact seals.

- Supporting the electronic interoperability between business actors involved in multimodal transport chains using UBL electronic messages standards in transport worked out in the European research project called " Freightwise".

[1] This option is under development.

- Loads consolidation from different transport orders going in the same direction during the whole chain or at some stages of it.

Fig. 2-2 LogIT 4SEE standard services and data exchange



Source: Logit 4See

2.2. Target groups

Main group of users of Logit 4SEE are **transport organizers** who plan the intermodal transport chains using own means of transport or hiring other carriers or logistics service providers in transport chain legs. The system is also supportive for **logistics service providers** who offer their services like :

- Transport
- Warehousing
- Handling in logistics hubs and ports
- Insurance companies

Finally system is useful for **cargo owners** or **shippers** who need to order the door to door transport or want to cut their costs using alternative routes or by consolidating goods with other shippers.

2.3. Technical description

Logit4SEE is an internet based platform in JAVA and WEB 2.0. technology able to register services or transport orders either manually by user interface and with the electronic messages .It enables internal and external data available in real-time as a service. Data sourcing through EDI/XML, screen scraping, web-based & mobile interfaces. System uses the open Freightwise electronic messages standards (UBL version 2.1)

2.4. Benefits

From the planning point of view we have operational planning based on fulfillment options, as: lead time, costs and carbon dioxide emission. Execution of a logistics chain in a network of services may be performed according to long-term arrangements or spot contracts. System offers end-to-end visibility umbrella over existing systems and platforms, not replacing them. Other benefits:

- Transparency that shows how problems can be mitigated .
- Ease-of-use of multi-modal logistics chains.
- Collaboration & information sharing within communities.
- High throughput and turnaround capacity on terminals.
- Agile & decentralized implementations.
- Interoperability with other standards and systems (also for SMEs).
- Leverage for existing investments (AEO, ICT).
- One single service to plan and follow up multi modal logistics chains.
- Aggregation of data to cover blind spots in the chain.
- True visibility in the logistics chain, predicting the delivery time.
- Proactively reduction impact of deviations by dynamic rescheduling.
- Fast + simple implementation – no software, no training.
- Loads consolidation.
- Taking control of transport chain.
- Increased transparency & reliability.
- Reduction of lead-time and safety of stocks.
- Less disruption of production processes.
- Simplified administrative, operational & customer service handling.
- Quickly respond to deviations.
- Better tracing of damages & loss of cargo.
- Acceleration of time to cash cycle.

3. Demonstration of tool's support in the modal choice – Case Study

From the perspective of a transport user the main advantage of the tool is supply of market information concerning alternative modes of transport to road traffic available along defined routes. One of the main objectives of this TransBaltic working group was to demonstrate to the freight market stakeholders the advantages of different modes of transport on selected routes as an opportunity for significant reductions of the logistics expenses.

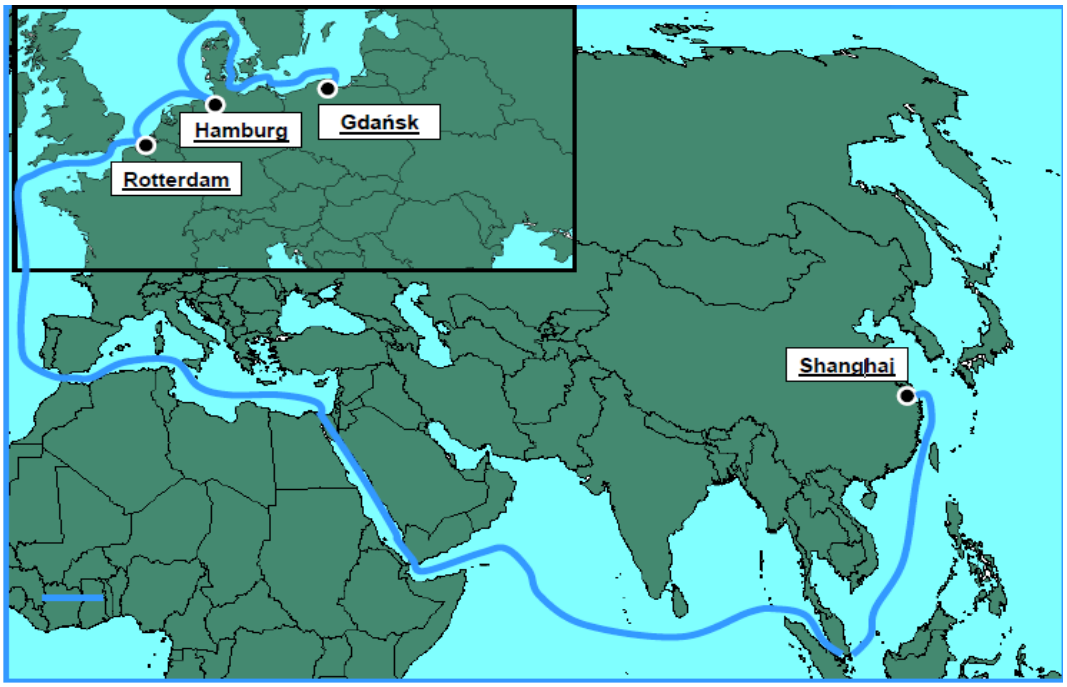
The case study has focused on the corridor for containerised transports leading from the Far East (namely Shanghai) to the main cities in Poland. There were few reasons for our choice:

- Transport of containers creates favourable opportunities for the development of mulitimodality due to unification of load units which facilitates smooth transhipments between different modes (vessel-truck, vessel-rail, vessel-barge, rail-truck, truck-barge e.t.c).

- Containers reaching Europe are unloaded in one of the European gateway ports. Hamburg, Rotterdam and Gdansk were selected for the purpose of the case study. Each of them offers alternative hinterland on-carriage services - on road or rails. Feeders circulating between Rotterdam, Hamburg and the Polish ports provide additional options.

- Container traffic from the Far East is quite significant for Poland in terms of current and forecasted volumes.

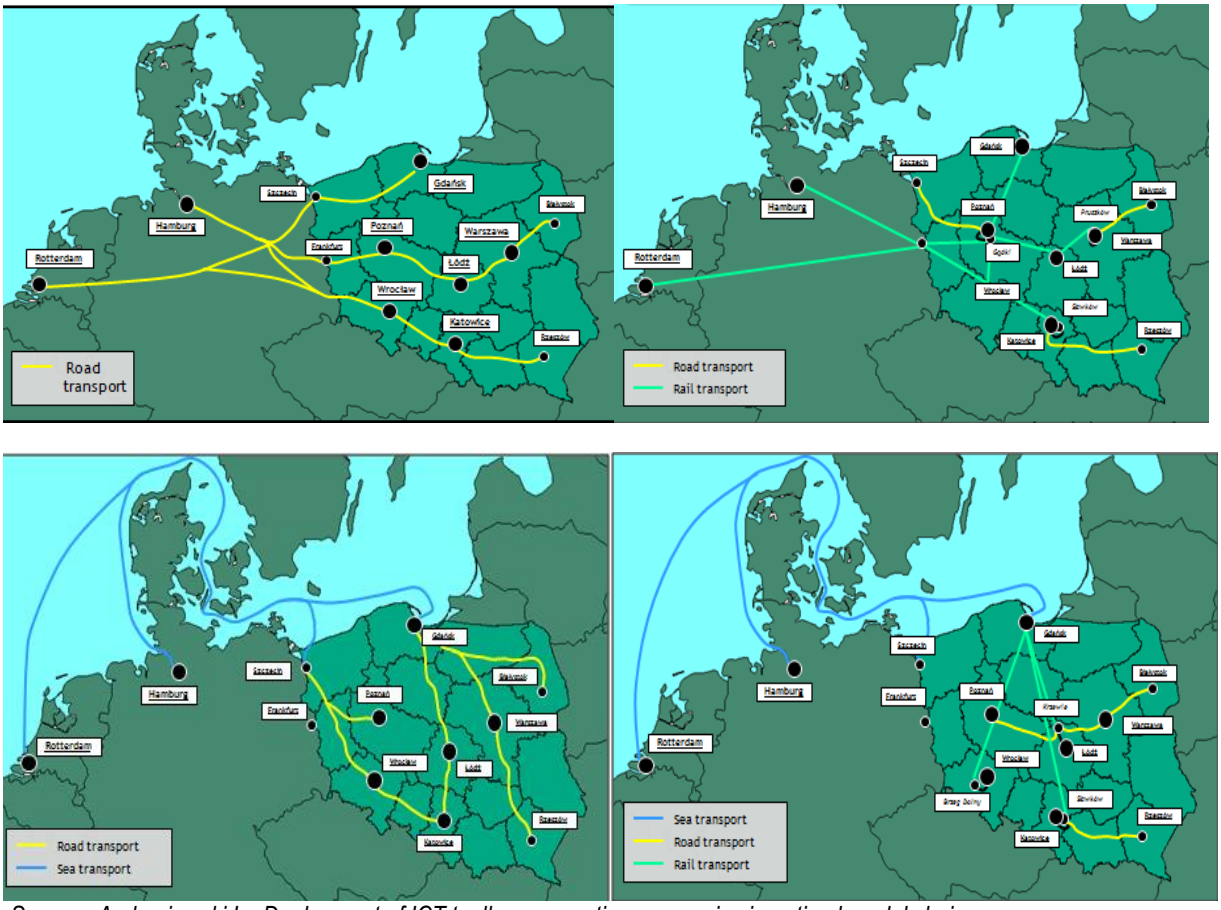
Fig. 3-1 Container transport route from the Far East to Poland with the alternative use of gateway ports of Rotterdam, Hamburg or Gdansk



Source : Andrzejewski, Deployment of ICT toolbox supporting companies in optimal modal choice

Thus the companies organizing transport process face a large number of transport alternatives on this last stretch of the route leading from the receiving European port up to the final destination being able to develop optimal modal composition bringing significant reduction of transport expenses.

Fig. 3-2 Alternative modal solutions in on-carriage of containers from ports of Hamburg and Rotterdam to Poland



Source : Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

3.1. Comparative analysis of transit time

Nowadays delivery time is quite critical criterion for many decision makers. Trends show rising customer's requirements towards shorter transit times and more frequent but smaller lots of cargo. In such circumstances there is no alternative to truck or plane. But there are types of cargo or markets where delivery time is not critical issue – in that instances there is room for taking advantage of cheaper but slower modes of transport as trains or vessels.

Planning containerized deliveries from the Far East to Europe it has to be taken into account that the ocean sail takes more or less 30 days. This section of the delivery determine much the whole duration of container's journey. In turn, on-carriage of containers from the receiving European port to the final destination in Poland takes few more days only, being

- 2 days for trucks
- 3-4 days for trains including "last mile" road delivery from the last container terminal to the final receiver, or
- 5-6 days in case of feeders going to Polish ports.

Tab. 3-1 Delivery time of container deliveries ex the Far East to Warsaw depending on transport modal solution

Transit time of deliveries ex Shanghai to Warsaw					
via port of:	Ocean sail	Total transit time including on-carriage by:			
		road	intermodal train	Feeder+ truck	Feeder + train + truck
Rotterdam	30	32	33	36	37
Hamburg	30	32	33	35	36
Gdansk	32	33	35		

Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice ILiM analysis based on transport operators time-schedules.

Summing up: for the delivery planners – the time required for hinterland deliveries from the gateway European port up to the final receiver do not matter much from the perspective of the whole supply process but - it may be much more important for those who pay only for this last stretch of the route.

3.2. Comparative analysis of transport costs

3.2.1. Analysis assumptions

There are many types of sea containers being utilized in maritime transportation but the study is focused on the most popular, general purpose dry containers of 40 FT(ISO type -1A) and 20FT (1C).

The following three scenarios in terms of container volume per unit delivery were considered:

- Transport of single 40 FT container (representing ca 65% of number of containers utilised in maritime transport).

- Transport of single 20 FT container (which is commonly used for transporting spatially small but heavy loads, weighing about 20-24 tones).

- Transport of 2 pieces of 20 FT containers on one road container chassis what may be practiced in executing transport orders received from 2 separate clients concerning deliveries to nearby

locations. This way of transporting containers is rather rare. However significant reduction of freight charges may prompt the tool users to generate joint transport order.

In order to determine the level of transport costs, the price indications were obtained from a few transport operators representing alternative modes of transportation of containers on the given routes, including ocean shipping lines, freight forwarders, intermodal train operators as well as shipping lines using feeders – small container vessels transferring containers between European ports.

,

Received freight charges indications refer to small orders to carry a few pieces of containers only - what seems to be typical situation of the companies from the SME sector. Shippers offering large number of containers usually gain substantial volume discounts, particularly from the railway and feeder operators. The scale of these discounts is of course a trade secret, but it can be estimated at a level of 10-20%

The price information obtained contains freight charges for :

- Ocean freight from Shanghai to the European gateway ports.
- Terminal Handling Charges in sea ports.
- Road transportation of containers from the receiving European port to the final destination in Poland.
- Intermodal door-to-door transport of containers from the receiving European port to the final destination in Poland including transhipment at container terminals (wagon-yard and yard-truck) as well as road on-carriage.
- Transport of containers on feeders going from the receiving European port to the Polish ports of Gdansk, Gdynia or Szczecin with the road or rail on-carriage to the final destination in Poland.
- In case of transport from the gateway European port up to a receiver in Poland, the cost of return transport of empty container is included

The freight rates represent the level of the 1st part of 2011

3.2.2. Main trends recognized

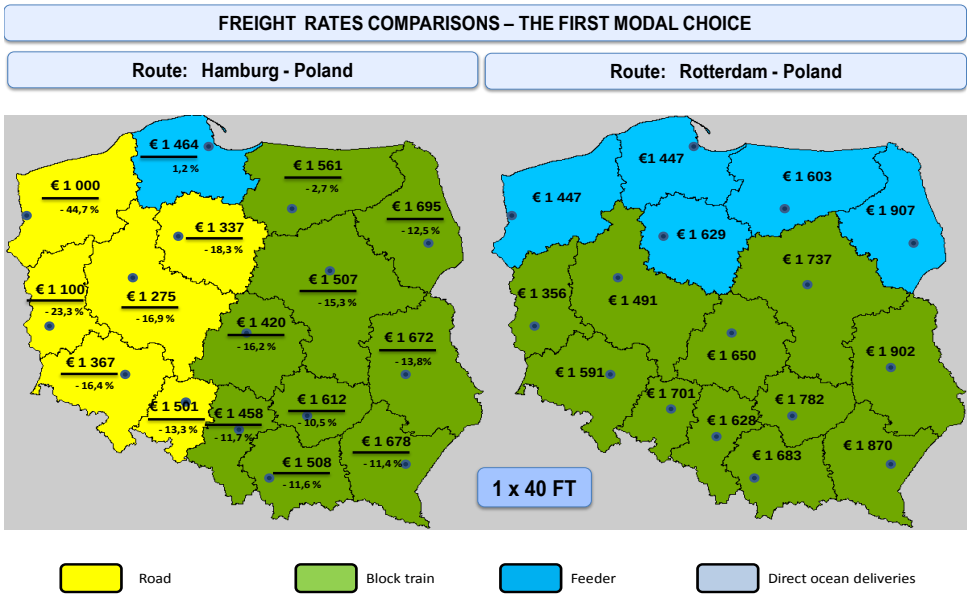
As we stated before, the tool is helpful for the freight decision makers to determine the best modal choice on the selected route as well as may be helpful for the freight forwarders to establish modal strategy of transport services offered to their customers: The outcome of the comparative study showing the best modal choice - depends on which parts of a supply chain (being defined by the INCOTERMS rules) are under consideration.

3.2.2.1. CIF Hamburg / CIF Rotterdam

A Polish importer purchasing commodities on CIF Hamburg or CIF Rotterdam terms covers all container transport expenses from this receiving European port up to final unloading place in Poland.

Transport of a 40FT container from Hamburg to Poland by road is unbeatable for a distance below ca. 750 km. This confirms the generally known principle that the rail begins to be competitive over longer distances. Further on, beyond this line intermodal transports door-to-door are cheaper. For deliveries addressed to the district of Gdansk it is efficient to use feeders. Choosing Rotterdam as the gateway port the freight payer shall be aware that road transport to Poland is not competitive at all on such long distance. Intermodal connections to Poland are less expensive to the central and south parts of Poland while the north parts are domain of feeder deliveries. Having any impact on choice of gateway port a Polish importer shall prefer Hamburg due to cheaper hinterland and feeder connections.

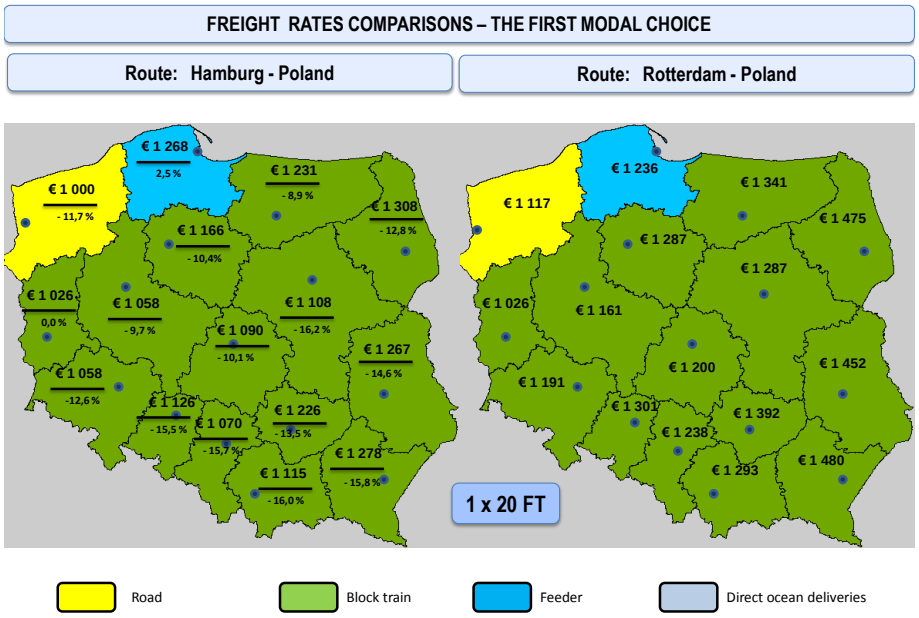
Fig. 3-3 Comparison of cost of different modal solutions in on-carriage of 40FT containers from ports of Hamburg and Rotterdam to Poland



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

There is quite different situation in case of supply "heavy" 20 FT containers. Due to relative low freight rates offered by rail operators the overall transport costs are much lower comparing to road deliveries reaching 20-30% difference on longer distances.

Fig. 3-4 Comparison of cost of different modal solutions in on-carriage of 20FT containers from ports of Hamburg and Rotterdam to Poland



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

On the contrary, carriage of two 20 FT containers on a single road chassis is much more competitive on road due to division of a road freight charge between two shippers. It can be easily demonstrated on the exemplary transport of 20FT container from Hamburg to Warsaw alternatively carried on road chassis or in block container train.

Tab. 3-2 Transport expenses on the route Hamburg – Warsaw per 20FT container.

Transport expenses (€) per 20FT container on the route Hamburg-Warsaw *			
Type of transport	Road chassis	Container train	Road chassis
	1 x 20FT	1 x 20FT	2 x 20 FT
Terminal Handling Charges	220,00	220,00	220,00
Transport charges **	1 350,00	890,00	675,00
Total expenses	1 570,00	1 110,00	895,00
Reduction of cost (€)			215,00
Reduction of cost %			19%

* rates valid in the 1st part of 2011

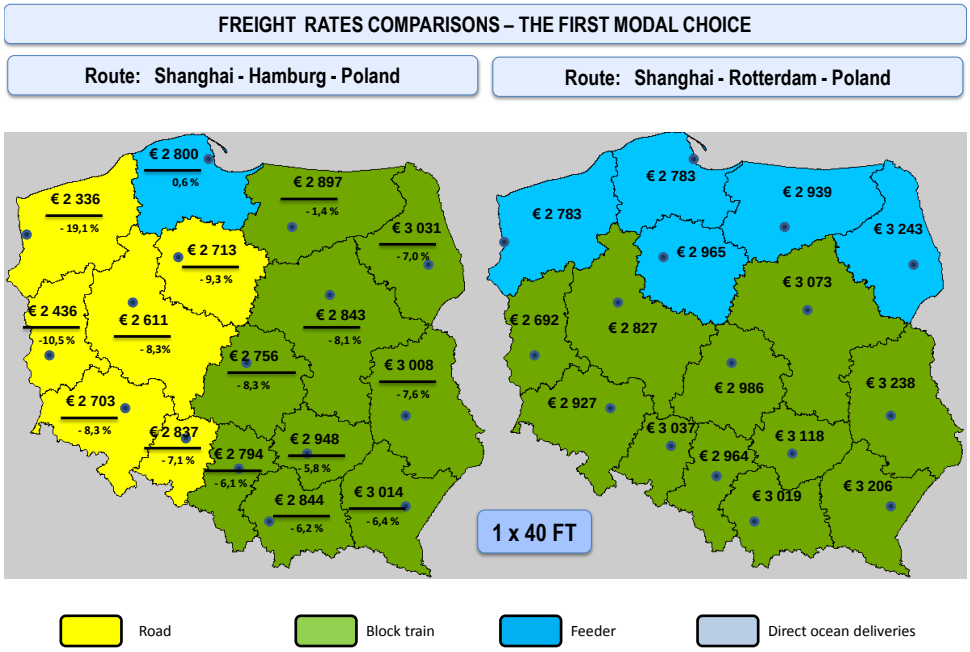
** rates including return of empty container to the port of Hamburg.

Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

3.2.2.2. FOB Shanghai via Hamburg or Rotterdam

Taking into account freight contract on FOB Shanghai basis – when a Polish importer pays for the ocean sail as well – the competitive situation is not much different since majority of shipping lines offer the same freight rates for Hamburg and Rotterdam or Antwerp - in spite of actual distance, being the longest for Hamburg.

Fig. 3-5 Comparison of cost of different modal solutions in on-carriage of 40FT containers from Shanghai to Poland



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

3.2.2.3. Direct deliveries Shanghai - Gdansk

Since the beginning of 2010 this traditional pattern of delivering containers from the Far East to Poland (via northern ports of Hamburg, Rotterdam or Antwerp) has been changed significantly with the introduction by the Maersk Line - direct calls from Shanghai to Gdansk with the use of large container ships. Gdansk is so far the only Baltic port receiving the greatest container vessels carrying 15.000 TEU. It was possible to due to:

- deepening of the port enabling calls of 15 m draft ships,
- open port (i.e.. free of ice during the whole year),
- good (strategic) location for feeder services to the other, more distant Baltic port,

- building modern and efficient container terminal in Gdansk (DCT – Deepwater Container Terminal) with the handling capacity of 1 mio TEU p.a,

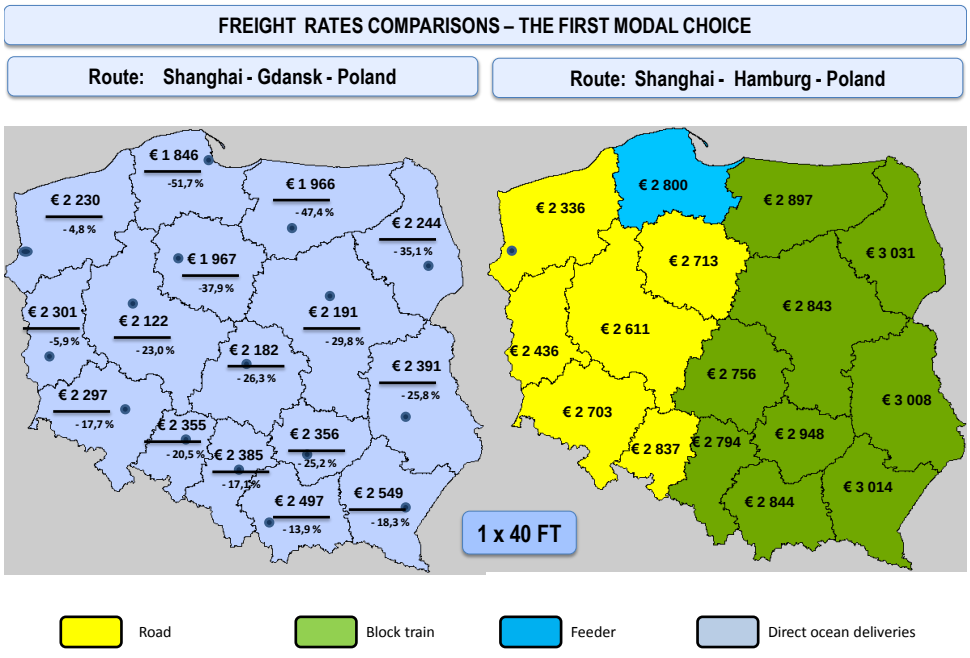
Gdansk became the gateway for :

- containers addressed to Poland with the possibility enlarge hinterland deliveries to neighboring countries and,
- hub for containers to be transferred on feeders to St. Petersburg or Finland.

According to our analysis this new connections becomes revolutionary in terms of competition. Comparing to the second best solution – traditional deliveries via port of Hamburg it is much cheaper In case of 40FT containers , they are cheaper by:

- 35-50% for destinations in the north part of Poland,
- 20-30% for central locations and
- 15-20% for south of Poland.

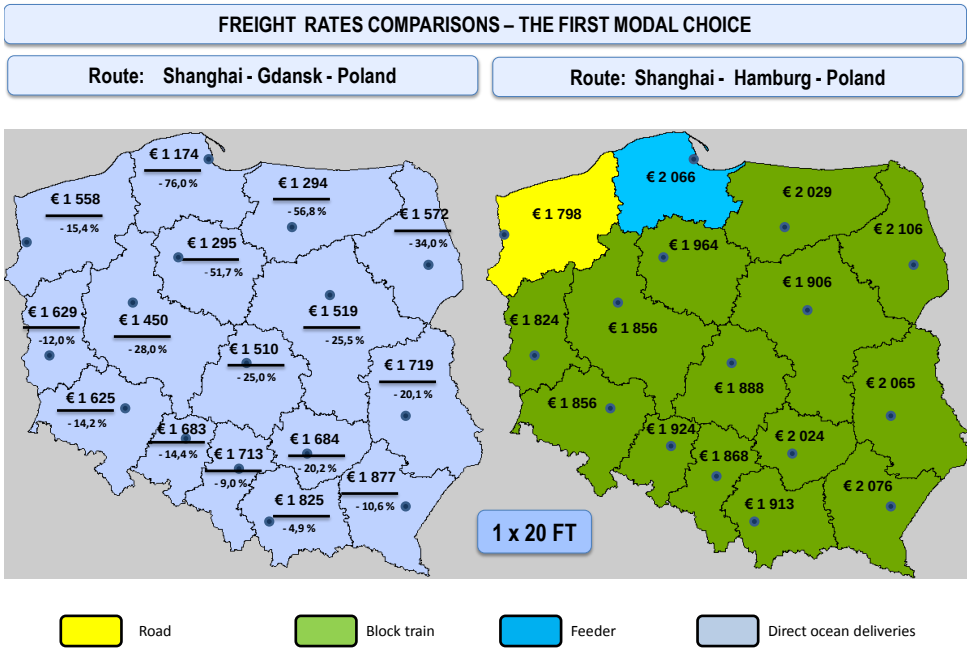
Fig. 3-6 Comparison of cost of different modal solutions in on-carriage of 40FT containers from Shanghai to Poland with the use of the direct Shanghai-Gdansk connection



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

In case of 20FT containers – the new solution is even much competitive for all destinations in Poland comparing with traditional transports via port of Hamburg.

Fig. 3-7 Comparison of cost of different modal solutions in on-carriage of 20FT containers from Shanghai to Poland with the use of the direct Shanghai-Gdansk connection



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

3.2.2.4. Deliveries via port of Koper

In the mid 2012 the new intermodal connection was launched linking the port of Koper in Slovenia to Dabrowa Gornicza in the south of Poland. Thus the long lasting idea of the Adriatic – Baltic transport corridor equipped with intermodal solutions becomes real. How this new business venture may be positioned ?.

Comparing the average time of ocean sailings the new connection is not bringing much change due to the fact that the sailings from Shanghai to Koper are not widespread yet. The sail takes in average 29 days while Hamburg may be reached in 30 days and Gdansk in 32. It is expected that introducing quicker connections ca. 4-5 days may be saved.

Tab. 3-3 Delivery time of container deliveries ex the Far East to Warsaw depending on transport modal solution

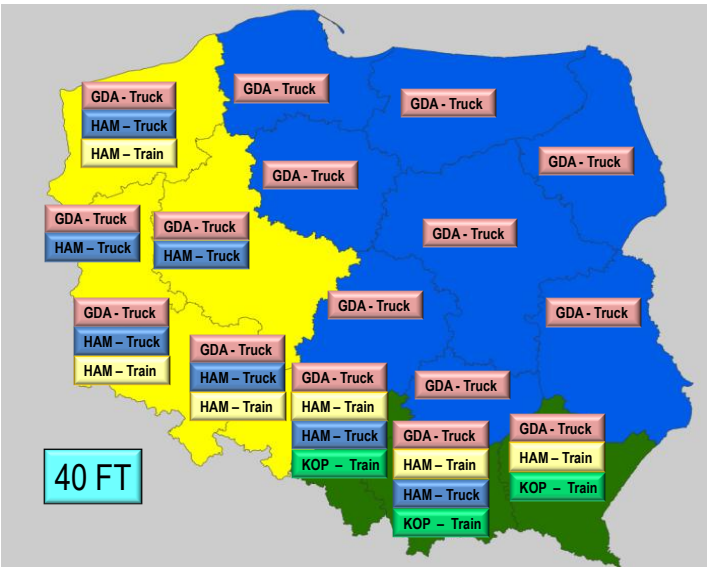
Average transit time ex Shanghai to Warsaw (days)			
via port of:	Ocean sail	Total transit time with on-carriage by:	
		Road	Rail
Rotterdam	30	32	33
Hamburg	30	32	33
Gdansk	32	33	35
Koper	29	31	32

Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

Cost wise the new intermodal connection is attractive. We made an analysis of territorial influence from the three competing ways of transport containers from the Far East to Poland (via Hamburg, Gdansk or Koper) , taking into account the best choice offers and these that excessed the best one not more than 20%

As far as 40FT containers are concerned - the north part of Poland is a region of the big advantage of deliveries directed via port of Gdansk. In the west parts of Poland - road deliveries from Hamburg may be an alternative option why in the south part of Poland intermodal deliveries from Koper, or Hamburg may be negotiated.

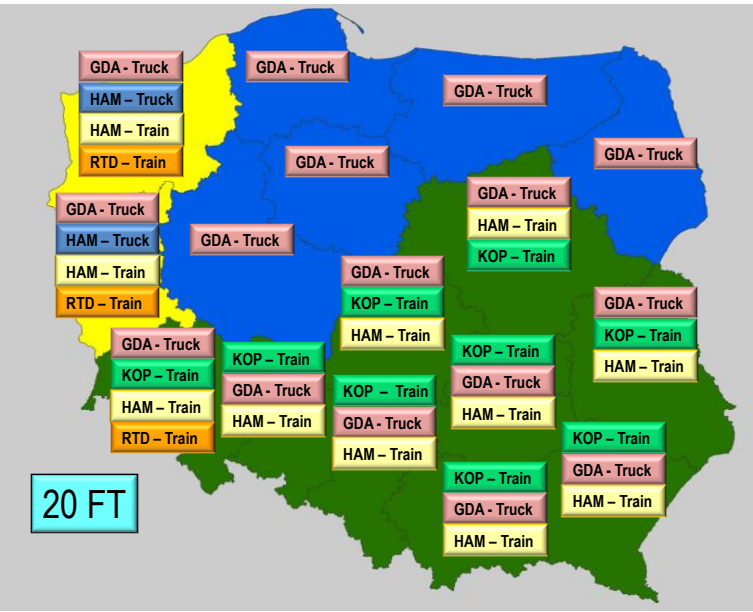
Fig. 3-8 Spheres of competitive influence of different modal solutions in transport of 40FT containers from Shanghai to Poland.



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

In case of 20FT containers the influence of alternative to Gdansk solutions is even bigger.

Fig. 3-9 Spheres of competitive influence of different modal solutions in transport of 20FT containers from Shanghai to Poland.

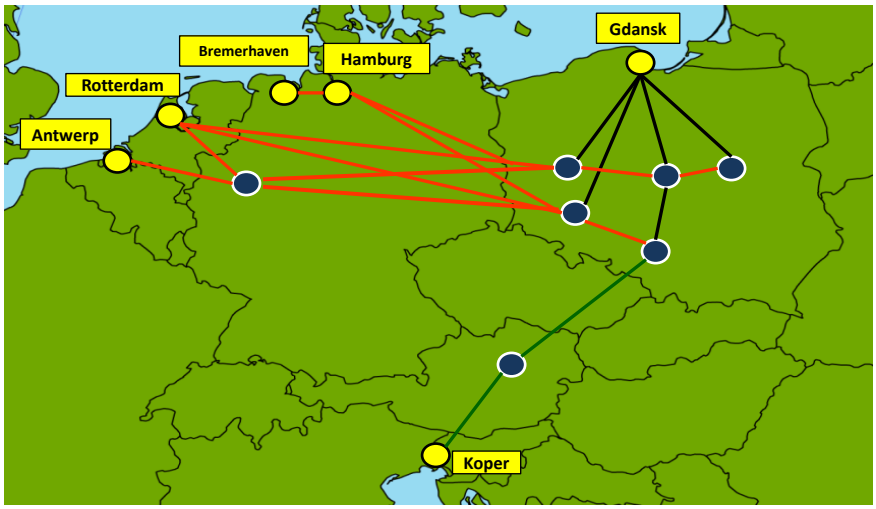


Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

Actual utilization of container block trains in transfer of containers from European ports to Poland is not as big as it may be expected from comparison of transport costs. Unfortunately it is very difficult to obtain complete statistics but according to the statistics of port of Hamburg in 2008-2009 the share of intermodal solutions in overland hinterland transports ex Hamburg to Poland is 40% while 77% in transport to Czech Republic , 50% to Slovakia and 68% to Hungary.

The demonstrations of the comparative cost analysis were aimed at making shippers aware of numerous actual transport opportunities in transport of containers with the use of different gateway European ports of Hamburg, Bremerhaven, Rotterdam, Antwerp, Gdansk or Koper that may help in optimisation of their supply chain. Showing advantages of intermodal network may inspire shippers in inquiring their freight forwarders to include this option into consideration.

Fig. 3-10 Europe wide intermodal network utilized in imports of sea containers ex the Far East to Poland.



Source: Andrzejewski L., Deployment of ICT toolbox supporting companies in optimal modal choice

Demonstrations were in parallel addressed to freight forwarders in order to include intermodal options in scope of their services as slightly slower but cheaper .

4. Pros and cons of "Journey Planner" type applications

Direct transfer of the "journey planner" idea from the passenger traffic to the freight transport sector is quite challenging. Data bases of the passenger trip planners being a collection of time schedules and tariffs published by transport operators are relatively easy to be built and updated.

Freight transport environment is much more complex. There are several significant differences affecting the process of creating data bases consisting of freight transport companies offers:

- The number of potential locations involved in a door-to-door transport process is practically unlimited.
- Road transport is not executed according to time schedules and tariffs. It is typical spot market sensitive to sudden changes in demand for transport services. Freight charges depend much on mutual negotiations between transport user and transport service provider in the specific market situation in given time on given routes.

- Railway and maritime containerised transports in turn are performed according to time-schedules and tariffs however finally agreed level of freight rates may differ much from the general tariffs due to volume discounts. Results of negotiations depend also on lading space filling factor.

In the ICT tools optimising freight transport planning, based on" journey planner" concept there are a few problems to be solved :

- One of the main challenges of building data bases of transport offers is to encourage transport services providers to publish and update their details on the internet platform. Large transport operators are interested mainly in rendering their services to large customers (Key Accounts) preferring rather mutual negotiations.

- Due to the large number of potential locations in the road transport it is not realistic to demand from the transport companies to quote large number of routes. Some simplified quoting system basing on distance have to be implemented.

- Freight transport market is complex due to a few levels of sub-contracting and changeable alliances of co-operating partners. The process of configuring supply chains must respect these alliances in order to offer interoperable transport solutions.

- While in the passenger transport planners it is quite easy for a user to build a multimodal chain of a trip leg by leg in the freight transport version of a tool it will be much more comfortable for a user to automate the process of building multimodal supply chain which is much complex.

- Tool's data base contains general , "initial" tariffs. Planning based on the rough indication of freight rates make sense only under condition that it is not far from actual level of rates being concluded between parties of a transport contract.

- Opposite to the passenger journey planners enabling direct booking of tickets, booking loading space in freight transport need to be preceded by negotiation phase for final agreement of freight rates, transit time as well as payment conditions.

- Small companies may rarely take use of intermodal transport solutions. Offering small volumes they cannot reach satisfactory freight rates. Consolidation of loads shall be solution for reaching effect of scale.

- Although we are focusing on module enabling transport service provider choice – it is very important that the tool also gives the user opportunity to conclude freight transport contract with the selected carrier or freight forwarder. For managing the supply chain through the tool establishment of an electronic internal communication system is required.

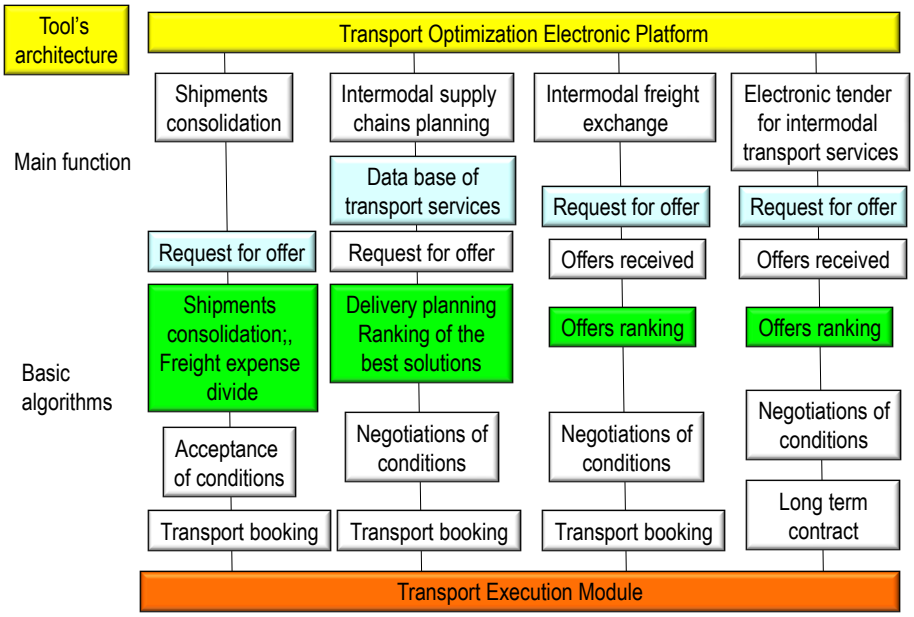
The modal choice optimising tool must find solutions to the all of the specified problems in order to meet market acceptance.

5. Proposed improvements in tool's functionalities

5.1. General architecture of improved version of the tool.

The general directions of the tool's improvements following specification of requirements presented earlier are taken into consideration in our proposal for the new tool's architecture. The functionality of decision support is much more advanced comparing to original LOGIT4SEE solutions. There should be four main functional modules supporting shippers or freight forwards in their decisions, covering the most important requirements.

Fig. 5-1 The architecture of a target ICT tool supporting stakeholders in their modal choice.



Source : Andrzejewski, Deployment of ICT toolbox supporting companies in optimal modal choice

These modules are:

Intermodal supply chain planning module

This is based on the LOGIT4SEE application with the data base as a central component and algorithms allowing to compare different transport alternative solutions according to criterions of transit time, transport expense or CO_2 emissions.

The advantage of a planning module is the possibility of an analytical study of the different supply chain scenarios, including wide range of transport options offered by all modes of transport. From the perspective of EU sustainable transport policy it is the ideal tool to achieve co-modality – i.e. apply the optimal transport solutions by taking advantage of competitive strengths of each mode. The proposed tool provides stakeholders with an extensive market knowledge and also simplifies benchmarking by automatically configuring multi-modal operable supply chains.

Nevertheless the tool has to be enlarged with the communicator making possible final agreement on freight rates and other important transaction conditions as payment time. It has also to be enlarged by additional supplementary functional modules in order to increase its market value.

Intermodal freight exchange

The mechanism of transport exchange so popular in the road transport sector can be also creatively used in the proposed tool's version. This open Web based solution enables shippers to arrange immediately delivery of their goods by asking potential transport service providers for bids. What is new, it is incorporation of intermodal offers into set of quotations to be considered by the inquiring party.

For example a shipper asking for offers for transport of containers from the port of Hamburg to Warsaw will receive not only quotations sent by trucking companies. He also will be automatically supplied with the quotations from intermodal operators contained in the tool's data base with the link enabling final contractual agreements.

Electronic tender for intermodal transport services

While intermodal freight exchange fixes the current transport needs, tender is suitable tool to arrange long time contracts for transport services. Tenders are commonly used by the large shippers to secure their transport needs resulting in conclusion of yearly service contracts with the selected transport service providers. Electronic tender module is designed as dedicated solution. Inquiries will be sent only to the logistics service providers pre-selected by a customer. The practice of conducting periodic tenders result in a reduction of freight rates through periodic deep analysis of the freight market as well as stabilization of freight rates in the long run.

Shipments Consolidation Module

The tool shall be supplemented with the solution being especially convenient for the shippers representing the SME sector. Small companies are not able to obtain favourable conditions from the intermodal transport operators due to the small volumes. Consortia of the small shippers consolidating their shipments may reach much better freight rates thus becoming much more attractive partners for these carriers.

5.2 . Processes supported by Intermodal Transport Planning System

The planning system is based on a few processes supporting decision making in transport.
Some of them are new not being included in the LOGOT4SEE application. Among the processes there are:

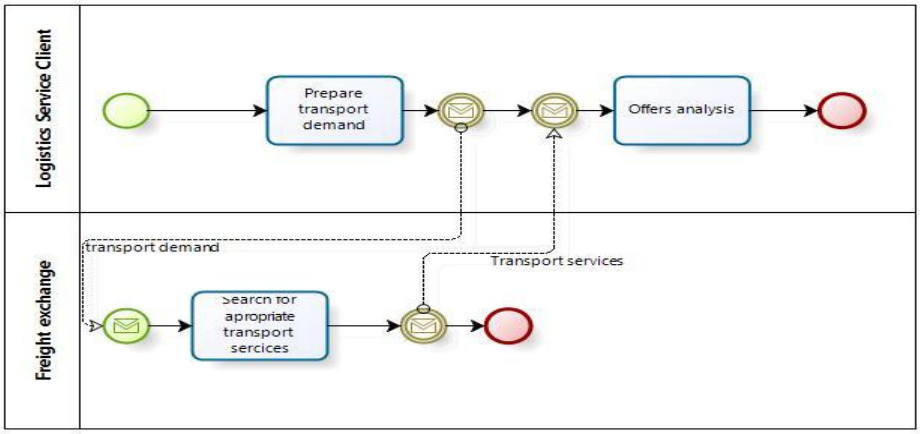
- adding new services to the tool's data base,
- searching for the transport offers from the tool's data base,
- searching for the transport offers with the use of the freight exchange,
- obtaining ranking of offers from the data base arranged according to criterion of transit time, freight charge or CO_2 emission,
- negotiation of contractual conditions,
- delivery planning ,
- execution of transport plan.

Processes being newly defined or re-defined are present below:

5.2.1. Search for transport offers

In this process a potential logistics service client is going to find the offers for transport of goods between the given points defining starting and final points of the transport process. Originally in the LOGIT4SEE tool a shipper address its inquiry to the tool's data base. What shall be added is process of searching for the best transport solutions on the freight exchange marketplace. When the inquired transport service cannot be found in the tool's data base (what may happen quite frequently due to problems with availability of data) a shipper may continue search by asking through the intermodal freight exchange receiving ad hoc offers from the transport operators interested in providing this particular service. Using freight exchange mechanism the shipper may ask for the door-to-door service or may also choose the best opportunities on the individual sections of the supply chain.

Fig. 5-2 Search transport services on freight exchange

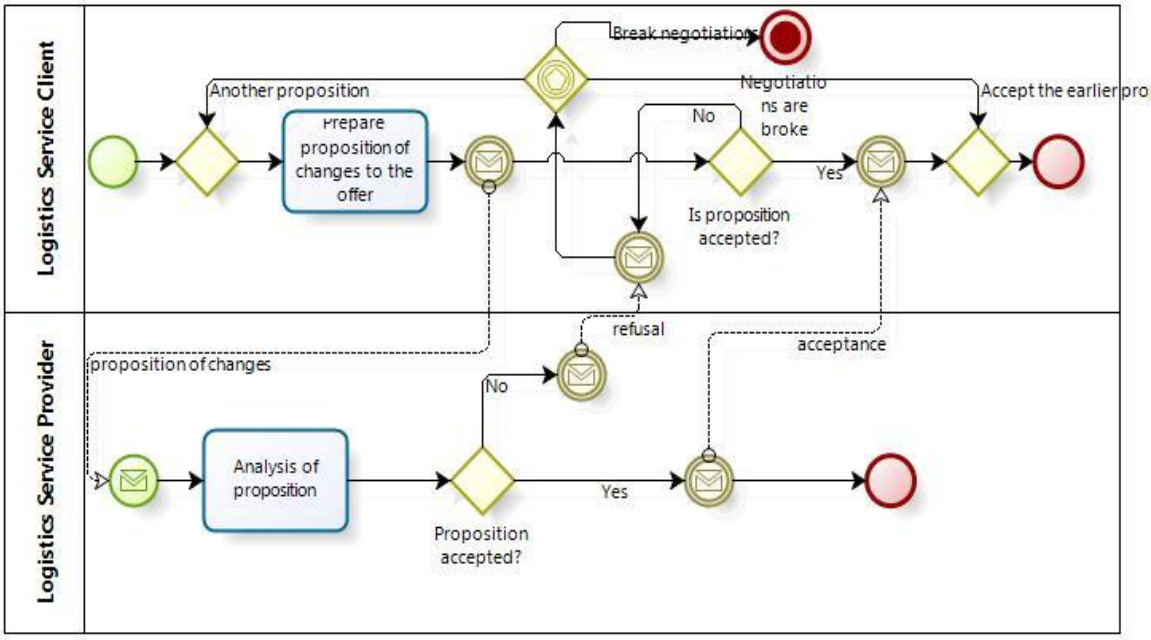


Source: ILIM own study

5.2.2. Negotiation of the offer

This process describes the negotiations between user and logistics service provider regarding the offer. User may propose some changes to the offer. Changes may concern the price of the service or transit time as well as terms of payment . Logistics Service Provider may accept the proposal of the user or reject it. Negotiations are requested in the both modules – intermodal freight exchange and in module basing on services searching through data bases. It has to precede placement of a transport order.

Fig. 5-3 Negotiations of an offer.

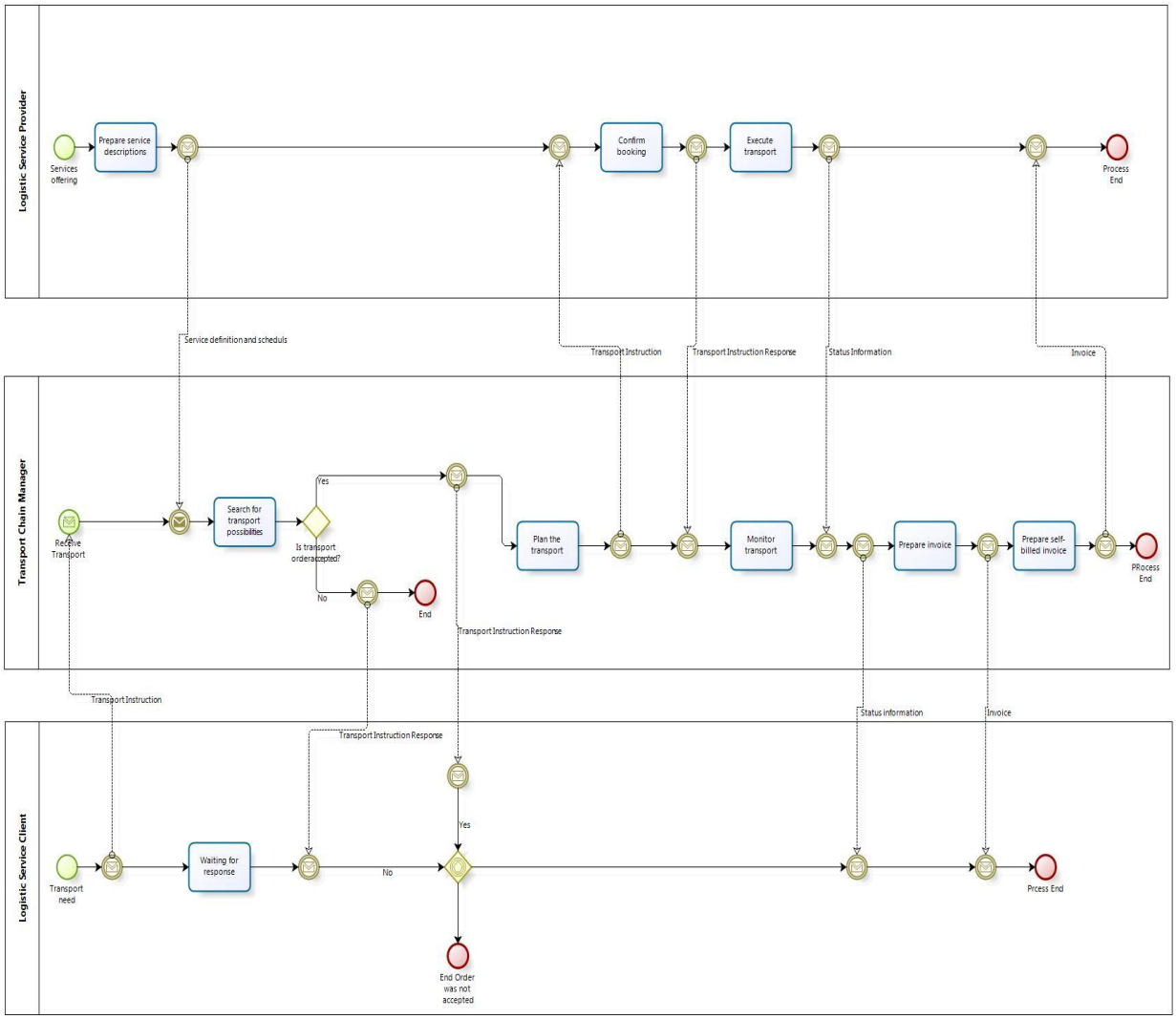


Source: ILIM own study

5.2.3.Transport planning and execution process

The general process of planning delivery remains the same besides building-in negotiations mechanism. In this process a transport manager gets a transport demand from logistics service client and plan the transport according to inquired conditions. Transport manager uses the available fixed resource (the services of logistics service providers) to plan the transport for logistics service client. Transport manager monitors and sends and receives notifications from and to logistics service providers and logistics service client.

Fig. 5-4 Simplified Transport Process with one LSP



Source: ILIM own study

5.3. Concept of intermodal planning

5.3.1. Resources

The concept of new intermodal transport planning system combine in one place several logistics process which enable to more versatile planning and better resource utilisation. The two main fields have been extended and changed which bring new quality and flexibility into multimodal transport planning. First the resource management. The categories of resources have been extended to three types:

- fixed resources,
- rough resources and
- on demand resources

Introduction of more versatile resources categories opens more possibilities in smooth integration of different transportation lanes in multimodal transportation plan. It helps to combine resource characteristics and their availability for container multimodal transportation. There are more variables like service time, volume of transported goods and so on, which might influence resource cost, speed of services or accessibility. Application of three resources categories provide one flexible solution which covers wide geographical service area and allow to use many transportation modes.

In addition, the new concept of multimodal planning module utilizes the notion of combining benefits of multimodal transportation network with flexibility of a freight exchange platform. The conventional concept of planning activities bases on assigning available resources to planed tasks in the future. All attributes of resources like cost, performance and availability have to be known at planning time. Furthermore, resources should have defined services activities which are constant during planning process. The fundamental differences between new and old planning method lay in managing logistic resources. From the point of view of availability there are two kinds of resources:

- Estimated availability of resources in the tool's data base;
- Request for available resources through the freight exchange

Now we might assume that there is possibility to establish delivery plan for estimated resources and their availability and cost. The first category allow to define the range of services and availability of resources. It is possible that transportation resource might start anywhere in defined region and end somewhere in another region. Only certain type or resources, which have flexibility and freedom in selection of start and destination might fall in this category.

The second type of resource comes from the freight exchange portals concept and it is modified to use for multimodal container transportation. The freight exchange portal is widely used for short and medium range distance transportation for Full Truckload – FTL and sometimes is used for Less Than Truckload –

LTL. The notion of the freight exchange will be extended to the containerised transports that may be performed on road chassis, container trains, barges or feeders and large vessels.

The introduction of request for available resource type has substantial influence on planning concept. It divides planning process into two stages. At the first stage basing on current demand the Request for Resources – RFR is coming from the demand for transportation services. At the second stage all available resources available at the market are confirmed and converted into available for planning resources. The actual planning process integrates all demands – transportation request with all three types of resources in one planning activity. The system at one point of time confronts transportation request with all possible resources organized by three categories which might be assigned in order to build intermodal transportation plan.

The new concept of multimodal transport planning introduces another useful feature for Logistic Service Client. He might have opportunity to see more than one possible planning solution using different available resources types. The ICT application operator can rank proposed plan by the:

- cost category;
- delivery due time;
- CO2 emission;
- Handling flexibility;

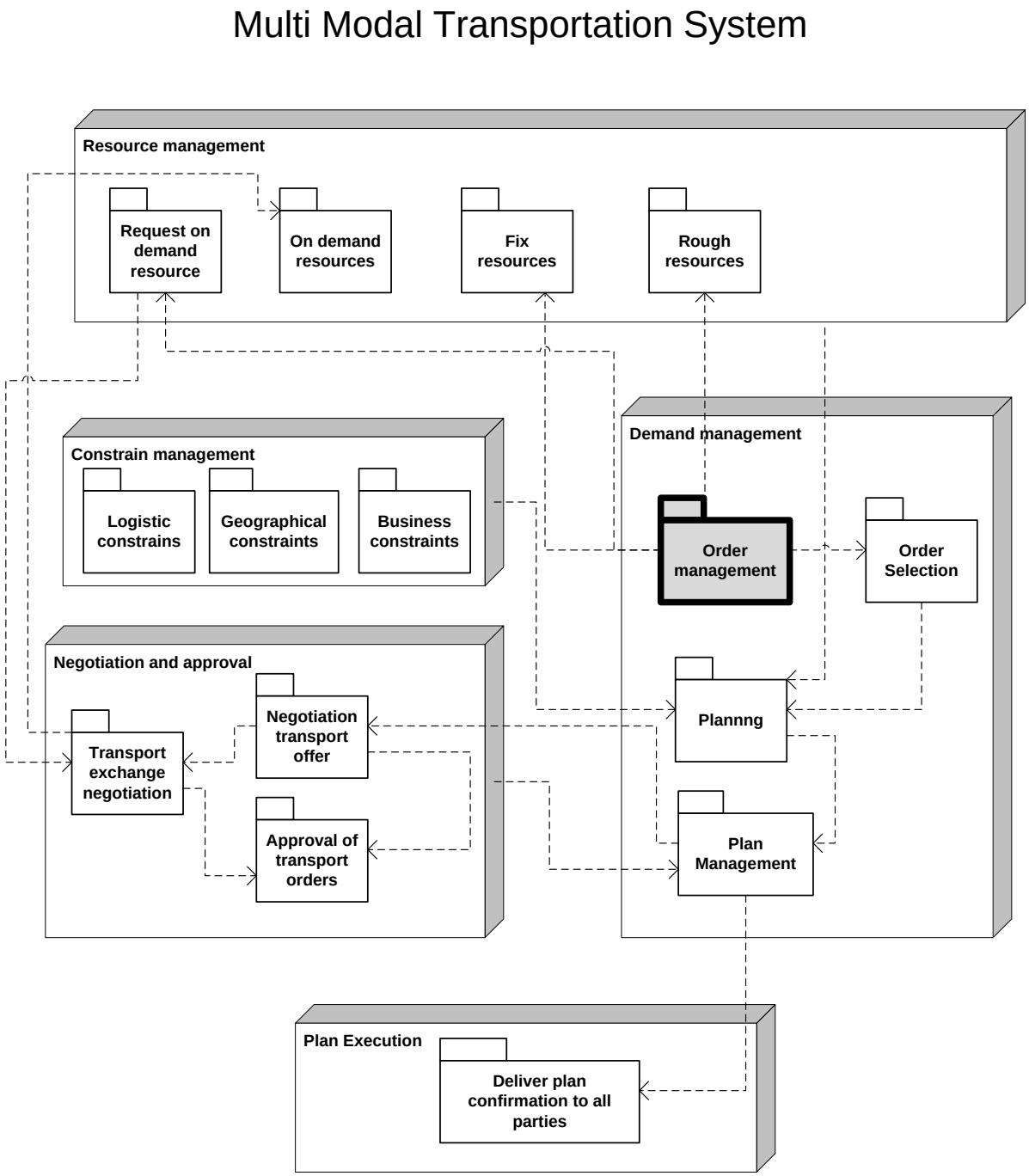
5.3.2. System architecture of intermodal planning

The intermodal Transportation Planning System is composed of five modules responsible for handling dedicated areas:

- resource,
- constrains,
- demand,
- negotiation and approval of a plan and
- execution.

The process begins at the order management rectangle located in demand management module. This module is responsible for managing demand and calculation integrated intermodal plan. The resource constrains management deals with of all kind of constrains which need to be fulfilled by calculated delivery plan.
The negotiation and approval module helps to conduct communication with service providers in obtaining additional resources form transport exchange and helps to conduct negotiations between partners involved in delivery planning. Once the plan is approved it goes to the execution module were final confirmation from resources are received.

Fig. 5-5 Architecture of the Intermodal Transport Planning System.



Source : ILIM own study

5.3.3. User profiles

In the Intermodal Transport Planning Tool the following business roles have been identified.

Logistics Service Provider (LSP)

Logistics service providers represent companies rendering logistics and transport activities with the use of all modes of transportation. That include road transport hauliers, operators of intermodal transport, owners of large container vessels as well as feeders. The freight market structure is quite complex due to widely used sub-contracting. Beside direct carriers, owners of transport means there are numerous companies managing supply chains as freight forwarders, 4thPL integrators offering door-to door service sub-contracting selected carriers on particular sections of the route.

Logistics Service Client (LSC)

Logistics Service Client deals with all activities defining the need for transport and identifying the appropriate services (in industrial transport mostly based on pre-existing agreements especially in case of large shippers). Logistics Service Client in some cases can be Consignor in other Consignee or shipper. Always the one who pays for the transport service. Freight forwarders sub-contracting carries may also be the service client.

Transport Manager, Administration, Security (TMA)

All activities that are directed to setting up and monitoring adherence to rules and regulations in freight transport belong to this domain. One example is monitoring movement of dangerous goods. Another is customs clearance. A third task is related to security along the supply chain. Responsible for proper functioning of the system

Transportation Network Manager(TNM)

Transportation Network Manager extracts all information available regarding the infrastructure (static or dynamic) related to planning and executing transport and makes this information available to the Transport Service Client and the Transport Service Provider. The typical example may be container terminal being independent offering it's handling services to the transport companies. On the other hand many inland container rail terminals are part of the intermodal operators' networks and do not offer independently handling services.

5.3.4. System modules of the Intermodal Planning System

Intermodal Planning system contains the following modules:

a) **Resource Management module** - This module handle all three types of resources. The fixed and rough types that are stored in database and are ready to be used. The requested resource coming from transport exchange are obtained on demand from external services. This module helps to convert them to stage ready to use by planning part of the system.

b) **Demand Management module** - is a module responsible for providing and managing the transport orders. Logistics service clients who are registered in the system can provide their transport inquiries to the system using user interface or electronic message. The transport inquiries are managed also by logistics service clients, they might be confronted with existing transport services on which the initial plan or offer is being built. Users then may choose the interesting offers for them and negotiate them or agreed with logistics service providers.

c) **Offers and Negotiation module** is a place where users may negotiate or re-negotiate the initial offers. The logistics service clients may propose changes in a few parameters like cost, service time and transport mode. This module is responsible for approval of requested resources from transportation exchange and confirmation of multimodal delivery plan for all services providers.

d) **Constrains management** – It contains subsystem responsible for handling business, logistic and geographic constrains. The first one helps to define condition and restriction for cooperation of service providers. Some logistic companies might not be open to accept all external services. The second subsystem helps to defines condition on logistic locations like service hours or available equipments. The last subsystem deals with calculation of distance between physical locations. Since system supports many resource types the distance calculation might be provided by linear equation computing cost of transportation means by covered distance. Another computation method relies on service area or zone of services. It does not require direct distance calculations but simple estimation of location beginning and ending of logistic services.

e) **Execution of transport plan** – this module distributes message with confirmation of booking resources for multimodal transportation plan. The major function of a module is controlling performance of the service. Clients are able to trace the current status of delivery stage provided by the service providers. It can also support communication between clients and service providers by helping notify some emergency conditions and coordinating payments for rendered services.

5.3.5. Management of Network Resources

The database of logistics services in combination of database of locations and information about the ad-hoc providers and container marketplace These are all resources we need to built the transportation networks. The services are provided to the system by service providers using the user interface or electronic messages. For the ad-hoc resources system keeps the information about logistics service providers and about the type and region of their services. Locations are provided to the system by the system coordinator and are required for definition some fixed services. These are mostly ports, logistics hubs and terminals.

Fig. 5-6 Three types of transport resources in intermodal transport system planning concept

Source : ILiM own concept

Fixed resources – long lasting connections between ports and logistics hubs. Mostly rail and sea connections but also air, in-land water and road. During planning process those resources are always in the same state and all attributes are known for planners. In the negotiation phase planer can obtain second quote for usage of those resources (next to contained in the data base).

Rough resources – in road transport there is practically unlimited number of locations that may be involved. It refers to the road transport service covering whole route as well as road pre-carriage and on-carriage of containers linking the delivery starting and final points with fixed transport hubs as sea ports or rail terminals. The problems of the multitude of locations and distance calculations have to be simplified. The definition of location might be carried by zip code or by range of longitude and latitude.

On demand resources –are the resources found on an open market of transport services, the logistics service client requests transport services and he will get transport offers from logistics service providers. Before those resources are used for planning they have to be approved and converted to known services called on demand resources.

5.3.6. Location management

Location are the geographical addresses defined in the transportation systems. Locations are needed to define fixed connections between ports and logistics hubs or city areas. The last delivery points are the physical addresses and mostly appears only on the transport order.

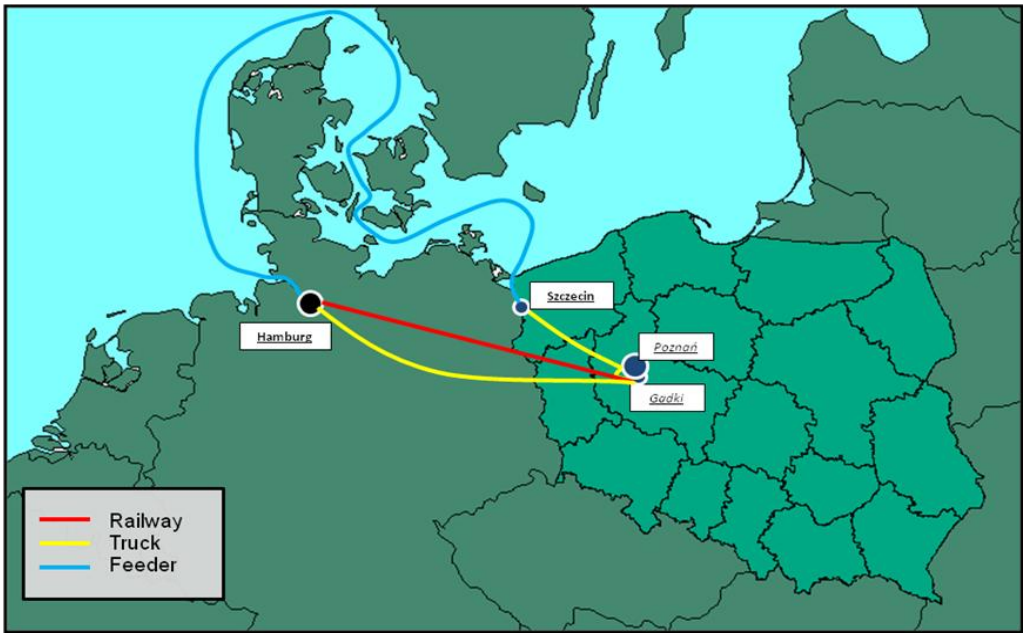
For the fixed services mostly rail and vessels, system allows to store the locations as the starting and ending point of services in the database. Besides these scheduled services there are many others, which starting or ending point might be different with the following transport orders. The physical addresses are passed to the map where the distance is calculated. Upon these distances the service costs might be calculated or determined by transport service providers.

5.3.7. Network Structure Definition

Transport networks are the rather fixed connections or transport corridors which exist because of geographical regions or long term business relationships and contracts. Example of that might be the transport corridor from Hamburg to Poland where most of containerized imports of Poland are coming this way. Network structure is built based on the defined services in system database of logistics services. The services are provided by logistics service providers using the user interface or electronic messages containing the definition of service. We can have the following types of logistics services: transport services, terminal handling services, warehousing and storage, documents preparation, insurance, customs clearance services.

In the picture below, the example of possible network structure from Hamburg to Poland is presented. This example shows the transport network with different alternative routes from Hamburg in Germany to Poznan in Poland. There are three alternatives by feeder and truck , truck and railroad and only by truck. Those solutions vary in terms of cost, delivery time and number of services. Depending on transported volume and requested speed of delivery in some case one solution might be more favourable then other.

Fig. 5-7 Example of transport network from Hamburg to Poznan



Source; ILiM own study

In the picture above two stages of this transport chain composed of see and road legs are presented. Besides transport services there are other services necessary for this transport chains, which is loading and unloading of the containers, customs operations if it is required and others.

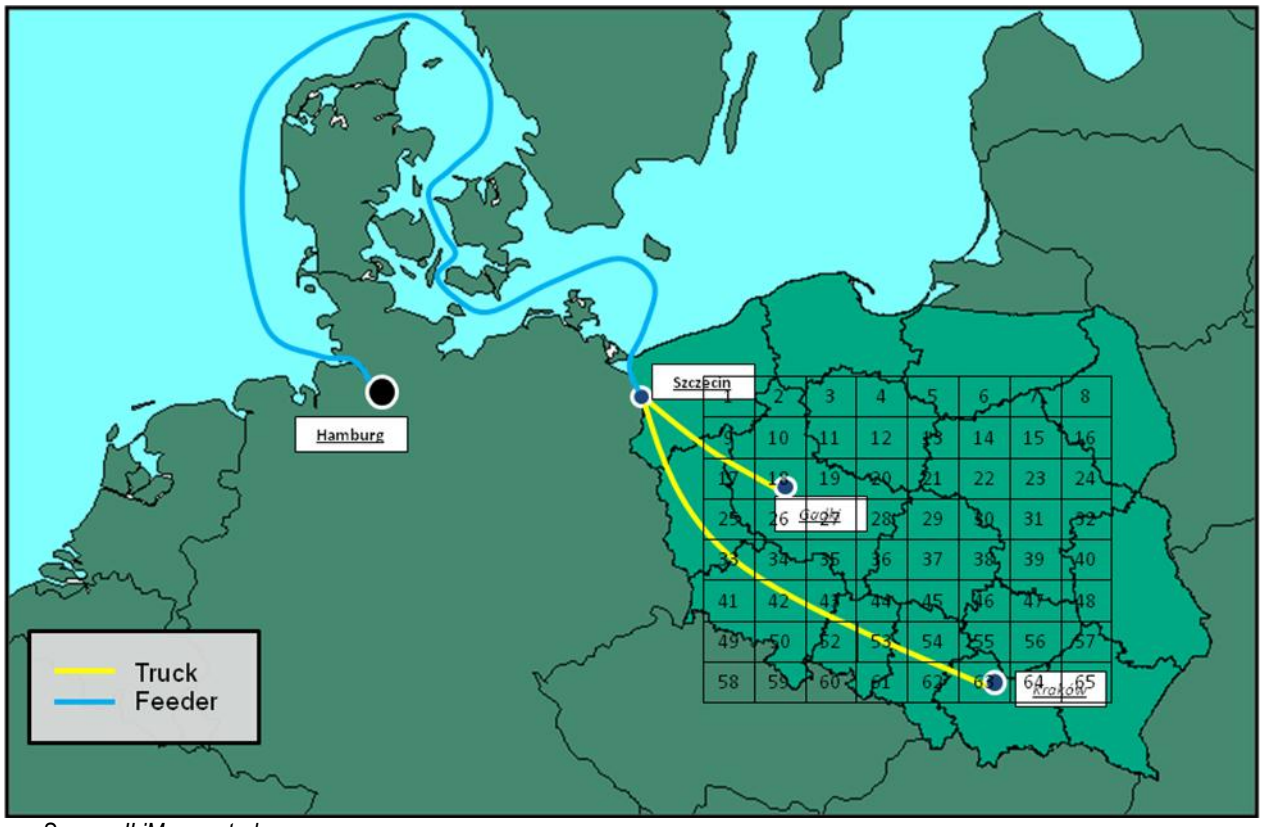
Handling fixed resources

There are three types of service providers: fixed resources, resources on demand and rough resources. Each services provider corresponds to one of above resource type. Once he was classified the planning system will handle it differently. The railroad connections between two cities or freight transport by sea ports are typical fixed logistics resources. They are fixed by nature of geographical infrastructure which for planning horizon cannot be changed.

Handling rough resources

The notion of rough resources was introduced in order to support pickup and delivery containers form any geographical locations. It is common practice that service providers distinguish price of delivery service by regions. In the picture below there is scenario of delivery containers from Hamburg by feeder to Szczecin and then by truck to Gadki and Krakow. The truck services are provided by rough resources with different quotation for every defined region. In this example there are 65 regions and Gadki belongs to region 18 and Krakow to 63.

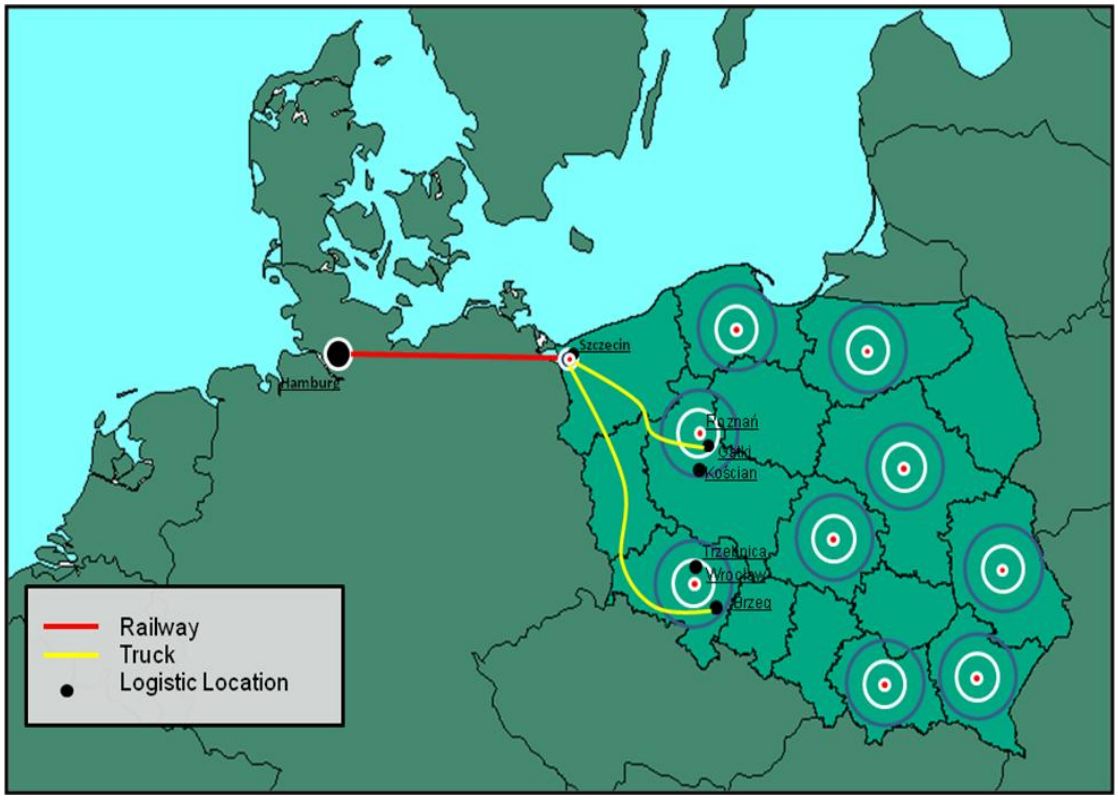
Fig. 5-8 Flexible resources - zones of services



Source; ILiM own study

In the following picture flexible resource are provided by service area. There is defined central location and range of distances from it. The further pickup or delivery place are the more expensive service are. Both types of flexible resources can help to cover geographical area and make feasible calculation of intermodal plan for any number of customers

Fig. 5-9 Flexible resources - service area



Source; ILiM own study

5.4. Calculation intermodal transport plan

The actual calculation process of delivery plan is executed after selection all orders, and gathering available resources. In addition system has to fulfill all defined constrains which include business, logistics and geographic conditions. Planner might decide that he has all resources to which he wants to assign transport orders or he need more form the market. In order to extend available logistic resources or find better alternatives he might substitute one resource by current offer from freight exchange market. After he get reply and confirm market transportation offers he can include them to planning process. Planer can even negotiation with all service providers which open possibility to request for better quotations. It can be particular useful in case of planning bulk transportation where services provider might give lower price in this case.

5.5. Planning of intermodal transport services

The concept of intermodal transport planning is depicted on UML sequential diagram in the picture below. It is composed of five main stages:

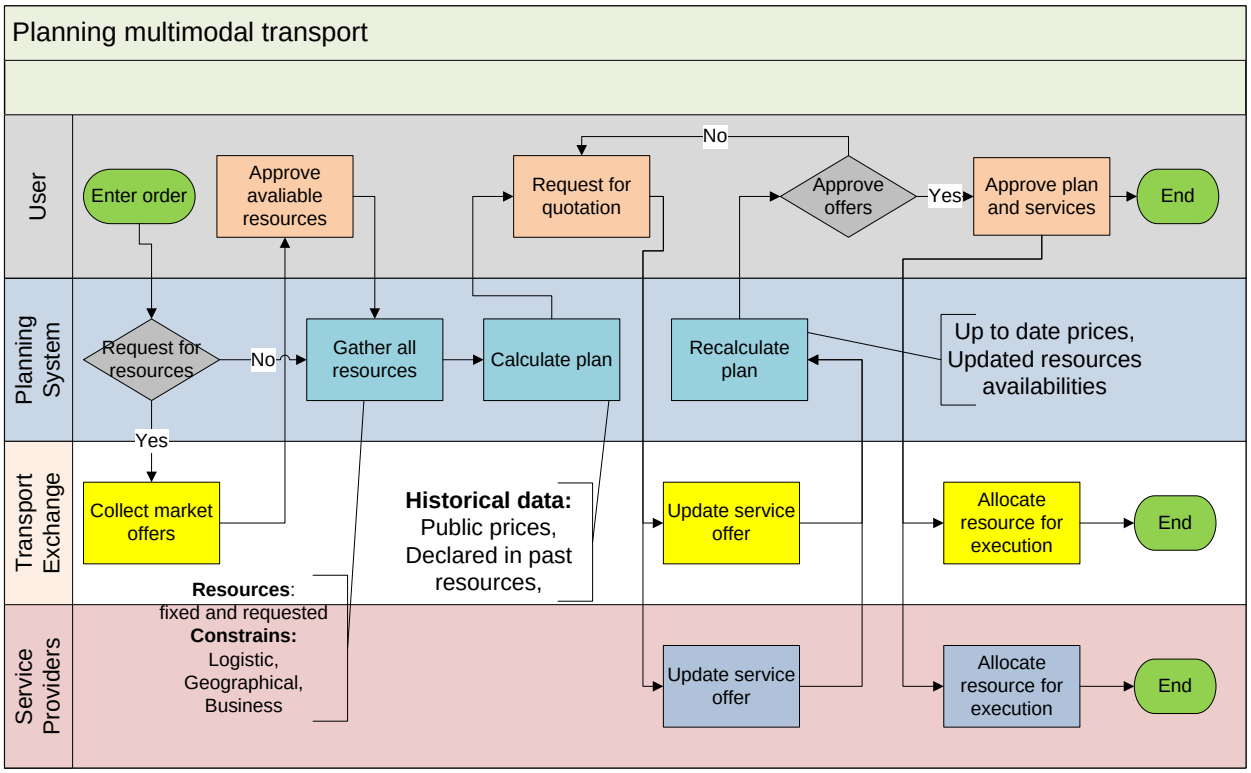
- collecting transportation market offers,
- gathering all system and resources constrains,
- calculate plan,
- negotiation with service provider for better transport service and
- selection the best transportation plan.

The system constrains include business, geographic and logistics condition which need to be fulfilled during computation of plan. Horizontal axes correspond to four actors of the system.

- user who wants to calculate intermodal delivery plan,
- information system,
- external transport exchange system,
- service providers which can render services for this particular plan.

The process begins at user channel from entering orders and sending request for resources to the Planning System. In response the external system can provide market offer which users need to approve and convert to resource used for planning. At this stage system gather all defined fixed and flexible resources from his local database and begin calculation of intermodal plan. Since the plan is computed users can began negotiation with service providers by requesting them for current quotation. He can get those information from freight exchange and from service providers. Again system computes intermodal plan. After users approves it the appropriate information about booking resources are send to transport exchange and all service providers. At this stage plan is ready for execution.

Fig. 5-10 The concept of the intermodal transport planning



Source : ILiM own study

5.6. Electronic communication module

The attractiveness of the ICT tool in consideration lies not only in supporting modal choice but also in possibility to conclude, control and settle a freight transport transaction. This operational module of the tool may be effective under condition of accepting the internal communication system by the participants.

Within a process of transport, lots of interactions occur between different types of business actors as logistics service clients and logistics service providers, between freight forwarders or the 4thPL integrators and sub-contracted partners. The number of interactions rises in case of multimodal supply chain where different logistics services are combined into comprehensive networks. These interactions are available due to the electronic data interchange. It is extremely important that communicating companies use the common set of electronic messages and common identifiers. These common electronic messages and identifiers are called standards.

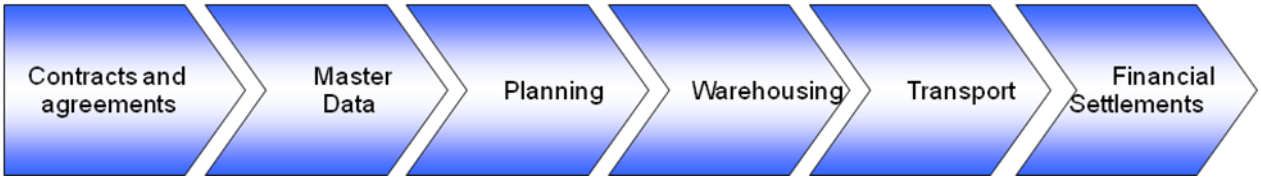
The problem is that there is diversity of communication standards. Large companies controlling their own supply chains use customized communication systems tailored to their individual needs. This creates a situation in which logistics companies providing their services for many clients and being the links in many

supply chains are forced to use several different communication systems. This diversity of standards is real bottleneck of the development of the ICT tools basing on co-operation of companies.

The effective implementation of the tool for optimizing modal choice, especially its operational module will also depend on mutual agreements on communication system for exchanging unified documents and messages. In transportation and logistics there were a few global initiatives for providing standards being recommended for the wide use. The two of them will be also recommended to be utilised in the tool's communication system.

One of them comes from a logistics forum within global GS1 organization where logistics standards working group has created a set of transport and logistics messages in GS1/XML standard. LIM - Logistics Interoperability Model contains the cooperation between logistics service provides and its business environment in all areas of cooperation from contracts and agreements through master data alignment, planning, warehousing, transport and financial agreement. [2]

Fig. 5-11 A range of processes supported by GS1 Logistics Interoperability Model. Source (GS1/LIM).



GS1 has elaborated the following standardised messages from the transport section of interoperability.

- **Transport Instruction**: The process to arrange the transport of the goods between parties including the delivery of goods, whether by request or as response.

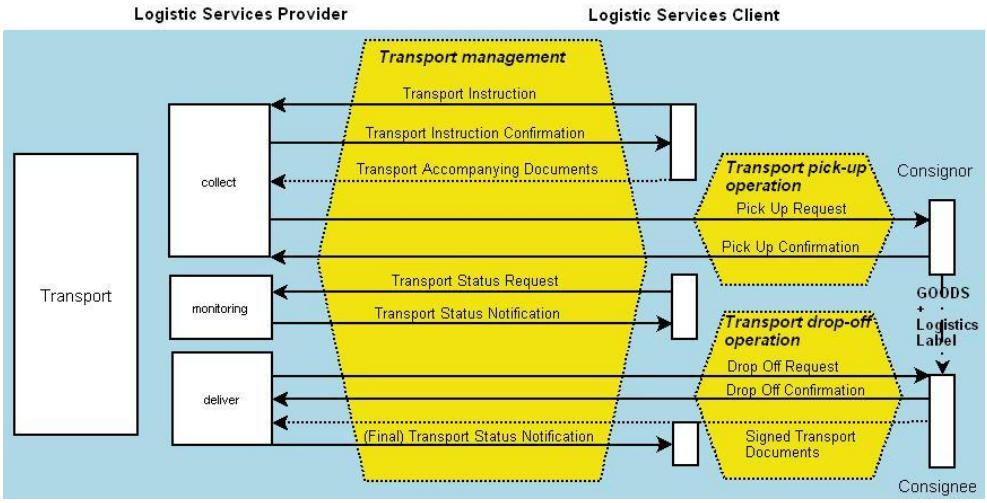
- **Transport Status**: The process to exchange the actual state of the transport between parties involved in the transport, whether by request or as a response.

- **Transport Pick Up Operations**: The process to arrange the loading of the goods, whether by request or as response.

- **Transport Drop Off** Operations The process to arrange the unloading of the goods, whether by request or as response.

[2] Set of transport messages is already released and was piloting in European project e-Freight and by Unilever company which was also engaged in develop process of those messages. The messages are available on the following website: *http://www.gs1.org/gsmp/kc/ecom/xml/xml_v_3* .

Fig. 5-12 Electronic messages exchanged in Transport process. Source (GS1/LIM).



Depending on the transport mode and type of services required the information exchanged in these four processes will vary.

- Road FTL
- Road LTL
- Short Range Air, Domestic Air,
- Rail
- Inland water
- Multimodal

The second initiative is a Common Framework developed in the FREIGHTWISE project. The Common Framework is not only about the standards of messages but also a model of interoperability between commercial actors and public authorities and units responsible for transportation network.

The messages developed in FREIGHTWISE became UBL (Universal Business Language) standards for transportation. Set of transport messages has been developed and it was agreed with the companies which were partners in this project. These standards then were verified in the next European project DISCWISE. Common Framework addresses interoperability issues at two main levels in a technology-independent way.

At the process and information level, the Common Framework is developed to ensure that only necessary and sufficient information is being exchanged, that the number of messages and their complexity is kept to a minimum, that the messages are unambiguous and that there will essentially be no need for business process harmonisation.

At the architectural level, the framework builds on open services platforms and self-configuring logistics networks and devices - to support Intelligent Cargo, Single Windows and other mechanisms for collaboration and monitoring.

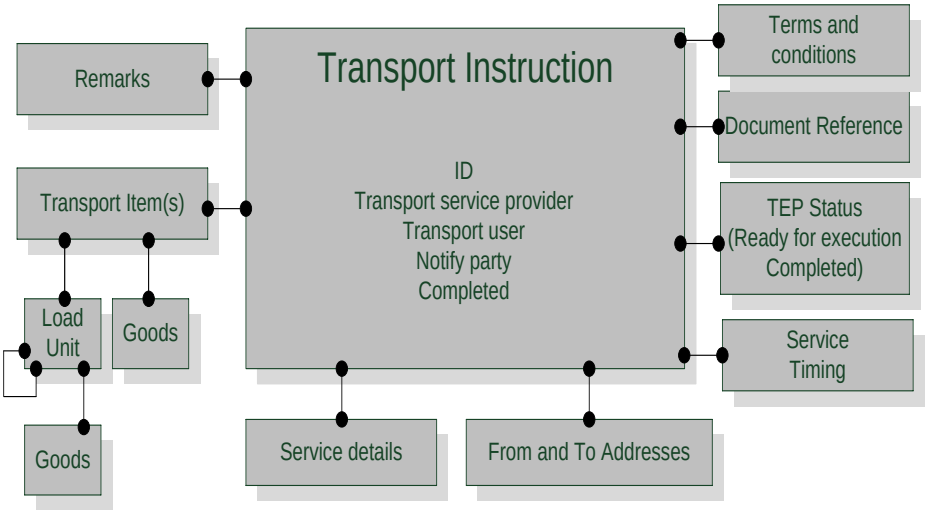
The Common Framework approach lowers the cost for companies to be electronically connected in transport and logistics, without forcing those who already have invested much in the area to stop using what they have. Close cooperation has been established with standardisation organisations. In addition to being deployed in industry, the Common Framework will provide a mechanism for current and new research and development project to provide interoperability of relevant results.

During the FREIGHTWISE and e-Freight projects there have been continuous discussions within the projects and between project participants and representatives from the logistics industry. The latter states that "all" needs identified in the processes Operational Planning, Execution, and Completion can be met by a well-defined "Transport Instruction" package and an associated status message. This, however requires that LSC and LSP have entered into a long term agreement where all terms and conditions have been defined and agreed.

Such long term agreements may not cover all eventualities. In the case where no long term agreement exists, interaction between LSC and LSP need to support negotiation of terms and conditions between the parties. This is needed when spot transport operations are required. It may also be needed in situations where transport initiated between LSCs and LSPs that have long term agreements between themselves, but where deviations during transport requires complete re-planning under conditions where the long term agreement are not valid. The "Transport Execution Plan" was developed to handle all forms of exchanges between Logistics Services Providers and their Clients related to individual transport services covering situations with or without long term agreement between LSCs and LSPs. Hence, the Common Framework will be based on this principle.

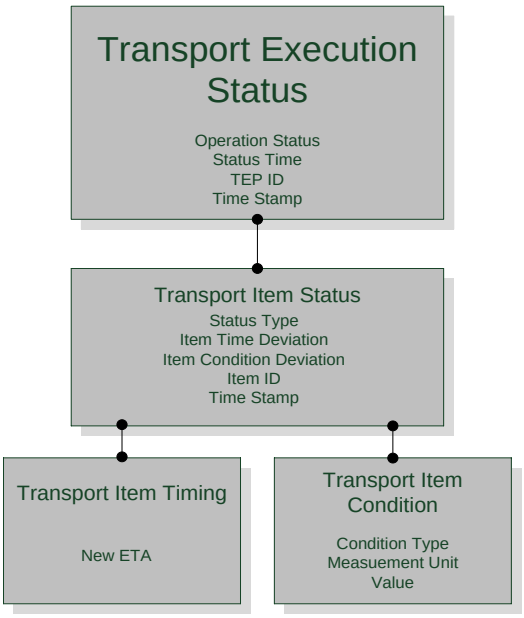
- **Transport Execution Plan (TEP)** – This contains all the information needed for a Logistics Service Client and a Logistics Services Provider related to the execution of a transport service. A Transport Instruction can be developed through several steps, or it can be created in one step only. This depends on the agreements already in place between the Logistics Services Client and the Logistics Services Provider, and the complexity of the service to be executed. The execution of a service can start when the Transport Instruction is marked "Ready for Execution". A Transport Instruction is identified by a unique identifier, valid for the relationship between a given Logistics Services Client and a given Logistics Services Provider.

Fig. 5-13 Structure of transport instruction. Source (Freightwise).



- **Transport Execution Status (TES)** – The Transport Execution Status information package gives the status for a Transport Instruction. The identifier of the Transport Instruction is needed. The status is marked as Boolean, either there is a deviation, or not. If there is a deviation, the identifier(s) of the transport item(s) causing the deviation is given. If there is deviation on a Transport Execution, this information package gives the status of the involved transport item(s). The type of deviation is given.

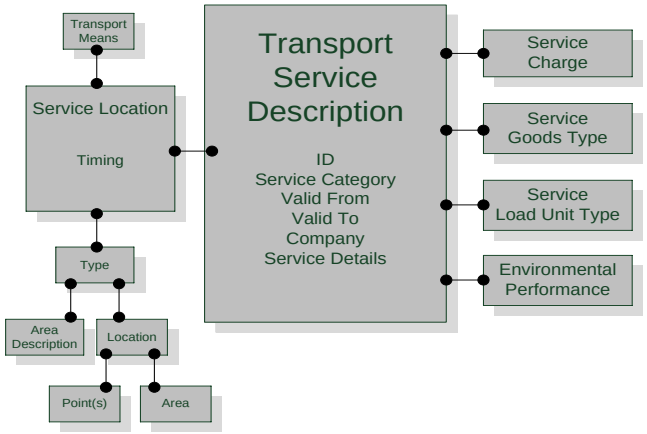
Fig. 5-14 Transport Execution Status. Source (Freightwise).



It is important that the information that is exchanged enables all stakeholders to perform well. Hence, information needs to be necessary and sufficient. The two messages described above are necessary, but three more are needed in order to make the communication between Transport Demand and Transport Supply complete:

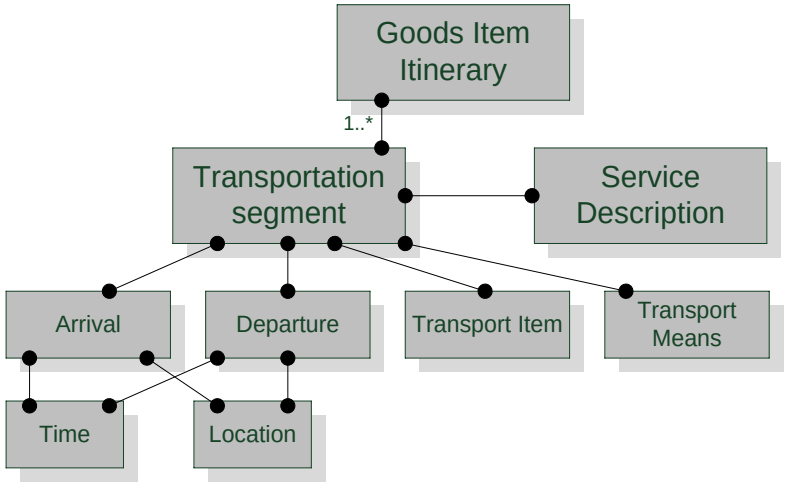
- **Transport Service Description (TSD)** – This is the information that any Logistics Services Provider needs to communicate to Logistics Services Clients (potential clients) such that they may use the information about the service provided when the need for transport has been established. This is an attempt to define a standard way of describing transport services such that they will be "searchable" and such that individual services may be automatically connected into transport (supply) chains.

Fig. 5-15 Transport Service Description. Source (Freightwise).



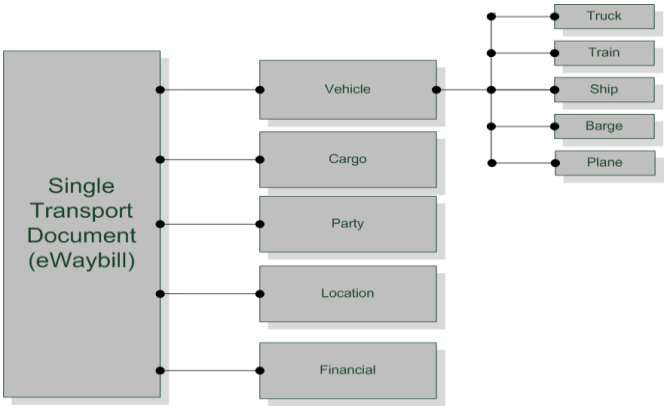
- **Goods Item Itinerary (GII)** – All door-to-door transport operations using more than one mode of transport, and many of those that use only one mode, are not direct services being provided without transhipment. Hence, it is necessary to be able to describe the complete itinerary for a given goods item. The Goods Item Itinerary provides this capability and the planned, estimated, and actual times for departure and arrival for each service, or segment is included. This means that information in the GII may later be used to trace the exact movement of goods through a supply chain. It is communicated from the Logistics Services Provider to Logistics Services Client when the Transport Instruction is marked "Ready for Execution".

Fig. 5-16 Goods Item Itinerary. Source (Freightwise).



- **The Single Transport Document (STD)**- This document may also be called the multimodal **eWaybill**. A Waybill is issued by the Logistics Services Provider to the Logistics Services Client. It states the details of the transportation, charges, and terms and conditions under which the transportation service is provided. A Waybill is not negotiable and cannot be assigned to a third party, it essentially a confirmation that the transport will be performed.

Fig. 5-17 Single Transport Document. Source (Freightwise).



The UBL standard for transportation contains the following messages :

TSD Transport Service Description – a standard description of transport services suitable for automatic detection

TEP Transport Execution Plan– describing all the information needed related to the execution of a transport service.

GII Goods Item Itinerary – providing information about the movement of the goods (possibly through a chain of services)

TES Transport Execution Status – providing information about the progress of the transport and of the cargo condition

STD Standard Transport Document – providing a multimodal eWaybill signifying that an agreement to transport cargo has been reached

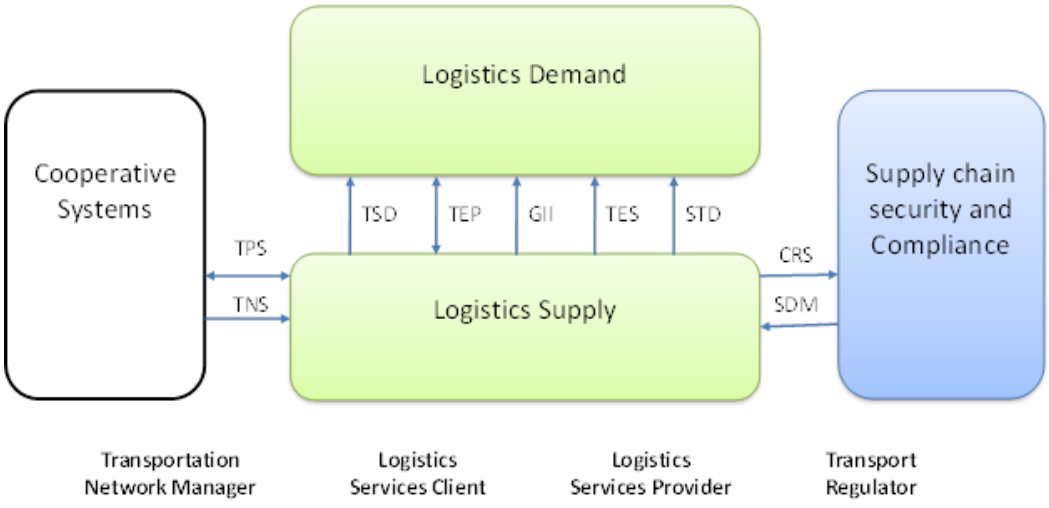
CRS Common Regulatory Schema – providing a unified way of informing authorities about transport such that compliance may be verified.

SDM Security Data Message – providing information about the security of a sealed load unit.

TPS Transport Progress Status – assisting in establishing the best possible arrival time estimates

TNS Transportation Network Status – not suggested as a new standard, but a pointer to messages providing such information for the different transport modes.

Fig. 5-18 Common Framework information exchange (Source: Discwise Project)



5.7. Consolidation of loads

As we stated earlier consolidation of shipments is a way that allows small companies to take advantage of the intermodal transport solutions.

One manner of consolidation is sharing one road chassis for carrying two 20FT boxes by two shippers ordering transport from close located points of loading up to close points of unload. Another, much more effective way of consolidation of containerized shipments may be made by consortia of the small

companies in order to obtain volume discounts. This is why the additional module managing consolidation of loads has to be incorporated into the transport optimization platform.

5.7.1. Need for consolidation of loads

In the age of rapid economic changes, companies are forced to continuously search for ways of cost rationalization. For manufacturing and distribution companies reduction of logistics costs and in particular transport ones is the most important. Obtaining this target depends on their ability to make process analysis of transport activities as well as being open to new logistics management concepts.

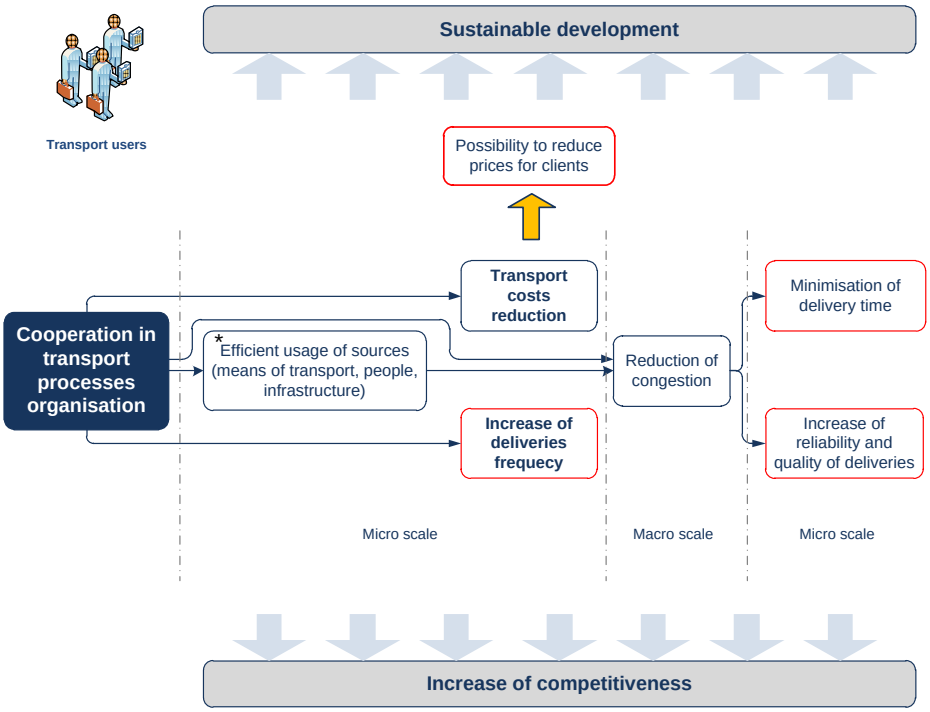
The analyses prove that in many cases transport costs account for more than 50% of total logistics costs. As a result, more and more companies have started to pay particular attention to them and make attempts to optimize them. Most companies have already noticed that effective transport process organisation has a great influence on their current performance, which determines total company costs. It has resulted in creating many methods of business process realization and reengineering.

From manufacturing and distribution companies perspective customer requirements are always in the first place and the whole transport and distribution process should be designed to meet them. Customers tend to require more frequent supplies of small lots of cargo performed in the shortest possible time. Because of time pressure suppliers decide to focus on road transport. But frequent and quick deliveries require more transport means to be involved, which makes traffic congestion bigger and road safety worse. Growing traffic congestion decreases the average technical speed of vehicles, which makes delivery time longer. Longer delivery time can cause customer dissatisfaction and, in the worst case, loss of some orders.

5.7.2. Shared Supply Chain Concept

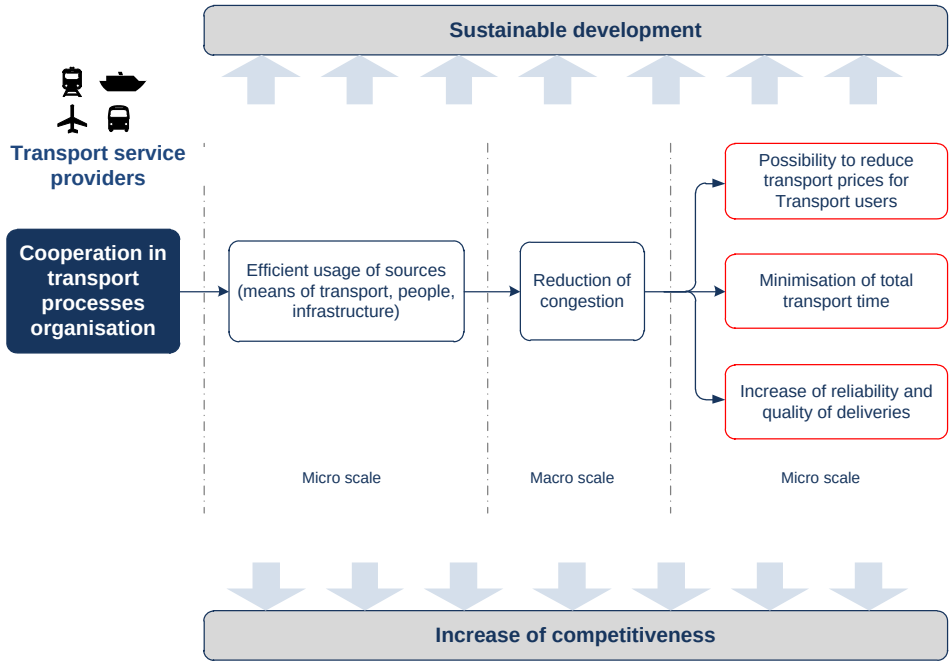
Taking into account these trends there is demand for the ICT tools that will provide solutions for co-operation between group of companies to increase their competitiveness by consolidation of their loads. In the two figures beneath the benefits of transport users and transport service providers resulting from a Shared Supply Chain initiatives are shown

Fig. 5-19 Benefits for the transport users from participation in the Shared Supply Chains



Source: Hajdul M, 2009

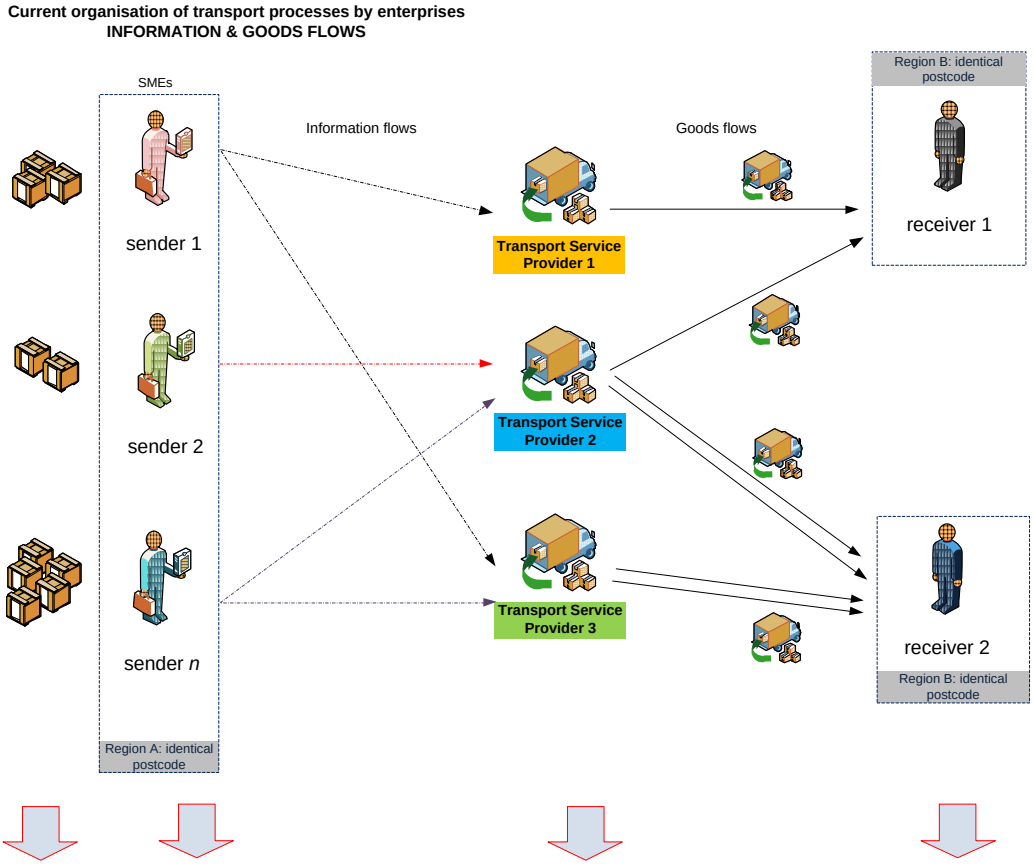
Fig. 5-20 Benefits for the transport service providers from participation in the Shared Supply Chains



Source: Hajdul M, 2009

In traditional organisational models of the transport process, manufacturers or distributors concentrate on fulfilling everyday orders from customers and ordering goods from their suppliers, as presented in figure 5-21. Delivery and distribution of finished goods can be carried out with the use of their own transport resources or by a specialized transport/forwarding company.

Fig. 5-21 Traditional way of organizing transport process



- High unit transport costs (e.g. per one parcel) as a result of small amount of cargo to send.

- No cooperation in transport processes organisation results in selection of different transport service providers;
- No IT tools to support cooperation in transport processes organisation
- Different standards describing the same localisation, type of goods and transport needs
- Not an attractive customer for intermodal service providers

- Load factor at low level (around 50%) in road transport results in high transport price for individual senders
- Increased congestion
- Too small amount of cargo to provide attactive offer concerning intermodal haulages.

- Necessity of receiving several small deliveries instead of one aggregated results in higher logistics costs and is time consuming.

Source: Hajdul M, 2009

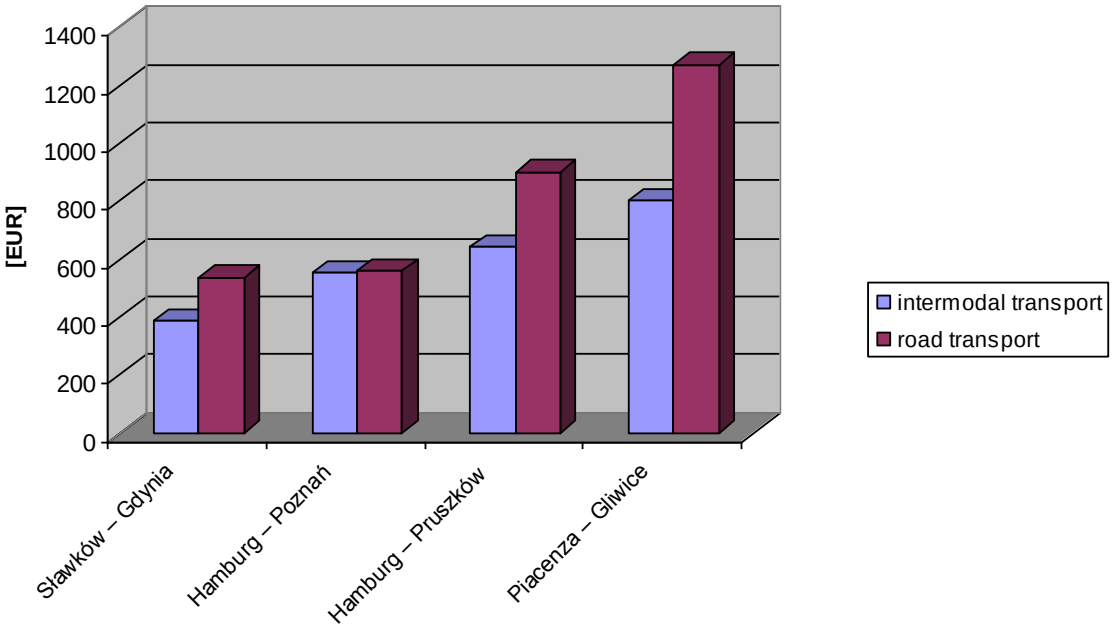
The source of the benefits from participation in the Shared Supply Chains is the general rule is that transport companies offer lower unit price for larger delivery quantities. For both cases, whether transport is undertaken by the company or by an external provider, the cost per weight unit declines with the increase of delivery weight.

Unfortunately, the current trend for more frequent and small deliveries results in increasingly high transport costs. Furthermore, the number of delivery trucks is also increasing, which worsens traffic congestion and, as a result, leads to longer delivery times, which is another disadvantage.

5.7.3. How the Shared Supply Chain concept may be used in the containerized transport sector.

A similar study has compared the intermodal and road transport costs, using the examples of one 20-foot and 40-foot containers being carried out on 4 selected routes. It was assumed that the main route in Europe will be by rail, for intermodal transport, compared with road only, and it was also assumed that average distance between container terminal/logistics centre and point of destination is 50km. Figure 5-22 compares 40-foot container road and intermodal transport (road-rail) cost on 4 routes.

Fig. 5-22 Comparison of 40-foot container transport costs on selected routes



Source: ILIM own study

The comparison shows that in some parts of the Europe an intermodal solution can be cheaper than road haulage. The simulation shows that intermodal haulages can be attractive for companies on medium and long routes, and that the cost saving directly depends on the number of containers which are being transported. As for road transport, the cost per weight unit declines with the increase of delivery weight. The calculations assumed a 30% transport operator's margin, so the price of intermodal haulages could be reduced still further if all actors involved in transport processes agreed on new terms. However, this statement depends on many local constraints, cannot be generalized and should be verified in different EU regions.

One crucial constraint for SMEs, as well as for some large companies, looking to use intermodal haulage is that smaller volumes are less able to benefit from this type of transport (e.g. one or two containers per week). For this type of clients, transport service providers in many cases cannot offer a better price than for road transport. Nevertheless, vertical cooperation between transport users can support the process of aggregation of goods. Furthermore it also supports increasing of transport order size, which makes it viable to use intermodal transport instead of road transport, and to achieve a significant reduction of costs.

It is envisaged that the project will provide solid recommendations and best practice in order to make supply chain sharing a common practice wherever applicable.In order to achieve that, the future activities concerning intermodal transport development should focus in particular on:

- guidelines on information sharing based on the Common Framework or any other joint
- communication standard,
- practical web-accessible tools enabling automated information exchange between involved
- parties within the whole supply chain in order to start vertical cooperation between companies to reduce transport cost (road, as well as intermodal),
- increase usage of intermodal haulages through vertical cooperation
- some possible pre-defined scenarios, based on
    - product categories,
    - current distribution network set-up,
    - geographies,
    - scale economies,
- guidelines on ordering processes optimisation within the supply chains,
- other changes to present operations that are envisaged,
- cost and value analyses for transport users, as well as service providers,
- key performance indicators.

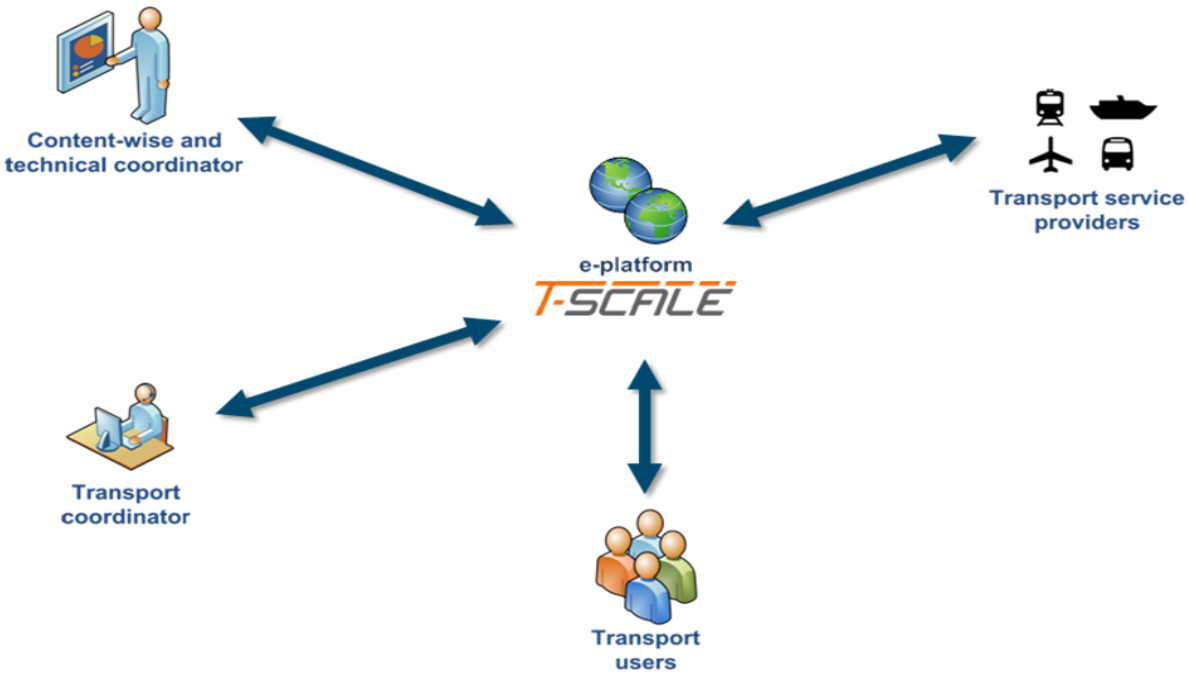
5.7.4. Concept of joint organisation of intermodal transport processes

The idea of new concept of joint organization of intermodal transport processes focus on elimination of bottlenecks presented earlier and stimulation of consolidation of containerized cargo. The new business model assumed vertical and horizontal cooperation between logistics service clients (consignees, consignors) and transport service providers (SMEs), with the aim of increasing the load factor, reducing transport costs and exploiting co-modality concept (use of different modes on their own and in combination in the aim to obtain an optimal and sustainable utilisation of resources). Therefore, this solution supports intermodality where it is possible.

This cooperative business model requires sharing knowledge and information along the supply chain, according to the reference architecture. To achieve this, the information and communication systems and/or decentralized e-logistics platform used for managing transport and logistics operation need to interact efficiently and share information. They must be interoperable and the actors must be able to share that information according to their own business rules.

Four actors categories that perform dedicated roles are defined in the reference model

Fig. 5-23 Roles within the new transport processes organisation model



Source: ILIM own study

Users of logistics processes (service recipients) – companies producing and/or distributing and selling products. Logistics is not their main source of activity and has only a supporting role to achieve the main objectives. These companies may have their own resources to implement selected logistics processes or collaborate with service providers (e.g. logistics operators). As users of selected transport processes they generate specific needs in the form of orders (e.g. for transport). Contracts for carrying out specific services are concluded between users and providers of logistics services.

Logistics service providers (service providers) – companies whose main activity is the provision of logistics services. In the model, their task is to fulfil common logistic needs of cooperating companies - users.

Transport Coordinator – this is an independent entity delegated by the other two groups, whose task is to obtain economies of scale. They also have powers to enable meeting the needs of a group of cooperating companies, related to organization of logistics processes. For example, with the process of movement of goods, they coordinate transport processes (e.g. analysis of possible to combine transport orders of various users, price negotiations, selection of branches of transport), cooperation with providers of transport services, monitoring the implementation of joint transport processes, conducting analyses at micro and macro level. The coordinator may also act locally and focus on handling a selected process or group of companies in the region. They can also operate globally, collaborating with local coordinators, in order to achieve even greater economies of scale.

The role of coordinator can be realized in several ways. It may be the position funded by the cooperating companies. Coordinator may be an independent economic entity supporting coordination of logistics processes, which invoices users based on the number of orders executed. Finally, it may be a forwarding company, operating exclusively for handling the companies which have decided to cooperate in organizing transport processes. All this depends on the arrangements between independent entities which decide to undertake cooperation.

Content-wise and technical coordinator - this is an independent entity who is a software provider, responsible for maintenance of the system. He is also playing as an independent auditor of the transport coordinator and transport users. His participation focuses on impartial assurance

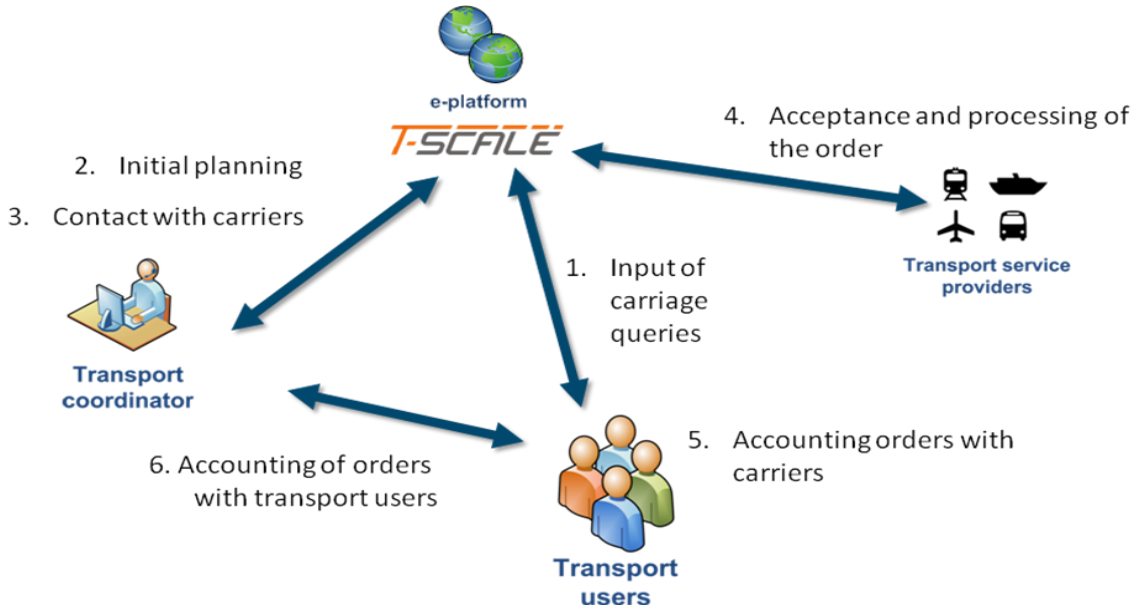
5.7.5. T-Scale platform as a tool supporting consolidation of containerized cargo

One of the key issues during implementation of containerized cargo consolidation is to ensure efficient, quick and safe exchange of information between different transport users and internal IT tools. One of the recently developed solutions which facilitates the exchange of information in real time between entities involved in the transport (transport user, transport service provider, coordinator) is T-Scale platform.

The purpose of cooperation within T-Scale platform is to optimise transport costs, owing to economies of scale at balanced use of group's resources. The cooperation will also contribute to reduction of company costs related to transport organisation, by transferring selected responsibilities to transport coordinator. The cooperation of independent companies is also a way to increase the availability of cargo space. Yet another benefit is the reduction of traffic, i.e. decrease in the negative impact of road transport on the environment.

As opposed to the existing transport exchanges (for road transport, like timocom), T-Scale gives an opportunity to coordinate and consolidate orders, which translates to transport cost optimisation resulting from the economies of scale. The general process within T-Scale platform is easy to implement.

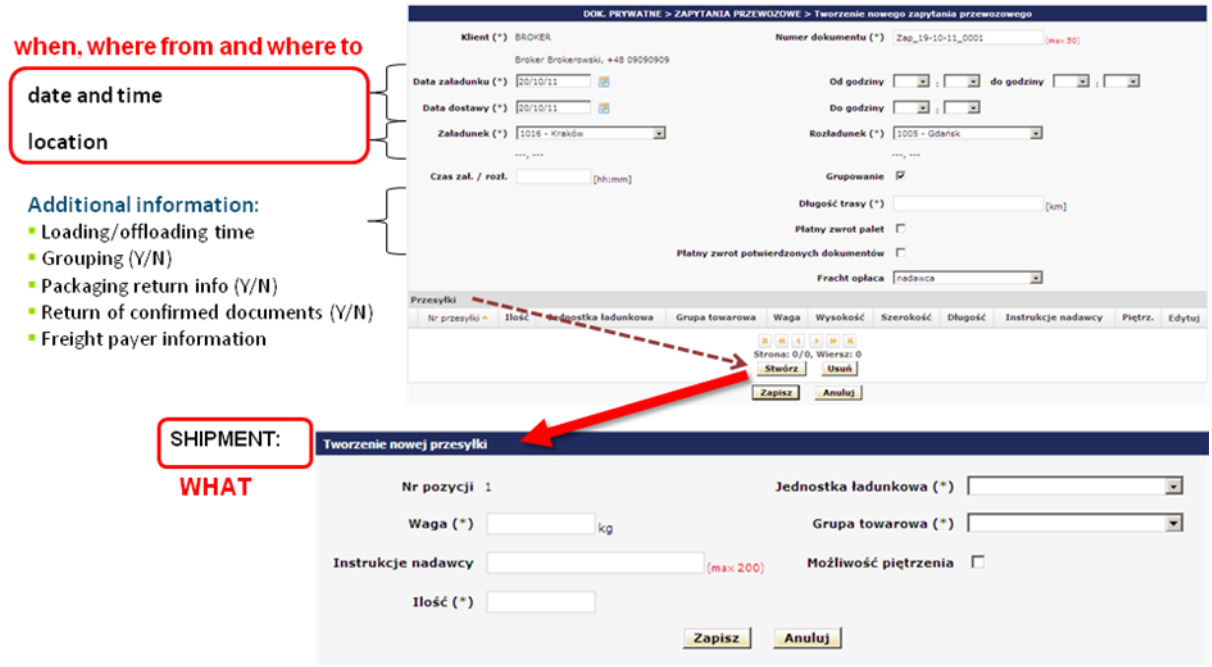
Fig. 5-24 Overview of the information flow on the T-Scale platform



Source: ILIM own study

What is really important to achieve consolidation only exchange of basic transport details are crucial.

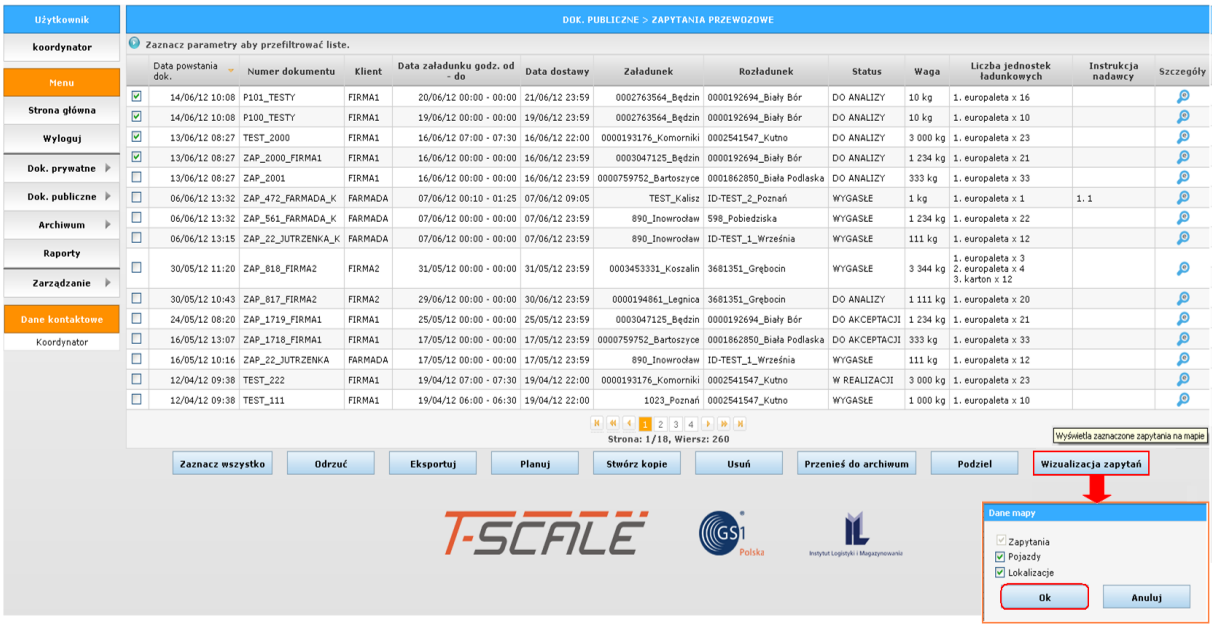
Fig. 5-25 Basic data structure describing transport needs on the platform



Source: ILIM own study

In the next step transport coordinator can see all transport requests from the transport users.

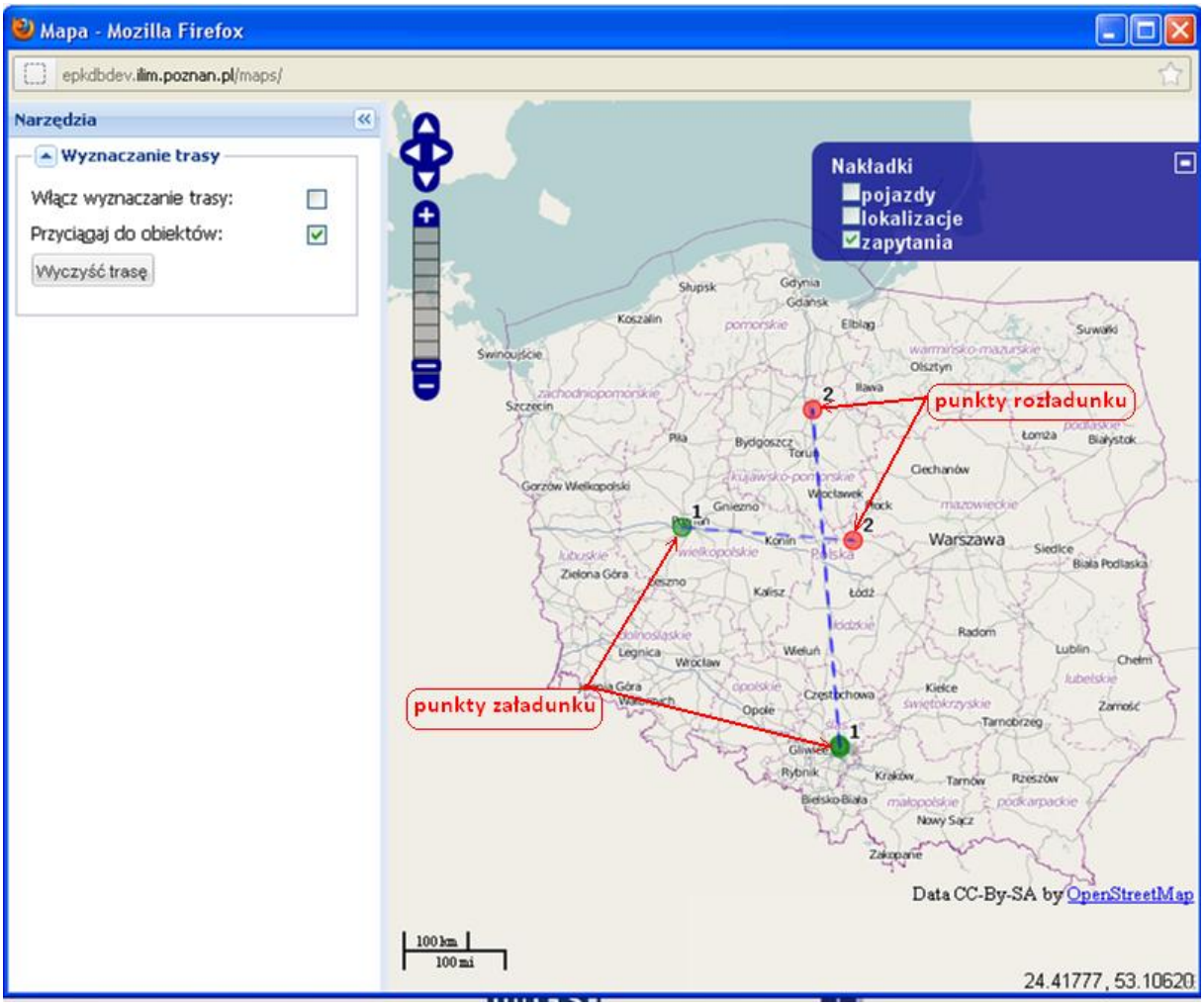
Fig. 5-26 General overview of the transport request on the platform



Source: ILIM own study

Based in that information he can visualise individual request on the map and create consolidated transport plans. Each of request is characterised by information which is necessary to execute consolidation.

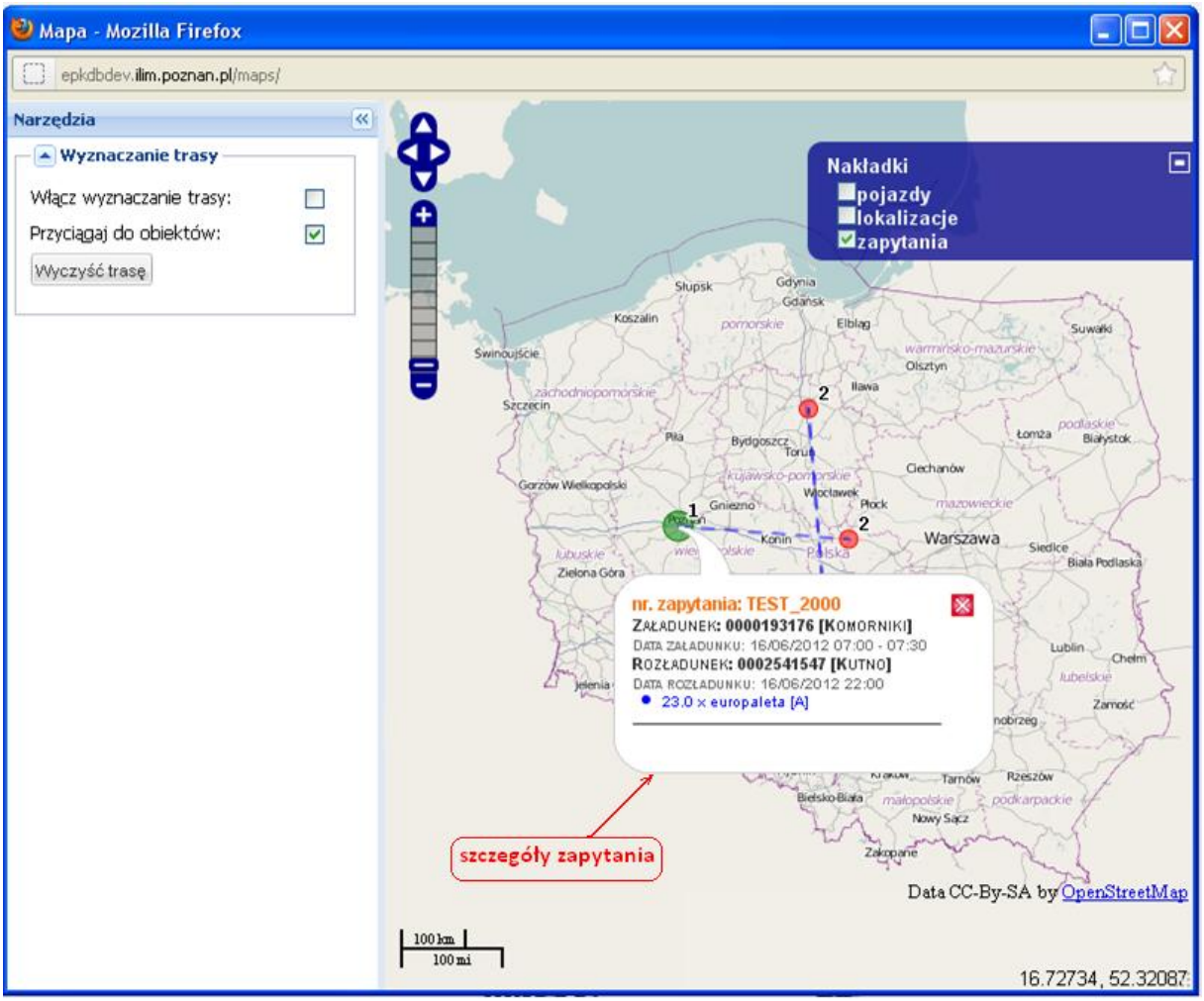
Fig. 5-27 Visualisation of the possible routes on the platform



Source: ILIM own study

In the next step, based on the information (live update via GPS or SMS) in the system, transport coordinator is able to select precise transport route and choose the best transport providers for each of the leg of intermodal route.

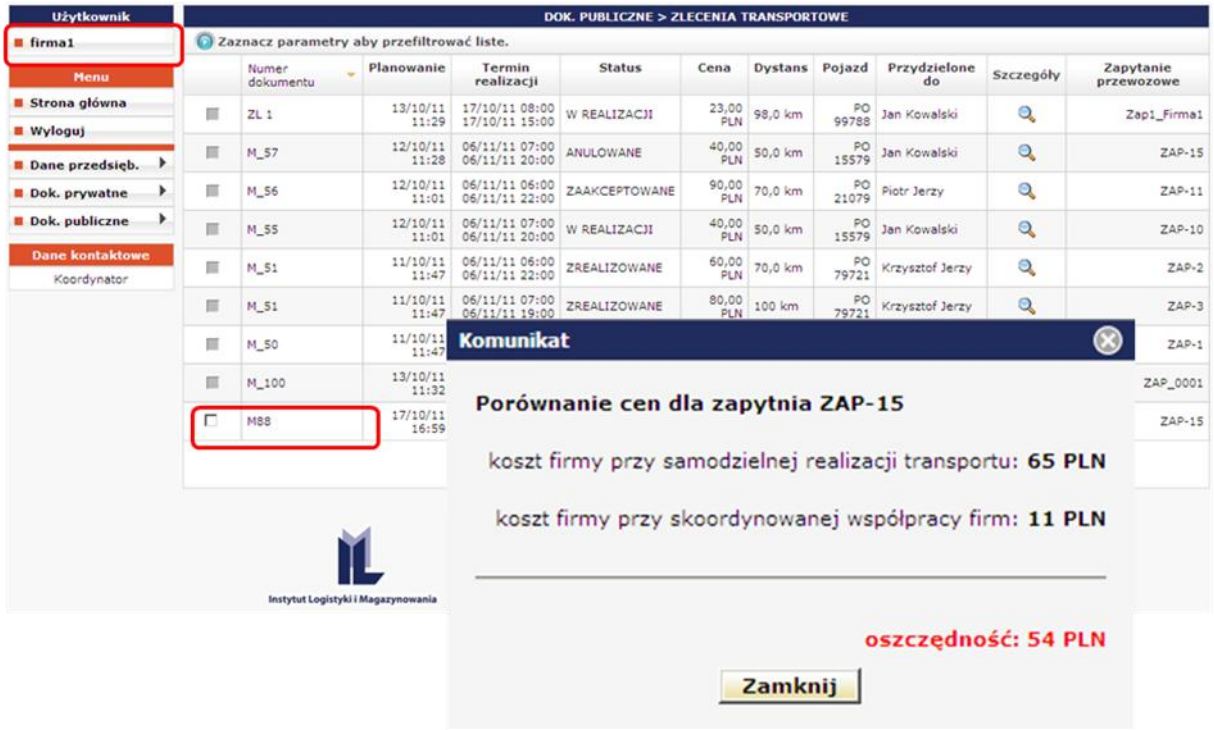
Fig. 5-28 Visualisation of the possible routes on the platform



Source: ILIM own study

Finally, the transport user can see offer which was achieved through consolidation of his transport request with request of other transport users. Moreover, transport user is able to compare new suggested transport costs with price that he had paid on the same route in the past.

Fig. 5-29 Comparison of transport costs for individual transport requests



Source: ILIM own study

Currently, this platform allows only consolidation of cargo for road transport. Algorithms optimizing selection of road transport providers are implemented. Therefore, T-Scale platform can be used for containerized cargo consolidation and intermodal transport planning after implementation of the following minor changes:

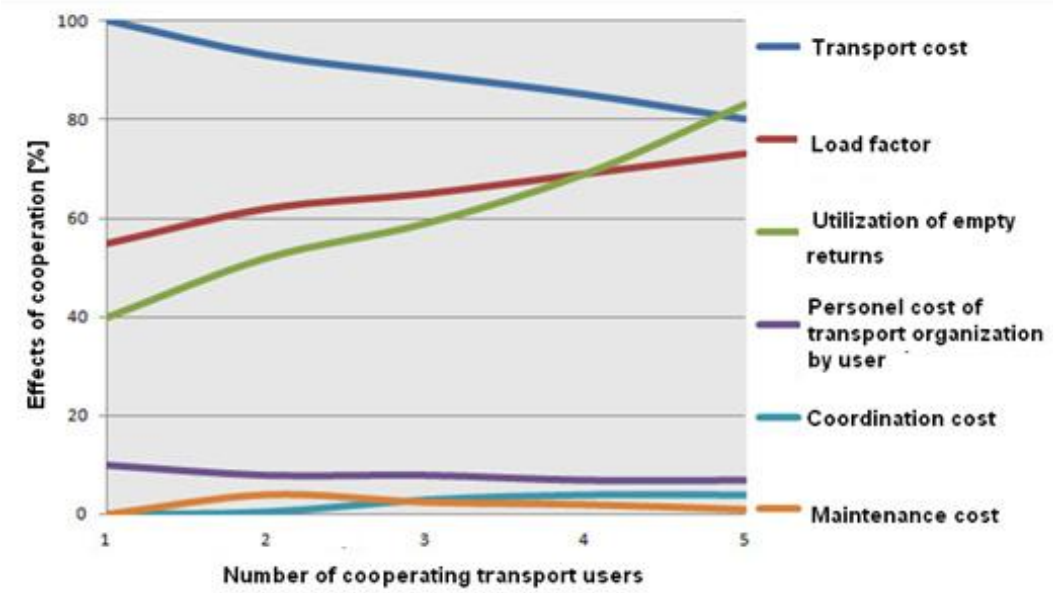
- Detailed digital map of intermodal infrastructure in Europe (localization of container terminals, logistics centers).
- Detailed information concerning intermodal services in Europe offered by different transport service providers.
- Modification in existing planning algorithm.
- Modification in visualization of intermodal infrastructure.
- Modification of transport cost calculator.
- Preparation of multi-language version.

5.7.6. Lessons learned

The idea of consolidation of containerized cargo with support of T-Scale platform led to the following conclusions and insights:

- There is a need and a niche for ICT solutions supporting vertical and horizontal cooperation of independent companies with the support of standardized data exchange like Common Framework.
- Implementation of the consolidation model in the group of small and medium shippers (producers, distributors) allows them to reduce transport costs through achieving the economy of scale effects.
- For many intermodal service providers, the minimum number of containers which can be accepted for transport is 5 pcs. of 20 feet containers. SMEs mostly do not have enough containers, are not an attractive player for intermodal service provider and therefore are forced to use only road transport. This drawback can be eliminated through acting as a group of companies which is represented by the coordinator.
- In road transport users achieved significant improvements (figure 5-30). Therefore, it might be assumed that for other transport modes similar results can be also achieved.

Fig. 5-30 Practical results of implementing Common Framework and T-Scale platform in selected group of small, medium and big companies from ECR Poland



Source: ILIM own study

6. Deployment plan

6.1. Basic implementation variants

As it was mentioned earlier the analysed type of the ICT tool may be implemented in two basic versions as an in-house solution customized to the heeds of an individual enterprise or as an open web based application.

In-house solution

An in-house version may be implemented by a company (shipper or freight forwarder) willing to manage and optimise the whole supply chain. As a result of progressing process of outsourcing of logistics activities the tool is expected to become interesting especially for the large forwarding companies. Some of them already started to develop their own optimisation tools. Implementation process in such a case is more easy – especially in such aspects as:

- building data bases of logistics quotations – because transport service providers will eagerly provide customers with all required data hoping for being constant part of the supply chain,
- establishment of the internal electronic communications system tailored to the requirements of the enterprise managing the supply chain.

Open Internet platform.

The public version of the tool securing full access is much more difficult in implementation phase. First, it has to be clear that such a platform is a commercial enterprise. Income from service fee shall cover building data bases and platform development and maintenance. It means that the initial phase of implementation may be risky from the financial point of view.

The process of implementation of the public version of the tool is determined by many limitations and difficulties that may be classified as resulting from;

- market trends
- attitudes of decision makers
- development of ICT

<u>Market trends</u>

As it was stated earlier freight transport market is flexible and complex structure. Service providers may be direct carriers being owners of transport means as well as different kinds of brokers as freight forwarders or more advanced the 4th PL integrators of services rendered by sub-contractors. Sub-contracting in

logistics is common occurrence. The networks of cooperating logistics service providers are usually build on mid – or long term agreements however such alliances are changeable as result of mergers or not keeping key performance indicators by some chain participants. It is why freight transport market is completely not transparent for their clients

Another characteristic feature of logistics industry is change of competition nature that is becoming from competition between companies to rivalry of entire supply chains therefore it is extremely important to improve the quality of cooperation of companies in such aspects as interoperability of services, joint efforts for shortening transit time and reduction of logistics expenses in order to obtain competitive advantage of a chain as a whole. It is also characteristic that logistics companies cooperating in one supply chain are competitors in the others . This duality of functions also weakens mutual trust and transparency of the market.

Attitudes of transport decision makers

Logistics markets are diversified in terms of size of companies rendering this kind of services. Besides thousands of small carriers there are large logistics operators rendering comprehensive logistics services Large logistics companies are focused mainly on large customers. Although small shippers represent together significant potential reaching ca, 50% of loads to be transported, they do not benefit from effect of scale due to individual small volumes

Additionally large transport operators are not much interested in selling their services through open internet platforms. It looks that there is no large demand yet for such form of transport services purchase. Bigger shippers prefer to arrange their transport needs with freight forwarders in the form of direct negotiations.

Development of ICT sector

There is still poor choice of the universal ICT applications managing cooperation of many companies along supply chains. Implementing cooperation based on sharing information is relatively easy in individual supply chains being customized to the needs of company managing it. Diversity of communication standards and forms of electronic messages and documents however are the main reasons for lack of universal communication system being widely used.

6.2. Tool's data base building issues

Complex data bases are the central part of the tools supporting intermodal supply chains planning Efficiency of these applications relay on their completeness and timeliness. The creation process however is much challenging.

6.2.1. Geographical scope of data bases

Building data bases means gathering and updating data received from the transport operators representing different modes of transport. First of all time schedules, transit time and transport expenses Since this is time consuming process it is expected that data bases will be built gradually corridor by corridor.

Selection of the corridors is a crucial decision determining tool's efficiency. Only corridors providing modal competitive environment shall be taken into account. It is the most likely to happen in containerised transports leading from the sea ports to the final inland destination (and vice versa)

Large quantities of containers are sent through intercontinental supply chains. Flows destined for European customers usually reach one of the gateway ports as Rotterdam, Antwerp, Hamburg, Bremerhaven and many others. From there containers may be transported alternatively on road chassis, by container train or on barge. Containers may be also transferred to another sea port being closer to the final receiver with the use of smaller container vessels called feeders.

From the perspective of each country of the Baltic Sea Region such alternative containerised transport corridors may be marked out. In case of Poland for example deliveries go traditionally along Hamburg, Bremerhaven, Rotterdam or Antwerp. For the last two years direct deliveries through the port of Gdansk proved to be an absolute hit on the market. Due to deepening the port entrance Deepwater Container Terminal in Gdansk may receive large ocean going container vessels carrying 15.000 TEU. Recently, the new competitive connection through the port of Koper was launched. Swedish receivers may consider deliveries through Rotterdam, Hamburg or Gothenburg. Finnish clients may evaluate alternatives of Hamburg or Gdansk while Russian importers may additionally think over proposals of Klajpeda or Riga.

In strictly overland transports, unrelated to the intercontinental traffic, containers are not commonly used due to the problem of return of empties. The most likely is establishing balanced dedicated connections between co-operating companies with the use of containers or swap bodies. Such connections will not probably offer the access to other shippers.

6.2.2. Registration of locations

Contrary to ICT applications for planning passenger journeys based on time-schedules, in freight transport we face unlimited number of locations that may become starting or final point of the transport process. All of them must be clearly identifiable. The practical solution utilized here base on zip-codes. Geographic coordinates are much more precise and shall supplement the system to reach ambiguity.

6.2.3. Registration of logistics service providers

As it was mentioned earlier the structure of the freight transport market is complex. The number of companies rendering logistics services increases due to growing outsourcing. Specialisation leads to common sub-contracting. On the other hand often occurring effect of simultaneous partnership between a logistics service provider and other companies in one supply chain and competition towards the same companies in the other supply chain evokes not transparent market.

How to make it transparent for the tool's users? Gathering data from the freight forwarders and their sub-contractors may create conflict situation. So, collecting process shall be preceded by market research in order to be able to build compatible supply chains.

Let's trace the process of transport of container leading from the Far East to Europe in order to define what kind of freight transport actors we can contact with to order this service. Let it be route from Shanghai to Warsaw. Whom is expected to contact a Polish client willing to transport container containing the goods he had purchased on FOB Shanghai basis (i.e. he will pay freight charges on the whole route from Shanghai to Warsaw) ? He can approach to fulfil its task in two ways.

First, he may ask for the door-to-door service, so he will contact shipping lines or freight forwarders to quote. But he may also ask for quotations referring to transport on particular sections of the route. There are at least 2 of them :

- Ocean sail from Shanghai to one of the gateway European ports (Hamburg, Rotterdam, Gdansk e.t.c.).
- Overland delivery from this gateway port up to the unloading place in Warsaw by road or on rails But container landing in Rotterdam for example may be also transferred to one of the Polish ports (Gdansk, Gdynia, Szczecin) to continue its journey on road or rail chassis.

The first, ocean section is domain of shipping lines. Additionally some large freight forwarding companies acting as non vessel operating common carriers (NVOOC)[3] may offer equally competitive rates.

[3] A shipment consolidator or freight forwarder who does not own any vessel, but functions as a carrier by issuing its own bills of lading or air waybills and assuming responsibility for the shipments.

The second route section offers much more opportunities.

- road transport – it is the most diversified freight transport sector. Inquiry may be sent to :
  - freight forwarder,
  - large trucking company specialised in transport of containers
  - small tracking company – they usually offer the most competitive rates.

- rail transport - there are few intermodal transport operators managing their own Europe wide transport network of container terminals. They usually offer door-to door deliveries – from the port of unloading up to the final destination including so called „last mile" delivery performed with the use of road chassis – from the last rail terminal up to the receiver. Some of the intermodal operators sell their services by themselves, the other rely in 100% on contracts with shipping companies and freight forwarders.

- short-sea deliveries - the operators of feeders – small container vessels carrying usually 500-1.500 TEU - sail between gateway ports and other ports being closer to the receiving markets. They usually (at least in Poland) are focused on maritime deliveries not offering hinterland on-carriage.

So summarising, following the way of thinking of this exemplary Polish importer the data base may be build with

- offers covering the whole route from shipping lines and NVOOC operators
- offers relating to defined sections of the route from
  - shipping lines and NVOOC operators (ocean),
  - intermodal operators (hinterland rail including last mile road transport),
  - tracking companies (hinterland-road),
  - feeder operators (maritime port-to-port).
  -

The data base structure has to allow the user to chose between these two main attitudes:

- arrange door-to-door delivery – which is slightly more expensive but a shipper is free from the risk of building not compatible or not interoperable supply chain,

- plan deliveries leg-by-leg. In building data base interoperability between particular links has to be checked. It means interoperability allowing smooth transhipment from transport technology point of view as well as taking into account co-operation alliances.

As we stated earlier – large transport operators are not much interested in selling their services through the open internet platforms preferring mutual direct negotiations. As we have seen in specification of actors being active along the Far East – Europe transport corridor big logistics services providers control

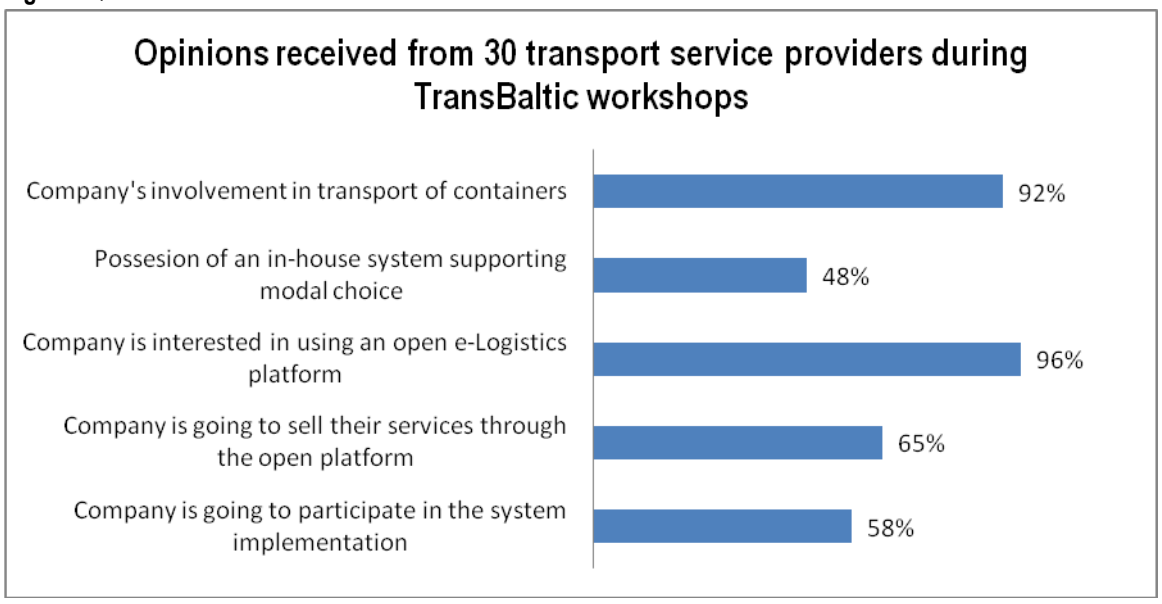
large part of the freight market. The degree of their participation in building data base process will determine efficiency of the tool as well as correctness of rankings of the best transport solutions on the given route being the base for shippers' modal choice.

During the demonstration of the tool for shippers and transport and forwarding companies we noticed quite significant interest of the both target groups in the tool functionality and scope of market information available.

During the TransBaltic project we managed to construct small data base of quotations for transport of sea containers from Shanghai to the main cities of Poland using alternative routes through the gateway ports of Rotterdam, Hamburg, Koper and Gdansk and then with the use of road, rail and maritime solutions from these gateway ports to the final destinations. There were all together 7 transport companies participating in the operators including 3 intermodal ones. Data base was far from being complete because next 10 inquired companies refused to give any data for rates comparisons. Thus data base was not complete however large enough to be able to express the competitive advantages of intermodal offers on long distances.

According to the opinion of the transport service providers gathered during some workshops there is also relative high interest in selling services through open web based platforms confirmed by declaration for participation in the tool's implementation phase. This may be the nucleus of a cluster of companies willing to collaborate in the creation of this specific ICT tool.

Fig. 6-1 Questionnaire results



Source: ILIM own study

6.2.4. Registration of the transport offers.

Since the tool is designed for evaluation of logistics offers according to the two main criterions – transit time and cost of transport this chapter will be devoted to present issues referring to registration of time and price factors.

Transit time.

Transit time of deliveries is expressed in two ways.

In road transport, delivery time between starting and final points of transport process is expressed in hours. At the first stage the shortest route is marked out with the use of an electronic map. Then algorithms assign an assumed speed of the vehicle to the category of roads being involved in route planning. Calculated transit time is corrected according to the drivers working time rules which are unified within the EU[4]

In maritime transport shipping companies publish the sailings time schedules in days as well as days of departures.

In intermodal transport, the operators present different attitude towards time schedules. Some of them publish time schedules indicating days of departure and arrival on defined routes. Others are more precise defining also closing time – i.e. the time at which the last loading unit is accepted at the despatch terminal and pick-up time i.e. the earliest time that the loading unit can be collected from the receiving terminal with the release of the transport paperwork.

There is a problem of planning time of transhipment operations anytime departures or arrivals are scheduled in days. Duration of handling may vary from hub to hub depending on volumes and handling capacities: It refers to the following transhipment models; vessel – truck, vessel – train, or train – truck. It will be very difficult to obtain and update information from the sea or inland container terminals not only due to changeability of handling time but also due to the fact that many operators treat handling capacity and delays as very sensitive matter.

[4] Within the European Union, EU Regulation 561/2006, In addition to the above requirements, drivers in the EU must also abide with the European Working Time Directive 2003/88/EC.

Cost of transport

As it was mentioned earlier price indications gathered and updated in the tool's data bases do not represent precisely the market level.

In terms of freight rates, the market for road transport has two faces:

- Large shippers tend to arrange long term contracts with selected logistics service providers in order to stabilize freight rates. They try to gain maximal reduction of logistics expenses through tenders arranged on yearly basis.

- The market for transport of loads provided by small businesses is in turn typical spot market. Freight rates are negotiated individually depending on negotiating power of parties, seasonality of flows, opportunities for the backload e.t.c..

Building data base for road transport quotation we face also problem of practically unlimited number of locations being potentially involved in the road transport process. Trucking companies cannot be requested to make and constantly update quotations referring to large number of potential routes. The tariffs have to base on rate per km taking into consideration degressive rates with increasing transport distance.

In case of modes in which the periodic tariffs are in common use – the final level of rate depends mainly on volume provided by a shipper. These volume discounts are secret and practically not obtainable. Thus the quality of planning and modal choice depends mostly on how these two categories of freight rates differ.

The topic of freight rates is also connected with the functionality of the tool which offers placing an immediate transport order with the transport operator (s) selected as the most convenient solutions time wise or pricewise. According to us such solution cannot meet approval of the freight market stakeholders since indication of prices in the tool's database can hardly be treated as final ones, both in terms of client and carrier. Mutual contact is required, so that both parties eventually agree on the level of freight rates ,bounding transit time and other elements of the transaction - for example, form and date of payment.

In the plan of the tool's improvements we propose to implement a freight exchange mechanism for the final verification of information gained from the data bases as a base for ad hoc order arrangements (freight exchange) or long term transport service contract (electronic tender) .

Summarising, this chapter devoted to database building issues - we would like to compare how this problem can be handled in implementation of the tool as in-house customized solution and a public one

Tab. 6-1 Comparison of data base building process in in-house and public versions of the tool

Issue	In-house solution	Public solution
Geographical scope of data bases Register of locations	Strictly depends on the company managing the chain. It will be adjusted to current and future channels used for transport of its goods.	Building world wide database is not realistic. It will be developed corridor by corridor.
Register of logistics services providers and offers	The application is expected to be supportive to create competitive environment for optimal execution of transport for the company managing its supply chains. In such circumstances service providers are expected to pass all necessary information in the hope of getting orders and becoming a permanent link in the supply chain.	The relationship between posting offers on the Internet platform, and the receipt of orders is not as obvious or close in time.
	Depending on the needs the Manager of the supply chain may ask for door-to-door offers or quotations relating to the various parts of the supply chain to ensure its full transparency.	Gathering offers on door-to-door basis will be more comfortable in order to avoid the dilemma associated with changeable alliances between freight forwarders and sub contractors.

Source : ILIM own study.

This comparison shows that the implementation of a dedicated application for the company managing the supply chain is much simpler than the tools of public coverage.

In case of supply chains managed by a freight forwarder we are dealing with the creation of a broad structure of alliances allowing for comprehensive logistics services for clients with the large needs. With the application supporting electronic supply chain management such forwarder has a chance to become the 4th Party Logistics operator.[5]

[5] A '4th PL' or fourth-party logistics provider; a supplier of outsourced supply chain coordination and management services that generally does not own or operate the underlying logistical assets and resources.- source: http://www.logisuite.com/logistics-terms-glossary/

Supply chains may also be managed by a large producing or trading company which is a user of transport, who holds large volumes of cargo. With this application - it produces a very competitive environment, which allows him to obtain very low freight rates while maintaining high quality services.

In the both cases we deal with models of cooperation resulting from high intensity competition for a big pool of transport orders to be executed in the short time horizon. In the public version of the tool the way from receiving inquiry to getting order seems to be much longer.

6.2.5. Conclusions and recommendations concerning data base creation

Construction of data bases is a complex long-term and expensive process therefore the implementation plan should focus on steps that provide the greatest probability of success.

a) It would be extremely difficult to develop a data base covering all the possibilities of transport between two arbitrarily selected points on the Earth. Therefore the method of preparation of data bases corridor by corridor shall be adopted. The efforts shall focused on routes where there is real competition between different transport modes. The best chances for the existence of such conditions provide the main container intercontinental (Westbound: Far East Asia-Europe or Eastbound: North America-Europe) transport routes leading on its last stretch from the European receiving sea ports to the final destination somewhere in the hinterland where road , rail or barge options may be considered. (It refers of course to the reverse direction as well). Unification of loading units gives great opportunities of efficient transhipment between modes. Corridors with higher competition are additionally more open to innovations.

b) Large transport operators are not much interested in selling their services through an open Internet platforms. They concentrate on servicing large clients with whom long-term contracts for transport services are directly negotiated. On the other hand, without their participation in data base, the ICT tool will not have too much substantive value. Assuring favourable and supportive attitude from the main actors being active in the transport corridor is one of the main condition for successful outcome.
Within TransBaltic project we managed to obtain data from several intermodal transport operators serving a major role in the supply of containers to Poland through Hamburg, Rotterdam and Koper. A comparative study of supply conditions for road and intermodal solutions have shown high competitive power of intermodal offers causing great interest of shippers during a series of tool demonstrations. Rapid growth of e-commerce and the growing competition, which will change the attitude of the large transport companies towards small shippers may convince them for sales via the open internet platforms. The inflow of orders obtained that way will create imitation effect.

c) The construction of the databases must ensure the compatibility of individual elements of a supply chain. The complicated structure of the logistics service providers market , the widespread

subcontracting and changeable alliances between transport organizers (freight forwarders, 4th PL integrators) and the direct carriers make this market completely not transparent. This complicates the construction of data bases as well. It is recommended, at least at initial phase of implementation to focus on door-to-door services which significantly reduces the risk of offering incompatible supply chains.

d) Registration of road supply costs cannot be based on the specifications of the routes, because of their potential multiplicity. The process of updating rates would be equally laborious. A method of determining the cost with the use of unit rates (per 1 km) taking into account its decline with increasing distance. The method has to be simple, not time consuming but reflecting the level of rates.

e) Despite the intentions of the authors of the software tariffs gathered in the data base cannot be subject to generate transport orders. The rates as well as other important contractual conditions as departure day obliged transit time, form and term of payments have to be agreed. So there is a need for build-in a negotiation module.

f) In parallel to the planning module based on data bases we propose to deploy freight exchange mechanism. It may essentially increase the value of the tool. Shippers receive offers to their inquiries for the whole route or to the part of it. This part of the tool allows also negotiation of the contractual clauses and conditions.

6.2.6. Deployment plan milestones

The process of implementation of the public version of the ICT tool for optimizing modal choice is a time consuming and complex process requiring a lot of efforts to be performed in parallel. There are two main directions of implementing works. The first focuses on creation data base and the second on tools' improvements.

In the table below the main milestones of building tool's data base are presented. First, the strategic decisions have to be taken concerning selection of the transport corridor and business model of running ICT platform containing optimization tools. The role of the platform coordinator have to be defined as well as the way of financing the tool. The establishment of a company with IT and logistics expertise for managing the electronic platform for transport optimization shall be also decided.

In the next phase the recognized logistics service providers who accepted participation in the tool's implementation will be questioned about their time wise and cost wise details of their services. It will be important to recognize if the transport operator is willing to offer entire door-to-door service or only part of it. It will be also important to identify any restrictions concerning co-operation alliances in order to avoid configuring non-operable supply chains.

Registered data concerning locations, delivery transit time and costs are multithreaded and mode specific. Some of them are difficult to obtain as:

- establishment of handling time in ports and sea or inland container terminals,
- volume discounts offered by the rail and maritime transport operators.

Tab. 6-2 Deployment plan milestones

Deployment plan mailstones	General issues	Logistics service providers (LSP)			
		Shipping lines	Road hauliers	Intermodal operators	Feeder operators
Selection of transport corridor	X				
Chose business model of ICT platform management	X				
Establishment of company being operator of the electronic platform for transport optimization	X				
Reaching acceptance of LSP participation		X	X	X	X
Register of logistics services providers		Recognizing co-operation alliances with sub-contractors	Recognizing co-operation alliances with sub-contractors	Recognizing co-operation alliances with sub-contractors	Recognizing co-operation alliances with sub-contractors
Register of locations		Ports, sea container terminals	Collection acc. to postal codes	Rail container inland terminals	Ports, sea container terminals
Register of delivery duration		Salilings schedules in days	Velocity according to road category	Time schedules in days	Salilings schedules in days
		Handling time in ports	Drivers working time	Handling time in inland hubs	Handling time in ports
Register of delivery costs		Terminal Handling Charges in sea ports	Rates per km including degresion tendency	Freight rates including handling fees	Terminal Handling Charges in sea ports
		Freight rates	Incorporation of tolls	Road on-carriage rates	Freight rates
		Cost of empty container return	Cost of empty container return	Cost of empty container return	Cost of empty container return
		Volume discounts	Volume discounts	Volume discounts	Volume discounts

ILIM own study

Independently of data base issues the tools improvements increasing its usable value are required. These are:

- automation of data processing in producing rankings of alternative supply chains,
- negotiation modules (freight exchange, electronic tender)
- module for consolidation of shipments
- internal system for sharing electronic information (messages and documents)

After completion of data base and securing basic functionality of the tool in planning and communication areas ,the phase of selling transport services through the platform may be initiated.

7. Key Performance Indicators

There are many Key Performance Indicators for evaluation of different aspects of the transport activities. This chapter is devoted to the measures of the quality of the tool supporting freight market stakeholders in their optimal modal choice. The evaluation refers to the tool itself at the consecutive

stages of implementation as well as the benefits obtained by the transport users and transport service providers.

7.1. Indicators evaluating quality of the tool

There are a few thematic issues in which the quality of the tool may be evaluated, as :

- scope of tool's functionalities,
- quality of data base,
- market acceptance of the tool,
- contribution to sustained development of transport system .

7.1.1. Scope of tool's functionalities.

The tool is responding to such needs of the shippers as :

- configuring optimal multimodal supply chains,
- planning of concrete deliveries,
- choosing the optimal set of logistics service providers being able to co-operate along the whole supply chain,
- placing orders with selected service providers,
- on-line monitoring of transport progress,
- conclude and perform paperless freight transaction.

Specification of tool's functionalities.

Tool may offer numerous functionalities that may help users make rational decisions in the field of transport. The scope of these functionalities may be ranked by order of their implementation:

- providing market information concerning transport service providers and their services (time schedules and tariffs),
- planning intermodal deliveries leg-by-leg basing on information contained in the data base,
- receiving automatically generated rankings of transport solutions on the selected route ranked according to criterion of transit time or transport cost,
- sending automatically generated transport order to the selected transport service providers,
- negotiating ad hoc multimodal transport services with the use of freight exchange mechanism,
- negotiating long term transport contracts with the use of electronic tender,

- sending transport order to the selected transport service providers after negotiations of the conditions of a freight transaction (freight rate, binding transit time, form and time of payment),
- receiving track & trace information covering whole route,
- receiving POD,
- generating invoices for the transport services,
- effecting electronic payment.

Scope of freight transport sectors covered by the tool functionalities

The maturity of the tool depends also on the type of transport sector being covered. There are different sectors offering various chances for development of sustainable modes of transport.

- The biggest chances for sustainable modes competitiveness is offered by the transport of containers. Unification of transport units allows smooth transhipments between different mode.

  There is competitive environment on the routes leading from the sea ports to the hinterland locations where container block trains or barges may be alternative option towards transport of containers on the road chassis. Frequently, feeders running between sea ports may be also competitive element of a chain. The sector of containerised transports is recommended as the first to be covered by the tool functionalities.

- The next sectors to be taken into account are :

  - The FTL transport sector . Full loads may carried by trucks, conventional or specialised wagons or barges.
  - The LTL transport sector. In distribution of smaller shipments dominated by road transport the most important issue is consolidation of shipments that may rationalise it by reduction of trucks being involved

Scope of agreed standards of the internal electronic communication system

The tool's evaluation may also refer to the efficiency of the internal communication module of the tool. The quality of communication depend on the number of agreed business models , standards, forms of messages and documents.

Track & trace coverage.

The system is prepared to present all statuses issues in XML standard provided by the transport service providers. The deviation from the full coverage will be noticed.

7.1.2. Quality of data base

There a few aspects of data base quality that may be subject of evaluation along implementation and development phases of the tool.

Territorial coverage

Building data base is time consuming and expensive so it will be performed corridor by corridor. Number of corridors, locations and routes covered by the data base is important to be perceived by the potential users as useful.

Number of transport service providers

Number of transport operators registered in the data base is general measure of the data base size. It has to show the number of registered carriers across the modes since the presence of transport operators representing sustainable modes of transport will be crucial.

Completeness of the data base.

This type of evaluation refers rather to the individual corridors. It is extremely important that it contains the data gathered from the most important transport service providers operating in the given corridor. The presence of the sustainable modes of transport has to be evaluated additionally. The total potential of the transport operators represented in the tool's data base to the total volume exchanged along the corridor would be the excellent measure of its completeness however precise statistics may be hard to be obtained.

Validity of the data base

Updating transport offers gathered in the tool's data base is essential for its functioning. The users become discouraged finding not valid tariffs or time schedules. The number of claims will be a signal of irregularity. Updating process is obligation of the transport service providers so the failure in updating their quotations may be an evidence of the loss of confidence in tool's efficiency as a source of transport orders.

Representativeness of the freight charges

Data base contains tariffs with freight charges gathered from carriers and freight forwarders. These indications cannot be subject to conclude freight contracts since the rates have to be finally agreed in negotiations. Difference between indicated and actual market rates defines the quality of optimisation of modal choice. Data base containing offers including volume discounts will be highly evaluated since the difference between indication tariffs and final rates will not be significant.

7.1.3. Market acceptance

The most important features evaluating the market acceptance of a tool are:

- Number of users – shippers or freight forwarders using the tool for optimising their modal choice. Since the system will base on subscription fee, the number of registered fee payers will be the subject to evaluations.
- Number of inquiries.
- Number of rankings produced to the users inquiry.
- Number of transport orders placed through the tool.
- Number of invoices generated through the tool.
- Turnover on the transports ordered through the tool.
- Turnover on transports executed through the tool.
- Turnover on invoiced deliveries through the tool.

In parallel to features listed above the amount of the service fee paid by the tool's users is important since it has to cover maintenance and development costs of running the platform.

7.1.4. Contribution to sustained development of transport system

The tool may be also helpful in monitoring changes important from the point of view of the sustainable transport policies efficiency. After the tool obtains maturity while the large volumes will be registered it may provide the regional and national public authorities with the statistics showing e.g.:

- share of sustainable transport modes in total business arranged through the tool (in tonnes / tonnes-km) across transport corridors or regions,

- share of shipments booked by the enterprises from the SME sector with the service providers representing sustainable modes of transport (in tonnes / tonnes-km).

- number of established consortia of small manufacturing or trading companies and economic results of consolidation of shipments,

- the scale of CO_2 emission reduction obtained by transferring loads from road to rails.

The full set of key performance Indicators referring to quality of the tool at different stages of its development is presented in the APPENDIX No.1

7.2. Indicators evaluating benefits obtained by the actors of the tool

The efficiency of the tool differs depending on the user role in the supply chain .

7.2.1. Customer using application as an in-house tool to manage its supply chain[6]

Such a company may efficiently control its supply chains thanks to transparency and competitive environment provided by the tool. The enterprise may measure the effect of using the optimisation application in many aspects, as e.g.:

- reduction of logistics expenses in analysed time periods, per loading unit , TEU, tonne, order e.t.c creating customized Key Performance Indicators,

- delivery transit time will be probably the next measured areas in terms of possibility to be reduced as well as reliability of delivery planning process (% of deliveries performed in time),

- for the supply chain manager it will be also very important to measure quality of all links of the chain. These will be indicators measuring punctuality on different stages of the process, completeness of supplies, the level of damages per order, tonne or in relation to value of commodities. The person managing the chain will receive full picture of its strong and weak links being very helpful in improvement actions,

- track and trace service of the tool will also gives an opportunity for analysing punctuality factor on-line but also the emergency measures – how quick the result of delivery delay may be fixed.

7.2.2. Ad hoc transport user

A Client using the tool sporadically is mainly interested in comparisons of the transport conditions data received through the optimising tool with historical or current offers obtained from the other source to recognize the scale of possible reduction of logistics costs or transit time.

[6] We mean a trading or freight forwarding company that operates the optimisation tool building own database of co-operating transport services providers ad their offers and concluded contracts.

7.2.3. Transport user – member of consortium of SME enterprises

The members of consortiums established in order to consolidate shipments is expected to reduce logistics expenses. They will be surely interested in measurement of this result.

7.2.4. Transport service provider (freight forwarder or carrier)

The main measure of the efficiency from placing own offers in the tool data base is contracted volume. This effect may be measured in:

- number of orders,
- number of transported units (containers, TEU, Loading Units, tonnes e.t.c),
- turnover from orders received through the tool.

In many supply chains cooperation between companies is based on periodical agreements or transport service contracts. For service companies it is very precious to receive such a contract securing permanent inflow of orders. There may be further indirect effects if the high quality partner will receive proposal for co-operation in other supply chains.

7.2.5. Transport service provider (freight forwarder)

Besides generated new orders freight forwarders are also interested in re-engineering of the supply chains they configure for their clients. The tool is very supportive in selecting the most efficient and loyal sub-contractors performing services on particular part of the supply chain in order to be able to secure high quality logistics service.

In the APPENDIX No. 2 there are some proposals of Key Performance Indicators that may be supportive for the both sides of the freight market – transport users and transport service providers in evaluating positive effects of utilization of the ICT optimization tool.

8. Conclusions

The European transport industry has developed very rapidly in recent years due to enlargement of the EU, liberalisation of trade and migration of production to cheaper labour markets. This dynamic increase of transported volumes has been captured to the great extent by the road transport, on account of several reasons. Some of them are of behavioural character and result from a general lack of awareness about

benefits offered by intermodal transport, low transparency and accessibility of adequate information or incompatible electronic services between customers and carriers.

At the same time, efficient logistics has become one of the most important competitiveness factors for each company, equally to price or a product quality. This has resulted in a growing demand for the ICT solutions optimising transport and logistics activities.

The ICT tools enabling rational modal decisions may be helpful in restructuring multinational transport networks into more sustainable according to the co-modality concept. The main idea behind implementation of such optimizing tools - is supplying shippers with objective market information concerning all possible transport opportunities along multimodal corridors. With on-line access to time schedules and tariffs of carriers and freight forwarders the decision makers may fully exploit modal advantages.

Such optimising tools may be used either as a dedicated in-house solution for specific supply chains being managed by a shipper or freight forwarder or as an open Web based tool accessible for any enterprise looking for transport expertise.

In- house ICT systems for multimodal transport management are increasingly popular among large multinational freight forwarders being able to finance such systems. Deployment of them is relatively easy but the positive effects are limited to their customers.

From the perspective of the EU transport policy the open ICT systems supporting modal choice are valuable unless they are accessible for all potential transport users including small and medium sized enterprises arranging transport for ca. 40-50% of volumes.

The public version of the tool is much more challenging in implementation due to many reasons:

- Some market segments seem to be entirely excluded from intermodality. Whenever customers require short lead times of frequent but small sized deliveries an intermodal option is not taken as an alternative. Delivery time however is often not critical criterion and alternative to road transport options might be taken into account. The problem is that they are often not considered as the railway or maritime offers are not easily accessible nor transparent. Sometimes modal choice is affected by partially justified stereotypes of railway services poor quality.

- Modal choice may be optimized unless alternative transport modes are able to provide reliable and competitive offer which is not that common. Railway or maritime transports of course are slower but expected to be cheaper at least on longer distances.

- Large intermodal transport service providers are focused on large customers mainly, not being much interested in small clients from the SME sector. It means that quite big portion of loads provided by small companies is not considered by the intermodal networks.

- Large transport operators do not tend to sell their services on open Internet platforms preferring rather bilateral direct negotiations.
- Attempts of building electronic communication systems for cooperation of companies being partners in supply chains has a significant bottleneck in diversity of standards of exchanging messages and documents.

Deployment plan should Take into consideration the following steps:

- Communicate success stories among transport users to show competitiveness of alternative-to-road modes of transport as well as scale of obtainable profits.
- Investigate, which transport corridors in the BSR offer chance for intermodal competition.
- Introduce an issue of open ICT platform to the agenda of corridor management structures.
- Initiate a dialogue with main transport operators on electronic communication standards, business models for the monitoring of deliveries, building database of transport offers etc.
- Create consortia of SME shippers for consolidation of loads to receive better price conditions form intermodal service providers. In parallel incentives for transport operators for preferred solutions for small customers may be considered.
- Launch the ICT platform by filling up a database with transport offers, creating negotiation module and consolidation of loads, and start selling transport services to shippers.

Realisation of the deployment plan calls for close co-operation of business and public sectors with research circles. Leaving development of the web based ICT tools to the market only will slow down the launching process. It is also very probable that transport users from the SME sector will be practically deprived of intermodal transport services as low volume customers.

It is expected that launching the tool supporting optimal modal choice will bring many positive effects, such as:

- Shippers will be supported by providing current market information on intermodal transport solutions considered as alternative to road transport.
- Shippers will be offered to utilise the internet tool enabling carry out paperless freight transport contract as well as monitoring transport service progress.
- Shippers from the SME sector may reduce their transport costs due to consolidation of cargo.
- The tool will create an opportunity for the intermodal transport service providers for obtaining new orders.

- Regions along the transport corridors may obtain high degree of co-modality due to optimal decisions of a large number of transport users.
- Transport corridors offering optimal modal choice will concentrate flows in order to effective use of vehicle's loading space.

Bibliography

[1] Adamczyk J., Nitkiewicz T., Programowanie zrównoważonego rozwoju przedsiębiorstw, Polskie Wydawnictwo Ekonomiczne, Warszawa 2007.
[2] Andrzejewski L, Deployment of ICT toolbox supporting companies in optimal modal choice, Presentation shown at the TransBaltic workshops and seminars with the freight transport market stakeholders, 2010-2012
[3] Andrzejewski L., Demonstration of the ICT toolbox for planning intermodal supply chains (Demonstration made during TransBaltic Seminar held in Poznań on 10th June 2010)
[4] Cempel C., Nowoczesne zagadnienia metodologii i filozofii badań, Wykłady Monograficzne Studium Doktoranckiego Wydziału SiMR Politechniki Warszawskiej, Warszawa 2005
[5] Coyle J., Bardi E., Langley Jr. C., Zarządzanie logistyczne, Polskie Wydawnictwo Ekonomiczne, Warszawa 2002.
[6] DISCWISE "One Common Framework for Information and Communication Systems in Transport and Logistics – Facilitating Interoperability" 2011.
[7] Enterprise Interoperability, IFIP International Working Conference on Enterprise Interoperability, Stockholm, IWEI 2011 edited by Martin Zelm.
[8] Gierszewska G., Romanowska M., Analiza strategiczna przedsiębiorstwa, Polskie Wydawnictwo Ekonomiczne, Warszawa 1994.
[9] Griffin W.R., Podstawy zarządzania organizacjami, Wydawnictwo Naukowe PWN, Warszawa 1998.
[10] GS1 – ecom Logistics Standards. GS1 XML v.3.0 Transport Management electronic messages.
[11] Hajdul M., Model zintegrowanego systemu przewozów multimodalnych ładunków zjednostkowanych, w: Europa-Azja. Gospodarka, transport, red. Mindur L., Instytut Logistyki i Magazynowania, Poznań 2007.
[12] Hajdul M., Koordynacja procesów logistycznych w oparciu o koncepcję zrównoważonego rozwoju, Logistyka 2009, nr 4, s. 81.
[13] Hajdul M., Guszczak B., Transfer wiedzy z zakresu nowoczesnych rozwiązań racjonalizujących procesy transportowe, red. Golińska P., Stajniak M., Wydawnictwo Politechniki Poznańskiej, Poznań 2010.
[14] Hajdul M., Model of coordination of transport processes according to the concept of sustainable development, LogForum 2010, nr 3 (21), s. 45–55.
[15] Hajdul M., Golińska P, Virtual logistics clusters – IT support for integration, Lecture Notes in Computer Science, 2012, Volume 7196/2012, s. 449-458

[16] Hajdul M., Coordination Model of Transport Processes Based on Sustainable Development Concept; Sustainable Transport. New Trends and Business Practices, Springer-Verlag, Berlin Heidelberg 2012, s. 83-108
[17] Hajdul M., Śliwczynski B., Golińska P.Standards for transport data exchange in the supply chain – pilot studies, Lecture Notes in Computer Science, tom 7327, str. 586-595, Springer-Verlag, 2012
[18] Jesper Aastrup, Per Homann Jespersen, Michael B. Pedersen "A Door-to-Door Combined Transport Planner", Trafikdage på Aalborg Universitet 2004
[19] Jong H.W. de, The structure of European industries, Kluwer Academic Publisher, Dordrecht 1988.
[20] Kawa A., Golińska K., Pawlewski P., Hajdul M., Cooperative Purchasing of Logistics Services among Manufacturing Companies based on Semantic Web and Multi-Agent System, w: Demazeau Y. (et al.) (Eds.): 8th International Conference on Practical Applications of Agents and Multiagent Systems, Advances in Intelligent and Soft Computing, Vol. 71, Springer-Verlag, Berlin, Heidelberg 2010.
[21] K.G. Zografos and A.C. Regan, Current Challenges for Intermodal Freight Transport and Logistics in Europe and the United States. Transportation Research Record 1873, 70-78 (2004).
[22] Kordel Z., Rola transportu samochodowego w łańcuchu dostaw, Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 2002.
[23] Lissowski O. (red.), Public-Private Partnershim in public management, Wydawnictwo Politechniki Poznańskiej, Poznań 2011.
[24] Logit 4See Transport Management System; Logit Systems, Norway, 2011.
[25] Logistics Interoperability Model Foundation Report Final. GS1 Global Office July 2007.
[26] Marit Natvig, Hans Westerheim, Tor Kjetil Moseng, Audun Vennesland, ARKTRANS The multimodal ITS framework architecture V6, 2009-07-29, Project nr. 90C211
[27] McKinnon A., European Freight Transport Statistics: Limitations, Misinterpretations and Aspirations, Report prepared for the 15th ACEA Scientific Advisory Group Meeting, Heriot-Watt University, Edinburgh 2010.
[28] Menard C., Economie des organisations, La Decouverte, Paris 1990.
[29] Milewska B., Możliwości zastąpienia relacji trade-off relacją trade-up w logistyce i produkcji, (cz. 1), Logistyka 2005, nr 5.
[30] Najda-Janoszka M., Organizacja wirtualna. Teoria i praktyka, Wydawnictwo Difin, Warszawa 2010.
[31] OASIS ebXML registry 3.0. Oasis organisation 2007.
[32] Pacholski M.L., Trzcieliński S., Koncepcje zarządzania przedsiębiorstwem (w otoczeniu burzliwym i nieprzewidywalnym), Wydawnictwo Politechniki Poznańskiej, Poznań 2003.
[33] Perishable goods logistics – feasibility analysis and ICT solutions; Global Integrated transport Logistics Data Network. Italy 2005.
[34] Rydzkowski W., Wojewódzka-Król K. (red.), Transport, Wydawnictwo Naukowe PWN, Warszawa 2009.
[35] Rydzkowski W., Hajdul M., Potential Effects of Differentiated User Charges on Intermodal Chains and Modal Change, DIFFERENT project, Deliverable 10.2, Poznań – Leeds 2008.

[36] Rydzkowski W., Hajdul M., Factors influencing modal split and construction of intermodal chains, w: Innovative perspective of transport and logistics, red. Burnewicz J., Wydawnictwo Uniwersytetu Gdańskiego, Gdańsk 2009.

[37] Skawińska E., Zalewski I.R. (red.), Klastry biznesowe w rozwoju konkurencyjności i innowacyjności regionów. Świat – Europa – Polska, Polskie Wydawnictwo Ekonomiczne, Warszawa 2009.

[38] Stajniak M., Foltyński M., Hajdul M., Krupa A., Transport i spedycja, Instytut Logistyki i Magazynowania, Poznań 2007.

[39] T.G. Crainic and G. Laporte, Planning models for freight transportation. European Journal of Operational Research 97, 409-438 (1997).

[40] The System for planning intermodal supply chains; Terms of References; WP3 of Interbaltic Project; Institute of Logistics and Warehousing, Poland, 2006.

[41] Transport – wyniki działalności w 2010 r., Główny Urząd Statystyczny, Warszawa 2011.

[42] Todd Litman Victoria, Introduction to Multi-Modal Transportation Planning Principles and Practices, 15 April 2011 Transport Policy Institute

[43] UN/CEFACT "Single Window" Project. http://www.unece.org/cefact/single_window/welcome.htm 2007-07-27

[44] W.T. Walker, Network economics of scale in short haul truckload operations. Journal of Transport Economics and Policy XXVI (1), 3-17 (1992).

[45] www.eea.europa.eu/data-and-maps/figures/road-freight-load-factors-during z dnia 14.07.2011.

[46] Wyrwicka K.M. (red.), Struktury klastrowe i ich funkcjonowanie, Wielkopolska Izba Przemysłowo-Handlowa, Poznań 2009.

[47] Y.M. Bontekoning, Hub exchange operations in intermodal hub-and-spoke networks. Ph.D. Dissertation The Netherlands TRAIL Research School, Delft (2006).

[48] Załoga E., Milewski D., Spedycja. Procesy i usługi, Wydawnictwo Naukowe Uniwersytetu Szczecińskiego, Szczecin 2005.

APPENDIX No.1

The ICT tool for:
planning of multimodal supply chains
and
opimising modal choice

Set of Key Performance Indicators
for evaluation of quality and implementation stage
of the tool

Project part-financed
by the European Union
(European Regional Devel

Instytut Logistyki i Magazynowania

Baltic Sea Region
Programme 2007–2013

SKANE

Q 1 KPI evaluating quality of the tool

Q 1.1 Scope of tool's functionalities

	Specification of functionalities	Points	YEARS											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	Provision of market information	10												
2	Delivery planning leg-by-leg	5												
3	Automatically generated rankings	10												
4	Automatically generated transport order	5												
5	Negotiating conditions in the freight exhange mechanism	10												
6	Negotiating conditions by an electronic tender	10												
7	Sending transport order after final negotiations	10												
8	Receiving complete track & trace information	10												
9	Receiving POD electronically	10												
10	Automatically generated invoices	10												
11	Effecting electronic payment	10												
	TOTAL	**100**												

Q 1.2 Transport sectors covered by the tool.

	Specification of transport sectors	Points	YEARS											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	Transport of containers	40												
2	FTL transport : road / rail / Inland waterways	30												
3	LTL distribution	30												
	TOTAL	**100**												

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
SKANE

Q 1 KPI evaluating quality of the tool

GS1 set of messages covering logistics processes

TI	Transport Instruction
TSD	Transport Status
TPO	Transport Pick-up Operations
TDO	Transport Drop-off Operations

Q 1.3 Agreed and implemented GS1 standards within tool's Electronic Data Interchange

Specification of standards		Points	YEARS											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	TI	25												
2	TSD	25												
3	TPO	25												
4	TDO	25												
TOTAL		**100**												

Q1 KPI evaluating quality of the tool

FREIGHTWISE models for interoperability

TSD	Transport Service Description – a standard description of transport services suitable for automatic detection
TEP	Transport Execution Plan– describing all the information needed related to the execution of a transport service.
GII	Goods Item Itinerary – providing information about the movement of the goods (possibly through a chain of services)
TES	Transport Execution Status – providing information about the progress of the transport and of the cargo condition
STD	Standard Transport Document – providing a multimodal eWaybill signifying that an agreement to transport cargo has been reached
CRS	Common Regulatory Schema – providing a unified way of informing authorities about transport such that compliance may be verified.
SDM	Security Data Message – providing information about the security of a sealed load unit.
TPS	Transport Progress Status – assisting in establishing the best possible arrival time estimates
TNS	Transportation Network Status – not suggested as a new standard, but a pointer to messages providing such information for the different transport modes.

Q 1.4 Agreed and implemented FREIGHTWISE standards within tool's Electronic Data Interchange

Specification of standards		Points	YEARS											
			JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	TSD	11												
2	TEP	11												
3	GII	11												
4	TES	11												
5	STD	11												
6	CRS	11												
7	SDM	11												
8	TPS	11												
9	TNS	12												
TOTAL		**100**												

Q 1 KPI evaluating quality of the tool

Q 1.5 Track & Trace services coverage												
No. of executed orders	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ocean sail												
Intermodal train trip												
Road houlage												
Feeder sail												
TOTAL												

No. of claims due to lack of T&T service	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ocean sail												
Intermodal train trip												
Road houlage												
Feeder sail												
TOTAL												

% of claims due to lack of T&T service	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ocean sail												
Intermodal train trip												
Road houlage												
Feeder sail												
TOTAL												

Q 2 KPI evaluating quality of the tool's data base

Q 2.1 Territorial coverage												
Coverage features	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Number of transport corridors												
Number of routes												
Number of locations												

Q 2.2 Number of registered transport service providers												
Number of service providers registered	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Freight forwarders												
Road carriers												
Intermodal operators												
Shipping lines												
Feeder operators												
Total												

Q 2 KPI evaluating quality of the tool's data base

Q 2.3 Completeness of data base analysed per corridor

Specification of transport operators	Estimated operator share in the market		Tool coverage (% of total volumes)
	Operators active along the corridor	Operators with registered services rebdered along the corridor	
Shipping lines			
1			
2			
3			
…			
TOTAL			

Specification of transport operators	Estimated operator share in the market		Tool coverage (% of total volumes)
	Operators active along the corridor	Operators with registered services rebdered along the corridor	
Container road houlage operators			
1			
2			
3			
…			
TOTAL			

Intermodal trains operators			
1			
2			
3			
…			
TOTAL			

Freight forwarders offering door-to-door solutions			
1			
2			
3			
…			
TOTAL			

Feeder operators			
1			
2			
3			
…			
TOTAL			

TOTAL			

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
Region Skåne

Q 2 KPI evaluating quality of the tool's data base

Q 2.4 No of claims due to lack of data in tool's data base												
No of claims	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
No. of received inquiries												
No. of inquiries not replied due to uncomplete data base												
% of claims												

Q 2.5 No of claims due to oudated offers in the tool's data base												
No of claims	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
No. of provided expertises												
No. of claims due to outated data base												
% of claims												

Q 2 KPI evaluating quality of the tool's data base

Q 2.6 Representativeness of the tariffs enclosed in the tool's data base												
Value of executed orders	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Value of orders according to tariffs in the tool's data base												
Value of orders according to final freight charges												
Difference in €												
Difference in %												

Q 3 KPI evaluating market acceptance of the tool.

Q 3.1 Number of transport users registered												
Type of transport user	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Freight forwarders												
- including SME												
- % of SME freight forwarders												
Shippers												
- including SME												
- % of SME shippers												

Q 3.2 Registered volumes and turnover												
Registered issue	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Number of inquiries received												
Number of rankings produced												
Number of orders placed												
Turnover on orders placed												
Number of invoices generated												
Turnover invoiced												

Q 4 KPI measuring tool's contribution to meet the EU transport policy priorities

Q 4.1 Share of sustainable modes of transport in total turnover on orders executed through the ICT optimisation platform													
Contribution to meeting EU Transport Policy Priorities		YEAR											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
TOTAL Figures	Turnover on all orders executed												
Modal mix	Road transport												
	Intermodal transport												
	Feeders												
	Ocean going vessels												
Percentage	% share of modes												
Modal mix	Road transport												
	Intermodal transport												
	Feeders												
	Ocean going vessels												

Q 4.2 Share of companies from the SME sector in total turnover on orders executed through the ICT optimisation platform													
TOTAL Figures	Turnover on all orders executed												
Company mix	Large shippers												
	Shippers from the SME sector												
	Large freight forwarders												
	Forwarders from the SME sector												
Percentage	% share of platform users												
Company mix	Large shippers												
	Shippers from the SME sector												
	Large freight forwarders												
	Forwarders from the SME sector												

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
SKÅNE

Q 4 KPI measuring tool's contribution to meet the EU transport policy priorities

Q 4.3. Reduction of CO emission													
Contribution to meeting EU Transport Policy Priorities		YEAR											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Distance covered by intermodal trains (km)													
CO emission /1 km refering to;													
rail transport													
road transport													
Total CO emissions refering to distance covered	rail transport												
	road transport												
	difference												

APPENDIX No.2

The ICT tool for:
planning of multimodal supply chains
and
opimising modal choice

Set of Key Performance Indicators
for evaluation of benefits obtained by the users
of the tool

Project part-financed
by the European Union
(European Regional Devel

Instytut Logistyki i Magazynowania

Baltic Sea Region
Programme 2007–2013

SKANE

KPI measuring performance quality

TU 1.1 TRANSPORT USER - Total tranzit time & logistics expenses

Transport expenss per 1 TEU	Before	YEAR											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ocean sail (port-port)													
Hinterland section (port-final destination)													
Total tranzit time													

Tranzit time in days	Before	YEAR											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Ocean sail (port-port)													
Hinterland section (port-final destination)													
Total tranzit time													

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
SKANE

KPI measuring performance quality

TU 1.2 TRANSPORT USER Ranking of the best solution per routes

Transport leg	Kind of LSP	LSP name	Tranzit time	Transport expense
Door - to door deliveries	Freight forwarder , 4th PL integrator	1		
		2		
		3		
		4		
		5		
Ocean sail (port-port)	Shipping line	1		
		2		
		3		
		4		
		5		
Hinterland transport (port-final destination)	Intermodal operators	1		
		2		
		3		
		4		
		5		
	Road houlage	1		
		2		
		3		
		4		
		5		
The best door-to-door solution	Chains of cooperating companies	1		
		2		
		3		
		4		
		5		

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
SKANE

KPI measuring performance quality

TU 1.3 TRANSPORT USER (SME consortium mamber) - Freight charges reduction due to conslidation of shipments

Consolidation of shipments	Before	YEAR											
		JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Transport expenses acc. to tool's tariff / TEU													
Transport expenses acc. to actual rates / TEU													
Economic result of consolidation / TEU													
Transported volumes (in TEU)													
TOTAL effect													

KPI measuring performance quality

TSP 1.1 TRANSPORT SERVICE PROVIDER - Results from utilization of the eletronic platform

Results of using electronic platform	YEAR											
	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
Total no. of orders												
No. of orders generated throuth the platform												
% of orders generated through the platform												
Total turnover												
Turnover generated through the platform												
% of turnover generated through the platform												

KPI measuring performance quality

TSP 1.2 TRANSPORT SERVICE PROVIDER (FORWARDER)
Ranking of the best supply chains configyred for the clients (per routes)

Transport leg	Kind of LSP	LSP name	Tranzit time	Transport expense
Door - to door deliveries	Freight forwarder , 4th PL integrator	1		
		2		
		3		
		4		
		5		
Ocean sail (port-port)	Shipping line	1		
		2		
		3		
		4		
		5		
Hinterland transport (port-final destination)	Intermodal operators	1		
		2		
		3		
		4		
		5		
	Road houlage	1		
		2		
		3		
		4		
		5		
The best door-to-door solution	Chains of cooperating companies	1		
		2		
		3		
		4		
		5		

Project part-financed by the European Union (European Regional Devel
Instytut Logistyki i Magazynowania
Baltic Sea Region Programme 2007–2013
SKANE