Review of the ICT solutions supporting intermodal transport sector

Activity: WP 2, Activity 2.3

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1. Introduction

The aim of this report is to present selected available on the market IT systems which support operations in intermodal transport. This type of transport utilizes standardized loading units (e.g. containers or swap bodies) on the whole route of shipment by more than one mode of transport. [1]

1.1   Intermodal supply chains

Intensification of intermodal transport is linked to container carriage development. This wide, international process has begun in the 1960s-1970s (containers were using earlier, but only in local carriages in the United States). It was associated the most with occurring bottlenecks during changes in the mode of transport by freight. This problem was caused by that too many batches of goods had to be handled in the same moment, moreover they had to be stored occupying a lot of warehousing area and was generating high extra costs. The quantity of these batches was increasing due to intensification of worldwide economy and abiding development of international carriages. All above-mentioned facts caused problems with efficient freight handling transported by different modes of transport.

The solution to these problems was the introduction of containers with high capacity and payloads into service and the standardisation of parameters relating to the dimensions or weight of the loads. As a result, the process of cargo handling has been completely transformed. New solution let also made both: costs and risk of cargo damage lower. Container transport has also led to an intensive development of intermodal transport, which has been influenced in particular by the inclusion of railways in the transport system.

Currently, the most common, intermodal supply chain is intercontinental transport of goods by container ship. The containers are delivered to the loading port and transported from the unloading port to the receiver on railway platforms. In this case, the mode of transport is changed twice: in sea ports (ship – railway platform) and in the final intermodal terminal (railway platform – truck).

Intermodal transport is a complex transport process where freight is moved by vehicles representing various modes of transport what generates additional costs by not only physical flow of goods but also additional logistic operations (loading and unloading). That's why intermodal logistics is more complicated than just carriage from one point to another by one mode of transport. The businesses' main reason to use it is the fact that intermodal transport enables them to take advantage of an optimum set of the service and cost features characterising particular means of transport.

IT technology is an integral part of modern transport, which changes today's global supply chains. The development of advanced logistics software streamlines the handling of the delivery process and results in more efficient and customised services.

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[1]European Economic Commission, Eurostat, International Transport Forum: Illustrated Glossary of Transport Statistics, p. 166

All Supply chains and ICT tools to support the process are constantly changing. Modification became inseparable from logistic operations. The amount of external factors which cause this transformation is still growing and they are getting more complicated.

1.2   Development of ICT tools supporting transport decisions

Transport topic appeared in IT systems supporting company management created in the 70s and 80s. **MRP I (Material Requirements Planning)**and **MRP II (Manufacturing Resource Planning)**systems were developed at that time, and in the 1990s transformed into w **ERP (Enterprise Resource Planning)**, it's complex resource planning system. Delivery schedule specifying transport tasks depends of sales plans, production, supply as well as stock plans for materials and finished goods. Defined volumes of materials, goods and delivery dates are basis to prepare of specific transport orders. Operational handling of the transport process was outside the ERP system.

Around 2000, ERP systems were complemented by, among other things, a complementary application to the management of not only the processes taking place in the enterprise but the whole supply chain – **Supply Chain Management (SCM),** this solution was an electronic communications platform linking the supply chain management company with all their suppliers, customers as well as logistics and transport operators, this allows for efficient synchronization of the flow of materials and goods through the supply network.

Except internal issues related to supply, production and distribution, SCM is coordinating inventory levels throughout the supply chain, optimizing the flow of materials and goods between the company and their suppliers and receivers.

This system can work effectively thanks to the development of the Internet and electronic communications system (EDI) for exchanging electronic messages, automatic cargo identification (ADC) systems, and vehicle and cargo traffic monitoring systems (track & trace).

SCM systems are most often used by large and medium-sized manufacturing companies with a distributed structure including their own production and distribution networks[2], which will strive to reduce inventory in their transport network, using a broad range of JIT rules, i.e. small but often complementary supplies. It promotes road transport, which in the most flexible way adapts to market segments requiring short delivery times.

In case of rail or intermodal deliveries are concerned, the potential is related to large quantity of goods shipped in wholesale lots, full trucks (FTL), e.g. between consolidation and distribution

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[2] Chwesiuk K., Analiza porównawcza systemów informatycznych wspomagających zarządzanie w logistyce dystrybucji, p. 414

centres. It would also be important to have full transport control by the company managing the supply chain, which would make possible to optimization of transport system.

While ERP or SCM systems are managed by manufacturing companies with large batches of loads, the response of the logistic sector was to develop systems for managing the transport process **TMS (Transport Management Systems).**

The simplest applications of this type are managed by road carriers and usually have the following structure:

a) transport order management module. Thanks to which documents are exchanged between the shipper and the carrier, such as; inquiry, offer, transport order and confirmation of accepting an order to execution,
b) route planning module to minimize the number of vehicles involved, distance travelled etc.
c) track & trace module – monitoring by GPS or GSM devices, vehicle traffic on-line,
d) Fleet Management used to manage drivers (work time, payroll, accident record) and equipment (repairs, failures, technical tests, certificates, insurance, etc.),
e) mobile communication module between the dispatcher and the driver, explaining the reasons for changing the agreed route, setting a new transport task etc.,
f) invoicing module.

In recent times, multimodal TMS has been developed, providing the opportunity to consider alternative cargo transport routes using different transport modes.

These solutions have form of an electronic platform managed by a neutral market organization, equipped with a daily updated cargo database, as well as a list of carriers with information on the routes they offer, rates offered, declared transport times, equipment list, historical KPIs etc. Such platforms enable shippers (as well as freight forwarders) to optimize planned transports and carriers to obtain additional transport orders.

Another IT system support intermodal transport is **PCS (Port Community Systems),** it's also an electronic platform for communicating and transmitting documents between ship holders, freight forwarders, container terminal, rail and road carrier, all companies cooperating in the process of loading and unloading containers in ports. Another important functionality is the cooperation of enterprises with the customs tax administration in order to efficiently carry out customs clearance of cargo in ports.

More and more providers of ICT tools supporting logistics processes are providing software consolidating functionalities, which were previously available separately in various programs, for example Freight Capacity Exchange, whose functionality is now an integral part of the freight exchange.

2 Identification of members of multimodal supply chain process

This chapter identifies and describes the main participants of intermodal supply chains.

2.1 Shipper

Shipper is a person who purchases services as shipment of goods. A shipper can be either an individual or a business, e.g. a trader, who is a direct producer of goods or who buys or sells goods. The strong position of shippers on the mainly international market means that they have a real impact on the activities of carriers. In addition, shippers may set up organised purchasing groups which dominate the carriers, thereby strengthening their negotiating position with regard to the provision of transport services.

2.2 Road carrier

The road carrier is primarily responsible for the physical transport of goods on the road. The carrier determines the optimal routes for the drivers and controls their working time. Throughout the transport process, he should at all times be assured that the goods are adequately secured (depending on the instructions he has received). It can carry out transport on request from a customer or a forwarder.

2.3 Rail carrier

Rail carrier provides the transport services under a licence using the railway infrastructure. However, this infrastructure is managed and made available to rail carriers by the infrastructure managers. The tasks of rail carrier are to check the availability of the wagons ordered by the Intermodal Operator, to order the journey, to place the wagons at the terminal, to carry out the transport between the points of departure and destination.

2.4 Container terminal

A container terminal is a facility where containers are transhipped from one mode of transport to another for further transportation. Transhipment can take place between container ships and land vehicles (trains or lorries), in which case it is a sea container terminal. Transhipment can also be carried out between land vehicles, usually between train and truck, in this case the terminal is described as an inland container terminal.

Sea container terminals are usually part of a larger logistics facility - a seaport - and are located in or near large cities (e.g. Hamburg, Rotterdam, Gdansk). Inland terminals are usually located close to the so-called sales markets - places of consumption and production.

Both types of terminals: sea and inland, usually also provide storage yards for both loaded and empty containers. Loaded containers are stored for a relatively short period of time as they wait for the next leg of the journey. Empty containers, on the other hand, can be stored for a longer period of time depending on the plan of their reuse.

Container terminals are managed with the use of comprehensive IT solutions, i.e. Terminal Operating System (TOS). Dynamic development of IT technologies and increasing efficiency of container terminals necessitates constant improvement of TOS functionality. TOS is now becoming an essential tool for optimising loading and unloading processes.

2.5   Intermodal operator

An intermodal transport operator is a company which arranges the transport of goods (using at least two modes of transport) all the way from the place of loading (shipper) to the place of unloading (receiver), after concluding a contract with the customer (shipper or forwarder). He is responsible for every leg of the transport, including its damage. That's why he signs contracts on its own behalf with other carriers (road and rail) in order to comprehensively perform the whole transport.

2.6   Freight forwarder

The Freight Forwarder organizes the dispatch or collection of the goods and coordinates other processes related to shipment service in his own name, but on the Customer's account. Freight Forwarder is obliged to perform the carriage, carry out his own transport or choose the carrier in such a way as to meet the expectations of the Customer. The forwarding company supervises the transport in every respect and at every stage, even after handing over the goods to the carrier. The Freight Forwarder is responsible for contacting the Customer in crisis situations - such as delays or accidents - and for resolving problems during loading and unloading.

3   Review of IT tools supporting intermodal transport

The overview of IT tools has been divided into two parts:

1. Basic categories of ICT tools – 9 basic categories of IT tools supporting intermodal transport have been classified, each of them contains a detailed description with examples. Within each category, detailed inventories of ICT tools available on the market have been carried out in accordance with the structured form shown below.

Name of the tool	Tool provider	Web site	Type of the tool
Basic functionality			
Architecture and functionality			
Target groups			
Technical description			
Benefits			
Gap analysis			
Remarks, Challenges, expected problems, implementation bottlenecks			

2. Tracking Software – IT systems for monitoring the movement of transport units and cargo – this section describes the operation and use of functionalities for tracking cargo or vehicle.
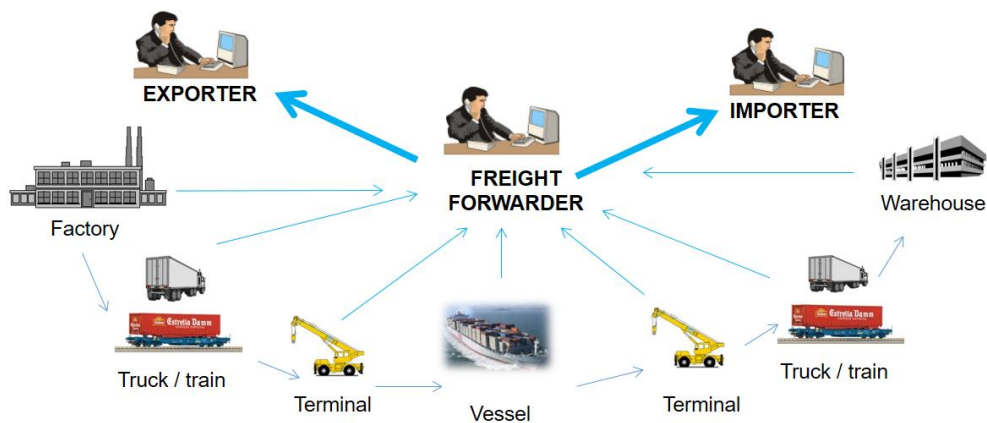
Figure 1 – ICT in Supply Chains (Monitoring movements of transport units and cargo)

3.1 Basic categories of ICT tools

Transport processes, especially those related to multimodal transport, have a high degree of complexity. Therefore, the role of tools supporting transport decisions both at the level of concluding a transport contract and controlling its implementation is high.

At the negotiating phase of the transaction, scheduling of deliveries is important, meaning that the choice of the best carriers on a given section multimodal supply chain is optimal, so as to achieve the optimum result of the entire supply from transport costs or service time side.

The final stage of the transactional part of the transport process is to book the service with the individual carriers, who will be required to carry out the service according to the planned supply chain by the decision maker (which may be directly the shipper or representing him freight forwarder or ship-owner).
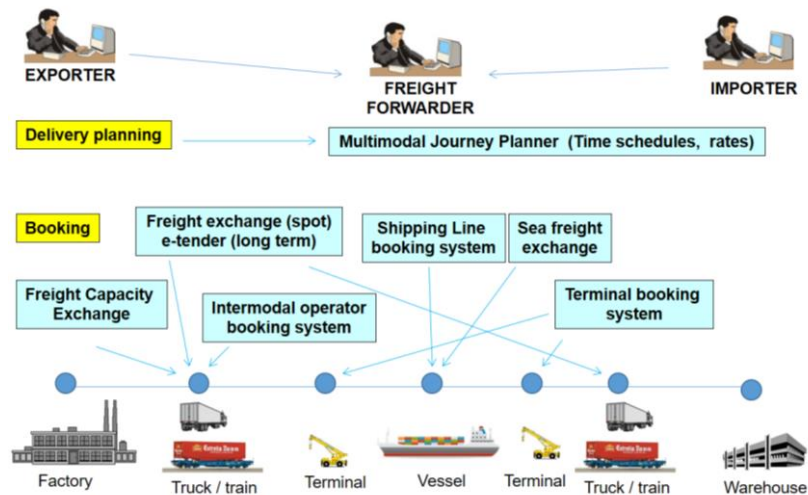
Figure 2 – ICT in Supply Chains (conclusion of freight contract)
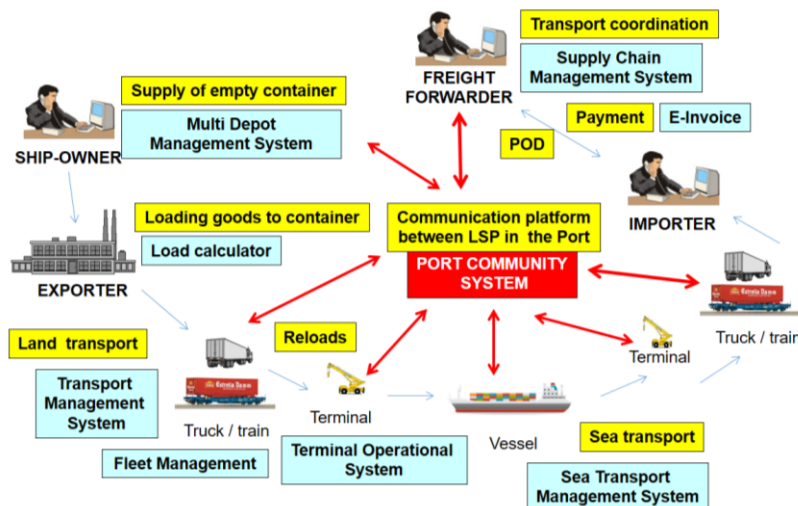
Figure 3 – ICT in Supply Chains (Support in operational processes)

There is a wide range of ICT solutions supporting the process of communication and management in the TSL industry. These include a wide scope of management support - from location tracking, internal and external communication to handling management, mode selection and spare capacity.

Decisions made in this regard may be assisted by electronic tools, as described in detail in the following sections.

3.1.1 Load calculator

It simple tool which is useful for every shipper, suggesting how to load a truck, wagon, container, depending on the dimensions of the vehicle's cargo space, unit dimensions of loads and weight of consignments.

3.1.1.1 Load Calculator (LC)

Name of the tool	Tool provider	Web site	Type of the tool
Load Calculator	SeaRates LP 101 Rose Street South Lane, Edinburgh EH2 3JG, UK	https://www.searates.com	Load Calculator

Basic functionality
Container Load Calculator simulates placing goods inside a container and determines their optimal positioning within. User specify the type of cargo and input its parameters (width, height, length, weight and number of units), there is possibility to pack cargo on pallets or directly into a choosing container. The application will display the most optimal way to position the goods.

Architecture and functionality
Load Calculator renders a 3D image with the optimal positioning of goods inside a container or truck. It displays the best way to load mixed size products into vehicles and containers. The tool comes with a handful of templates for pallets with standard dimensions, weight and other parameters. User can customize the position in which crates, cartons, boxes or other types of cargo are loaded. This feature is especially important for loading dangerous, fragile and oversized goods Load Calculator is available in the following languages: English, Arabic, German, Spanish, Russian and Chinese.

In few easy steps user can define:

1) Container type (select equipment: container or truck
2) Cargo type (select cargo type: boxes, BigBags, Barrels, Sacks)
3) Cargoes (cargo parameters: name, length, width, height, weight, quantity, colour)
4) Loading type (equipment for cargo loading: cargo stuffing directly into transport, pre-shipment cargo palletizing)
5) Pallets (Pallets parameters: length, width, height, weight, payload, max loading height level, thickness of separating plate)
6) Containers (Container list)
7) Packing parameters (Spacing settings of cargo in container)

Spacing settings of cargo in container

Select position(s) of load acceptable for the transportation of that cargo type. Putting limits on positions of load could adversely affect effective stuffing.

Cargo: **Cargo1**
Q-ty: 50 units
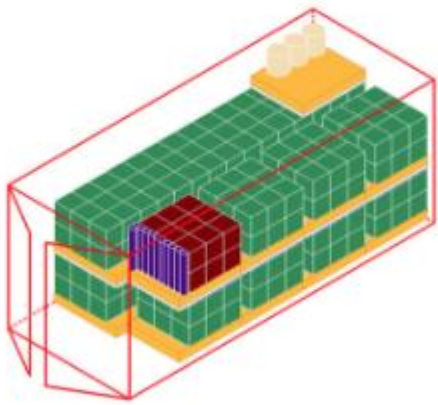
Weight: 600 kg.
Length: 1500 mm.
Width: 600 mm.
Height: 600 mm.

Height ☐   Length ☑   Width ☐
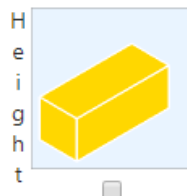
Back   Next

8) Results (graphical presentation of the optimal loading of the goods, including information about, quantity of packages, cargo volume, weight)

Transports	Cargo packing
All transports: Truck 1: 1 units Truck 2: 1 units	Total: 454 packages. Packed: 454 packages. (100%)

Truck №1 (Truck 1 1 units)

Packed: 374 packages: (82%).
Including:
- **Cargo2** - 11 packages (100%)
- **Cargo3** - 18 packages (54%)
- **Cargo4** - 306 packages (91%)
- **Cargo5** - 36 packages (81%)
- **Cargo6** - 3 packages (9%)

Cargo volume: 12.28 m^3
(37% of volume)

Cargo weight: 2931 kg.
(10% of max payload)

Cargo quantity is limited by volume

Show packing by blocks
Show packing step by step
Show pallet loading images

Target groups

All who are responsible for loading goods

Technical description

- web access
- Internet access is required
- registration not required
- informational character

Benefits

- possibility to add 30 cargo types in one calculation
- different cargo types can be mixed in the calculation
- possibility to add container truck. Changing data as new record appears in container list. The total container quantity can't exceed 20 units.
- wrong data warning: If total cargo weight exceeds container max payload user see information "You can fulfil calculation with the entered data but all goods will not be loaded into container. Do the calculation have to be continued?"
- file to print/download: packing by blocks, packing step by step, pallet loading images

Gap analysis

- lack possibility to import file with cargo dimension

●	doesn't store cargo data, user need to full every fields every time
●	error on the website of the calculator preventing preview of the second truck/container (no possibility to scroll the page)

Remarks (Challenges, expected problems, implementation bottlenecks)

1) A lot of internet free LC is based on SeaRates Load Calculator (provider share this tool for a fee)
2) Increasingly, LC is an additional functionality for ICT applications, not a stand-alone tool.
3) SeaRates also provide:

For freight forwarders:
- ● Container tracking,
- ● Route planner
- ● Shiplot
- ● Line Search
- ● Terminal

For exporters
- ● Trademod

Calculators
- ● Demurrage & Storage
- ● Load Calculator
- ● Unit Converter
- ● Freight Calculator
- ● Distances & Time

Shipping Services
- ● Demurrage & Storage
- ● Load Calculator
- ● Unit Converter
- ● Freight Calculator
- ● Distances & Time

3.1.1.2   The 3D Load Calculator (LC)

Name of the tool	Tool provider	Web site	Type of the tool
The 3D Load Calculator	PIER2PIER	http://www.pier2pier.com/loadcalc	Load Calculator

Basic functionality

Calculate the best way cargo loading / optimisation of container contents

The 3D Load Calculator is a tool where user can insert all needed pieces to load in a container and see the optimal way to load it in a container

A PDF stuffing report can be created or can be send the unique URL so load planner can show how intend the container to be loaded

Architecture and functionality

1) Start page (define reference number, possibility to open earlier calculation)
2) Cargo dimensions

	Cargo name	Length (cm)	Width (cm)	Height (cm)	Weight piece (kg)	QTY	Colour	Allow cargo rotation	Allow cargo stacking ON TOP	Allow cargo stacking UNDER	Include in loading
Add box cargo											
❌ 42 CARGO	42	37	24	302	40	au ▾	☐	☐	☐	☑
						40					

	Cargo name	Diameter (cm)	Height / Lenght (cm)	Weight piece (kg)	QTY	Colour	Allow cargo rotation	Allow cargo stacking ON TOP	Allow cargo stacking UNDER	Include in loading
Add cylindric cargo										
Import data										
Change to imperial system / ❌ Cargo15, 16, 17	40	300	22	4	au ▾	☑	☑	☑	☑
					4					

3) Loading (load as bulk cargo, load on pallets)
4) Pallets (selection of pallet type, or define by user)

Select Pallet Type: EUR pallet ▾

- EUR pallet
- 1/2 EUR pallet
- EUR plastic pallet
- US Pallet
- User defined

Pallet Width (cm):	80
Pallet Length (cm):	120
Max Loading Height Level (cm):	200
Payload (kgs):	1500
Pallet Height (cm):	16

5) Packing (Spacing settings of cargo in container)

Please de-select if cargo can NOT be turned in some directions

Cargo name 42 CARGO
Quantity 40
Weight per piece 302 kgs
Standard 42cm x 37cm x 24cm
Rotation / Turn up 24cm x 42cm x 37cm
Rotation / Turn side 42cm x 24cm x 37cm
Loading order:
Optimized/Random ▾

Standard ☑
Rotation / Turn up ☐
Rotation / Turn side ☐
No overstack: ☑
No understack: ☑

6) Equipment (choosing king of container, possibility to select or create equipment)
7) Result

20' DC

235.2
239.3
228
589.8
234
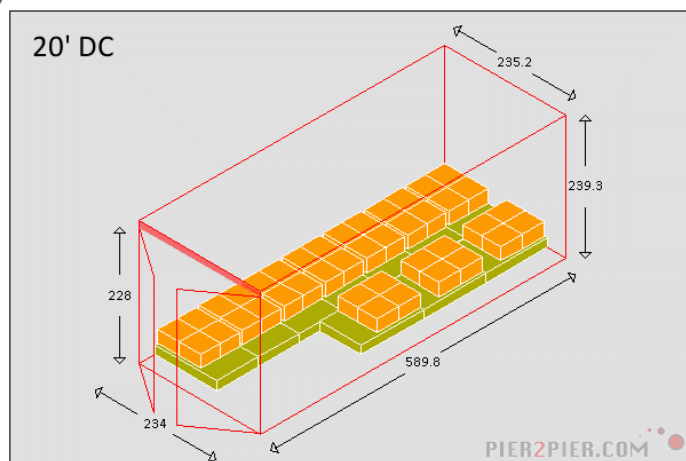
Equipment type : 20' DC

Cargo name	Pieces loading	Pieces total
42 CARGO	40	40

	Total	Maximum
Weight (payload) in KG	12080	28200
CBM	1.492	33.196
Load centimeter	560	589.8
Pieces	40	

Show packing blocks
Show packing sequence
Create PDF stuffing report

PIER2PIER.COM

Target groups

All who are responsible for loading goods: road carrier, shipper

Technical description

- web access
- Internet access is required
- registration required
- informational character

Benefits

- cargo names and values are saved, so they can be re-used for next loading
- possibility to import cargo dimensions
- different cargo types can be mixed in the calculation
- wrong data warning
- file to print/download: packing blocks, packing sequence, PDF stuffing report
- free 3 months trial version

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)

Increasingly, LC is an additional functionality for ICT applications, not a stand-alone tool.

PIER2PIER also provide:
Most popular

- Track & Trace
- Track & Trace Surveillance
- World Map

Contact details

- Carrier contact
- Carrier websites and SCAC
- Container truckers
- Container leasing and depots

Container information

- Container details
- Container specifications
- Container prefixes
- Container check digit calculator
- Demurrage calculator

Educational

- Educational tests
- Trucks (Pic/Movie)
- Port and Vessels (Pic/Movie)

Various

- Books, magazines and posters

- Countries, zip codes and dialling
- Document builder
- IMDG
- Port and zip code lookup
- Rate of Exchange
- Rules and regulations
- W/M and temperature
- Co2 and Distance Estimator
- VGM submission

3.1.2 Intermodal Route Planner

The basic element of this tool is a database including a list of logistics service providers along with tariffs and timetables. The IRP is a resource to identify and plan optimal, more efficient and cost-effective journeys through more sustainable freight routes. Based on world map and real data from providers, the IRP calculates the fastest freight route by road, rail and sea against estimated journey times across Europe, and provides associated costs. It is online route planner to allow different combinations of journey for all modes across Europe and which provides cost estimates. This integrated approach helps freight providers find feasible alternatives to road transport, therefore reducing CO_2 emissions and air pollution.

Companies for which ecology is important, take into account the use of more "green transport branches" in their route selection: rail, ferries, boats, feeders especially in cases where a short delivery date is not an important contractual condition.

Poniżej przedstawiono wybrane przykłady rozwiązań ICT

3.1.2.1   Zeeland Seaports Intermodal Planner (IRP)

Name of the tool	Tool provider	Web site	Type of the tool
Intermodal Planner	Zeeland Seaports Schelpenpad 2, Postbus 132 4530 AC Terneuzen Tel: +31 (0) 115 647400	https://intermodalplanner.eu	Intermodal Route Planner
Basic functionality			
Planning possible transport connections for intermodal transport // inland shipping, rail and sea			
Architecture and functionality			
Planner – user enter needed transport (origin and destination, which can be entered via a map or by directly address field), using Find connections display the list of possible connections, clicking on a table row shows route main information (operators, terminals, transport time per day, frequency per week, way of transport).			

Route	Transport time (days)	Frequency (per week)	Number of transshipments	Modality
Frankfurt/Oder - Rotterdam - Riga	3	1	1	

After select interesting route, user will see details, map, how many time will take exact part of route, which operator will hang it, also additional information if it's needed.

➢ Catchment area – map with ports and transportation lead time
➢ Terminals - terminals overview (table with name, country, city)
➢ Operators - list of operators included in the Planner (if operator didn't find his details can add it by sending an email)
➢ Instructions – short description how does it works
➢ Contact – contact details
➢ Disclaimer – information's and warnings about risk and benefits related to use Planner

- all services shown, have a frequency of at least once a week

- through website Planner Zeeland Seaports provides information on a large number of container terminals and a variety of services provided by more than 50 transport operators.

Target groups

all who need to plan possible intermodal transport, or want to check route (Freight forwarder, Intermodal operator, Rail carrier, Road carrier, Shipper)

Technical description

- web access
- Internet access is required
- registration is not required
- informational character

Benefits

- planning a possible transport route, providing information about terminals and logistic operators, and delivery time at each stage
- planned route can be exported in pdf format
- planner provide hyperlinks to the logistic operators websites, which makes contact with them easiest, but the process is not integrated
- available for free

Gap analysis

- data in the Planner can be outdated because of the sources which don't always mention the period for which the services are valid

●	the sources don't always mention the name of the terminal, but suffice to show the place of departure or arrival. This can result in unnecessary inter-terminal transport
●	not all direct links within Europe have been included in the Planner, it's possible that connections with a detour will be shown

Remarks (Challenges, expected problems, implementation bottlenecks)

- lack Information about CO_2 emission
- errors may occur, tool provider don't guarantee the accuracy and completeness of the information and is not liable for damages caused by using the presented results
- lack information about freight price,
- add new functionality like: book transport, contact with logistic operator by planner, enter cargo weight, cargo consolidation

3.1.2.2 Intermodal Route Planner (MJP/IRP)

Name of the tool	Tool provider	Web site	Type of the tool
Intermodal Route Planner	Weastflows	http://www.intermodalrouteplanner.com	Intermodal Route Planner

Basic functionality

Planning possible transport connections for intermodal transport // inland shipping, rail and sea

Architecture and functionality

Planner – user can easily point From – To locations on the map, or write it manually, software gives a number of possibilities to execute the order. The software can be changed to offer other possibilities like sorting on CO2, Shortest route, quickest route, and so on.

Target groups		
all who need to plan possible intermodal transport, or want to check route(Freight forwarder, Intermodal operator, Rail carrier, Road carrier, Shipper)		
Technical description		
● web access ● Internet access is required ● informational character		
Benefits		
● planning a possible transport route ● information about price and delivery duration ● available for free		
Gap analysis		
Remarks (Challenges, expected problems, implementation bottlenecks) ● little information on the website about this tool,		

3.1.3   Freight Exchange

While the above planning tools don't provide opportunity to negotiate terms, the transport exchanges are an ideal tool for determining the final freight rates. Mainly on freight traffic markets, such as the full truck market. It is a platform for the exchange of information between carriers and freight forwarders, supporting communication and speeding up transactions in the transport sector.

Transport exchanges use the Internet as a tool, where in real time it is possible to find or place freight or vehicle, contact a contractor and conclude service contracts, this is similar to tender bids. The use of the freight exchange allows transport companies to reduce empty freight, optimise the use of cargo space, top up and secure additional transport orders, thereby reducing the cost of service provision. Two main elements of the freight exchange include:

- freight exchange - including transport offers (this includes free cargo to be transported)
- vehicle exchange - collecting information on available means of transport and/or cargo spaces (monitoring of vehicles and freight - analysis and selection of transport route, analysis of storage space)
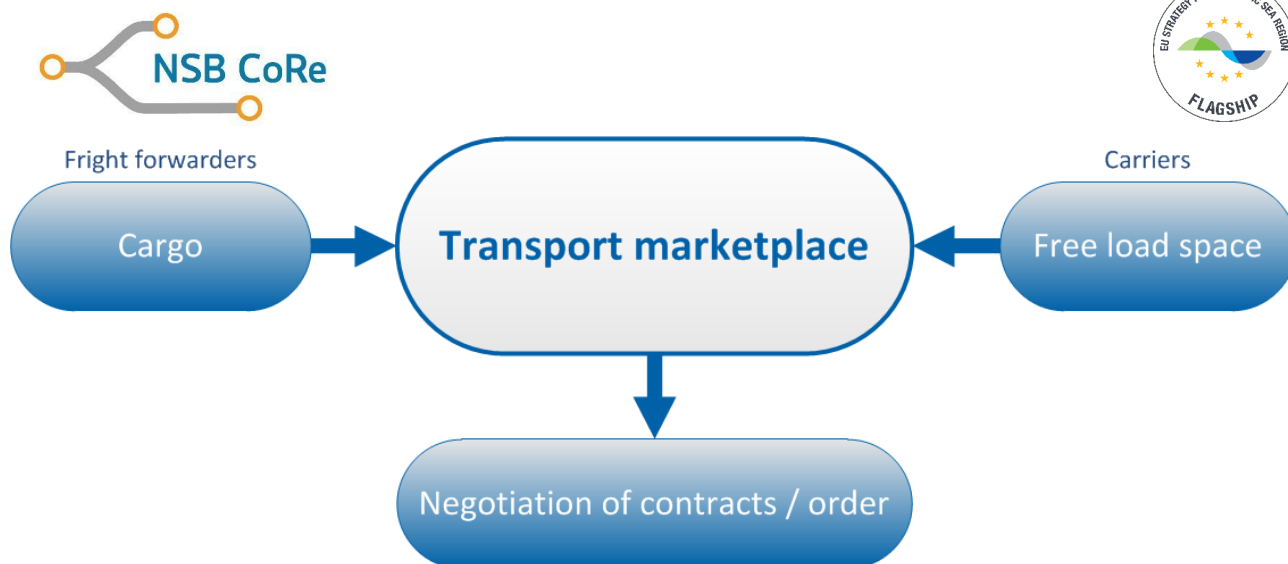
Recently was created specialized freight exchange for container transport. At moment, they are focused on optimizing cruises without the possibility of concluding a land transport contract.

Initially, the transport exchange was used for communication between the seeking cargo and the transporting goods, currently its functionality is much larger and regularly developed.

3.1.3.1   TimoCom (FE)

Name of the tool	Tool provider	Web site	Type of the tool
TimoCom Transport platform	TimoCom	www.timocom.co.uk	Freight Exchange

Basic functionality
Platform for exchanging information between carriers, freight forwarders and shippers. They facilitate communication, transaction processing, and acquisition of new orders. First and foremost, they allow for minimizing empty running and optimizing the use of the cargo area, and - consequently - reducing costs.   • transport exchange,   • tendering platform,   • tracking platform,   • warehousing exchange,   • business directory.
Architecture and functionality
The freight exchange   • Transport exchange - connects road hauliers, freight forwarders and companies from manufacturing and trade. There is something in for anyone: Up to 750,000 freight and vehicle offers are offered in the freight exchange by more than 120,000 users from across Europe (status quo: 05/2017) – tendency is increasing.

- Freight offers - user can offer and also find all types of goods at the freight entry and freight summary section. Describe consignment's size, type, weight, origin and destination with as much detail as possible. This makes it easier for those searching for freight to find exactly what they need and user will be contacted more quickly. Because to find an adequate load for available vehicle space quickly, those searching for freight use the list in the freight search. The contractor can see contact data by clicking on offer and can contact directly.
- Vehicle offers - on the transport platform user can find freight overview and a vehicle entry section to help optimise vehicle's space capacity. As a contractor, user can enter vehicle space offers with information on vehicle type, volume/weight, date, current location and destination of the vehicle. This way user avoid empty runs as well as unnecessary costs. With one click on offer, verified customers can get in contact with directly and conclude a transport order
- Warehouse offers - the warehousing exchange on transport platform helps to reduce empty warehouse space and make the most of capacity. If, on the other hand, user are looking for warehouse space, either long-term or due to bottle-necks, have access to up to 30,000 warehouse and logistics spaces spread across 44 European countries. Simply click on a warehouse offer to receive contact information on potential business partner, and get in touch with them directly. The warehousing exchange is included in every price package

Additionally

1) Transport tenders
   - Tendering system
   - Service provider search
   - Current tenders

2) Transport orders
   - Quote request – possibility to send transport quote request digitally to various business partners simultaneously.
     o Simple networking by sending requests to business partners directly on the platform
     o Save process costs and time by digitally requesting transport quotes
     o Order agreements without additional communication tools
     o Information from business partners on daily prices in real time
     o Select and compare received transport quotes
     o Central overview of all operations and their status
     o Possible additional orders by means of specific transport quote requests
     o Create templates for repetitive requests and use them at any time
     o Receive messages on relevant operations
   - Order handling - carry out all transport orders in "Order handling" with business partners. In doing so all order operations are documented and managed centrally
     o Simple networking by handling directly on the platform
     o Save process costs and time by digitally assigning orders
     o Order agreements without additional communication tools
     o Mutual assurance with a binding contract document
     o Central overview of all operations and their status

o Transport orders with the company logo, documents and a personalised order number generator
o Create templates for recurring orders and use them at any time
o Receive messages on relevant operations

3) Tracking
● Vehicle localisation - The powerful tracking solution combines all standard telematics systems in transport platform. User can view relevant positional data in a clear bundled form. In addition, with the route planning and calculation tool, user can directly determine the corresponding route and estimate the resulting transport and additional costs from the freight and vehicle exchange.
o All vehicles can be tracked on our transport platform, no matter which telematics systems is using
o No need to log into several different telematics systems
o Separately mark vehicles that user have temporarily activated for tracking in "Enter vehicle"
o Use user current location as a starting point for searching for freight nearby
o Save vehicle location in the route planning to calculate
o Get a clear picture and ensure transparency at all times
o Create trust and enhance credibility when assigning jobs and contract processing
o Save valuable time with reduced need for communication
● Telematics provider – 234 integrated telematics providers

4) Connecting customers
● Business directory - access to a logistics network of over 38,500 verified companies from all across Europe
● Messenger - The TimoCom Messenger enables, as a contractor and customer from manufacturing and trade, freight forwarding agencies and transport companies to chat with each other directly. The service is available to either fix offers or chat in general. With the Messenger user can negotiate simultaneously with various potential business partners.
o Offer-related chat including an export function – perfect in order to handle and document binding offer related (price) negotiations
o Synchronisation of contacts and chats across mobile devices – using it on tablet or smartphone is possible from anywhere
o A clear layout as well as filtering and administering of chat subjects and business partners within one window – all essential by offer-related requests
o Verified business partners as well as compliance with the data protection guidelines guarantee security in the accustomed TimoCom quality
o General chat functions to network before and after a transport job
● Timocom mobile - app for tablets and smartphones

Target groups

Road carriers, freight forwarders, shippers

Technical description

- Access by website or installed software
- Internet access is required
- Registration required
- Fee required

Benefits

- Helps to avoid expensive empty runs
- Up to 750,000 international vehicle and freight offers daily
- More than 120,000 users from all across Europe
- More than 516 million tons of freight per annum
- Special offer for Courier / Express / Package service
- The highest possible level of security for national and international transport thanks to TimoCom security network
- Reasonable monthly flat-rate access to our transport platform
- User can find freight and offer vehicle space wherever he is via the transport barometer app
- Data are "Hosted in Germany"
- Allows user to react flexibly to bottle-necks, reduce empty space and make full use of capacity
- Possibility to test it for free up to 4 weeks, including a personalised introduction to the functions in user native language
- Access up to 30,000 warehouse and logistics spaces across 44 European countries
- Enter company in the TimoCom business directory, our logistics network with 38,500 vetted premium contacts
- Available in 24 European language

Gap analysis

- lack Information about CO_2 emission

Remarks (Challenges, expected problems, implementation bottlenecks)

One of the biggest European freight exchange

3.1.3.2   Trans.eu (FE)

Name of the tool	Tool provider	Web site	Type of the tool
Trans.eu Road Transport System	Trans.eu BV Koninginneweg 1 3331 CD Zwijndrecht The Netherlands	www.trans.eu	Freight Exchange
Basic functionality			

Platform for exchanging information between carriers, freight forwarders and shippers. They facilitate communication, transaction processing, and acquisition of new orders. First and foremost, they allow for minimizing empty running and optimizing the use of the cargo area, and - consequently - reducing costs.

Architecture and functionality

- Exchange - vehicle and load offers from all over Europe
- Safety - reliability ratings and certification of the best companies
- Messenger - Quick and easy contact with the counterparty
- Tools - managing orders and monitoring drivers
- Integration - connection with external applications via API
- Clusters
- Specialist groups of reliable carriers

Target groups

Road carriers, freight forwarders, shippers

Technical description

- Access by website or installed software
- Internet access is required
- Registration required
- Fee required

Benefits

- 200,000 transport offers from all over Europe everyday
- A modern and intuitive load and vehicle exchange
- Approx. 30,000 forwarding, transport and production companies
- Proven companies, maximum safety
- Free registration and service
- Trusted and proven counterparties
- Filtering offers in accordance with selected criteria
- Simple and fast offer submission
- Tools for handling large transport orders which save time and money
- Submitting documents online, faster payments
- TransRisk reliability index calculated for each company
- Counterparty rating and opinion system
- Support with debt recovery
- Constant access to counterparties open to cooperation
- Archiving of all arrangements and transactions
- Instant offer submission and browsing
- Simple company, counterparty database and fleet management
- Submitting and receiving transport orders in an instant
- Access to the system at any time and in any place
- Fast, efficient and stable
- Modern management for the company and its tasks
- Free integration with customer system via API interface
  - add offers selectively or in a group
  - update and delete offers
  - look for the offers in unpopular directions
  - search for offers recursively in accordance with specific criteria
  - submit vehicle offers without assigned orders

	o submit the offer again automatically o adjust the future orders to the vehicle route o easily create reports and statistics o look for offers and added loads on the route
Gap analysis	
Remarks (Challenges, expected problems, implementation bottlenecks) Possibility to integrate via API to other software's (ERP, TMS for example)	

3.1.4 Logistic Platform / Electronic Transaction Platform

It is an Internet tool used to support business operations of enterprises. Using the platforms, it is possible to plan purchases and sales, negotiate, invest, as well as to conduct controlling process. It operates on the basis of an open or closed B2B platform and is used through appropriate software or any web browser.

The idea behind the platform is to expose companies to the demand for goods or services. Such a demand includes specific requirements for the good itself as well as for the suppliers. It is also important to choose the way of offering and selecting a supplier.

At the moment there are many types of trading platforms available on the market. They are based on outsourcing of purchases or constitute open transaction platforms. The main modules of the platform are as follows:

- internal procurement flows
- qualification of suppliers,
- transaction,
- booking,
- suppliers notification
- suppliers assessment,
- dashboard

The completion of the negotiation process of delivery conditions is the booking of transport from the carrier. Once it is confirmed, a transport order is created - delivery obligation according to agreed conditions.

The transport process is also monitored by service providers and shippers. There are many instruments supporting operational staff to facilitate the impact on the efficiency of transport processes at various stages of the service

3.1.4.1 INTTRA (ETP)

Name of the tool	Tool provider	Web site	Type of the tool
INTTRA		www.inttra.com	

			Electronic Transaction Platform

Basic functionality

Electronic transaction network for the ocean shipping industry

- access to sea carriers schedules
- booking containers
- containers tracking
- decision support
- e-invoicing
- shipping instruction
- shipping orders
- C-FAST

Architecture and functionality

INTTRA is the largest neutral electronic transaction platform, software and information provider at the center of the ocean shipping industry. INTTRA's innovative products, combined with the scale of our network, empower our customers to trade with multiple parties and leverage ocean industry information to improve their business. Connecting over 225,000 shipping professionals with more than 50 leading Carriers and 120 plus software alliance partners, INTTRA streamlines the ocean trade process. Over 700,000 container orders are initiated on the INTTRA platform each week, representing more than one-quarter of global ocean container trade. We provide a superior customer experience with user-friendly products and a deep commitment to customer care. INTTRA offers the ability to search ocean schedules, book and track containers, submit shipping instructions and VGMs electronically, and more. With Decision Support Dashboards, users can use historical data in order to leverage business insight.

1) Ocean Scheduling
   - Over 35 leading carriers
   - Over 18 million schedules and 420,000 location pairs available for search
   - Search capabilities by port of load, port of delivery, voyage number and vessel name
   - Cloud -Based Technology
     o for API Integrations
     o Easy & seamless integration
     o Eliminates data storage vs EDI
     o Improves request\response system interaction
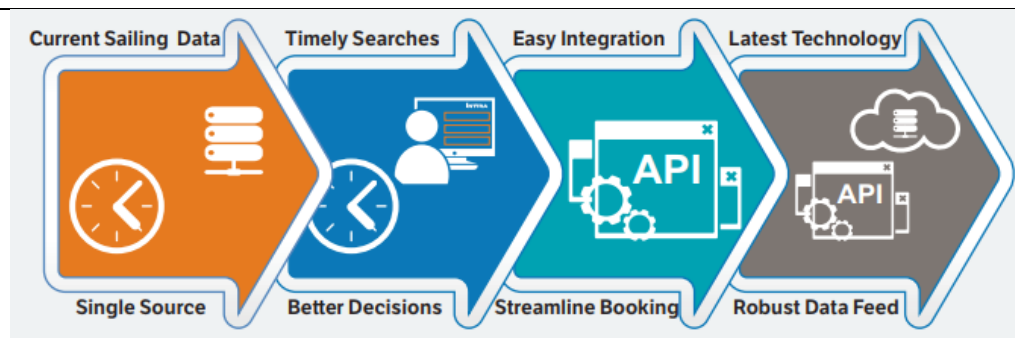
2) Container booking
  ● Automatic notifications of changes in booking status
  ● Creation of Shipping Instructions from a confirmed booking
  ● View complete booking history when accessed through online channels
  ● Integrated carrier schedule data to further leverage shipping and planning
  ● 220,000 shippers and forwarders using INTTRA
  ● Auto-recommendations to catch potential errors

3) Container tracking
  ● With INTTRA T&T, user have access to all carrier-provided updates –vessel load status, departure and arrival information for all shipments
  ● Advanced tracking tool enables to search containers by date range, latest location, carrier, trading partner, latest status event, vessel or voyage.
  ● Unlimited searches and data.
  ● Available through online portal or EDI data feed.
  ● Customized data – user can see only the data he want to receive.
  ● Confidentiality – T&T users must be a coded party on the Booking Request or B/L.
  ● Timely customer notification – INTTRA T&T allows for multiple parties to receive status events.
  ● 24/7 customer support in 7 languages.
  ● Easy access through the INTTRA portal when user request bookings or enter shipping instructions through INTTRA.

4) Decision support
  ● tool that compiles all of the shippers' ocean tracking data from multiple sources onto a user friendly interface.
  ● INTTRA dashboards enable shippers to optimize planning by leveraging key performance data and shipping behaviours in multiple scenarios (Dwell Time and Status Event Performance Dashboard)
  ● INTTRA offers a complete portfolio of dashboards that provide customers with a comprehensive overview of their shipment performance and efficiency to drive insights from their own, most relevant data.
  ● Shipment Reliability Dashboard
    o Effectively plan for seasonal shipments
    o Choose optimal routes with higher performance

- o Improve time to market commitments for customers
- o Predict and account for historical delays
- o Efficiently manage volume allocations
- o Analyze transit time and ETA trends
- ● Booking Response Dashboard
  - o Predict response timeliness across trade lanes / regions
  - o Analyze differences between specialized and standard cargo
  - o Regional views with container volumes and response times
  - o Analyze shipping volume and response timing correlations
  - o Measure impact of booking response to seasonal shipments
  - o Measure location / response time relationships
- ● Dwell Time Dashboard
  - o Volume breakdown by dwell tiers for additional demurrage charges
  - o Measure individual port dwell activity between empty pickup, gate in / out, vessel load / unload, and returned
  - o Analyze potential cost impact by dwell tier
  - o Avoid high risk ports with historically lengthy dwell periods
- ● Status Event Performance
  - o Customized views to account for containers in transit
  - o Enhanced view of containers with incomplete status events information
  - o Track performance of individual status events
  - o Capture statistics on data quality for event timeliness
  - o Analyze individual shipment and overall performance

5) e-invoicing
- ● Automatic, online invoice creation and delivery

6) Shipping Instruction
- ● INTTRA provides a simple, streamlined Shipping Instructions (SI) application, designed to help avoid costly fines and delays frequently associated with non-compliant documentation.

7) Shipping Order
- ● Designed to simplify China's unique shipping procedures

eVGM for SHIPPERS
- ● Features a SaaS web application submission providing simple work-flow based data entry forms. The data flows into an eVGM repository, accessible to Carriers and third parties such as Weight Station Providers and Terminals.
- ● EDI inbound submission as VERMAS, or via Shipping Instructions (IFTMIN) EDI messages, and/or XML equivalents.
- ● Access through multiple channels (web online, mobile, EDI or web service) delivering VERMAS EDI messaging directly to subscribed Ocean Carriers.
- ● Supporting multiple weighing scenarios and submission use cases, including third party authorization and submission.

- Use of INTTRA's eVGM application does not require Booking or Shipping Instructions to be submitted via INTTRA.

C-FAST for Freight Forwarders

INTTRA C-FAST provides an automated, intuitive method for Freight Forwarders to guide shipments through an efficient and contract-aware allocation process. INTTRA C-FAST reduces manual effort nearly 40% by matching customer forecast and carrier capacity through the use of a predictive, controlled workflow.

- Manual collection & analysis of vendor and customer contracts
- Matching customer demand with vendor commitments
- Incomplete customer forecasting for business decisions
- Lost business opportunities with insufficient utilization of space

Target groups

Shippers, freight forwarders, Intermodal operator, NVOOCs (Non-Vessel Operating Common Carrier)

Benefits

- access to the most extensive selection of ocean carriers in one platform.
- quick and errorless booking with immediate confirmation and generation of Shipping Instruction
- access to all carrier-provided updates –vessel load status, departure and arrival information for all shipments across 50+ leading carriers and NVOCCs.
- advanced tracking tool enables to search containers by date range, latest location, carrier, trading partner, latest status event, vessel or voyage.
- optimizing planning by leveraging key performance data and shipping behaviours in multiple scenarios
- Decision Support Dashboards allow freight forwarders and shippers to analyse performance and reliability of their shipments while gaining insights that will enable them to optimize planning and avoid costly risks in their ocean supply chain.
- Automatic, online invoice creation and delivery, avoiding inherent risks involved with manual input.
- Single process for submitting and amending Shipping Instructions, in multiple languages.
- Re-use and edit existing booking data to create new Shipping Instructions.
- Automatic SI receipt acknowledgements from carriers. 24/7 access to Shipping Instructions with the ability to track, audit and amend.

C-FAST Key Benefits
- Maximize Allocated Capacity and Business Growth by optimizing available capacity, contractual commitments, and procurement efforts
- Improve Booking Reliability using comparisons of customer forecasts and actual bookings to develop valuation trend analysis and segmentation
- Automate Allocation Process using a predictive, controlled and contract -aware work flow for faster operational decision making

Container booking:
- Reduce costs associated with manual errors and late bookings

	• Improve operational excellence by submitting and receiving more complete, accurate information
	• Receive and/or deliver booking confirmation faster than with manual processes
	• Standardize globally on a singular booking management platform
Technical description	
	• Access by website or installed software
	• Internet access is required
	• Registration required
	• Integrations via EDIFACT, ANSI, XML, CSV, Web API
	• For free
Gap analysis	
The application does not include overland transfer of containers (precarriage / oncarriage)	
Remarks (Challenges, expected problems, implementation bottlenecks)	
World's largest electronic transaction network for the ocean shipping industry (25% of containers are booked through INTTRA	

3.1.4.2   SeaRates.com (ETP)

Name of the tool	Tool provider	Web site	Type of the tool
SeaRates.com	SeaRates LP 272 Bath Street, Glasgow, G2 4JR	www.searates.com	Electronic Transaction Platform

Basic functionality
1) Request a Freight Quote
2) Services on map
• Container tracking • Distances and time • Logistic Route Planner • List of world sea and air ports • Sea Lines Explorer • Route Explorer • Sea Freight Exchange
3) Smart tools referring to DIMENSIONS
• Load calculator • Containers Dimensions • Pallet Dimensions • ULB Containers types and dimensions (for air freight) • Types and dimensions of railway wagons

4) Additional Tools

- Demurrage and Storage
- Incoterms 2010
- IMO classes
- Currency converter
- Unit converter
- Abbreviations
- Liner terms
- Services & Fees

5) Inspection Services

- Product Testing Services
- Pre-Production Inspections
- First Batch Inspection
- During Production Inspection
- Pre-Shipment Inspection
- Container Loading Inspection
- On-site Sorting Service
- Supplier Verification
- Step-by-Step Order Tracking
- Surprise Factory Visit
- Price and Terms Negotiations
- Product Sourcing
- Quality Assurance
- Engineering
- Lab Testing Advise

Architecture and functionality

1) Request a Freight Quote

Shippers and forwarders may obtain knowledge about rates for LCL, FCL containers as well as bulk

- seaport – seaport
- airport - airport
- port – destination (road haulage or rail freight)

2) Services on map

Container tracking
The tracking system allows us to define the current position of the container on the world map (Google Map) and determine the port and the time spent in port of congestion. To track the location of the container, user must specify its number and the shipping line. The result will be displayed on the map showing the current location of the container.

Distances and time
Distances and Time - Online tool for calculation distances and shipping rates between air and sea ports. Whether user need "port-to-port" or "door-to-door" transit time and distances, just need to choose place of loading and discharging of the shipment. In several seconds will get

the duration of transit time, including inland transportation of cargo to the port of loading. Data on the transit time of shipping lines is calculated in a combined way, based on the statistical data obtained from "container tracking" service. All the data will be informatively represented on Google Map.

User also get a layout of the estimated time costs in accordance with basic terms of delivery (Incoterms).

Logistic Route Planner
No matter what mode of transport is using (air, land or multimodal), customers will be sure where their cargo is located and when it will be delivered. User plot personal route for every client with own booking number. Therefore customer can check cargo location anytime, just enter booking number.

Sea Lines Explorer
The service is very simple and quick in use. In order to get the most complete information about the nearest container terminals and shipping lines in the region chosen, the only thing user need is to select the place of origin and destination of the shipment. Within a few seconds will get an informative image of ports and container terminals in the selected region on Google map. In addition, the service includes information regarding all shipping lines operating on the routes chosen.

Routes Explorer
- Find the best ocean freight from the top Shipping Lines as well as the most competitive transportation rates from Rail handlers, Freight Forwarders and Transport companies.
- From any origin to any destination in the world.
- From small airfreight to full ship loads.
- Place request on SeaRates.com, then simply wait for the top carriers to quote.
- User can choose who is best suited to move freight and at rates which both agree

Sea Freight Exchange
- SeaRates helps make booking easy, enjoyable, and safe.
- SeaRates verify personal profiles and rates, maintain a smart messaging system so carriers and clients can communicate with certainty.

3) Smart tools referring to DIMENSIONS (as support for loading process)
- Load calculator – for optimal loading of trucks and containers
- Containers Dimensions
- Pallet Dimensions
- ULB Containers types and dimensions (for air freight)
- Types and dimensions of railway wagons

4) Additional Tools supporting purchasing process
- Demurrage and Storage
- Incoterms 2010
- IMO classes
- Currency converter
- Unit converter
- Abbreviations

- Liner terms
- Services & Fees

Target groups

Shippers, freight forwarders, carriers, Intermodal operator

Benefits

General
- It's free
- User can choose from a large list of competitive quotes.
- An innovative online platform that allows to book and pay for shipments.
- Fast quotes from the most active carriers.
- Instant visibility with online chat.
- Track shipment on our interactive map.

Container tracking
When visiting the website with container tracking the client gets the chance to complete the request and establish new business ties.

Logistic Route Planner
Allow to:
- add any point of shipment to the route (city, port, terminal, etc.);
- plot shipping route with unique booking numbers;
- edit the route during the shipment;
- track the customer's shipments on website.

Complete list of ports, terminals and shipping port-to-port connections

Technical description

- Access by website or installed software
- Internet access is required
- Registration required

Gap analysis

Lack information about integration with other software's

Remarks (Challenges, expected problems, implementation bottlenecks)

SeaRates is a founder and trendsetter in the most of online tools for carriers, such as Tracking, Online-Quotations, Loading Calculation, Route Planning, Distances Calculation and various transportation services.

It's also modern trading platform, created to fully integrate all stages of sales and delivery, improve reliability and remove difficulties, increase sales and attract customers

3.1.5 Multi Depot Management System

The first step in the shipment of containerized goods realized as part of the export transaction is to deliver the empty container to shipper for loading of the goods. Container owners are ship-owners which put empty containers on the network, where they expect to be transported to the customer or to the port operator indicated by the ship-owner. Ship-owners need IT tools which allows them to make optimal use of the network, to provide customers with empty containers from the nearest depot.

3.1.5.1 DepotPRO (MDMS)

Name of the tool	Tool provider	Web site	Type of the tool
DepotPRO	Global Software Systems 40 Bloomsbury Way, Lower Ground Floor, London, WC1A 2SE	globalsoftsys.com	Multi Depot Management System
Basic functionality			
Depot Management System is way of managing the movement and maintenance of containers in container yard.			

Architecture and functionality

Systems functionality includes:
- Record Containers Gate In/Out, Status changes, Yard services, transfers, complete Container Tracking, with detailed History.
- Auto charge calculations for Handling, Daily/Weekly Storage.
- Repairs [M&R], Miscellaneous costs Repair Estimates and billing [advanced costing grids, inc. Reefer repairs], repairs profitability & stock control.
- Multi Depot, Multi Cost Centre, Multi Country.
- Multi Language.
- Full container & transaction history with detailed drilldown.
- Detailed Reporting, Daily Log etc. Client Revenue Reporting with graphs, inc. export to Excel, PDF, or email.
- Unique 'Generic EDI' - import/export any EDI files, makes EDI easy.
- Embedded SQL Query with export to Excel for 'ad hoc' reporting.
- Quick On-Line Container Status Enquiries/Release requests.
-

Options include;
- Hand Held Repair Estimates - portable data terminals on-line via our unique very long range radio modems.
- Hand Helds for Gate In/Gate Out/Yard Services/Releases etc.
- Imbedded Delphi Report Generator.
- Operating Country selector with invoice/tax rules for country selected.
- Internet client access and enquiries & Estimate approvals with WEBPARK.
- Fork Mounted RF Units, etc., plus many more unique features.

Target groups

Ship holders

Technical description
DepotPRO runs on an MS SQL Server database - a top quality & robust environment

Benefits
A full featured system with extensive reporting and analysis, Multi country, Multi Depot, Multi cost centre, Multi Language.
Have unique animated 3D On-Screen Visual Depot, for easy depot control.
DepotPRO includes auto-charge calculations for Handling, Daily / Weekly Storage, Repairs, and Miscellaneous costs, and our unique 'Generic EDI' - which automates and makes EDI easy. User can record Containers Gate In / Out Status changes, Yard Services, transfers, complete Container Tracking with detailed history.

Gap analysis
Lack information about integration and communication with other systems

Remarks(Challenges, expected problems, implementation bottlenecks)
Container Depot Management Systems can interfacing in to FinPRO - the Global Systems Financials, a full set of Windows Financials including Accounts Receivable, Accounts Payable, General / Nominal Ledger, Subcontractors Accounts Payable, Cash Book, Assets Register, Bank Reconciliation, Contact Management etc., and CONTRACK - the Container Transport System, plus StorePRO - the intelligent Warehouse Management System.
Global Software Systems also provide: ● Warehouse & Production Industries - systems for the Warehousing Industry, including 3rd Party Logistics and in-house company Warehousing. ● Transport Industry - systems for the Transport Industry, including operations/bookings, local and long distance haulage. ● Financials - a full featured and comprehensive fully integrated Financials package - good for high volume transaction processing. ● Container Industry - Systems for the Container Industry, including Depot Management, Container Sale, Hire & Self Storage, plus Container Transport.

3.1.5.2 CargoSmart Depot Management System (MDMS)

Name of the tool	Tool provider	Web site	Type of the tool
CargoSmart Depot Management System	DMS Support Center 3/FL., RuiFeng International Tower, No. 248, Yang Shu Pu Road	dms.depotsmart.com	Multi Depot Management System

	Shanghai, China		

Basic functionality

Depot Management System is way of managing the movement and maintenance of containers in container yard.

Architecture and functionality

<u>Booking Management</u> - provide container gate in/out booking of multiple types, including inbound/outbound, empty reposition in/out, and domestic; support designated containers to gate in/out; support container carrier rollover and LCL setting.
- Create & maintain gate in/out booking
    - Manual create booking
    - Import booking
    - Handle customer requirement on gate in/out container
- Create & maintain LCL container
- Import vessel manifest

<u>Gate Management</u> - support container gate in/out process; provide container gate in/out maintenance function; support EIR printing function.
- Container gate in/out
    - Gate in/out by booking
    - Comprehensive and configurable verifications
    - Auto recommend yard location
    - Customize gate form
    - Maintain gate in/out
- Print EIR, Search yard plan

<u>Container Management</u> - enable users to maintain container information; provide container gate in/out control rules setup; support yard planning for container gate in/out; support graphic container yard/area/bay views; support graphic container in-depot movement.
- Search & maintain container information
    - Batch update in-depot container
- Maintain container yard location
    - Multi-type graphic yard view
    - Graphic supported container movement operation
- Maintain yard plan
- Hold/Un-hold in-depot container
- Setup gate in/out control rule
    - Customize gate in/out control condition and severity

<u>Container Maintenance and Repair</u> - support container repair estimate submission/approval process; support hangertainer refit; support reefer container pre-cooling.
- HG refit and RF pre-cooling
    - Optimized HG/RF container gate out-process
- Container repair
    - Create & maintain repair estimate
    - Auto calculate labour / material cost
    - Integration with shipping lines system
        - Support CEDEX EDI standard

- Integrate with OOCL DepotSmartseamlessly
- Settle cash payment for container repair

Wireless Operation - provide wireless container gate in/gate out functions on wireless device; provide wireless container movement function on wireless device; provide wireless container change function on wireless device.

- Most cost effective depot wireless solution
    - PLMN based architecture
    - Cost effective implementation with short period
    - Stable and preeminent performance
- Container lift on/off and movement
    - Auto recommend most suitable yard location
    - Graphic supported operation
    - Various configurable verifications

Cargo Management - support cargo receive and stuffing; support cargo un-stuffing

- Cargo receipt
- Stuffing/un-stuffing

Billing Management - support depot in-house and customer agreed tariff setup; support cash payment collection; support credit billing report generation; support credit charge adjustment.

- Maintain charge item and tariff
    - Customize charge item
    - Maintain depot standard tariff
    - Maintain customer-agreed tariff (container repair tariff incl.)
- Settle onsite cash payment
- Maintain billing report for periodical charges
    - Support various configurable rules for storage fee calculation

EDI

- Gate movement EDI, container repair EDI,
- Billing EDI

Reporting- support container gate in/out report; support container storage report and average storage days statistics; support inbound/outbound report.

- Operation report
    - Container gate in/out report, container storage report
- Management report
    - Chart supported graphic report
    - Staff and facility/device work load statistics
- Customize report export format

Profile and Setting - provide profile and rule settings (financial & operation rules) for depot, carrier customers, and cargo agents; provide role and user maintenance; provide supporting data setup.

- Maintain user, depot, and customer profiles
- Maintain operation and finance rules
- Setup TODO tasks and exception alert
- View data amendment log

Target groups

Ship holders

Technical description
Lack information about implementation

Benefits
Gate In Performance Enhancement
● Increase Gate-In Throughput
o Speed up Gate In operation by 20%
o Improve customer satisfaction by lowering waiting time
● Improve Gate-In Accuracy
o Improve accuracy of container location by Wireless client
o Less manual input, more automated validation
● Increase Gate In accuracy rate from 90% to 99%
Yard Location Management
● Streamline yard operation process
● With more precise information provided by system, yard administrators can be freed from boring routine work, and spend more time in yard utilization.
● Improve competence of depot yard management
● Lower operation cost
● Minimize un-necessary re-marshal
● Improve customer satisfaction
● Respond to customers' request more efficiently
Container Gate Out Control
● Release error rate can be reduced by 80%
● Improve customer satisfaction
o Containers are correctly released
o Containers with higher priority are released earlier
Re-marshal Management
● Re-marshal cost can be saved by 40%

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)
- Supported by fully built in EDI and CEDEX

3.1.6 Transport Management Systems

TMS is a specialized computer software that supports transport, logistics, as well as distribution and trade processes. It can be implemented in any type of enterprise, however, it works best in transport, forwarding, logistics and warehousing departments as well as other companies owning or renting a car fleet.

TMS systems provide access to a number of functionalities facilitating the performance of basic tasks of forwarders and carriers, as well as access to extensive analytical and reporting modules. Modern TMS systems cooperate with GPS systems (possibility of integration with telematic systems and

digital maps) and can be operated by websites, and contacts with contractors are made by text message, e-mail or fax and by means of specially created accounts, which guarantee quick access to information. So far, the data has been stored mainly on a local server, but nowadays an increasingly popular solution is to build systems available through Internet platforms, which store data in the so-called CLOUD (software provider's server). The most important functionality of TMS systems are:

- planning and optimizing of transport routes
- fleet management
- monitoring & management of transport orders (real time vehicle tracking, analyze deviations from the planned route, control the use of designated parking lots and petrol stations)
- control of transport costs (amount of purchased fuel and its level of consumption, drivers working time, technical reviews)
- clearing transport services
- statistics and analyses

TMS designed to handle other branches of transport, such as sea or rail, take into account their specific characteristics.

3.1.6.1 MercuryGate (TMS)

Name of the tool	Tool provider	Web site	Type of the tool
MercuryGate TMS	MercuryGate Corporate Office: 200 Regency Forest Drive, Suite 400, Cary, NC 27518	www.mercurygate.com	Transport Management System

Basic functionality
1) Multimodal deliveries planning based on the database of rates, schedules and carries capacities supported by database of historical rates, trends and forecasts. 2) Shipments optimisation by consolidating parcels, groupage and part loads, securing backhauls and searching for the best multimodal transport solutions. 3) Procurement of the multimodal and multi-leg transport services including electronic bid solutions and freight exchange mechanism. 4) Paperless management of freight transaction (orders management, cost allocation, creation and reconciliation of invoices, paying commissions e.tc). 5) Control Tower securing end-to-end shipment visibility of multimodal, multi-leg shipments for all trading partners.

6) Easy-to-read dashboards supporting executives with comprehensive analysis of transport services progress.

7) Fleet management including vehicle monitoring, diagnosis and maintenance as well as drivers management.

Target groups

1) shippers

Critical needs

- Negotiate and procure the optimal transport rate
- Simultaneously optimize inbound and outbound transportation
- Select the optimal mode, carrier and rate
- Achieve control tower visibility & decision support
- Conduct effective freight audits and manage fully landed costs
- Centralize & standardize to reduce costs
- React quickly to the changing global market
- Optimising delivery plan to minimize costs
- Shippers negotiate for rates from a position of strength
- Selecting the best carrier for every load
- Adapt to changes quickly and effectively

2) freight forwarders, freight brokers, 3PL (third party logistics)

Critical needs

- Deliver multiple services with a single scalable platform
- Rapidly on-board new clients
- Negotiate rates and select the optimal carrier
- Simultaneously optimize inbound and outbound shipments globally
- Provide control tower visibility and decision support
- Allocate fully landed costs, audit & pay invoices, and pay commissions
- Rely on powerful analytics and reporting
- Configure workflows, user roles, and interfaces

Architecture and description of tool functionality

Modular structured Transport Management System offering solutions for freight forwarders, freight brokers,3 PL companies as well as for shippers.

1) Module for Transport Optimisation - MOJO – dedicated for SHIPPERS

The Basic part of the tool is data base of current rates of approved carriers, their specified capacities and transit times. After importing current shipments from shipper's TMS,ERP,WMS or spreadsheet Mojo automatically determines the most cost effective route and load to consolidation. Optimisation goes across all modes, including parcel, LTL, TL, rail, intermodal, air freight, ocean and multimodal. Pooling points and back haul may be considered as well as multiple modes or international shipments.

The application will also determine the optimal ship dates and delivery appointments based on carrier resources, available docks, and delivery windows. Mojo optimisation is based on the cost, mileage and CO_2 emissions reduction for the planned shipments compared to point-to-point loads. When the loads are optimized shipment details are sent to TMS to the operational personnel. Integrated with MercuryGate TMS. (standalone solutions are also available).

2) Module for carrier management – CARMA – dedicated for freight forwarders and shippers

The heart of the system is centrally managed a large carriers database that is interactively updated by carriers.

Shippers may keep here documentation of all carriers that serve them, together with the all reports.

With accurate information about each carrier's locations, equipment, and preferred lanes, the MercuryGate TMS will have everything it needs to suggest the best carrier for every load shipped.

Using Carma, the process may be set up and user roles defined. LSP may collect and evaluate information before releasing carriers for transportation planning processes. Carriers can share the burden of keeping their information current. Using a web portal, carriers enter critical information about their insurance, equipment, contacts, preferred lanes, and much more.

3) Module for procurement of transport services – MercuryProcure – for shippers, freight forwarders and freight brokers.

MercuryProcure, supports effectively procure and manage both long-term contracts and spot rates. Eliminate repetitive manual work and streamline document creation, bid generation, bid response normalization and contract creation. Perform lane-by-lane analysis and evaluate bid responses holistically leveraging real life shipment data. Rank carriers based on pre-defined criteria and compare with market benchmarks. Post contract award, monitor compliance of execution with contracts and ensure things go according to plan.

Consolidate and work with different business units to forecast capacity requirements and combine volumes to negotiate better rates with carriers. Carry out iterative bids with carriers to fine tune rates. Leverage carrier portals to enable active participation from carrier community.

Leverage what if simulation to evaluate lanes, pool points, cross docking and impact of different modes on total transportation spend. Analyzes bid responses with actual shipment data from TMS. Evaluate carrier bids to identify least cost provider, carrier mix and mode.

4) Module for fleet management by carriers called MercureFleet

Module allows carriers to manage drivers, equipment and operations. Carrier's safety records may be protected by analyzing driver performance based on history of accidents, incident, and violations

Using algorithms of Driver Safety Management System driver scores may be predicted

Expirations of inspections and registrations may be better managed. Breakdowns may be avoided by proactively managing service cycles. Easy access to specifications and warranty information expedites repairs.

Optimization of transport execution and improvement of assets utilization by:

- Enabling two-way communication drivers via mobile applications
- Tracking equipment in real time with control tower visibility
- Optimizing combination of private fleet and common carriers
- Elimination of redundancy with one system for drivers, equipment, and operations by
- Eliminating redundancy in business processes and data entry with an integrated TMS and Fleet Management system
- Managing by exception across entire transportation network- drivers, equipment, and operations
- Enabling efficient operations and make smarter decisions with comprehensive visibility

5) Module called RateFriend being the global freight market index (for all modes : Air, Sea, Road, Rails and Intermodal)

Whether comparing spot quotes or evaluating contract bids it is good to know what others are paying and where the market is headed.

RateFriend provides a clear and accurate picture of market rates, information can be used to drive down transportation costs. Compare existing contracts with spot-market rates. Identify carriers that may be overpriced. Find the most cost-effective mode for any shipment. Quote rates with confidence

And index data is updated nightly, with over 120,000 new loads added every 24 hours..

6) ICT tools for monitoring cargo flow

a) Control Tower Visibility Tool

- This door-to-door transportation visibility is the MercuryGate Golden Thread.
- It helps clients determine where their goods are located within the transportation chain.
- The "Russian doll" concept keeps track of items placed in boxes stacked on skids located in a container.
- Combined with the location of the goods in the Golden Thread, the Russian doll allows users to see the location of detailed SKUs (down to serial numbers)

b) MacroPoint Tool (tracking with the use of mobile technologies)

- The only shipment tracking solution built to work on ANY cell phone,
- Real-time Tracking Updates: Compatible with both single and multi-stop shipments, MacroPoint delivers third-party validated tracking updates.
- Off Schedule Dashboard: This 100% automated system provides instant insight into which loads are "on schedule", behind schedule" , or "in trouble".
- Breadcrumb Mapping: The MacroPoint dashboard will map the exact path a shipment has taken during transit

- **Automated Arrival and Departure Alerts:** Featuring geo-fencing, MacroPoint will send updates as shipments are leaving or nearing their origins and destinations.

c) MercuryGate + FourKites Tool

- FourKites integrates the location data from telematics servers with weather and traffic information to create actionable insights for MercuryGate customers.
- **Location Updates:** Updates every 15 minutes on the location of loads.
- **Exception Alerts:** Email and system alerts to always know if a truck will be late or is off-course.
- **ETA Updates:** Always recalculating ETAs based on the current truck location, weather and traffic data.
- **Automatic Arriving, Picked-up and Delivered Updates:** Always know when truck is arriving or leaving the pick-up or delivery locations
- **Innovative Workflow:** The unique workflow always protects the sensitive fleet information of trucking companies.

7) Tools for analyzing transport processes

a) MercuryEdge Tool

- Merge data from multiple sources (Data can be pulled from all MercuryGate TMS tools as well as external sources)
- Automate calculations (Determine commissions, cost savings, and over-payments)
- Create instant info graphics (Export data to create charts, graphs, and tables)
- Analyze: (Profitability analysis, Shipment analysis, Commission analysis, Carrier analysis, Manage margins and profitability)
- Monitor Carrier Data Quality :Timeliness, accuracy, and completeness, Tender accept / reject ratios,
- Claims and freight bill accuracy, Overall carrier score
- Reporting: Monitor shipment processing time, Verify and monitor carrier updates, Audit carrier performance standards, Validate shipment rates.

b) Embedded Analytics Tool

- Increase/decrease the number of loads offered to carriers based on historical availability, superior acceptance percentage, and on-time performance (and within the limits of volume incentive agreements)
- Allocate premium appointment slots to the carriers that habitually demonstrate the best on-time performance so that facilities operate smoothly during peak periods
- Give preferential treatment to the best carriers or trading partners, and reward them with expedited payment to influence load acceptance and on-time performance
- Utilize load/unload and historical transit times to validate appointment duration and current trip time between appointments.

Technical description

TMS operates in the cloud, enabling all agents and partners to participate in the screening, execution, and clearance process in the most efficient and effective manner possible.

Benefits

1) General advantages of MercuryGate

- Supports all modes, including: Parcel, LTL, TL, Rail, Air, Ocean, and Intermodal
- Useful for small companies with low volumes to large global conglomerates with huge volumes
- Manage brokerage business regardless of mode for any business perspective from a small sales force to a nationwide agency model
- Supports all types of freight management business models including buy/sell, management fee, gain-share and more
- Manage global shipments and operations
- Supports optimization across all modes, even parcel, across all clients or subsidiaries
- Customers access the information user want them to see from the web and can create their own quotes and track progress

2) shippers

- Real time access to global logistics data makes shippers smarter
- Modelling scenarios using real shipments, actual carrier rates & KPIs, and locations delivers transportation plans optimized to deliver minimal costs.
- Easy access to information by all trading partners provides the ability to quickly adapt and change the plan when things don't go as planned.
- Supercharged shippers negotiate for rates from a position of strength.
- Easy access to historical and current industry rates, carrier's past performance, and expected load volumes insures always use the best available carrier at the best available rate
- An integrated transportation management system can make a difference in the company's ability to exploit new market opportunities and be more competitive.

3) freight forwarders, freight brokers, 3PL (third party logistics)

- Planning for shipments that span multiple countries can be complex and often requires multiple legs, such as rail, dray, ocean and air.
- TMS seamlessly optimizes these legs, enabling to maintain control over costs and single-system visibility to the entire transaction.
- It is also possible to consolidate of LCL shipments into full containers and reduce costs

Rail, ocean, and air modes introduce an additional level of complexity to transportation planning: schedules.

TMS integrates schedule data from leading providers to ensure shipments depart and arrive on time.

Generating and uploading documents, booking with carriers, tracking shipments while in transit, and settling invoices are all vital components of the shipment execution process.

TMS provides a customizable workflow engine that creates, assigns, and tracks activities at the user or group level

 By effectively managing these activities in a single system delays can be minimized and

carrier performance can be more efficiently measured.

Multilingual, multi-currency, multi-UOM are all constants for global trade transactions

Operating in the cloud, TMS offers user-level localization so all parties can communicate with each other in their own languages and currencies.

TMS offers analytics that truly impact day-to-day operating decisions.

The automated in-alerts keep user informed about everything from late shipments to past-due work assignments for a given user.

TMS' rate quoting portal provides clients with a self-service quote request application as well as a bid request and management tool for carriers.

The client invoicing module provides ultimate flexibility in covering the true shipment costs while the carrier invoicing module provides visibility and control over questionable charges

The cost allocation module captures fully-landed cost and allocates all appropriate costs to the item level. Pay commissions and track margin on a shipment-by-shipment or office-by-office basis.

Gap analysis

TMS covers USA territory and ocean deliveries to other continent ports. The stretch from these ports to the hinterland locations is missing.

Remarks (Challenges, expected problems, implementation bottlenecks)

Demo is available

3.1.6.2   CarLo (TMS)

Name of the tool	Tool provider	Web site	Type of the tool
CarLo	Soloplan Polska Sp. z o. o. Sp.k. ul. Dąbrówki 13 40-081 Katowice Polska	www.soloplan.pl	Transport Management System

Basic functionality

CarLO - transport management and transport planning
- calculation of offers, order management, delivery planning, freight billing and evaluations
- optimisation of vehicle scheduling and multi-stop tours
- automate billing
- creating freight documents being transferable through interface
- extensive evaluations and statistics

Carlo exCHANGE- logistics platform for shippers and forwarding companies
- real time exchange of messages and documents through web based logistics platform. The main functionality:
- track & trace of shipments
- time slot management
- freight exchange for distributing transport orders by shippers and freight forwarders among logistics operators to receive bids

CarLo inMOTION– fleet management
- fleet management for carriers
  ▪ vehicle appointments management
  ▪ drivers management
  ▪ refuelling stops management
  ▪ identification of deviations

CarLo inTOUCH – telematics
- current location of vehicle on digital map
- track & trace of vehicle movements
- transfer of orders to drivers
- exchange of messages between drivers and carriers

CatLo inTOUR - Trip planning with vehicle-specific profiles
- planning road deliveries on digital map (time and cost)
- calculation of toll rates
- identification of potential transport problems (e.g. too narrow roads, too low bridges)

CarLO inAIR&SEA - Functionality referring to SEA transport only

Direct connection to:
- platform INTTRA for booking and tracking sea shipments
- Port Community Systems as Dakosy or BHT

CarLo inSTORE – warehouse management

- warehousing processes
- inventories
- connection to CarLo
- calculation of warehousing and service charges

Architecture and functionality

1) CarLo

With CarLo, user get the right solution for efficiently planning, controlling and tracking transports. From the calculation of quotes and order management through to transport planning, freight billing and statistical evaluations. The Order Management area allows user to quickly record freight information or conveniently import these data using an interface. Offers and order templates can also be conveniently managed.

Optimise scheduling of vehicles and carriers and create tours based on economic factors. Numerous assistants and restriction checks support the dispatchers' daily work thanks to statuses for appointments, vehicle utilisation – e.g. volume, weight or store places – contribution margins for tours, remaining driving times of drivers, or mixed loading prohibitions.

Powerful billing tools support user in determining prices for invoices and credit notes. Regardless of whether user work with flat rates or complex tariff tables – and if user want to, it can be fully automate process.

Elaborate user and role concept can be define in detail which data and functions are available for him. There is possibility to manage all relevant settings centrally easily.

CarLo support creating all relevant freight documents and invoices. All documents are adapted to needs and printed, e-mailed or transferred by interface – whichever user prefer.

Extensive evaluations and statistics as well as flexible data visualisation tools with integrated Cockpit functionality helps to analyse a large variety of areas.

All customary telematics systems are fully integrated into CarLo's surfaces: orders, actual times, status feedbacks, messages, driving times, document exchange, loading unit exchange, tour structures with stop sequences and countless other details are also available with CarLo.*

Telematics solution CarLo inTOUCH for mobile devices offers a simple entry into telematics.

Handling of direct, broken and intermodal transportation are the further options

2) CarLo exCHANGE

The integration of partners into processes offers endless possibilities: exchange information and data in real time, systemise workflows, transfer orders with a mouse click, time and cost savings, and much more. CarLo exCHANGE offer a web-based logistics platform whose range of features, such as time slot management, Track&Trace, or connecting to telematics.

"Direct Order" allows to directly transfer transport orders, entire tours and any relevant transport documents to logistics partners. User receive real-time feedback on planned and actual data about transport orders and know their status at any time. User can work exclusively on the platform, using interfaces to current system or benefit from complete integration into our logistics software CarLo®. Automate workflows and save precious time during daily business.

"Best Offer" allows to offer transport orders to a group of chose logistics partners. Receiving bids from partners, choosing favourite and place order.

Time slot management helps user to significantly optimise loading schedules and reduce waiting times. Forwarders can freely book open time slots for loading and unloading. Avoid inefficient use of ramps by deploying loading teams "just in time". Moreover, inbound vehicles can benefit from guaranteed schedules and receive text messages calling them to the ramp.

The web-based logistics platform CarLo® exCHANGE is available for user "anywhere and anytime". Even when out of the office, user can always access incoming transport orders or track their statuses in real time. This option is also available from smartphone or tablet.

Diverse reports and statistics help to analyse and evaluate logistics partners. Additionally, comparisons of target and actual values for delivery times and agreed dates enable evaluation based on various quality aspects, while an overview of the annual number of consignments helps optimise synergies and may be used as a basis for negotiations. Using CarLo® exCHANGE and uploading transport orders is free; a flat-rate charge only applies if a transport order is accepted.

Track&Trace allows to automatically keep customers updated on consignment's status, helping to stay one step ahead of customers' desires and improve service quality.

3) CarLo inMOTION

Manage commercial fleet in compliance with legal requirements: schedule, perform and document vehicle appointments, driver licence checks and much more.

Continuous and cost centre-based vehicle cost calculation: records of repairs, vignettes or carwashes. Mass data, such as refuelling stops, are automatically imported via interfaces – integration of all fuel card providers available as standard.

Detailed reports and analyses at a glance: asses fleet with regard to cost structures and identify anomalies and deviations – either as a visual or in tables, depending on the application.

4) CarLo inTOUCH – telematics

With CarLo inTOUCH user know vehicles' locations at any time and can track tours by taking a look at the digital map.

Orders are transferred to the devices in electronic form and can be processed directly from there.

Status messages keep drivers and dispatchers updated on a tour's current progress and are saved in CarLo for later. For example: waiting times upon delivery, the number of swapped pallets, or actual weights for bulk goods.

Dispatchers and drivers can exchange messages, documents and images (e.g. damage in transit) without leaving CarLo.

5) CarLo inTOUR

Show planned trips directly on a map, including the distance, trip duration, European toll rates applying to the route and alternative routes, if needed. User can also use certain optional truck attributes, such as roads too narrow or bridges too low, when planning trips for vehicles.

Recurrent addresses are saved to database and can be quickly accessed. Freely definable parameters allow user to save cost structures and speed profiles specific to individual vehicles.

6) CarLO inAIR&SEA

Conveniently manage all necessary transport details relevant for sea freight, such as POL/POD information – based on official UN/LOCODES, shipping line and vessel information as well as reliable master data sources.

Connection is made via the bidirectional INTTRA platform. This allows for a free communication regarding booking requests or status messages. Moreover, we offer direct connection to portals such as Dakosy or BHT.

Take the opportunity to enter all relevant data – such as information on shipping lines, ports, dangerous goods etc. – into one single system, but still output the data on individual reports afterwards.

7) CarLo inSTORE – warehouse management

Describing store places using four dimensions, such as warehouse, row, level, and column. Specify load limits and dimensions to find the most suitable store places when storing goods

Using handheld scanners to electronically exchange data warehousing processes (stock placement, transfer and removal using connected scanners)

Target groups

1. CarLo – shippers, freight forwarders and carriers
2. CarLo - exCHANGE - shippers and freight forwarders
3. CarLo in MOTION – carriers
4. CarLo inTOUCH – carriers
5. CarLo inTOUR – freight forwarders and carriers
6. CarLo inAIR&SEA – shippers and freight forwarders
7. CarLo inSTORE - shippers

Benefits

- reduction of time as an effect of exchange real time messages and documents
- support for transport decisions referring to delivery planning, modal choice, booking, scheduling etc.)
- end-to-end visibility of vehicle and shipment movements

Technical description

-Supports all the latest operating systems - from Windows 7 to Windows 10

Gap analysis

- It is unimodal TMS focused on road transport providing also some solutions for air and sea transport.
- ICT solutions refers rather to compete loads
- No support for rail and intermodal transport.

Remarks (Challenges, expected problems, implementation bottlenecks)

3.1.6.3 Descartes (TMS)

Name of the tool	Tool provider	Web site	Type of the tool
Descartes	Descartes 120 Randall Drive Waterloo, Ontario N2V 1C6 Canada	**www.descartes.com**	Transport Management System

Basic functionality

1) Traditional transport management solutions

   a) Freight contract management
   b) Load planning and optimisation
   c) Freight Audit & Settlement
   d) Visibility, Tracking & Performance Management

2) Advanced capabilities

   a) Private / dedicated fleet
   b) Dock Scheduling & Yard Management
   c) Pool Distribution
   d) Descartes Order Express™ Multimodal Shipping Software
   e) Global Logistics Network Services

Target groups

- shippers (manufacturers, retailers, distributors)
- logistics service providers (freight forwarders, 3PL, carriers, ship-owners)

Architecture and functionality

1) Freight contract management

Descartes has developed rich contract management functionality that can handle multimodal agreements with significant flexibility, provide for ease of set-up and role based access. It supports thousands of contracts and millions of rate lines in real time.

Customizable geography definitions for lanes, zones, transit times, effective dates, and notification of expiring contracts can be incorporated into carrier profiles

Descartes addresses mode specific contract rules and rating such as:

- LTL/TL freight class mappings, discount structures, and coverage areas:
- Ocean contracts, rates and price management
- Carrier compliant parcel rates
- Air freight

2) Load planning & optimisation

Descartes offers solid optimized planning, consolidation and tendering capabilities based upon over 25 years of proven experience. It provides proprietary multi-stop, aggregation, and pooling optimization functionality to help user determine the right consolidation options to reduce freight spend

Using a settings-based approach, optimization and consolidation configuration are straightforward to understand and adjust.

Descartes supply chain solutions address specific planning and benefit driven execution capabilities across modes:

Transportation Planning

Load Planning/Consolidation: Load planning is the process by which shipments are turned into larger loads. With Descartes users can combine shipments for efficiency and cost savings with the ability to manually create loads, or to use the system's aggregation and routing algorithms to automatically create optimized shipment combinations.

Carrier Selection: Carrier selection is a critical part of the transportation management compliance process. The automated carrier selection capability within Descartes' decision engine can quickly assesses a range of user-established decision criteria, such as contractual obligations, shipping lanes, shipment priority, cost and carrier past performance and evaluates how to best convey the shipment. Descartes tracks when planners deviate from the system selected carriers and provides historical analysis of the extra costs incurred..

Carrier Connectivity: Electronic connectivity to carriers is a key driver in helping to facilitate effective plan execution. This is where reality meets the plan in terms of achieving desired costs savings and services levels. Effective collaboration with carriers is essential to streamlining the end-to-end transportation management process and ensuring carriers and other logistics intermediaries meet the service levels organization demands. The Descartes GLN™ enables users to connect and collaborate with "high tech", "low tech", and "no tech" carriers and logistics services providers for the tender through proof of delivery execution process.

Transportation Execution

Tendering & Booking: Electronically offering a load to a carrier and efficiently managing their response is a key element of effective transportation execution. With Descartes, tenders can be communicated to the carrier via the Descartes GLN through automated electronic methods including auto-faxing, e-mails (text or HTML), XML and EDI; hybrid electronic methods via the user interface or booking portal; or manual methods including telephone and fax.

Documentation: Shipment documentation is a core component of the logistics process. Some of the shipment documents supported by Descartes include but are not limited to:

- Truck: Bill of Lading (BOL), Master Bill of Lading (MBOL)
- Air: Airway Bill (AWB), House Way Bill (HWB)
- Ocean: Bill of Lading (BOL)
- Parcel: Carrier compliant parcel labels

Tracking & Proof of Delivery (POD): By enabling the systematic sharing of data such as advanced shipment notices, booking confirmations, carrier statuses, proof of delivery and

more using electronic messages via the Descartes GLN, Descartes empowers effective monitoring and performance management of the shipment process.

3) Freight Audit & Settlement

Transportation and Freight Auditing Software helps Automate the Manual Freight Auditing and Settlement Processes.

Freight bills can be handled via multiple workflows including self-billing, e-invoicing, and traditional match-pay supply chain processes. The software can be optionally configured for audit processes via distributed bill audit/centralized bill payment in large or divisional organizations. With robust capabilities for automated freight audit and settlement, Descartes Transportation Manager™ can enable business to:

- Improve cash flow by gaining the ability to pre-audit freight bills prior to payment;
- Reduce time spent on freight audit and approval;
- Eliminate invoice paperwork through automated processing;
- Avoid paying incorrect carrier freight invoices;
- Recover carrier overcharges;
- Improve financial reporting; and
- Ensure optimal pricing from suppliers

4) Visibility, Tracking & Performance Management

The Descartes Transportation Management suite can enable business to:

- Achieve shipment and/or line-item level visibility across multiple parties and modes of transportation;
- Decrease order failures by predicting or being alerted to them before they happen;
- Provide a role-based, customized view of data for buyers in the purchasing department, expediters in the logistics department, customer service reps, and materials managers in manufacturing to streamline logistics flow; and
- Reduce uncertainty and ultimately inventory/safety stock.

5) Private / dedicated fleet

Tremendous benefits can be realized by integrating and optimizing across a company's own fleet and purchased transportation

Companies choose to use a private or dedicated fleet for many different reasons, such as ensuring capacity and service, branding, scheduling flexibility, and fulfilling requirements for specialized equipment, configurations, and capabilities.

Decisions about when and how to use 'for hire' services vs. the private fleet are often made using static rules (such as distance from the DC) during the planning phase. Conversely, unplanned last-minute events can also result in suboptimal decisions, expediting, and higher

costs. A more promising approach is emerging: taking the dynamic and holistic approach of looking at fleet and for hire together.

The fleet is typically managed separately from for hire transportation, creating isolated 'islands of capacity' and missed opportunities to optimize across modes. Once integrated, new opportunities are realized, often through seemingly counter-intuitive choices, using carriers where user previously used the private fleet or vice-versa.

Similar to the way omni-channel integration has become critical to the success of retailers, leading firms are starting to do 'Omni-Mode Integration' for transportation. This entails having visibility across all available modes (private fleet, common carrier, parcel, rail) with the ability to optimally select the best one to fulfil any given order. Just as with omni-channel integration, tight integration with execution systems is critical for the success of Omni-Mode Integration.

6) Dock Scheduling & Yard Management

Dock Appointment Scheduling is a collaborative solution that enables shippers, carriers and consignees to schedule dock door appointments. It streamlines the dock appointment process by distributing the responsibility for scheduling warehouse deliveries or pickups to carriers and suppliers.

By ensuring all supply chain partners are involved in the process and have visibility into requested, scheduled and rescheduled dock appointments, this solution optimizes receiving operations for inbound shipments and helps coordinate outbound pickups.

The solution offers:

- Online appointment scheduling for carriers and vendors to book dock appointments over the web, and monitor the status in real time;
- Ability for inbound coordinators to prioritize shipments, refuse carrier requests, or configure prioritization rules and constraints to automate the scheduling process;
- Automated recurring appointment scheduling with load/unload service time calculations taking into consideration trailer type, dock type, special equipment, and product handling unit types;
- Load levelling of the flow of goods to dock resources;
- Appointment audit trail and reporting;
- Milestone notification;
- Historical data analysis and compliance tracking;
- Improved visibility to the inbound supply by tying purchase order to inventory to shipment data;
- Integration to transportation and warehouse management systems.

Descartes Yard Management™

Descartes Yard Management is specifically designed to help operators more effectively manage the movement of trailers and the associated inventory. Real-time visibility into trailer

content and locations within the yard enables organizations to quickly identify and access stock on hand, thereby reducing inventory requirements to save costs and improve efficiencies. With Descartes Yard Management, coordinators can plan and track trailer positions, arrivals and departures across distributed or centralized yards, as well as record trailer status, moves, inspections and security seal changes.

The solution also offers:

- Touch screen devices with graphical user interface that is optimized for use in-cab, while walking through the premises, or in the guard shack to identify and validate loads that arrive and leave the yard, or confirm the location of a trailer;
- The ability to assign parking and quickly locate trailers in the yard;
- Identify contents within a trailer as well as its age and condition;
- Automatically record all trailer movements; and
- Maintain a valid audit trail for loss prevention and security.

7) Pool Distribution

Pool Distribution is the distribution of products, orders or shipments to numerous destination points within a particular geographic region. Characteristics include a high frequency of regular shipments in LTL quantities. Pool distribution represents a cost-effective way to ship as compared to the high cost of shipping primarily LTL.

Pool distribution orders are shipped to regional terminals in truckload quantities. There the pool is off loaded, segregated and sorted by consignee, then reloaded onto local delivery trucks for delivery to various pool destinations. Benefits Include:

- Lowering overall transportation cost
- Reducing inventory cost
- Improving time in transit
- Reducing the number of potential claims through reduced handling of freight
- Increasing customer satisfaction
- Maintains temperature integrity

8) Descartes Order Express™ Multimodal Shipping Software

Descartes Multimodal Shipping Software Integrates:

- Freight Rating
- Automated Execution of Shipping Process
- Shipping Labels and Documentation
- Customizable Shipping Scripts

9) Global Logistics Network Services

The Descartes Global Logistics Network™ (Descartes GLN™) is the standard for multimodal, inter-enterprise electronic data and document exchange.

The Descartes GLN gives the flexibility to connect and collaborate way. It was designed to be a network, and is not an application attempting to act as a network. User can seamlessly move or transfer data through the network to various trading partners, leverage Descartes' network-based solutions or connect to customer existing solutions. This inherent flexibility of the Descartes GLN gives the ability to create logistics business processes to operate or to differentiate yourself from the competition.
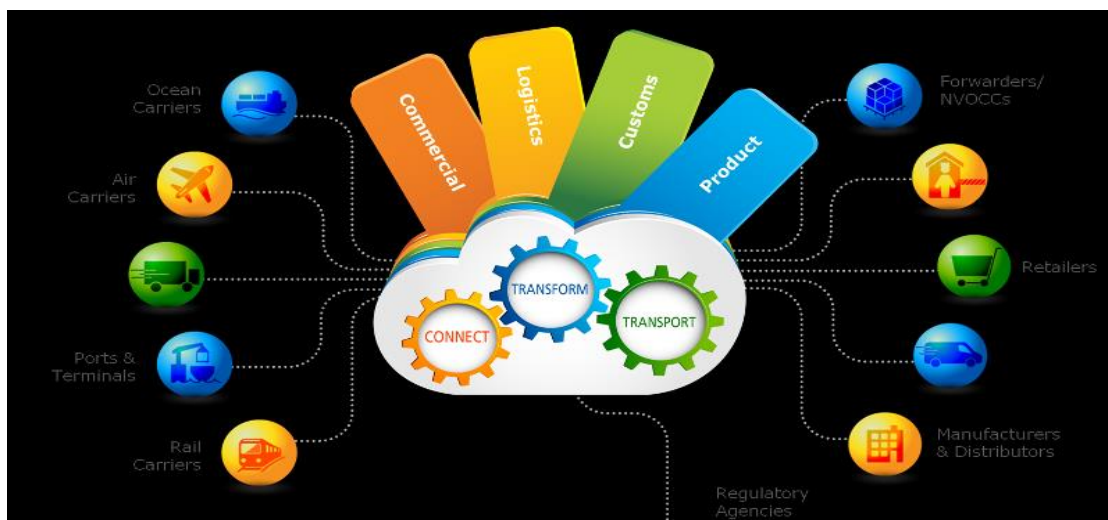
Descartes Leading Global Logistics Management Solutions

- Industry leading electronic management of a rich set of commercial, logistics and regulatory documents, including air, ocean and truck messaging standards
- High-speed, real-time message transfer
- Interconnectivity with 26 general and industry specific Value-Added Networks (VANs)
- Support of "high-tech", "low-tech" and "no-tech" connectivity
- Connections to the most extensive logistics community in the world
- Ad hoc connectivity to non-registered parties
- Wireless device connectivity
- Message management dashboard and data quality solutions

Technical description
Lack information about technical description

Benefits
See description of applications

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)
Extensive download centre Descartes provide solutions: ● Transportation Management ● Routing, Mobile & Telematics ● Global Logistics Network ● Customs & Regulatory Compliance ● Broker & Forwarder Enterprise Systems ● Logistics Technology Platform

3.1.6.4   Glomaris (TMS)

Name of the tool	Tool provider	Web site	Type of the tool
Glomaris	E Foqus Danmark A/S Firskovvej 36, 1. DK-2800 Lyngby +45 70 209 201	**glomaris.com**	Transport Management System for sea shipments

Basic functionality
● Multiple bunker – calculation of consumption of bunker, hazardous goods transport management ● Dynamic routing and distances ● Laytime Calculator ● Vessel Monitor ● Accounting Integration ● Registration

Architecture and functionality
1) Multiple bunker Glomaris supports all of the many different bunker restrictions around the world, and calculates consumption for each bunker type. The Glomaris distance server also helps user steer clear from hazardous areas and navigate restriction zones, warning users when entering pirate-risk and low-sulphur areas, respectively.

2) Dynamic routing and distances

The Glomaris distance server covers more than 5,000 ports globally, and provides navigation using a high-quality map that allows to visualize port positions and the shortest or most optimal routes. It also supports SECA and ECA zones, as well providing warnings for hazardous areas, and is available in three different clients: Web browser, Web service and App

3) Laytime Calculator

The Laytime module allows to calculate demurrage and despatch based on voyage data. Figures are transferred to the invoicing module of the fixture automatically and integrated into shipping accounting software. The module supports several clauses and shinc/shex codes.

4) Vessel Monitor

Glomaris integrates with MarineTraffic.com, providing real-time data from more than 140,000 ships. This provides current position of vessels, noon position data and port facts (such as ETA, ETD and bunkers), which can all be imported automatically into Glomaris. Integration through XML files and e-mail is also possible.

5) Voyage Estimator

The voyage estimator, central to any commercial shipping operation, performs voyage charter, time charter, cargo relet and broker fixture estimations, and features the entire view on a single screen. Some of the items and features included in the shipping module: Full integration with the online distance server Unlimited number of cargoes and ports Canal and port expense calculation Accurate route plotting Easy transfer of vessel information to the estimator DWCC calculations for cubic intake and draft restrictions Speed comparison for multiple speeds and speed optimization Easy retrieval of bookings and contract lifting into the estimator Sensitivity analysis, making it possible to see the impact on voyage result when changing freight, hire, bunker prices, and voyage duration Bunker consumption based on FIFO principle Full schedule of a vessel's intended trade and routing point(s) Comparison of multiple estimates

6) Accounting Integration

Glomaris shipping software is integrated with Microsoft Dynamics ERP accounting system and is paramount for enabling to control businesses and generate real-time statistics for decision making. Our integration with Dynamics allows users to see postings and balances from NAV

system directly in Glomaris. The system also offers a comprehensive reporting structure compatible with Microsoft Excel integration to Microsoft Exchange, etc.

Glomaris also integrates seamlessly with many other corporate accounting systems using XML files, web services or direct SQL transactions.

7) COA Register

The contract register is integrated into Glomaris, where bookings and contracts can be entered to comprise full and automatic updates of lifted shipments via the voyage estimator. The contract terms can be entered to avoid future re-keying of information in the shipping software. Easily create new contracts and bookings based on an estimate.

8) Integrations

Glomaris integrates with several third-party providers. Some examples:

- Q88/Baltic 99: Download vessel data covering more than 9,000 vessels.
- MarineTraffic.com: See real-time vessel position and port information based on AIS signals, via both ground antenna and satellite. It provides data from more than 140,000 ships.

9) BI Integration

BI integration makes it easier to extract and manage data, enabling to visualize most important elements. Create dynamic reports, matching business. Easily customize dashboard and explore the data to create new insights and effective visualizations.

Target groups
Ships' agents, shipping companies

Benefits
- The whole company on one dashboard – so user can monitor all of most important data   - Show performance data for all vessels and voyages in a visual diagram   - Create impressive interactive reports   - Share reports instantly within the organization   - Easy to get started, helping user become more efficient

Technical description
The Glomaris client requires at a minimum Windows 7.x, but will also work on MAC computers as long as they have any standard virtualization tool installed

Gap analysis

ICT system focused on sea journeys not including overland deliveries (oncarriage, precarriage)
Remarks (Challenges, expected problems, implementation bottlenecks)
mobile app available

3.1.7 Terminal Operation System

Seaport container terminals are a meeting place for many, not only for cooperating, but also for competing entities. Terminal Operation System (TOS) must meet the requirements and respond to the needs of terminal employees and its clients, e.g.:

- the operators of the reloading equipment need simplicity;
- planners responsible for the appropriate planning and coordination of reloading and storage processes, expect intuitiveness and comprehensive visibility in the graphical scheme,
- truck drivers need flexibility in the ability to enter data.

Integration of all needs in the organizational and operational level is the main task for TOS. The capabilities of the software used and its functionality result from the nature of the specific terminal.

TOS is the basic tool for recording, planning, controlling and monitoring for modern container terminals. TOS serves and is supported by planners (both ship, yard and rail) as well as forwarders and ship-owners. TOS has a strong impact on both strategic and tactical activities aimed at increasing the efficiency of the terminal's operation and improving cooperation with customers. It is also a key part of the supply chain and, above all, it aims to control the flow of cargo within the terminal area.

The aim of TOS is to provide the necessary set of computer procedures for managing the flow of goods, machine work and people leading to increased process efficiency. The basic functions of the TOS system are:

- documentary function - unification of all terminal documentation,
- information function - enables to log in to the terminal database via a web browser: shippers can find out container status (e.g. unloaded, cleared, detained for inspection, etc.); intermodal operators, ship agents or ship-owners can submit loading lists to their trains/ships and define notification of arrival to the terminal
- planning function – allows for detailed planning transhipment process of ships, trains, trucks, as well as handling of containers inside the terminal.
- identification and tracking function – automated tracking of goods in the supply chain, support for the exchange of information on the location and current status of containers.
- economic analysis function – plans and manages revenues and expenses, verifies the compliance of the financial and accounting system with the previously defined requirements of the company.

3.1.7.1 Master Terminal (TOS)

Name of the tool	Tool provider	Web site	Type of the tool
Master Terminal	Jade Logistics Unit 15.69, 15th Floor World Trade Center Beursplein 37, 3011 AA Rotterdam Netherlands	jadelogistics.com	Terminal Operating System

Basic functionality

Jade Software's Terminal Operating System (TOS), Master Terminal™, solves the complex problem of managing a variety of mixed cargo. Master Terminal provides a single integrated, real-time view of all operations and data, allowing user to make smarter decisions faster, resulting in improved productivity and operational efficiency

Support all port's cargo types, equipment, planning processes, and reporting.
• Full cargo support covers conventional sized containers (20' and 40'), specialized sizing including 30', 45' and 53' containers, break bulk of all
types, motor vehicles and bulk, steel and forest products, rolling cargo,
and all local general cargo varieties.
• Support for equipment includes chassis, underslung and nose mounted generators, cassettes, MAFIs, and trailers.
• Over-dimensional cargo support crosses road, rail, ship and yard.
• Full support for IMDG hazardous cargo segregation across road, rail, ship and yard.
• Highly configurable reporting and data queries covers all cargo types.
• Data export is available in multiple formats, both standard and
user-defined.
• Advanced notification engine lets users decide which notifications to
receive, and create custom notification events.
• Data access is instantaneous, for all data at all times. As the database size increases. Performance is not affected.
• Full audit trail and exception handling capabilities allow configurable warnings and error reporting.
• Planning is supported whether manual, semi-automatic or fully automatic.
• Fully automatic background task scheduler runs reports and scheduled tasks.

Architecture and functionality

YARD OPERATIONS
Define terminal and yard areas for all types of cargo and operations, create user-specific terminal layout views that let each user see the areas that matter most to them, and see all cargo in real time, using current, short-term, or long-term planning modes. Fully audit all planning operations, provide support for labour working within site, and automatically plan

yard locations for any operation and all cargoes. Prioritize, categorize, and schedule next day's work, create 'To Do' tasks on containers and cargo, and track Key Performance Indicators (KPIs) on yard operations.

GATE OPERATIONS

Manage gates in real time on touchscreen and mobile devices, controlling and monitoring truck and cargo movements to increase efficiency. Keep detailed information about vehicle visits, instantly control and monitor gate flows, and integrate gate operations with both pre-advice processing and truck visit appointment system. Get real-time updates on all truck processing within the terminal, monitor and analyse detailed KPIs, and speed up inter-terminal cargo transfers by allowing rapid access with no data entry. PIN and gate touchscreen kiosks ensure paperless rapid throughput.

VOYAGE PLANNING AND OPERATIONS

Make fully informed decisions, with ship and yard operations integrated in one seamless system. Define vessels, see and control operations in real time, and report and compare a full history of vessel visits. Allocate jobs between crane resources, and track progress with graphical displays. Plan break bulk, bulk, and general cargo in detail, and handle Lift-On/Lift-Off (LOLO) and RORO planning and operations. Configure and automate cargo stops, and aid management decision-making by monitoring vessel operation performance.

MOBILE APPLICATIONS

Use handheld and vehicle-mounted mobile devices wherever cargo goes, including in the yard, on ship, and within warehousing and general cargo operations. Convenient and flexible, mobile device applications access Master Terminal using Wi-Fi or cellular connections, feature touch screens with easy to follow graphical user interfaces, and support for multiple languages. Role-based security allows system administrators to configure which mobile device functions are available to each handheld application user.

RAIL

Manage and track train schedules and wagon fleets, and easily share the right data with train companies. Control all weight and dimension rules for rail wagons, handle containers of varying sizes, and manage full train scheduling. Control operations in real time, see graphical views of trains and rail areas for planning and operations, complete planning before trains arrive, and automatically plan train load and discharge.

REPORTING

Use powerful and flexible built-in reporting to create an extensive range of reports and save them in accessible formats such as CSV, PDF, XML, or HTML. Reports can be customized to meet specific requirements, integrated into users' menus so they are easy to find, and automatically scheduled to be sent to email recipients. Data can be exported for archiving, data warehousing, or processing by other systems.

INVOICING

Configure and track charges and invoices for every cargo event. Automatically charge for all cargo and vessel activities, including yard storage, in real time, with fully configurable invoice

creation. Handle flexible tariffs and rates, multiple currencies, and cash payments. Integrate with standard invoicing systems, output invoice data for auto-emailed invoices, and track and trace any invoice back to its source.

INTERFACES

Integrate Master Terminal with general ledger system, port hardware, peripherals, and more. Mechanisms for interfacing to third-party systems include EDI, file export, web services, SQL, and real-time TCP/IP connections. Over 80 standard EDI formats are supported, plus custom EDI formats can be defined. Peripheral devices are supported, including printers, barcode scanners, radio data terminals, in-machine electronic scales, weigh bridges, and external gate systems.

WAREHOUSING

Master Terminal's warehousing functionality allows you to easily and efficiently manage cargo storage – a key way to attract new business and revenue streams. Define any terminal area as a general cargo area for warehousing. Within this area, user can define any combination of ground and rack locations and assign them unique identifiers. View current capacities with a highly graphical display, use handheld applications to manage cargo, and configure billing by storage area, operator, or cargo attributes

HARBOUR MANAGEMENT

Managing harbour requirements is easy with Master Terminal's harbour management solution. The highly intuitive graphical user interface allows user to easily manage the complex problem of scheduling vessel visits, resources, and personnel in busy ports. Harbour management is multi-terminal-capable, allowing user to schedule visits across terminals with multiple harbours and berths. Dynamic tidal modelling provides intelligence to safely manage arrival and departure movements in harbours with significant tidal movement.

ACCESS CONTROL AND DATA SECURITY

Control access to the system with a unique username and password for each user, and grant permissions to control exactly what each user can view and update. Securely store data within a high-performance database and export data to an SQL server for archiving or data warehousing. Protect data with full disaster recovery from built-in replication technology and Master Care's expertise.

Target groups

Ports and terminals operators

Technical description

User can run Master Terminal on standard hardware as it easily scales to fit operation.
One system covers whole port, in real time, for everyone.
- One workstation application and a companion mobile app suite unite seamlessly to give entire enterprise real-time access to information.
- Industry standard, distributed client-server architecture can be scaled
- horizontally and vertically to the size of operation.

	● Windows/Intel servers and workstations are all user need—no specialized or expensive hardware. ● A high-performance database with enterprise-class resilience and scalability, bundled with the product, guarantees the ultimate application performance. ● Thin clients and a Rich Internet Application are fully integrated, so user get tailored, direct access to the system.
Benefits	
	● Single integrated system - real-time view of activity and cargo across entire port. ● A stable solution capable of forming the core of port's information systems. ● Supports all cargo types and is available for all styles of ports. ● Scalable, reliable, and flexible. Master Terminal can be customized to fit business. ● Master Terminal implementation and training record is second to none in the industry. ● Excellent support from a company with a proven track record and a wealth of industry knowledge.
Gap analysis	
Remarks (Challenges, expected problems, implementation bottlenecks) Supplier provide customized training solutions ensure users are rapidly up to speed and able to make the most of the Master Terminal solution.	

3.1.7.2   Navis N4 (TOS)

Name of the tool	Tool provider	Web site	Type of the tool
Navis N4	Waalhaven OZ 123 3087 BM, Rotterdam Postbus 5303 3008 AH Rotterdam The Netherlands	navis.com	Terminal Operation System

Basic functionality
● N4 is a modern platform that scales as operations change. It's the only TOS that supports multi-terminal operational visibility and control. ● Avoid expensive customization and tailor N4 to meet specific needs with system options that involve advanced configuration, customization and integration. ● Advanced EDI Options provide an innovative approach to EDI management that significantly reduces the amount of on-going maintenance with a highly configurable and accessible EDI format. ● Mobility Execution Options offer real-time monitoring and management of all equipment. ● Facility Planning and Control offers real-time features in the XPS client application providing world renowned operational efficiency.

- A complete suite of optimization modules provide help to automate decisions and improve efficiency and productivity.
- Advanced Rail Options offer advanced monitoring and management of rail operations.
- Advanced Yard Options enable optimized use of yard space and CHE's and optimized Equipment Control.
- Automated Terminal Option supports unmanned automated equipment

Architecture and functionality

The Navis N4 terminal operating system (TOS) is built on a highly scalable fault tolerant architecture and is based on latest J2EE design concepts, advanced metadata driven model and highly configurable business rules. These features give terminals the advantage of having the most modern technology platform available with access to the industry's most advanced optimization modules. N4 also helps terminals avoid expensive customization with functionality that helps to reduce administrative and customer support costs.

N4 is a modern platform that is easily scalable and the only TOS that supports multi-facility operational visibility and control. Features include:
- Multiple Platform(OS) and Database Support
- Multiple User Interfaces utilizing powerful Rich Thin Client
- Code extension management
- Data Model Extensions including the ability to add custom features to N4
- Monitor Operational and Performance Data in Real-time
- Historical Reporting and Trend Analysis in Navis Analytics
- General Cargo Management includes Cargo Lot Management and receipt/delivery of general cargo through the gate, by vessel and rail
- Container Freight Station Management
- Service Order Management for terminal equipment, vessels and rail
- Vessel Operations Configuration and Management
- Yard Operations Configuration and Management Rail Configuration and Management

N4 can be tailored to meet specific needs with system options that involve advanced configuration, customization and integration helping terminals avoid expensive customization. This functionality includes:
- Full multi-terminal operational visibility and control with a configurable topology
- Inventory management web services to automatically synchronize unit, holds and permissions data from other in-house corporate or third party systems
- Configurable reports Advanced notifications, messaging and flex fields
- SDK Options enable terminal operators to customize and extend N4 to suit specific needs. Gate Automation: integrate third party gate devices through a series of API's
- Automated reefer tracking, monitoring and control
- Equipment Gross Weight API updates individual container weights
- Equipment Real time Locating System API

Flexible and configurable gate functionality enables:
- Multi-Gate or Multi-Facility Gate Clerk
- Appointments Configuration and Management

- Equipment Delivery Order Management
- Integrate Bills of Lading and Import delivery orders with gate operations
- Integrated Billing Functionality includes invoicing, payments, credits and ED

Advanced EDI options provide an innovative approach to EDI management that significantly reduces the amount of on-going maintenance with a highly configurable and accessible EDI format, including:

- Easily configure EDI and the ability to provide this EDI to partners
- Ability to store operator load and discharge lists

Facility Planning and Control offers real-time features in the XPS client application providing world renowned operational efficiency, including:

- Detailed yard model, graphical yard views, and real-time yard planning
- Plan, view and check vessel stowage with vessel planning and control
- Complete management of rail operations for terminals
- Efficiently choreograph real-time container moves among Container Handling Equipment (CHE) operators with Equipment Control
- Graphical interface provides a 360 degree, real-time view of the entire terminal operation
- Chassis Tracking in yard

N4 Mobility Execution Options offer real-time monitoring and management of all equipment.

- Manage data using handheld devices at the gate, in the yard and at the quay
- Record real-time detailed crane activity
- Inspect rail loads and discharges on and off rail
- Manage reefer maintenance and automate connection work list and monitoring
- Container Handling Equipment Management (CHE)
- General Cargo Support for gate, vessel and rail management

A complete suite of Optimization Modules provide the ability to automate decisions and improve efficiency and productivity.

- Advanced Vessel Options offer monitoring and management of vessel activities and berth scheduling.
- Integrated Billing Functionality based on configurable business rules includes invoicing, payments, credits and EDI
- Graphical crane sequencing, berth scheduling and integrated crane shift assignment management
- Quay Commander: Crane planning and real-time monitoring of crane schedules, vessel container moves, vessel activities, and vessel labour assignments.
- Full berth scheduler
- Ro-Ro stowage: define deck layouts using lists
- Vessel hazardous checks
- Vessel AutoStow: automatic and optimized vessel stowage based on user defined requirements

Advanced Rail Options offer advanced monitoring and management of rail operations.

- Advanced monitoring and management of rail operations
- Graphically define and display the track plan layout

- Rail AutoStow: automatically plan trail loads based on user defined requirements
- Rail Gantry Crane Scheduler and Decoupled Trackside Operations

Advanced Yard Options enable optimized use of yard space, CHE's and optimized Equipment Control.

- Yard hazardous checking by class
- Expert Decking: automatically distribute containers throughout the yard with minimal on-going management from yard planners
- PrimeRoute for Straddle Carriers: automatic dispatching of straddle carriers
- PrimeRoute for Terminal Tractors: automated dispatching of internal trucks at RTG terminals
- Schedule the best current job of each straddle carrier
- EC Console: set parameters and view productivity for each point of work
- Equipment Pooling and optimized dispatching
- Supports twin, tandem and quad lifts for straddles move management
- Multi-Lift: automate and optimize quay crane multi-lift operations for straddle and truck sites

Automated Terminal Option supports semi-automated and automated equipment.

- ASC Manager: centralize control and monitoring of automated stacking cranes
- ASC Stack management with stack status control, yard file configurations and inventory protection Reduce administrative and support costs with:
- ASH horizontal transport (3.1 - 3.2 delivery timeframe, C-ARMG
- Crane Automation System API
- Generic yard crane interface for Semi-automated terminals

Reduce administrative and support costs with:

- Community Access Portal (CAP) UI
- Powerful, flexible reporting
- Detailed Reefer, Hazardous Detail, Inventory, Event, Billing and Reporting Management
- Record container guarantees
- Crane Team User Interface

Target groups

Ports and terminals operators

Technical description

N4 employs extensive data-driven business logic to create a highly configurable solution, thereby avoiding many of the common customizations required by less flexible TOS alternatives. In addition, N4 software development kits (SDKs) make it possible to extend and integrate TOS solution with other internal and external systems. If customization is truly required, N4 allows user to embed source code specific to operation within deployed version of N4. All of these options are available using choice of internal IT resources, third party contractors, or Navis Professional Services, thus giving user the control and flexibility user

require. In addition, the N4 Community Access Portal (CAP) enables customer self-service system access the reduces customer support costs.

Benefits
Increase in Gate Productivity - 21% of Navis N4 terminals have seen greater than a 75% increase in productivity at the gate and 44% have increased productivity by at least 50%
Increase in Yard Productivity - 61% of Navis N4 terminals have increased their productivity by at least 50% and 24% have shown greater than 75% improvement.
Increase in Vessel Load and Discharge Productivity – 61% of Navis N4 terminals have increased their productivity by at least 25% and 17% have shown greater than 75% improvement.
21% of IT staff using Navis N4 have increased their productivity greater than 75%
Gap analysis
Remarks (Challenges, expected problems, implementation bottlenecks)

3.1.8 Supply Chain Management

The development of SCM-class systems is related to the progressive evolution of the supply chain concept. Over the years, their functionality and the complexity of the supported logistics processes have changed significantly. In SCM systems, priority is given to the secure flow of information accompanying key business processes throughout the entire supply chain. They have become more comprehensive solutions used to support strategic goals of the supply chain, whose main task was focused on multifaceted business integration of all cooperating enterprises.

Currently we can notice rapid development of SCM information systems. The solutions offered on the market are technologically advanced and usually form a group of integrated applications dedicated to various sub-areas of the supply chain. It should be pointed out here that SCM systems operate only at the information layer of the supply chain.

The information available in the SCM system is derived from the MRP II or ERP class system (usually ERP). The ERP system integrates all information within one application, and individual SCM system applications use it as a source of current data.

Individual SCM applications therefore use ERP as the primary source of data. Therefore, the implementation of the SCM system in the enterprise requires an inseparable implementation of the ERP class system. SCM optimizes the most important business processes in the company and what is essential, supports electronic channels of information exchange between the participants of the chain with suppliers, partners or clients, ensuring transparency at the level of goods flow, inventory control, forecasts or plans created.

The implementation of the SCM class system in the enterprise translates into a number of benefits, among which the most important ones include:

● processing and consolidation of data coming from various sources of the ERP system and then making them available in the form of precise information on current needs and requirements of clients, reported demand to all partners cooperating within the supply chain. Thanks to the accuracy and speed of the information obtained, you can make adjustments to the selection of production resources on an ongoing basis, adjust the production volume to the reported needs, or more efficiently manage inventory, significantly reducing storage costs.
● response to changes occurring anywhere along the supply chain. Changes in demand and other unforeseen events or errors are immediately reported in the system to all its participants. Thanks to this, interested parties can quickly take appropriate corrective actions in current supply or distribution production plans.
● savings thanks to better planning of supply, production or distribution. The processed data from the ERP system regarding the production plan at the customer's site, made available in SCM, are also a delivery schedule for suppliers. We are dealing here with full synchronization of the chain parties' activities which significantly contributes to the market needs reported to the client.
● lowering the level of stocks to the necessary minimum. The availability of information about the current and expected level of production allows to synchronize production plans with the volume of deliveries within the framework of the Just in Time concept. As a result, the level of inventory is reduced and the production capacity is more evenly used. With SCM systems, therefore, it is not justified to apply a traditional approach to planning the level of stocks based on the economic size of the order.

There are significant differences between the implementation of the Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems. Unlike ERP systems, SCM solutions require a data model that allows real-time support of a large number of complex transactions. Until now, in order to obtain comprehensive solutions, it was necessary to integrate specialized software with its own ERP system and create special interfaces supporting external data sources. This method brings results, but it involves high costs. The benefits of implementing the SCM system are as follows:

● increasing profit in cooperation with suppliers,
● improving customer service and reducing material shortages,
● reduction of costs related to the transport of materials,
● optimization of supply chain value to reduce costs and increase profit,
● reduction of operating costs at the enterprise level and reduction of manufacturing costs of finished products,
● increasing competitiveness by optimizing the flow of materials and goods and reducing storage costs, as well as material flow planning,
● achieving the transparency of the supply chain, including among trade partners,
● efficient adaptation of enterprises to changing market conditions and situations for the customer.

SCM systems have evolved significantly over the last dozen or so years. In the currently implemented solutions, the main emphasis is placed on the close integration of the company with its business partners (suppliers and customers). Consolidation of various functions within key business processes, supported by SCM class systems, leads to creating a new dimension of supply chain value, also processing into an increase in the competitive advantage of its individual participants.

3.1.8.1 SAP (SCM)

Name of the tool	Tool provider	Web site	Type of the tool
SAP	SAP Deutschland SE & Co. KG Hasso-Plattner-Ring 7 69190 Walldorf	sap.com	Supply Chain Management

Basic functionality

Real-time delivery network management with complex supply chain management (SCM) processes - from demand planning to inventory management. Optimising supply and demand through technologies such as the Internet of Things, RFID and advanced analytical tools.

(Based on ERP)

Architecture and functionality

SAP Functional Modules
- SAP FI module: Financial Accounting.
- SAP CO module: Controlling.
- SAP CRM module: Customer Relationship Management.
- SAP CS module: Customer Service.
- SAP EC module: Enterprise Controlling.
- SAP EHS module: Environment, Health & Safety.
- SAP FM module: Fleet Management.
- SAP FSCM module: Financial Supply Chain Management.
- SAP HR module: Human Resources.
- SAP IM module: Investment Management.
- SAP MM module: Materials Management.
- SAP PLM module: Product Life Cycle Management.
- SAP PM module: Plant Maintenance.
- SAP PP module: Production Planning.
- SAP Product Costing: Product Costing deals with Plan Costing + Actual Costing of Finish Products.
- SAP PS module: Project Systems.
- SAP QM module: Quality Management.
- SAP RE module: Real Estate.
- SAP SD module: Sales and Distribution.
- SAP SM module: Service Management.
- SAP TR module: Treasury.

- SAP WM module: Warehouse Management.
- SAP LO module: Logistics General.

SAP New Dimensional Modules also known as SAP New Modules

- SAP APO module: Advanced Planner Optimizer.
- SAP EWM module: Extended Warehouse Management.
- SAP SCM module: Supply Chain Management.
- SAP SEM module: Strategic Enterprise Management.

Target groups

Shippers

Technical description

Option for SAP Integrated Business Planning:
SAP Integrated Business Planning is a set of cloud applications delivered via a subscription model. Each of the solutions can be subscribed to individually:

- SAP Integrated Business Planning for sales and operations
- SAP Integrated Business Planning for response and supply
- SAP Integrated Business Planning for inventory
- SAP Integrated Business Planning for demand
- SAP Supply Chain Control Tower

All subscriptions include the following:

- SAP HANA Cloud database
- SAP HANA Cloud Integration for Data Services (SAP HCI-DS)
- SAP HANA Smart Data Integration (SDI)
- Single sign-on (SSO) authentication via SAP Cloud Identity (SCI)
- Software maintenance and support
- System operations and support

The enterprise version of SAP Jam is required to support some of the collaboration functionality in SAP Integrated Business Planning, and can be licensed separately.

Benefits

Option for SAP Integrated Business Planning:
Responding to new market expectations with real-time supply chain planning features that help to meet demand profitably. Engaging and connect with stakeholders across organization with cloud-based features that combine sales and operations, demand, response and supply planning, and inventory optimization.

- Cloud deployment
- Integrated planning
- Sales and operations planning
- Inventory optimization
- Real-time supply chain management
- In-memory technology
- Fast implementation

12% reduction of days in inventory with dynamic, frequently updated forecasts.

20% decrease in unplanned costs with improved visibility into in-transit and network-wide inventory.

Reduce inventory levels, increase fill rates, and increase team productivity

SAP Ariba

Complete supply chain visibility with SAP Ariba Supply Chain Collaboration. Integrated with others ERP and supply chain optimization systems, this collaboration platform equips user to work safely and easily with multiple tiers of contract manufacturers and suppliers across key supply chain planning and execution processes.

- Possibility to share production forecasts, orders, quality, and inventory information with suppliers and obtain their responses in real time.
- Anticipate and resolve supply assurance problems quickly with collaboration dashboards that alert to supply and demand mismatches.

Onboard suppliers using on-demand tools, multiple integration options, and supplier enablement teams with decades of onboarding expertise.

Actionable intelligence - dashboards help to identify supply-demand mismatch and quality issues quickly, displaying supplier responses and status of their commitments to forecasts, orders, quality notifications, and inventory pulls.

Improved compliance - with standards-based and secured electronic communications, as well as customized configuration of inter-company supply chain business rules, drive greater compliance with orders delivered correctly and on time.

Efficient onboarding - multiple integration options ensure that sophisticated suppliers will participate.

Easy integration - solution can be integrate with any back-office system. Packaged integration is available with SAP ERP and supply chain solutions.

Fast time-to-value - fast time-to-value through efficient onboarding and quick deployment of this user-friendly solution, encouraging broad adoption by internal teams and external trading partners.

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)

- Long and expensive implementation of solution delivered by SAP
- Very popular software
- A lot of training materials available online
- Innovating thinking

SAP also provide:

ERP and Digital Core
- SAP S/4HANA and ERP for Large Enterprises
- ERP for Midsize Companies

- ERP for Small Businesses
- Cloud ERP

Cloud and Data Platforms
- SAP Cloud Platform
- SAP HANA and Databases
- Data Warehousing
- Big Data
- Enterprise Information Management
- Application Integration and Infrastructure
- Procurement and Networks

Supplier Management
- Strategic Sourcing
- Procurement
- Services Procurement and External Workforce
- Selling and Fulfilment

Analytics
- Business Intelligence
- Enterprise Performance Management
- Predictive Analytics

Customer Engagement and Commerce
- Marketing
- Sales
- Service
- Commerce
- Revenue

IoT and Digital Supply Chain
- Supply Chain
- Internet of Things (IoT)
- Manufacturing
- R&D / Engineering
- Asset Management

Human Resources (HR)
- Core HR and Payroll
- Time and Attendance Management
- Recruiting and Onboarding
- Learning, Development and Collaboration
- Performance and Compensation
- Workforce Planning and Analytics

Finance

- Governance, Risk, and Compliance
- Financial Planning and Analysis
- Accounting and Financial Close
- Treasury Management
- Payables and Receivables
- Real Estate Management
- Travel and Expense

Name of the tool	Tool provider	Web site	Type of the tool
Plex	PLEX Corporate Office 900 Tower Dr. Suite 1500 Troy, MI, 48098 888-454-7539	plex.com	Supply Chain Management

Basic functionality

Centralized Purchasing Modules
Extend supply chain operations with other businesses for higher efficiency and greater accuracy.

Purchasing Modules
Automate supplier-receiver interactions and purchasing functions with full traceability and visibility.

Supplier Portal Modules
Suppliers are closer to customer for higher visibility and more effective supply chain management.

Architecture and functionality

Centralized Purchasing Modules - maintain complete supply chain visibility for increased efficiency through extended inter-entity purchasing integration, including automatic release creation and end-to-end container traceability.

Enterprise Release Management

- Issue purchase orders (POs) that automatically create corresponding sales orders and releases in the Plex system of user sister company. Similarly, let POs issued by sister companies who are also using Plex automatically create sales orders in user system.
- Ship product to sister companies that is already labelled and identified in their inventory as in-transit and ready for receipt finalization — and receive the same from them.
- Advantage of Plex inventory traceability from the manufacturing process of companies in enterprise to point of receipt.

Consolidated Purchase Order

- Issue a consolidated purchase order, taking advantage of bulk purchase terms, consistent pricing and single point of supplier relationship.
- Allow entities to issue releases against consolidated purchases orders, as and when their business requires, taking advantage of centralized terms and yet localized material management.

<u>Purchasing Modules</u> - track purchasing from start to finish. Automate complex purchasing processes and decisions for a streamlined supply chain.

Auto AP Creation
- Configure and control automatic creation of pending accounts payable (AP) records when material is received
- Take advantage of the evaluated receipts methodology (also known as "three-way match") for reconciled voucher records

Requests for Quotation (RFQ)
- Issue, track and manage the lifecycle of requests for quotation (RFQs) to suppliers and bids from suppliers
- Create RFQs with multiple details lines with different price points and specification attachments – for parts, items, and services
- Optionally, convert one or more requisitions to an RFQ, and also choose to link the RFQ with an Engineering Change Request (ECR) and/or a customer quote
- Issue RFQs to specific suppliers based on their ratings, even at the detail line level, and capture suppliers' responses against those RFQs
- Compare RFQ responses for sourcing decision

Inbound Shipping
- Plan and prepare for the pickup and shipment of incoming goods ordered via the purchasing system

Purchase Orders
- Create and maintain purchase orders (POs), including blanket POs and one-time "spot buys"
- Control blanket PO release schedules via material requirements planning (MRP)
- Email or fax POs and release schedules directly from the screen, or share the same via the supplier portal or send them via electronic data interchange (EDI)
- Define and apply standard clause text (also called "boilerplates") by PO type and customize to suit specific business needs
- Use automated workflow for electronic review and approval of POs based on user roles and authority

Requisitions
- Enable users to easily request common items and services
- Use automated workflow for electronic review and approval of POs based on user roles and authority
- Combine and add approved requisitions into new or existing purchase orders or RFQs

Supplier Returns
- Track product returns and warranties with suppliers using serial and lot numbers

Subcontract Shipping/Receiving
- Manage shipments of work-in-process inventory to subcontractors
- Optimize shipment quantity to subcontractors based on lot or minimum quantity parameters
- Track outside inventory, including return due dates, by subcontractor
- Receive processed inventory with integrated quality inspections
- Account for the consumption of ingredients or components used by subcontractors
- Analyse and choose subcontractors based on their processing time as well as the quality of their work

Supplier List
- Create and maintain a master list of suppliers, including their detailed address, contact and financial information
- Maintain all supplier-related data such as status, rating and approval

Supplier Part
- Manage multiple supplier-specific part records for each internal master part for easy integration into their businesses
- Let suppliers view part information in Plex for the parts they supply

Supplier Pricing
- Apply the correct pricing to spot-buys and recurring blanket releases by defining pricing components, price breaks and effective date range
- Support centralized pricing with flexibility to accommodate local pricing factors like freight

Supplier Portal Modules – to make supply chain more responsive with instant bi-directional communication and proactive visibility through the Plex Supplier Portal

- Configure and manage highly flexible, instantaneous and paperless bi-directional communication between company and suppliers
- Provide controlled access to documents like standard policies, procedures and engineering specifications
- Collaborate with suppliers on production readiness (supplier production part approvals) and engineering change requests (either party can initiate such requests) as well as quality concerns and ongoing improvement:
  - Pre-Production Approval Process (PPAP) submissions
  - Access to technology assessments
  - Self-service maintenance of certifications and capabilities
  - Collaborative problem control with templates for 8D, 7-step, etc.
  - Access to supplier scorecard details
- Publish purchase orders and releases to suppliers via the Internet
- Allow suppliers to proactively log in, view supplier material forecasts, access supplier releases and commit to delivery dates, view supplier Kanbans, print barcoded labels and notify of shipments (including drop shipments to customers)
- Provide self-service access to supplier invoice payment status to reduce unnecessary calls to accounts payables team

Target groups

Shippers

Technical description

Implementation of ERP required

Benefits

- Bring suppliers closer to receiver business with real-time EDI communications for streamlined and timely fulfilment of orders
- Increase efficiency by providing visibility of demand to suppliers for planned shipments and access to self-service portals for proactive inventory management

● Automate purchasing and reordering processes, RFQ generation and related response management for a shortened time to market ● Track inventory with end-to-end traceability across supply chain to satisfy industry-specific compliance standards ● Stay on top of quality through integrated quality management functionality, with better tracked processes and checkpoints for both suppliers and materials ● Making informed decisions by scoring suppliers on quality, timeliness, costs, terms and other key factors
Gap analysis
Remarks (Challenges, expected problems, implementation bottlenecks) Plex also provide Plex Manufacturing Cloud, Inventory Traceability, Two-Tier ERP, Business Continuity with Cloud ERP ● Accounting and Financial Management ● Customer and Sales Management ● Enterprise Management ● Human Resources Management ● Suppliers and Purchasing ● Supply Chain Planning (SCP) ● Product and Program Management ● Advanced Planning & Production Scheduling ● Inventory Management Solutions ● Production Management ● Quality Management Plex Connect is an open ERP system integration framework that enables manufacturers to connect Plex with other applications, people and things. Mobile ERP for Manufacturers. Plex Platform Administration

3.1.9 Port Community Systems

A special type of information system is Port Community Systems (PCS), these are systems managed by the port authority (or its commission) being communication platform for the exchange of information and electronic documents between all transport companies realizing transport services, storage, transhipment and customs services for port cargo. It's mean: sea terminals, ship-owners, freight forwarders, road and rail carriers, container train operators, authorities and customs offices. At the same time, the same platform serves to exchange information between companies serving ships in port (for example: towing companies or receiving impurities). Some PCS systems allow shippers and forwarders to complete the shipping planning process and conclude a maritime or land transport contract.

Name of the tool	Tool provider	Web site	Type of the tool
APCS	APCS Team Address: Brouwersvliet 33 2000 Antwerp	portofantwerp.com/apcs/en	Port Community System

Basic functionality

1) Logistics & cargo

- Booking maritime transport by shipper or freight forwarder
- Shipping instruction (B/L)
- Notice of arrival import cargo (ocean vessel)
- Notification booking containers
- Planning request (barge)
- Pre-announcement container delivery and collection (road, rail)
- Loading/discharge order containers (ocean vessel)
- Loading/discharge order containers (barge, rail)
- Loading/ discharge order break bulk (ocean vessel)
- Loading/discharge order break bulk (inland transport)
- Container release
- Stowage position information
- Track & trace containers
- Electronic invoicing
- Electronic payments

2) Customs

- Customs declaration
- Declaration export manifest
- Declaration import manifest
- Declaration ISPS
- Exchange of MRN
- Notification of arrival (ocean vessel)
- Notification of arrival export cargo
- Notification of departure (ocean vessel)
- Notification of incoming ocean vessel
- Notification transhipment

3) Hazardous goods

- Consultation IMDG-register
- Declaration hazardous cargo
- Notification of arrival/departure hazardous cargo
- Notification SafeSeaNet

4) Nautical

- Berth reservation (ocean vessel)
- Consult lock planning

- Declaration berthing dues
- Declaration waste collection
- Disposal notification
- Electronic invoicing
- Ordering pilot, tug and mooring services
- Planning request (barge)
- Position request
- Pre-announcement (ocean vessel)
- Terminal planning (barge)

Architecture and functionality

1) Logistics & cargo

a) Booking maritime transport by shipper or freight forwarder

The shipper/forwarder sends an IFTMBF message to the shipping company or the vessel's ship's agent with all the details of the order. This contains all details of the order. This data can also be entered in the INTTRA web portal. The shipping company checks whether the booking can be accepted on the desired vessel and sends a response: the IFTMBC message.

b) Shipping instructions

The forwarder sends the shipping instructions to provide basic information to draw up the bill of lading. The forwarder collects this information based on the orders he received from the shipper.

c) Notice of arrival import cargo (ocean vessel)

By sending the notice of arrival the ship's agent informs the consignee the goods are available. In the notice of arrival the ship's agent reports the 'expected time of arrival' (ETA) of the vessel and the provisions for collection of the goods. Based on this information the consignee or his forwarder is able to make preparations for an efficient delivery of the cargo.

d) Notification booking containers

The ship's agent receives a transport order of the forwarder and passes this on to the Terminal operator. The ship's agent sends the information regarding the booking to the Terminal operator. Based on this the Terminal operator is able to include the container in his Terminal planning based on the vessel's planned berth. The Terminal operator informs the ship's agent about these container movements on the Terminal, including transport mode and possible damage.

e) Planning Request (barge)

By sending the notice of arrival the ship's agent informs the consignee the goods are available. In the notice of arrival the ship's agent reports the 'expected time of arrival' (ETA) of the vessel and the provisions for collection of the goods. Based on this information the consignee or his forwarder is able to make preparations for an efficient delivery of the cargo.

f) Pre-announcement container delivery and collection (road, rail)

The carrier uses this message to notify the Terminal operator that a truck will be arriving to load or discharge. This pre-notification enables the Terminal operator to plan the loading and/or discharging of the trucks.

g) Loading/discharge order containers (ocean vessel)

The ship's agent gives the Terminal operator the order to load or discharge containers in or from the ocean vessel. The Terminal operator sends a confirmation of execution to the ship's agent afterwards.

h) Loading/discharge order containers (barge, rail)

Transparency about the time of handling and the number of containers to be handled. Less turnaround time on the Terminal and precise estimate of the required manpower and equipment at the Terminal.

i) Loading/ discharge order break bulk (ocean vessel)

A shipping order for conventional break bulk which the forwarder sends to the Terminal operator and which must be confirmed by the ship's agent.

j) Loading/discharge order break bulk (inland transport

The ship's agent/forwarder gives the Terminal operator the order to load or discharge non-containerised goods in or out of a truck, wagon or inland barge. The load order applies for goods coming from an ocean vessel; in case of a discharge order, the cargo has an overseas destination.

k) Container release

The Container Release message is the commercial release of a Container. Containers discharged from the ocean carrier by the Terminal operator are blocked in stack on the Terminal until they are released by the ship's agent. Only then can the Terminal operator load the containers on a truck, wagon or

inland barge.

l) Stowage position information

This functionality allows shipping companies and Terminal operators to exchange stowage plans electronically.

m) Track & trace containers

Track 'n trace makes sure that all parties involved in the consignment are able to follow up the status of the consignment.

n) Electronic invoicing

This functionality allows paperless invoicing for the user in accordance with European regulations. This comprises both the incoming and the outgoing invoicing process. For

instance, a forwarder is able to receive invoices of the shipping company or carrier, but also send invoices to his customers/shippers.

o) Electronic payments

Twikey is a user-friendly electronic solution to replace payments by paper cheque. This fully paperless process cuts down on the mountain of paperwork that forwarders, shipping agents and banks have to deal with.

2) Customs

a) Customs declaration

The customs broker has to declare all cargo entering, leaving or staying in transit in the EU, to Customs. Excisable goods have to be declared. These three types of declarations have been streamlined on European level: they are PLDA, NCTS and EMCS respectively.

PLDA (Paperless Customs and Excise) was developed for the electronic submission and processing of import and export declarations. NCTS (New Computerised Transit System) applies to transit goods that are transported under customs supervision. EMCS (Excise Movement and Control System) replaces the accompanying paper document of the excisable goods by an electronic acceptance process.

b) Declaration export manifest

According to the European Export Control System (ECS) the ship's agent must submit a cargo manifest to Customs. This allows Customs to register the cargo that has left the European Union. Customs can use it to verify whether an export declaration was submitted for this cargo.

c) Declaration import manifest

The Customs Import Manifest is a summary declaration of the cargo transported over sea and discharged in at Belgian port.

d) Declaration ISPS

The International Ship and Port Facility Security Code or ISPS code stipulates that vessels wanting to call at a EU port, need to provide certain information in the form of an 'ISPS Declaration' to the authorities.

e) Exchange of MRN

According to the European Export Control System (ECS) the 'trader at exit' must notify the arrival of the cargo in the area of the Customs office of exit. In the port of Antwerp it is agreed the Terminal operator is the 'trader at exit'. He sends the arrival notice to Customs on the physical arrival of the cargo at the Terminal. The Terminal operator needs the data of the customs declaration of the customs broker. The e-Desk application facilitates this process by simplifying the flow of information from the customs broker to the Terminal operator.

f) Notification of arrival (ocean vessel)

This message notifies Customs electronically of the arrival of a vessel in port.

g) Notification of arrival export cargo

Under the European Export Control System (ECS) the 'trader at exit' must notify the arrival of the cargo in the area of the Customs office of exit. In the port of Antwerp, it is agreed that the 'trader at exit' is the Terminal operator. He sends the arrival notice to Customs on the physical arrival of the goods at the Terminal. The Terminal operator receives the data of the customs declaration from the declarant or his broker.

h) Notification of departure (ocean vessel)

This message electronically informs Customs of the departure of a vessel from the port of Antwerp.

i) Notification of incoming ocean vessel

Before the arrival of the ocean vessel, the shipping company/ship's agent notifies Customs of the incoming ocean vessel using the Benelux 20 declaration.

j) Notification transhipment

The Transhipment Notification is a procedure that can be applied when containers of an incoming ocean vessel are transhipped to a departing ocean vessel, to avoid the need to draw up NCTS documents.

3) Hazardous goods

a) Consultation IMDG-register

The IMDG register is the dangerous goods database which is used as reference file in the Antwerp Port Information and Control System (APICS) to validate dangerous goods declarations.

b) Declaration hazardous cargo

Handling of dangerous goods in the port of Antwerp is subject to the provisions of the Dangerous Goods Codex, as well as EU legislation, Belgian national legislation and Belgian regional decrees. By "handling" is meant: inward transport to the port, onward transport from the port, loading, unloading, interim storage on quay or in warehouse, and keeping aboard.

The ship's agent/forwarder must declare dangerous goods to the Harbourmaster's Office. The latter in turn uses these declarations to draw up a safety dossier, so that it knows which dangerous goods are located where in the port at any moment.

c) Notification of arrival/departure hazardous cargo

The information contained in the IFTDGN declarations submitted by the forwarders and ship's agents is supplemented with the effective handling times by using the information from the CODECO and COARRI terminal reports submitted by the terminal operators.

d) Notification SafeSeaNet

SafeSeaNet is an exchange platform of maritime information about vessels and their cargo between the EU member states, Norway and Iceland. The aim of this platform is to react

quickly and effectively to incidents and pollution and detect high-risk vessels early in the process.

SafeSeaNet is managed by the European Maritime Safety Agency (EMSA) in Lisbon. According to European directive 2002/59/EC and the amended version 2009/17/EC, every member state of the EU must provide maritime data or be able to request data from SafeSeaNet, 24/7, via its own NCA-organisation (National Competent Authority).

The Antwerp Port Authority is connected to the SafeSeaNet as an LCA (Local Competent Authority) via the Maritime Rescue and Coordination Center (MRCC) in Ostend, which acts as NCA for Belgium.

4) Nautical

a) Berth reservation (ocean vessel)

The ship's agent/shipping company needs to list a preferred berth to the Harbourmaster's Office. This berth reservation is done using the BERMAN message.

b) Consult lock planning

The Port Authority offers Terminal and barge operators the opportunity to consult the planning of the locks in the port of Antwerp.

c) Declaration berthing dues

Every ocean vessel calling at the Port owes berthing dues to the Port Authority. To calculate these dues, the ship's agent needs to specify the type and amount of cargo that was discharged and loaded when the vessel was in port to the Port Authority .

d) Declaration waste collection

To protect the environment, ocean vessels need render their waste in seaports with recognised collection facilities. The Port Authority charges ocean vessels a waste contribution irrespective of the actual delivery.

If the ocean vessel's waste is effectively collected, it receives a subsidy depending on the amount and the nature of the waste, broken down according to Marpol I and Marpol V categories. For a precise calculation of the subsidy, all waste dropped off needs to be declared to the Port Authority by the waste collection companies. This data also allows the waste flows to be meticulously monitored.

e) Disposal notification

The ship's agent/shipping company is required by law to declare the ship's waste on board to the Harbourmaster's Office 24 hours before arrival at the port. This waste concerns, among others, oil residue, plastic, empty bottles, empty paint pots, chemicals, kitchen waste, wood and rope.

All ships must pay the port a fixed amount for the collection of their waste, irrespective of the fact whether it is picked up or not. This notification is made using the WASDIS message.

f) Electronic invoicing

For sustainability reasons the Port Authority opts for electronic invoicing as much as possible. The Port Authority makes invoices and credit notes available online for all its customers.

g) Ordering pilot, tug and mooring services

The ship's agent/shipping company can inform the Harbourmaster's Office what additional services the vessel requires before entering the port. E.g.: sea, river and dock pilots, tugs on the Scheldt and in the docks, crew members, fenders ... This request is made via the BERMAN message.

h) Planning request (barge)

Over the past years, the number of inland container barges in the port of Antwerp has increased exponentially. Container barges often call at several Terminals in the port during the same call. To limit the administration regarding a port call as much as possible, an electronic platform was established in 2007 which allowed container barges to request a handling slot for all the Terminals in a uniform manner.

i) Position request

The Port Authority offers Terminal and barge operators the opportunity to request the positional data of inland barges. Terminal operators are able to request the position of every known inland barge. Barge operators are only able to request the positions of their own inland barges.

j) Pre-announcement (ocean vessel)

The ship's agent/shipping company is required by law to provide information to the Harbourmaster's Office about the ocean vessel calling at or leaving the port. This is done by the pre-notification of arrival- message.

k) Terminal planning (barge)

Over the past years, the number of inland container barges in the port of Antwerp has increased exponentially. Container barges often call at several Terminals in the port over the course of the same visit. To limit the administration regarding a port call as much as possible, a unique electronic platform was established in 2007 which allowed container barges to request a handling slot for all the Terminals in a uniform manner. Based on the received requests the Terminal operator can optimise his Terminal planning.

Target groups

- Consignee
- Forwarder
- Shipping company
- Ship's agent
- Shipper
- Inland barge operator
- Rail operator

- Terminal operator
- Road carrier
- Customs agent
- Customs authorities
- Port authorities
- Waste collection facility

Benefits

1) Logistics & cargo

- data does not have to be entered manually: less mistakes and cost saving
- reuse of booking data in the transport order and shipping instruction
- Diminished administrative workload
- Less errors
- electronic processing of container data enormous efficiency increase of the loading and discharge orders
- transparency in the supply chain stakeholders are able to follow their consignment exception report: customer is notified in case of deviation
- Cost savings (no paper, postage, archiving, manual action)
- Increase of the quality of the invoicing process: less errors and discussions, less lost invoices, possibility of correspondence with the purchase order
- Environmentally-friendly solution
- Secure way of invoicing that meets all legal requirements
- Just as secure as a cheque
- Approved by the banks
- Control over the date of execution
- Easy and fast with eID
- No more need for credit lines
- No more running to the bank
- No more paperwork

2) Customs

PLDA:

- goods released sooner
- numerous validation rules
- calculation module for owed duties and taxes
- easily capture data
- user-friendly

NCTS:

- fast and efficient declaration
- fast acceptance by Customs
- fast clearance and release of securities
- fast intervention in case of abuse

EMCS:

- administrative simplification
- efficient procedure and therefore faster release of security

- Immediate notification in case of cargo that is not acceptable
- Faster and reliable feedback of the proof that the cargo has reached the final destination
- limited risk that the cargo is sent to the wrong consignee

3) Hazardous goods

- whether transport permits from other public bodies are required and whether quantity restrictions apply.
- The Harbourmaster's Office has all the required information in electronic format.
- Arrival/departure of dangerous goods at or from the terminal is always notified in real time.
- The safety dossiers for the seagoing ships and terminals are always up to date.
- single point of contact efficient manner to meet the European obligation

4) Nautical

- Efficient and reliable way to reserve a berth Faster service (time savings)less errors
- planning can be adjusted by the Terminal operator
- a Terminal request can be adjusted by the barge operator
- the skipper knows best what lock to use
- the skipper can optimise his speed
- efficient way to meet all obligations less administrative work reuse of ship's details based on the vessel and waste notification
- Efficient, fast and reliable notification process better follow-up of the waste flows protection maritime environment
- electronic overview of invoices and credit notes per call data can be uploaded into the Customer's accounting package no postage less paper
- efficient and fast services efficient and reliable way to order additional services
- uniform method to create planning requests and to give Terminal planning feedback
- shorter waiting times for inland barges at Terminals
- less errors (efficient, single data entry and proactive conflict notification)
- efficient interactive planning of arrival and handling
- permanently available and up-to-date ship register, Terminal information and planning data
- transparent and cost-effective
- planning can be adjusted by both Terminal operator and inland barge better estimate of times of arrival the barge operator is able to optimise his speed
- simple, quick and reliable notification process improved service level
- less errors by single data entry and proactive conflict notification
- efficient interactive planning of arrival and handling
- permanent available Terminal information and planning data
- transparency
- efficient, flexible and uniform way to request a Terminal
- cost-efficient, fast handling
- shorter waiting periods and less congestion for inland barges

Technical description

In Antwerp the electronic message standards are based on the EDIFACT standards of the United Nations. All participants (private companies, Customs, the Port Authority) are

connected to the system via a unique identification. Via the network they send and receive electronic messages to their business partners and government-agencies. The clearing centre results in lower costs of connection and maintenance per user.

The platform over which the messages are distributed acts as a, trusted third party. This guarantees the confidentiality of the data. This network supports EDI and XML versions of the electronic standard messages, as well as the sending of other formats and scanned or otherwise generated documents.

All partners smartly connected through one single platform
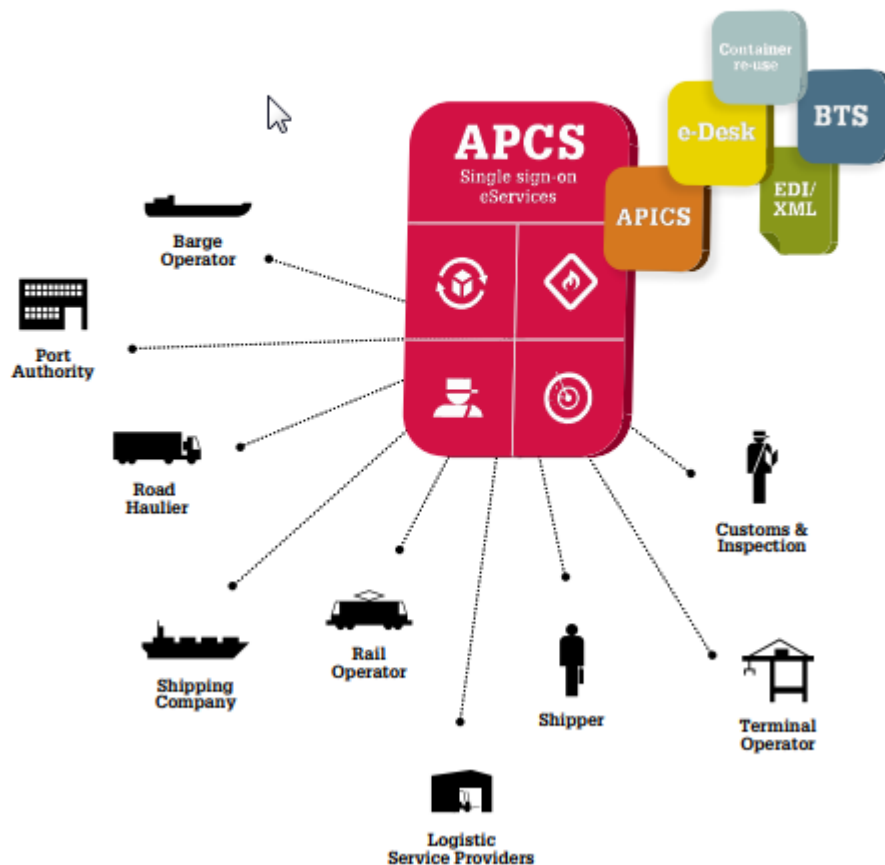
Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)

- Transmission of standardised EDIFACT or XML messages
- Conversion of message formats
- Business rules and routings

- Supporting network for all applications that exchange electronic messages
- Interconnections to an unlimited list of international networks worldwide
- Optional archiving of all messages for a period of at least 10 years
- Track & trace of sent and received messages, guaranteed delivery
- Immediate access to the Descartes Global Logistics Network
- Authentication of sender and recipient

3.1.9.2 Portbase (PSC)

Name of the tool	Tool provider	Web site	Type of the tool
PORTBASE	Portbase Blaak 16 3011 TA Rotterdam	https://www.portbase.com/en/port -community-system/	Port Community System

Basic functionality

1) Vessel Call

- Notification Waste Disposal
- Notification Dangerous Goods
- Notification Single Window
- Vessel Notification 1.0 and 2.0
- Statement Harbour Dues Rotterdam/Moerdijk
- Statement Harbour Dues Amsterdam
- SPOC NL
- Notification Crew and Passengers

2) Import cargo management (customs formalities)

- Cargo Declaration Status Report
- Customs Scan Process
- Cargo Information
- Discharge Confirmation Report
- Discharge information
- Discharge List
- Notification Local Clearance
- Notification Bonded Warehouse
- Cargo Declaration Import
- Declaration Food and Consumer Products
- Notification Import Document
- Transit Declaration
- Discrepancy List
- Veterinary Inspection Process
- Pre-arrival Cargo Declaration Import (24h)
- Pre-arrival Cargo Declaration Import (4h)
- Seaport Statistics

3) Export Cargo Management (customs formalities)

- Loading List
- Notification of Arrival Export Containers
- Notification of Arrival Export ECS Cargo
- Cargo Declaration Export Containers
- Cargo Declaration Export
- Exit Summary Declaration
- Track & trace Export
- Seaport Statistics
- Clearance NCTS Export Containers

4) Organization of Hinterland Transport

- Barge planning
- Inland Ports Dues
- Wagonload Information System
- Rail Planning
- Road Planning
- Transport Order

Architecture and functionality

The PCS includes three main components:

- The application layer services.
- A platform with common facilities for all services.
- A central database where all the information comes together that companies and governments exchange via Portbase.

1) Module: Vessel Call

a) Notification Waste Disposal

Via the service Notification Waste Disposal, user can easily comply with the obligation to notify the Harbour Master of the waste on board for every vessel visit. The operation of the service is fully tailored to practice. The captain of the vessel can complete the notification in Excel.

b) Notification Dangerous Goods

With the service Notification Dangerous Goods, user inform the Harbour Master about the dangerous goods that are on board for every vessel visit. Participation is possible either via a system interface or by making use of web pages. The service is tailor-made for each cargo segment (liquid bulk, other cargo). It is immediately clear what information user need to provide. Automatic reuse of the information already present in the Port Community System ensures that in all cases user can fulfil obligations in the most efficient way with a minimum of entry work.

c) Notification Single Window

SPOC NL is the Single Point of Contact for the Netherlands for the European SafeSeaNet. Under the responsibility of the European Maritime Safety Agency (EMSA) in Lisbon, the information about vessel voyages and dangerous is collected here from all European countries. In case of emergencies at sea, it is possible based on this to intervene earlier, and environmental disasters can be prevented. Every EU Member State is obliged to provide SafeSeaNet with information via a Single Point of Contact.

d) Vessel Notification 1.0 and 2.0

Vessel Notification 2.0

With the service Vessel Notification 2.0, user can submit all mandatory vessel notifications to the Harbour Masters and Customs. The service is highly user-friendly and optimally matched to daily practice. User are assured of a streamlined process 24/7, including the notification of the mandatory security information (ISPS). After entering four pieces of data, user immediately receive the Call Reference Number (CRN). This CRN is key throughout the vessel call.

User can also easily transfer a vessel call to another shipping agent using Vessel Notification 2.0. Plus, can assign a different party as the financial declarant for the statement harbour dues and/or authorise a cargo handling agent to register (dangerous) cargo.

User is able to use Vessel Notification 2.0 for vessel notifications in the ports of Rotterdam (including Dordrecht), Amsterdam, Moerdijk, Harlingen, Delfzijl and Eemshaven.

Vessel Notification 1.0

Vessel Notification 1.0 is the earlier version of this Portbase service and is in use for vessel and cargo notifications to Dutch Customs in Zeeland Seaports (Vlissingen and Terneuzen), Scheveningen and Den Helder.

Using the services Vessel Notification 1.0 and 2.0 is free of charge.

e) Statement Harbour Dues Rotterdam/Moerdijk

Straightforwardly submit harbour dues statements to the Port of Rotterdam. Authority for arriving seagoing vessels.

Customised service provision

The service Statement Harbour Dues Rotterdam/Moerdijk provides a made-to-measure service. User can submit the information requested and required by the port authorities straightforwardly. In doing so, user can make optimal reuse of the information already present in the Port Community System.

Free participation

Participation in the service Stagement Harbour Dues Rotterdam/Moerdijk is free. Due to the strategic importance of the service to the functioning of the port, the costs are financed from the Port of Rotterdam Authority's general income.

f) Statement Harbour Dues Amsterdam

Straightforwardly submit harbour dues statements to the Amsterdam Port Authority for arriving seagoing vessels.

Customised service provision

The service Statement Harbour Dues Amsterdam provides a made-to-measure service. User can submit the information requested and required by the port authorities straightforwardly. In doing so, user can make optimal reuse of the information already present in the Port Community System.

Free participation

Participation in the service Statement Harbour Dues is free. Due to the strategic importance of the service to the functioning of the port, the costs are financed from the port authorities' general income.

g) SPOC NL

SPOC NL is the Single Point of Contact in the Netherlands for the European SafeSeaNet. Under the responsibility of the European Maritime Safety Agency (EMSA) in Lisbon, information about voyages and dangerous goods on board is gathered in SafeSeaNet for all Member States of the European Union. This makes it possible to take rapid and appropriate action in case of emergencies at sea, while also assisting in the prevention of environmental disasters.

All EU Member States must provide SafeSeaNet with data via a Single Point of Contact. In the Netherlands, this is the job of the Directorate-General for Public Works and Water Management (Rijkswaterstaat). This government department has asked Portbase to develop and manage SPOC NL on its behalf.

Portbase has also linked its own service, Notification SafeSeaNet, to SPOC NL. Via this service, all Dutch ports that are connected to the Port Community System supply the data for SPOC NL electronically.

2) Import cargo management (customs formalities)

- Cargo Declaration Status Report
- Customs Scan Process
- Cargo Information
- Discharge Confirmation Report
- Discharge information
- Discharge List
- Notification Local Clearance

- Notification Bonded Warehouse
- Cargo Declaration Import
- Declaration Food and Consumer Products
- Notification Import Document
- Transit Declaration
- Discrepancy List
- Veterinary Inspection Process
- Pre-arrival Cargo Declaration Import (24h)
- Pre-arrival Cargo Declaration Import (4h)
- Seaport Statistics

3) Export Cargo Management (customs formalities)

- Loading List
- Notification of Arrival Export Containers
- Notification of Arrival Export ECS Cargo
- Cargo Declaration Export Containers
- Cargo Declaration Export
- Exit Summary Declaration
- Track & trace Export
- Seaport Statistics
- Clearance NCTS Export Containers

4) Organization of Hinterland Transport

a) Barge planning

Optimal handling at the terminal

Via the service Barge Planning, user can easily make appointments with container terminals about when processing is to happen. Moreover, user can send electronic loading and discharge lists to the container terminals. Then automatically receive status information from them about the availability of these containers. If needed, user can still sort out missing information. Afterwards, user also receive a loading/discharge confirmation for each container.

Barge Planning: the condition to pick up or deliver containers

The terminals APM Terminals Maasvlakte II (APMT MVII), APM Terminals Rotterdam and Rotterdam World Gateway (RWG) are not set up to solve administrative issues or Customs matters at the gate. Pre-notification via Portbase is the condition to pick up or deliver containers here.

Cost-free participation

Due to the strategic importance of good advance information for the port's operation, participation in the service Barge Planning is free to barge operators. Sea terminals pay a contribution for the use of the service. Portbase is a non-profit organisation.

b) Inland Ports Dues

This service information is only available in Dutch

c) Wagonload Information System

This service information is only available in Dutch

d) Rail Planning

Efficient communication

Via Rail Planning, user can communicate efficiently with all the parties in the rail chain. For the dry bulk sector, the service is targeted at the information exchange about trains; for intermodal transport at both the trains and the cargo. Every terminal visit can be prepared optimally via Rail Planning.

Rail Planning in dry bulk transport

Traction suppliers inform bulk terminals at the sea port via Rail Planning about the train compositions and wagon orders. With this information, the terminals can organise the loading optimally. The traction supplier receives the loaded weights automatically.

Rail Planning in intermodal transport

Rail operators can submit their loading and discharge lists simply. The rail terminals automatically provide feedback about the status of the pre-notified containers, multipurpose wagons and chassis. If needed, missing information can still be added. Rail operators receive a loading and discharge confirmation for the containers automatically.

Rail Planning: condition to pick up or deliver containers

The terminals APM Terminals Maasvlakte II (APMT MVII), APM Terminals Rotterdam and Rotterdam World Gateway (RWG) are not set up to solve administrative issues or Customs matters at the gate. Pre-notification via Portbase is the condition to pick up or deliver containers here.

Cost-free participation

Due to the strategic importance of good advance information to the operation of the port, participation in the service Rail Planning is free of charge for rail operators. Traction suppliers, rail terminals, sea terminals and rail infrastructure operators pay a contribution for the use of the service. Portbase is a non-profit organisation.

e) Road Planning

Each terminal visit proceeds efficiently

Through the service Road Planning user can easily report the arrival of drivers at sea terminals. The container terminals can therefore prepare the visit well. User receive automatic feedback on the status of containers (actually present, commercial release, customs blocked, customs documents present). This prevents unnecessary trips. The turnaround time for the driver at the terminal is also shorter.

Road Planning: condition to pick up or deliver containers

The terminals APM Terminals Maasvlakte II (APMT MVII), APM Terminals Rotterdam and Rotterdam World Gateway (RWG) are not set up to solve administrative issues or Customs matters at the gate. Pre-notification via Portbase is the condition to pick up or deliver containers here.

Maasvlakte 2: pre-notify container and request slot time

Road hauliers can easily pre-notify their containers at RWG and APMT MVII and at the same time request a slot time here for each visit. This allows both automatic terminals to be well prepared for each visit and to make optimum use of the available capacity.

Road hauliers participate free of charge

Due to the strategic importance of good advance information for the functioning of the port, participating in the service Road Planning is free of charge for road hauliers. Sea terminals pay their contribution for usage. Portbase is a non-profit organization.

 f) Transport Order

Uniform way of working

Via the service Transport Order, clients and hinterland transporters can exchange transport orders with each other in a uniform way. The cancellation of orders, the forwarding of changes and the sending/receipt of order confirmations are all very straightforward via the service.

Everyone can work more efficiently. All the information goes directly from computer to computer; no-one has to retype information.

Reuse of information

The hinterland transporter can simply and efficiently reuse the operational information that he receives into his in-house computer system via the service Transport Order. The information is the basis for his pre-notifications via the services Road Planning, Rail Planning and Barge Planning (System Interface) to container terminals and depots.

Target groups

- Ships agent
- Barge operator

- Empty containers depot
- Freight forwarder
- Exporter
- Importer
- Inspection station
- Planner
- Shipbroker, shipping company
- Rail infrastructure operator
- Rail operator
- Rail haulier
- Surveyor
- Terminal
- Road haulier
- Customs
- Port of Amsterdam Authority
- Port of Rotterdam Authority
- Food and Consumer Products Safety Authority

Benefits

- Greater efficiency;
- Lower costs;
- Better service provision;
- Better, more transparent planning;
- More rapid throughput times;
- Fewer mistakes;
- Optimal re-use of information;
- Available 24/7

Technical description

The PCS includes three main components

1) The application layer services.
2) A platform with common facilities for all services.
3) A central database where all the information comes together that companies and governments exchange via Portbase.

Each service includes multiple service processes. These processes describe the required message exchange and interaction between the parties. This involves messages between systems (system messages) and messages between people (notifications). The platform ensures that the processes are in accordance with the established rules. Thanks to the central database is optimal reuse of data. Companies need to provide data, but only once.

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)

Name of the tool	Tool provider	Web site	Type of the tool
Dakosy	DAKOSY Datenkommunikationssystem AG Mattentwiete 2 20457 Hamburg	dakosy.de	Port Community System

Basic functionality

The Port Community System (PCS) for the Port of Hamburg is operated by DAKOSY. The digital platforms for import processing Import-Message-Platform (IMP) and export processing Export-Message-Platform (EMP) enable all businesses and authorities involved in cargo handling to perform fast, efficient and largely-automated processes in seaports as well as perfectly integrated intermodal hinterland handling of all modes of transport.

Architecture and functionality

Dakosy Port Community System, offer solutions that support additional processes including Customs export handling (ZAPP-Sea), hazardous goods management (GEGIS), and managing the arrival and departure paths of large ships on the Elbe and in the Port of Hamburg (PRISE) . Carrier Services solutions provide corresponding platforms and interfaces which enable such transactions as the booking process with carriers (eBooking), the transmission of container weights to carriers (VGM-Portal), and Europe-wide port registration according to Directive 2010/65/EU (eDeclaration).

a) Import Message Platform (IMP)

IMP supports the requirements of carriers, terminals, freight forwarders, transport companies, importers and the relevant authorities to operate as a Single Window environment. It allows for

the electronic and mostly-automated exchange of information and thus speeds up import processing to make it more effective.

For each import process on the disposal and the manifest, IMP creates a data pool that is repackaged for each process step (declarations to authorities, transport processing, etc.) Current status information is continuously updated and helps improve planning and scheduling options for all participants. Bottlenecks can be identified early on - in the context of the goods - and can largely be avoided.
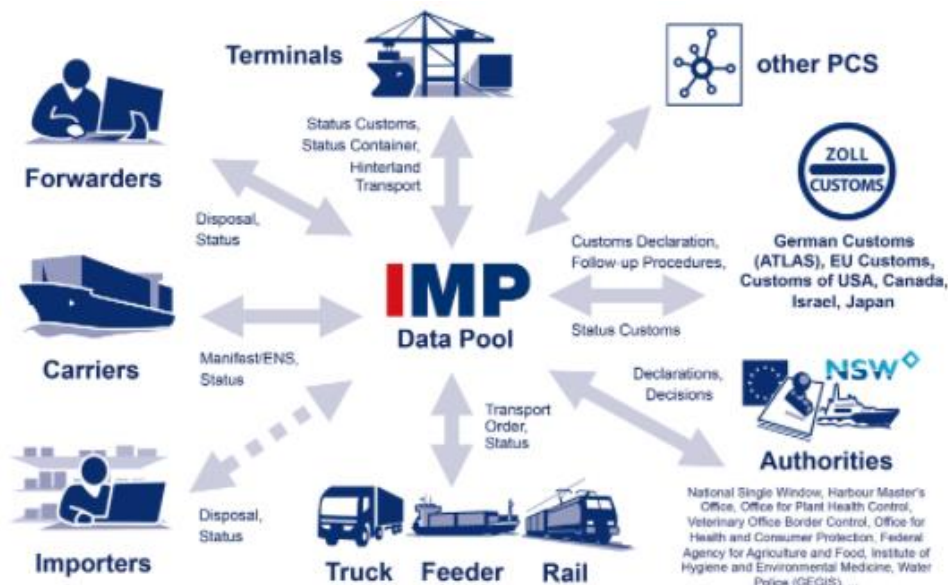
b) Export Message Platform

Shippers and forwarders can use the Export Message Platform (EMP) to ensure smooth, transparent and fast export processing throughout the seaport by exchanging status messages and Customs information with all business partners at the port, including terminals and carriers as well as relevant authorities.

All export messages can be implemented via interface to your own IT systems or communicated to business partners and authorities via our software solutions. These include the ZAPP-Sea software package for electronic export Customs declarations in the port of Hamburg, ZODIAK GE for the exchange of messages with the German Customs system ATLAS, GEGIS for the electronic registration of dangerous goods with the water police, CargoSoft GE for the communication of port orders to the terminals and the electronic processing of Bills of Lading between forwarders and carriers.

c) IHATEC research project EMP 4.0

Since August 2017, DAKOSY has been working together with its consortium and associated partners on the IHATEC research project EMP - Export Management Platform 4.0.

The establishment of an internet-based cloud with all export-related information at a central location will provide a high degree of planning security and transparency for all legitimated players. Following the ideas of Logistic 4.0, the goal is to achieve integrated planning, steering, execution, supervision and coordination of the whole transport chain. The project focuses on the complete export process chain from the sender to the destination port.

EMP 4.0 is a consortium project within the framework of the subsidy program for Innovative Port Technologies (IHATEC), funded by the Federal Ministry of Transport and Digital Infrastructure (BMVI).

The project supervisor is TÜV Rheinland Consulting GmbH. In addition to DAKOSY Datenkommunikationssystem AG, which holds the lead management position, DB Cargo AG and Kühne + Nagel (AG & Co.) KG are the consortium partners. Well-known representatives from the involved sectors (freight forwarders, carriers and transport service providers) as well as several industry associations were won over to become associated partners. This ensures comprehensive coverage of a broad spectrum of players in the export process chain.

The project EMP 4.0 will last until 31 March 2021.

d) PRISE - Port River Information System Elbe

PRISE is the world's only information platform for all ship arrival and departure paths in the port of Hamburg. It has been specifically tailored to the needs of the Port of Hamburg and developed by DAKOSY on behalf of the container terminals HHLA and Eurogate.

It supplies terminals, pilots, carriers/brokers, tugs, belayers and the harbour master's office with a wealth of up-to-date information. The data provided includes berth planning and registration at the terminals, status information about ship positions on the Elbe from the "Deutscher Bucht" to the "Leinen fest" mooring, ship notifications from the Elbe pilots, responsibility reports for tugboats and belayers as well as water level predictions from the Federal Maritime and Hydrographic Agency (BSH).

It is only by accessing this information that all parties are able to cope with the increasing complexity of planning and implementing the growing number of large container shipments. Thanks to PRISE, the planning capacity of the Elbe waterway as well as ship movements within the port have been improved and the overall traffic flow accelerated.

e) Carrier Services

Carrier services are tailored to the needs and requirements of carriers and brokers. However, this also involves other partners from the logistics branch, such as freight forwarders and loaders, since they also deal with the digital communication processes along the transport chain.

- eBooking

Freight forwarders and loaders can greatly simplify their processes by using the eBooking interface for bookings.

The booking requests are sent via DAKOSY or alternatively via the INTTRA booking portal directly to the addressed carriers/brokers. The freight forwarders also receive booking confirmations and further status information, e.g. depot information, which is returned electronically.

- eDeclaration

With eDeclaration, carriers and vessel declarants can easily fulfil all reporting requirements in accordance with Directive 2010/65/EU when entering and/or departing from EU ports. The messages are recorded electronically in eDeclaration and sent to the National Single Window (NSW). DAKOSY is a certified provider of the German NSW.

eDeclaration is also used by many port authorities. They can use the software to collect and process vessel information from carriers and vessel declarants in the National Single Window. Additional modules have been developed for ports which considerably simplify their work processes. These include a berth management module, a dangerous goods module, a statistics module and an easy way to export documents.

- VGM Portal

Using the VGM Portal, forwarders and loaders can communicate all information regarding the verified gross container weight to the carrier in accordance with SOLAS guidelines.

Customers can choose between the EDI platform and the web application. The EDI platform enables the integration of EDIFACT messages IFMIN (SI Shipping Instruction) and VERMAS into an in-house system. Using the web application, weight data can be recorded online and sent to the carrier/broker. The solution is also available as a "white label" and can thereby be offered as a service integrated into a company's own website design.

f) Dangerous Goods (GEGIS)

The dangerous goods information system GEGIS is operated by DAKOSY on behalf of the City of Hamburg specifically for the safety and monitoring of dangerous goods transports in the port. It provides the water police and fire brigade with an accurate and timely overview of all dangerous goods movements to, from and within the port area.

In accordance with applicable maritime safety regulations, companies involved in dangerous goods handling (terminals and carriers/brokers) must electronically report all dangerous goods movements to GEGIS. GEGIS offers an EDI platform and a web application. The EDI platform enables integration of the EDIFACT interface into existing in-house systems. The messages can also be easily recorded and transmitted via the web application. The GEGIS application simultaneously fulfils the arrival conditions regulations of the German central reporting office in Cuxhaven. Via the interface to Protect, you can also send messages to the ports of Amsterdam, Rotterdam, Antwerp, Felixstowe and Le Havre.

Target groups

- Forwarders
- Handling agents
- Carriers (air, sea)
- Liner agents
- Rail, truck, feeder and inland waterway vessel companies
- Internationally active trading companies
- Brand name companies
- Industrial companies
- Authorities, for example Customs, Water Police, Fire Department etc.

Benefits

a) Carrier services

Advantages for freight forwarders
- An interface with all carriers worldwide (via DAKOSY and INTTRA).
- Interfaces to other booking portals (e.g., GT NEXUS) are also possible.
- Free-of-charge EDI usage, dashboard, and support assistance.
- Integration of booking processes in CargoSoft GE.

Advantages for carriers / liner agents
- Broad DAKOSY coverage (more than 1,500 forwarders).
- Reduction of bilateral interfaces with freight forwarders.
- Dashboard and support assistance.
- Free-of-charge if shipping instructions are received via DAKOSY.

b) eDeclaration

Advantages for carriers / vessel declarants
- Available as web and EDI solutions, which can be combined.
- CSV lists, e.g., passenger lists, can be uploaded.
- Dashboard (events, warnings, additional messages for each Visit ID).
- On-board solutions: notifications (incl. PAR – Pre-Arrival Report) can be recorded in Excel, converted to a secure XML Format and sent directly from the vessel.
- Further processing of data recorded on board is possible.

Advantages for port authorities
- Available as web and EDI solutions, which can be combined.
- Mobile access via smartphone or tablet.
- Dangerous goods module.
- Berth management and statistics modules.
- Easy to export documents (e.g., waste declarations).

c) VGM Portal
- Available as web and EDI solutions, which can be combined.
- EDI platform for EDIFACT messages IFTMIN and VERMAS.
- Web application for online input of weight information (also suitable for service providers to freight forwarders).
- Upload function for data import, e.g., from Excel.
- Dashboard web platform as "white label."
- Integration into in-house systems via EDI or web.
- Broad coverage: reach all carriers/brokers worldwide via DAKOSY or INTTRA.
- Languages: German, English, and additional languages upon customer's request.

Technical description

a) EDI - Solutions for international electronic business communication
b) Customs - Solutions for customs clearance
c) Forwarding - Solutions for international forwarding (air and sea)
d) Carrier - Solutions for intermodal transport
e) Dangerous Goods - Solutions for dangerous goods handling
f) Cloud solutions

Gap analysis

Remarks (Challenges, expected problems, implementation bottlenecks)

Support, documentation, video material and training available on webpage

3.2 Tracking Software

The basis for the functioning of contemporary tracking software's is the GPS / GSM3 system, which uses a satellite navigation system. The use of these solutions in road transport allows obtaining a lot of data, extremely useful in a transport company. Modern IT systems combine tracking shipments with data processing through, which allows, among others:

- planning of optimal routes for transport using accurate digital maps and regularly updated system data,
- analysis and control of routes of movement of vehicles or loads, including minimization of their length and costs of carrying the transport, elimination of fraud, and therefore dynamic handling of transport orders,
- registration of basic operational parameters of the vehicle, i.e.: speed, distance travelled and route, engine speed, fuel consumption, axle loads, as well as monitoring the condition of the cargo space, control of on-board systems, temperature of transport, etc.,
- control of the driver's work in the light of the provisions on maximum driving periods, minimum breaks and rest periods, as well as in the use of optimal driving technique ensuring the economic operation of the vehicle, and if necessary the correct selection of routes, parking places, refuelling,
- increasing safety in transport, i.e. road safety and safety of drivers, vehicles and loads,
- reducing the threat of terrorism by creating the possibility of permanent control of the cargo space, integrity of customs seals, monitoring of interference in this space, counteracting illegal migration of population, precise timing of deliveries and optimal implementation of the distribution of goods.

Originally, there were many programs whose main task was to track the cargo or vehicle, the current functionality is rarely occurs alone. Frequently in modern logistic systems they know the time and place of stay of the vehicle and cargo at the time wants to have also the service provider or the recipient of the goods. These conditions have a direct impact on the length of the route, fuel consumption and the level of tolls. That is why more and more programs to support logistic processes are equipped with the function of tracking a vehicle or cargo.

4 Communication platforms and information exchange technologies

This subsection contains a description of existing information exchange technologies that are applicable to the previously mentioned ICT tool categories.

4.1   Communication platforms

Nowadays, it often happens that companies are not interested in big EDI project connecting two partners bilaterally. If companies have hundreds or thousands of cooperative partners, customers, suppliers, logistics operators and others. They are looking for alternatives in Electronic Data Interchange. They do not want bother with their EDI, they are looking for one single connections to communicate from their IT landscapes to their cooperatives companies. Such approach can be possible with use of an external EDI platform which ensures one standard connection to all players, that means platform needs to take care about different connectivity's and different messages standards and much more like issuing paper documents or images, manual information inputs and master data synchronization. Good commercial example of such platforms are Transporeon and AXIT operating in Europe mostly in logistics.

On the below example you can see a logical integration architecture for Intermodal Platform being implemented in Polish seaports. All the integration to the Intermodal Platform will be done via access point. The assumption is that all integration between Intermodal Platform are 100% done with e-Freight messages. For some of the message with other actors the connectors with messages translations will be built. Setting up architecture this way, Polish users could be easily connected to the e-Delivery infrastructure where more users are connected via access points. It means that they will able to share their electronic service and connect to other electronic services of other users without additional development on their side as this functionality brings the e-delivery infrastructure.
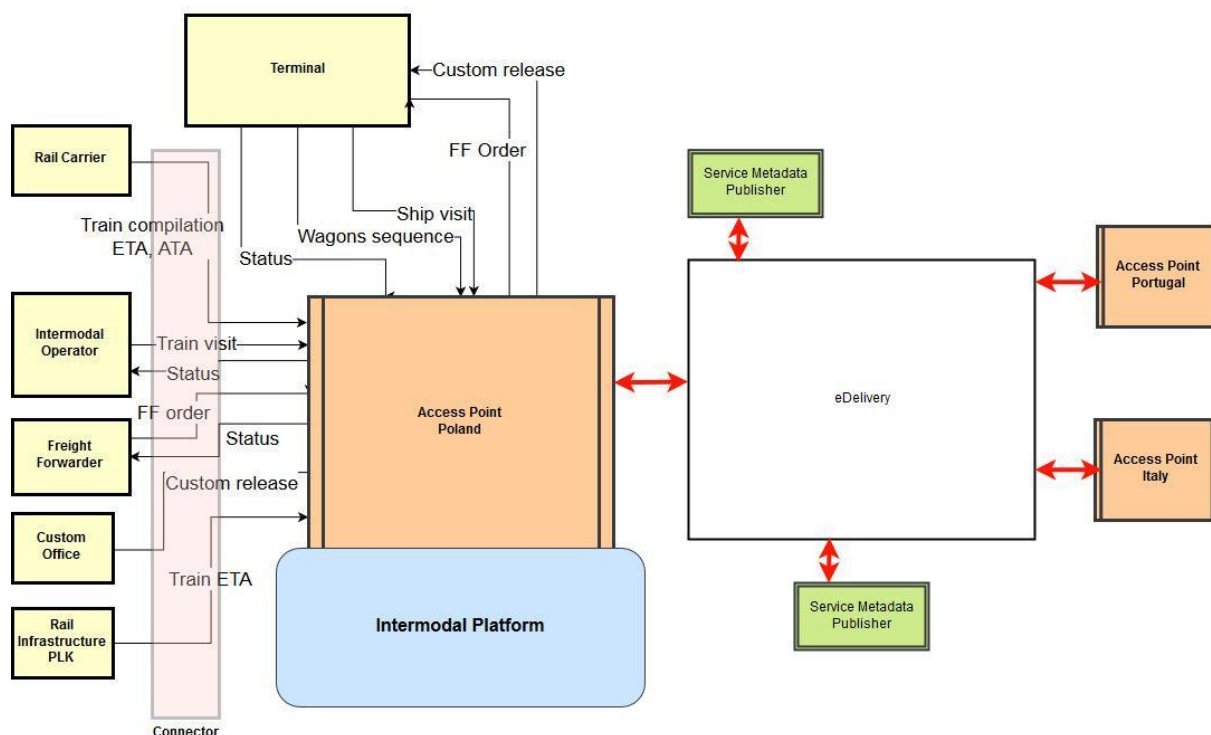
Figure 4 – Logical architecture of information flows

The companies are also implementing more and more API – which calls directly objects in companies databases or to companies semantics data models. With today's technologies for integration more important are well described semantics data models and methods to get or insert data than messages syntax themselves and there are already companies which are changing their approach to integration. World changes and conception of Industry 4.0 requires to exchange more and more information, this trend is specially seen in supply chains. Necessity of data exchange between business partners impact with a lots organizational activities inside companies. This all influence on costs of EDI implementation and maintenance. One of the direction which allows companies with reducing EDI costs are creation of automatic and semi-automatic integration solutions, this approach will let companies to:

- savings because of long term integration projects,
- reduction of human resources involved in testing and go-live process,
- reduction number of many EDI projects executed simultaneously,
- reduction of manual configuration and maintenance many configurations.

The report of EFT (Eye For Transport) organizations - 'Is EDI dead – The future of Data Interchange', http://events.eft.com/cio/pdf/InfographicAlt.pdf may prove this direction. It shows that companies are investing money in integration via API and WebServices, mobile solutions, outsource everything to

EDI specialized companies or EDI platforms, Only 25% of respondents are happy with current situation. The example of such approach in supply chain is Kuehne + Nagel Integrated Logistics where in global supply chain, 4PL service provider integrates with ten's, hundred's subcontractors, suppliers and consignees.[3] Application of this approach could adapted not only to logistics but all other branches where integration requirements are growing.

What alternatives to EDI are you considering?

Web service APIs
55.2%

Manually checking web sites
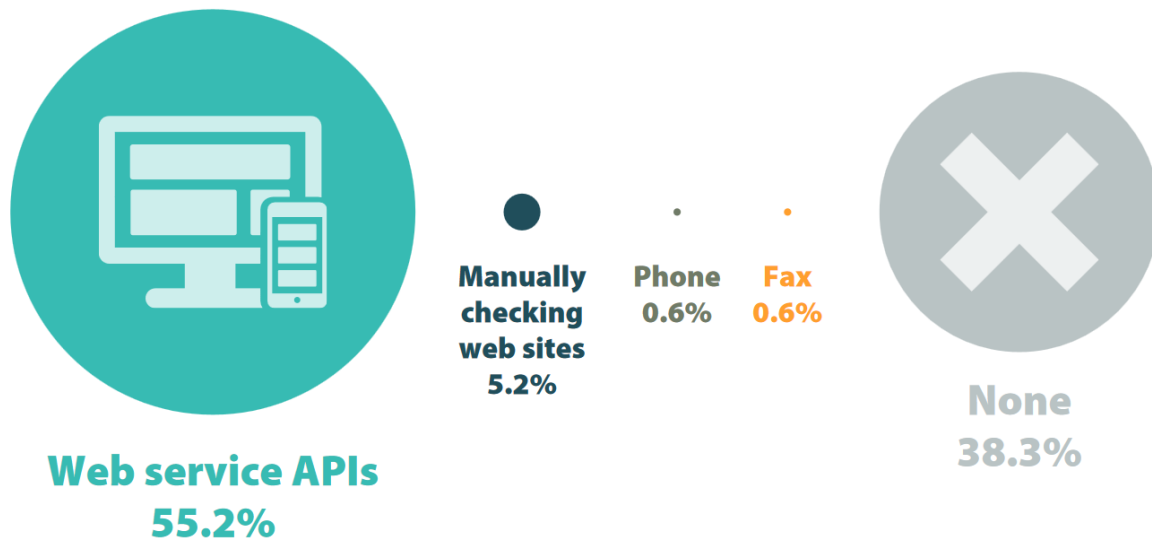5.2%

Phone
0.6%

Fax
0.6%

None
38.3%

Figure 5 – The EFT report, EDI alternatives to consider

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[3] Dębicki T., Logistyka zintegrowana – moda czy konieczność?, Gospodarka Magazynowa i Logistyka 5/2017

Where do you think the future of data interchange lies?

63.2% Web service APIs

39.0% Web/Mobile

13.2% Rely on software vendors to solve

+EDI **29.4%** One of the options above added to EDI

✓EDI **24.3%** EDI works - leave it alone

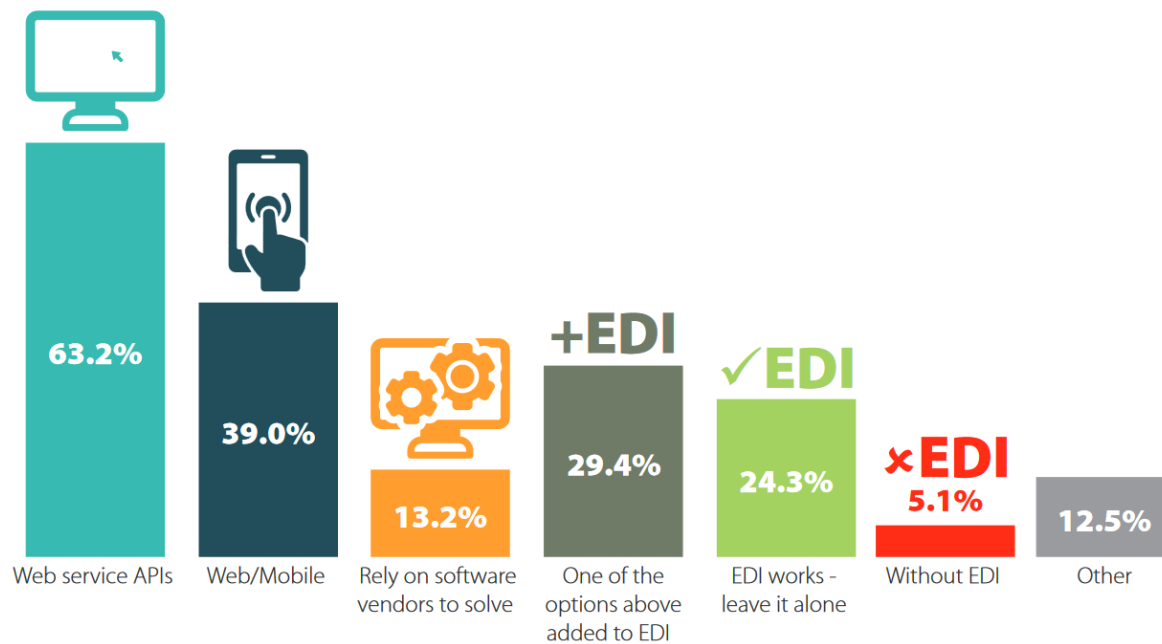**✗EDI** **5.1%** Without EDI

12.5% Other

Figure 6 – EFT Report . EDI's future

4.2 Data interchange - technology

To assess the interoperability possibilities of ICT tools two factors are important. First is a **connectivity** the established communication protocol like a pipe connecting two sides of the transactions and second a **message (document) standard** a syntax of the message within a content (interoperable data) are transferred. So more less like an order of the people in wagons which are transported on above mentioned pipe. There is one more thing in this context a wagon type which is an envelope where data are wrapped and send as a whole. Thanks to the this envelope which contains a metadata and basic information about sender, receiver and document type this message can be properly routed to via intermediate systems and information hubs to the receiver. Two most common used envelopes are **SBDH - Single Business Document Header**(UN/CEFACT) and **eBXML SOAP Envelope Extension**(OASIS).

4.3   Connectivity types

FTP, SFTP – Technologies based on File Transfer Protocol which is a standard network protocol used for the transfer of computer files between a client and server on a computer network. SFTP is a secured with data encryption with use of encryption technology SSL/TLS (FTPS) or SSH (SFTP).

OFTP – Odette File Transfer Protocol is an FTP protocol used by standardization body of EDIFACT messages in automotive industry. As it all started in the beginning of EDI and EDIFACT, the protocol was designed to point to point or in-directly via VAN (Value Added Networks) to secure file transfer of business documents over the internet, ISDN and X.25 networks. Till today two specifications of OFTP exists OFTP 1 and OFTP 2. OFTP 2 can work in a push or pull mode, as opposed to AS2, which can only work in a push mode. OFTP 2 can encrypt and digitally sign message data, request signed receipts and also offers high levels of data compression. All of these services are available when using OFTP 2 over TCP/IP, X.25/ISDN or native X.25. When used over a TCP/IP network such as the Internet, additional session level security is available by using OFTP 2 over TLS (Transport Layer Security).

HTTP, HTTPS – these are web browsers protocols to transfer hyper-text (HTML) files over internet. It can also be used for exchanging business documents which can be exchange via get, put and post methods.   The encrypted version is HTPS which use TSL (Transport Layer Security) or SSL(Secure Socket Layer) security standards. Mostly used in latest system for data interchange via webservices or API via http.

X400 – is a message handling service used widely for emails. But it was applied as an EDI protocol specially in aviation and military.

SOAP – Simple Object Acces Protocol, for exchange structured information about objects used for webservice implementation. It uses xml information set for message format and uses application protocol http, SMPT for message negotiation and transmission.

RFC – Remote Function Call, is the standard SAP interface for communication between SAP systems. The RFC calls a function to be executed in a remote system. Remote function calls may be associated with SAP software and ABAP programming and provide a way for an external program (written in languages such as PHP, ASP, Java, or C, C++) to use data returned from the server. Data transactions are not limited to getting data from the server, but can insert data into server records as well. SAP can act as the Client or Server in an RFC call.

AS2 – Is a specification about how to transport data securely and reliably over the Internet. Security is achieved by using digital certificates and encryption. Very popular and preferable always uses http and https.

AS4 – https://en.wikipedia.org/wiki/AS4_-_cite_note-2 majority of the AS4 are based upon the functional requirements of the AS2 specification. By scaling back ebMS 3.0 by using AS2 as a blueprint. It is a Conformance Profile of the OASISebMS 3.0 specification, and represents an open standard for the secure and payload-agnostic exchange of Business-to-business documents using Web services. Secure document exchange is governed by aspects of WS-Security, including XML

Encryption and XML Digital Signatures. Payload agnosticism refers to the document type (e.g. purchase order, invoice, etc.) not being tied to any defined SOAP action or operation.

Web-Services – A web service is a software system designed to support interoperable machine-to-machine interaction over a network. In a Web service, Web technology such as HTTP, originally designed for human-to-machine communication, is utilized for machine-to-machine communication, more specifically for transferring machine readable file formats such as XML and JSON. In practice, the web service typically provides an object-oriented web-based interface to a database server, utilized for example by another web server, or by a mobile application, that provides a user interface to the end user.

4.4   Messages standards

EDIFACT – (Electronic Data Interchange for Administration, Commerce and Transport) by UN. Is the international standard for EDI and one of the oldest that's is widely used all over the world. It has lots of sub-standards created by other standardizing bodies, national and branch organizations. It often happens that companies interpret EDIFACT by themselves and share its specification all over their customers and business partners. Example of EDIFACT subs standards: GS1/EANCOM standard of GS1 organisation, SMDG – maritime and containerized transportation, ODETTE – automotive and many others.

GS1/XML – a set of modern and well prepared XML standards by GS1 organizations. a GS1 set of electronic messages developed using XML, a language designed for information exchange over internet. GS1 XML is based on UN/CEFACT Core Component Technical Specification (CCTS) and UN/CEFACT Modelling Methodology (UMM).

UBL – Universal Business Language**,** open library of standard electronic XML business documents for procurement and transportation such as purchase orders, invoices, transport logistics and waybills. UBL was developed by an OASIS Technical Committee with participation from a variety of industry data standards organizations. UBL is designed to plug directly into existing business, legal, auditing, and records management practices. It is designed to eliminate the re-keying of data in existing fax- and paper-based business correspondence and provide an entry point into electronic commerce for small and medium-sized businesses.

e-Freight – a set of standards for transport and logistics based on UBL specifications and approach. e-Freight framework offers a level of standardisation that is different from the type of standardisation currently offered such that it will be possible for small, medium and large sized enterprises to implement it and connect to and/or be part of efficient multimodal logistics networks. The e-Freight framework has been adopted as part of the ISO / IEC DIS 19845 Standard

Ansi.X12 – Probably as mature as EDIFACT widely used in North America. American National Standards Institute (ANSI) in 1979, it develops and maintains the X12 Electronic data interchange (EDI) and Context Inspired Component Architecture (CICA) standards along with XML schemas which drive business processes globally. The membership of ASC X12 includes technologists and

business process experts, encompassing health care, insurance, transportation, finance, government, supply chain and other industries. It has a different branch version for Finance sector, Transportation, Supply chain, Insurance etc.

iDOC SAP – Intermediate Document, is a SAP document format for business transaction data transfers. Non SAP-systems can use IDocs as the standard interface (computing) for data transfer. IDoc is similar to XML in purpose, but differs in syntax. Both serve the purpose of data exchange and automation in computer systems, but the IDoc-Technology takes a different approach.

VDA – For automotive industry in Germany. Initially used for CAD systems data exchange format for the transfer of surface models from one CAD system to another. Its name is an abbreviation of "Verband der Automobilindustrie - Flächenschnittstelle", which translates to the "automotive industry association - surface data interface". Standard was specified by the German organization VDA.

CSV – a simple file where data elements are separated with an agreed separator mostly comma or semicolon.

5 Level of meeting the needs of the multimodal supply chain participants

In order to identify level of meeting the needs of the multimodal supply chain participant regarding ICT solutions, structured interviews have been conducted among the relevant target groups from the business side with strong interrelations along the NSB corridor.

The research was carried out as part of a European research project called the North Sea Baltic Connector of Regions (NBC CoRe) in 2017. In the research participated 119 entrepreneurs representing each countries that were part of the North Sea Baltic CoRe (Germany, Poland, Lithuania, Latvia, Estonia, Finland).

5.1 Characteristics of the surveyed group

Research was conducted on a deliberately chosen sample representing the Logistics Services Providers sector in six countries. The largest number of surveys was conducted in Poland 34% and in Latvia 19%, the percentage share is evenly distributed to other countries and is respectively 14% Germany, 14% Lithuania, 12% Estonia, 8% Finland.
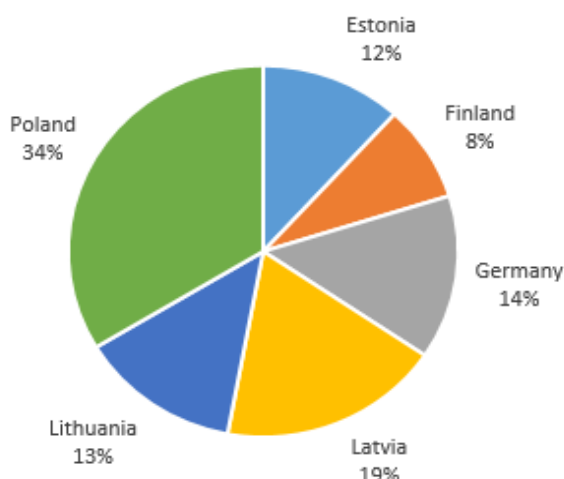
Figure 7 – Percentage of countries participating in the survey

The research sample consisted of 119 service providers of varied nature of their activity. Freight forwarders accounted for almost 43% of the surveyed population, road carriers were represented by 27% of survey participants, and container terminal operators by 13.4% of respondents. 10% of the respondents were intermodal operators. The least numerous were railway carriers, whose contribution in the sample amounted to 6.7%.
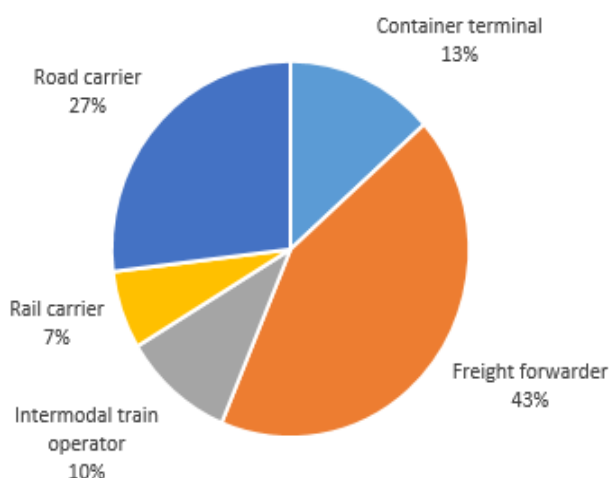

Figure 8 – Company's position in a supply chain

As far as the employment is concerned, the largest segment were medium-sized enterprises employing from 51 to 250 employees. The share of large enterprises was 25.2%, and micro and small enterprises – 36.1%. These proportions are shaped similarly taking into account the amount

of annual turnover. The representatives of enterprises participating in the study were high and middle level managers, most often employees employed in the rank of managers responsible for operational activities. The characteristics of the research sample are presented in Figure below.
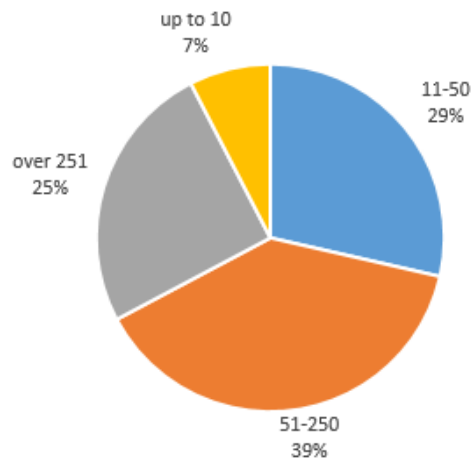

Figure 9 – Size of surveyed companies by number of employees

5.2 Survey results

The research questionnaire consisted of 4 questions, divided into two blocks.

> 1) **What according to you are the biggest barriers to the development of intermodal transport? (all respondents)**
>
> LSPs had been asked to rank the most important barriers to intermodal transport on a scale from 1 (no barrier at all) to 6 (very big barrier).
>
> To develop the statistical results, PS Imago 4 software was used. The statistical description used standard measures of descriptive statistics and the Kruska-la-Wallis test, which was used to compare the average results between the surveyed groups in relation to ordinal variables. It was assumed that the result is statistically significant for $p < 0.05$.
>
> Detailed results are presented in the chapter 5.2.1

> In the second block were placed 3 closed questions, to which they responded by selecting one of the available answers.
>
> 2) **Does your company use ICT tools to assist decision-makers in the following fields related to transport ? (all respondents)**
> 3) **Do you offer your clients track & trace services on each segment of journey? (freight forwarder)**

> *Do you offer your clients track & trace services? (intermodal operator)*
> 4) *Please evaluate the quality of existing system for exchanging electronic messages and documents between your company and the cooperated logistics service providers? (all respondents)*
> Detailed results are presented in the chapters 5.2.2, 5.2.3 and 5.2.4.

5.2.1 Identification of barriers to the development of intermodal transport

The table 1 shows the validity of barriers, which in the opinion of respondents, have a disruptive effect on the development of intermodal transport. As a grouping variable, the nature of the conducted activity was adopted. The research results are characterized by a low degree of differentiation. Generally speaking, the range of mean values measured on a 6-point scale ranged from 2.34-3.36 with a predominance of ratings close to 3, which on the one hand means that for many barriers respondents preferred to indicate neutral responses (neither important nor small significance), on the other hand, they assessed their meaning quite similarly.

Table 1 – Barriers to the development of intermodal transport from the perspective of logistic service providers, taking into account the nature of the business

Barrier category	Freight forwarder		Intermodal operator		Rail carrier		Container terminal		Road carrier		Total	
	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ	$\bar{x}$	σ
Too expensive comparing to road transport	3,57	1,08	3,42	0,79	3,63	1,06	3,06	1,12	3,09	0,86	3,36	1,01
Long transit time	3,35	1,02	2,50	1,24	3,00	1,20	3,38	1,02	3,44	1,13	3,27	1,10
Frequent deviation from schedule	2,94	0,99	2,75	1,14	2,38	1,30	3,19	0,83	3,06	1,08	2,95	1,03
Low security of cargo	2,39	1,15	2,25	0,97	1,88	0,83	2,13	0,81	2,53	1,05	2,34	1,05
Inadequate information about intermodal transport connections	3,08	1,11	2,75	1,22	2,88	0,83	2,63	0,72	3,09	1,30	2,97	1,12
Poor information exchange between logistics partners in intermodal supply chain	**3,35**	**1,09**	**2,75**	**1,22**	**2,88**	**1,25**	**2,75**	**0,93**	**3,25**	**0,98**	**3,15**	**1,08**
Lack of open inland terminals accessible for all carriers	3,43	1,01	2,83	1,03	2,88	1,13	2,19	0,98	3,25	0,98	3,12	1,07
High access fees to railway infrastructure	----	----	3,33	1,63	3,38	1,41	3,19	0,91	----	----	3,27	1,17

According to the presented results, among the examined factors the biggest obstacle to the development of intermodal transport is its high costs. Overall, the average of grades was 3.36 and was above the middle of the scale (3). The distribution of responses shows that over 40% of respondents attribute large and very significant importance to this factor, however, most often they

are railway carriers, freight forwarders and intermodal operators, in which there was a clear advantage of high marks (50.0%, 53.0%, 41.6%) over low ones (12.5%, 11.8%, 8.3%). As far as road carriers and container terminal managers are concerned, 31.2% and 18.8% of those surveyed were convinced of the importance of this factor. In both cases, the average ratings (3.09 and 3.06) were lower than the average railway carriers (3.63), forwarders (3.57) and intermodal operators (3.42). However, these are not statistically significant differences (Chi-square = 7.501 for p = 0.112).

Not without significance for the respondents were barriers referring to too long delivery time and high loads related to the use of railway infrastructure - in both cases with an average rating of 3.27. It turns out that the problems related to the long delivery time constitute a serious barrier limiting the development of intermodal services for container terminals (50%) of road carriers (47%) and forwarders (45%). Interestingly, the delivery time is not a serious development barrier for intermodal operators (2.50), in this case as many as 67% considered this factor as not important. Here, too, it turned out that the described differences are not statistically significant (Chi-square = 7.242 for p = 0.119).

As regards access to railway infrastructure, three respondents (intermodal operators, railway carriers and terminals) spoke out because the others (road hauliers and forwarders) do not know what these costs are, they are not directly involved in the organization and implementation of this part of the transport and don't have knowledge about the formation of rates for access to infrastructure. It is worth noting that both intermodal operators, container terminals and railway carriers are rather unanimous in assessing the significance of this barrier - the differences between them are not statistically significant (Chi-square = 0.056 for p = 0.973) and range from 3.19 in the case of terminals up to 3.38 for railway carriers.

Among the discussed barriers, it is worth pointing out the integration difficulties resulting from the insufficient exchange of information between cooperating logistics service providers. In this case, there are quite clear differences between freight forwarders (3.35), road hauliers (3.25) and other groups whose average ratings were well below the value of 3. Freight forwarders and road hauliers are therefore more convinced of the importance of this barrier than others service providers, although these are not statistically significant differences (Chi-square = 7.454 for p = 114).

Table 1 shows that the biggest differences in respondents answers were recorded when assessing the significance of the underdeveloped network of inland container terminals (Chi-square = 18.182 for p = 0.001**). The multiple comparisons test showed that highly statistically significant differences exist between container terminals (2.19) and road carriers (3.25) and forwarders (3.43). The research shows that limited access to services related to container reloading is a more serious development barrier for the last two groups.

Among the factors that have received the lowest rating are successively: insufficient information about intermodal connections, frequent deviations from the timetable and low level of cargo security. The first two barriers were rated between 2.97 and 2.95 - so both results oscillate around the center of the scale. The low level of cargo security (2.34) was considered as a factor of minor inhibitory

importance. On the other hand, the advantage of low scores (low significance and very low significance) over high (high importance and very high significance) of 56% of responses was noted. Taking into account the nature of the conducted activity, the average of grades in individual categories does not differ in a statistically significant degree.

5.2.2 Use of ICT tools to support decision making in transport

Respondents answering a question related to the use of ICT tools supporting the decision-making process related to transport, had the opportunity to choose one of three answers: YES, YES-con (applicable to container transport), NO. The questions that the respondents answered were dependent on the nature of their business.

The figure below presents the questions to which **freight forwarders** responded with the percentage contribution of each of the selected answers. The test results are characterized by a low degree of diversity. About half of the respondents confirmed that they use ICT tools for cooperation with other LSP at ports (Port Community System), consolidation from shipments, and presenting own services (data bases of delivery planning tools), (freight exchange). Most often, ICT tools are used by the shipper to collecting orders form the marker by own page more than 70% and by freight exchange more than 60%.
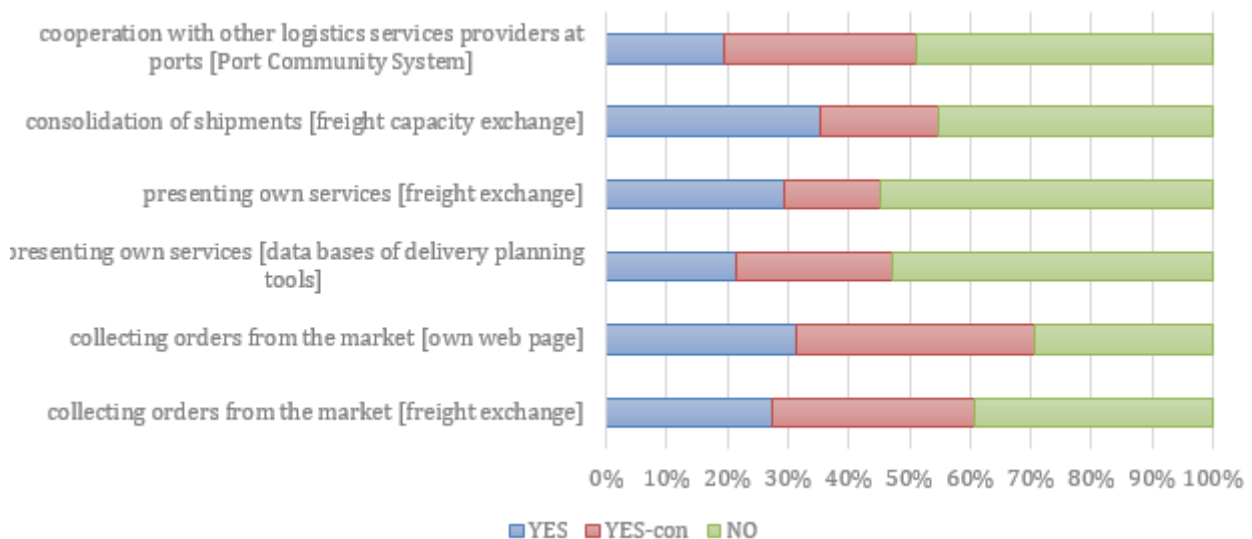

Figure 10 – Usage of ICT tools by freight forwarder

The figure below presents the questions to which **intermodal operators** responded together with the percentage share of each of the selected responses. The test results are characterized by an average degree of differentiation. About half of the respondents confirmed that they use ICT tools for cooperation with other LSP at ports (PCS), consolidation of shipments. Most often, ICT tools are used to presenting own services (data bases of delivery planning tools) more than 70%, collecting

orders form the marker by own page also more than 70% and by freight exchange more than 60%. The least is, however to presenting own services (freight exchange), about 35% responders chose that answer.
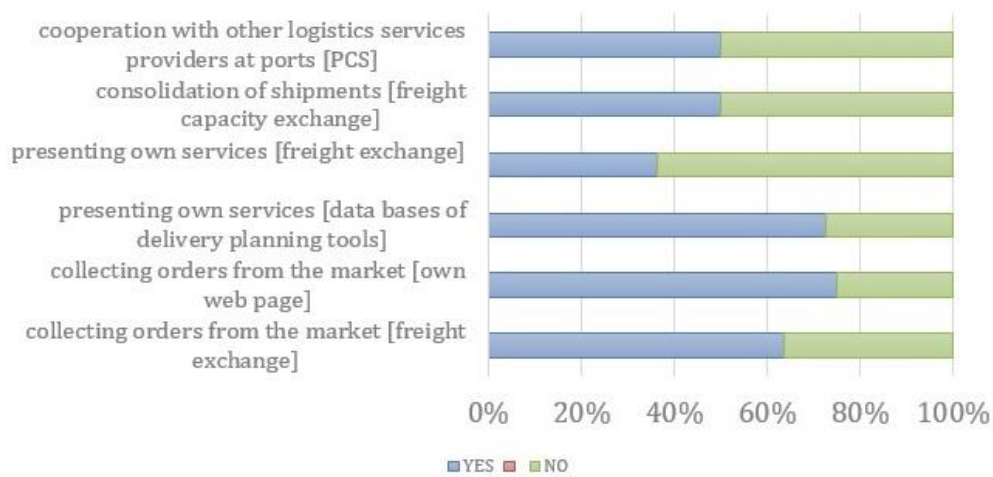

Figure 11 – Usage of ICT tools by intermodal operator

The figure below presents the questions on which **railway carriers** responded, together with the percentage share, of each of the selected responses. The test results are characterized by a low degree of differentiation. It is worth noting a very high percentage of using ICT tools to support decisions related to the implementation of the transport process. Almost 75% -88% of respondents gave an affirmative answer to all questions.
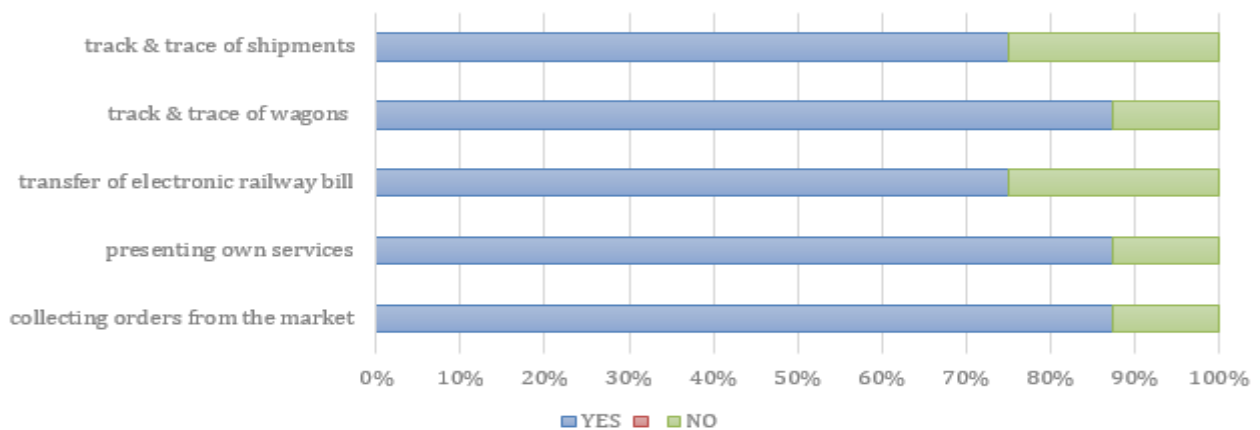

Figure 12 – Usage of ICT tools by rail carrier

The figure below presents the questions to which representatives of **container terminals** responded, with the percentage share, of each of the selected answers. The test results are characterized by a low degree of differentiation. About 75% of the respondents indicated that they use ICT tools to cooperation with other logistics services providers at ports [Logistics info exchange (e.g. electronic messages and documents)] and presenting own services. For all other questions about 55% of respondents made the answer in the affirmative.
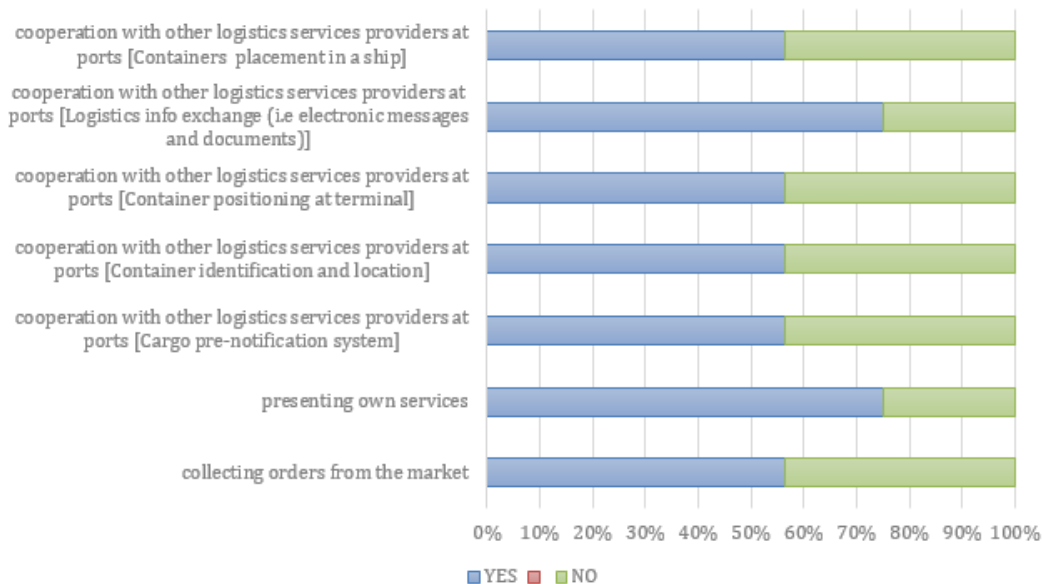

Figure 13 – Usage of ICT tools by container terminal

The figure below presents the questions on which **road carriers** were responsible, with the percentage share, of each of the selected answers. The test results are characterized by a significant degree of differentiation. The least often, ICT tools are used by respondents to support the improvement of service (parking lace booking) approx. 37% and consolidation of shipments (freight capacity exchange) approx. 43%. In contrast, the highest number of responses indicated two responses, improvement of services (route guidance) above 90% and improvement of services (route optimizing) around 88%.
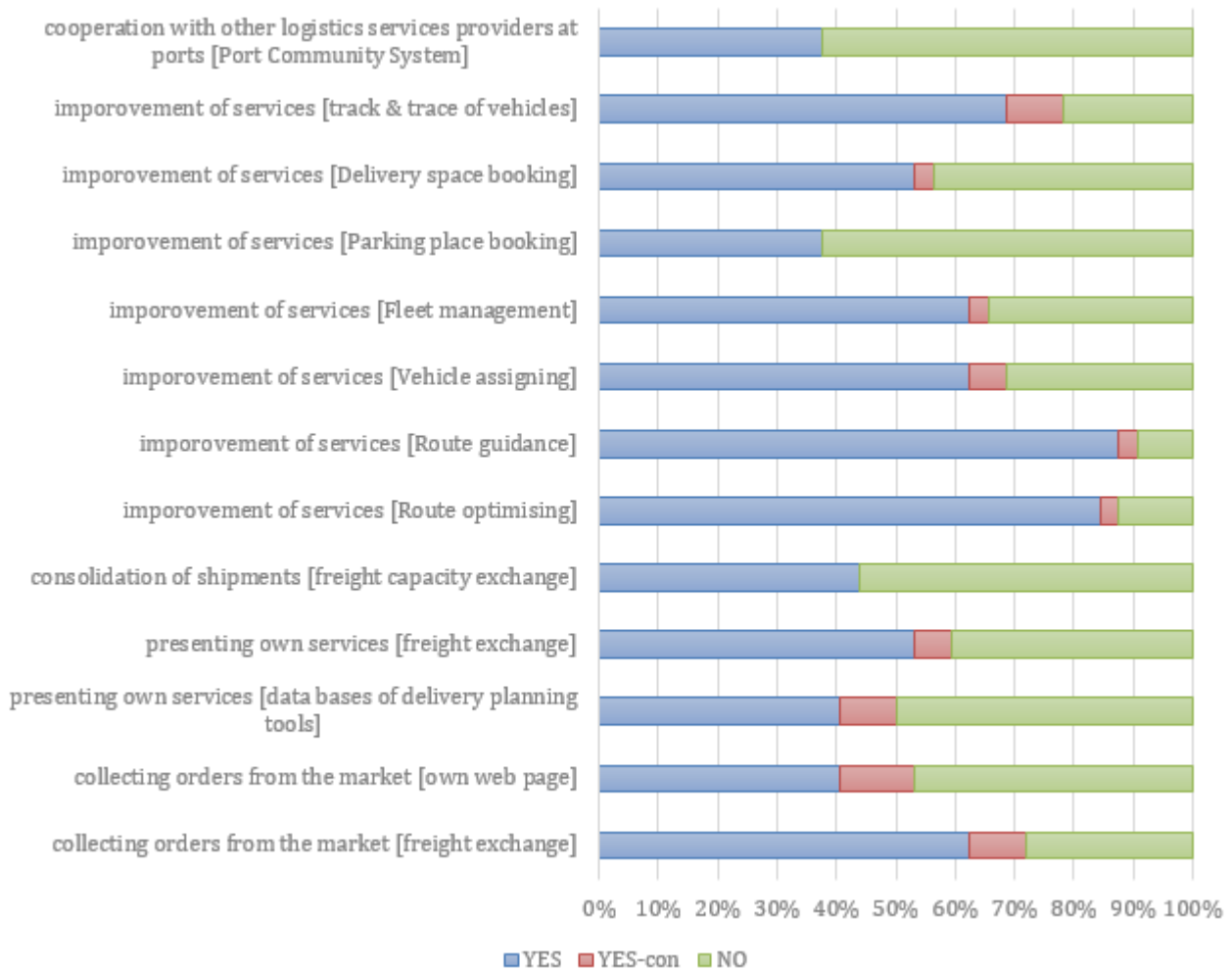
Figure 14 – Usage of ICT tools by road carrier

In the conducted research, it can be noted that respondents show frequent use of ICT tools to support decision-making processes related to transport. To the greatest extent, as much as around 80% in the case of a railway carrier, while the responses given by the remaining respondents are characterized by diversification ranging from approx. 35% -90% with a majority of responses above 50%.

5.2.3   Frequency of offering truck & trace services

The question regarding the offer of cargo tracking service during the delivery was given to respondents representing freight forwarders and intermodal operators. The forwarders responded to three questions, while intermodal operators responded to one query, with the option of choosing one of two answers: YES, NO.

In most cases, the parcel tracking service is offered by the forwarding agent on the section realized via road transport over 80% of cases, and less often on the section carried out by railway transport - less than 50%. The table below shows the full juxtaposition.
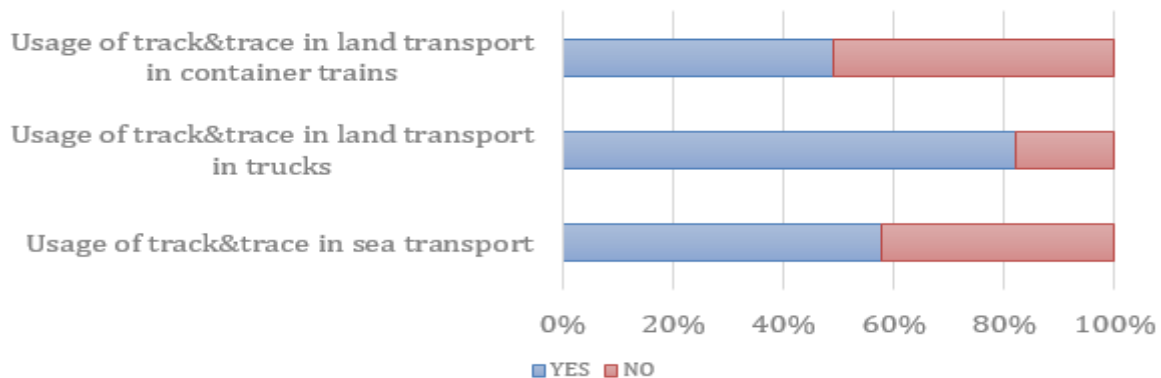

Figure 15 – Frequency of offering truck & trace services by freight forwarder

The graph below shows the frequency of the intermodal operator's ability to track the load to its clients, 57% of respondents confirmed the availability of this service.
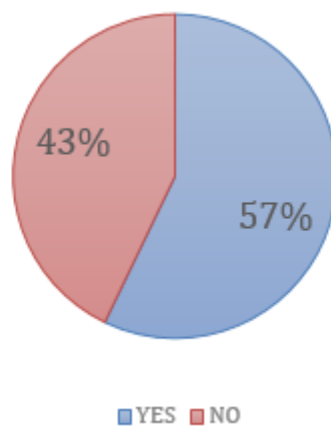

Figure 16 – Frequency of offering truck & trace services by intermodal operator

5.2.4 Quality of existing system for exchanging electronic messages and documents between companies

In the last question, respondents assessed the quality of the existing system of exchanging electronic messages and documents between their company and the indicated categories of Logistics Service Providers, using one of the three possible answers:

- Satisfactory,
- NOT satisfactory,
- NOT existing.

The **forwarder** as the most satisfactory considered electronic communication with the road carrier as many as 63% of respondents indicated this answer, then with the container terminal 43%. The least satisfactory 18% or defined as non-existent 47% was marked with an electronic data exchange between the forwarder and the intermodal operator. The collective results of the survey are presented in the Table 2.

Table 2 – Freight Forwarder's level of satisfaction from electronic data exchange with others supply chain participants

Freight forwarder opinion on electronic communication with:				
level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	18%	24%	43%	63%
NOT satisfactory	35%	37%	29%	27%
NOT existing	47%	39%	27%	10%

In the group of respondents representing **container terminals**, the coefficient of satisfaction with electronic information exchange with other participants in the supply chain was at the highest - 50% level in the case of cooperation with the intermodal train operator. The cooperation with the railway carrier and the container terminal was equally highly rated, they were indicated by 44% of respondents. The results of the survey were presented in the table below.

Table 3 – Conatainer terminal's level of satisfaction from electronic data exchange with others supply chain participans

Container terminal opinion on electronic communication with:				
level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	50%	44%	44%	38%
NOT satisfactory	31%	25%	31%	38%
NOT existing	19%	31%	25%	25%

The table below presents the level of satisfaction with electronic data exchange between the **intermodal operator** and other participants in the supply chain. The highest level of satisfaction was indicated in cooperation with a road carrier of 50%, slightly lower but still high, 42% in the case of a railway intermodal operator and a road guide. The exchange of information with the container terminal of 33% was indicated as the least satisfactory. The collective results of the survey are presented in the table below.

Table 4 – Intermodal operator's level of satisfaction from electronic data exchange with others supply chain participants

Intermodal operator opinion on electronic communication with:				
level of satisfaction	intermodal train operator	rail carrier	container terminal	road carrier
Satisfactory	42%	50%	33%	42%
NOT satisfactory	33%	25%	50%	33%
NOT existing	25%	25%	17%	25%

The **rail carrier** from all respondents showed the highest level of satisfaction related to electronic exchange of information, 63% of respondents indicated that answer as the most satisfactory, while in the case of the railway carrier and container terminal it was 50%. The survey results were presented in table below.

Table 5 – Rail carrier's level of satisfaction from electronic data exchange with others supply chain participants

Rail carrier opinion on electronic communication with:			
level of satisfaction	intermodal train operator	rail carrier	container terminal
Satisfactory	63%	50%	50%
NOT satisfactory	13%	13%	0%
NOT existing	25%	38%	50%

In the group of respondents representing **road carriers**, the satisfaction rate with electronic information exchange with other participants in the supply chain was at the highest 66% level in the case of cooperation with an intermodal operator, cooperation with the railway carrier was positively assessed by 31% of respondents. However, as unsatisfactory 19% or non-existent 53%, the

cooperation with the container terminal was assessed. The collective results of the survey are presented in the table below.

Table 6 – Road carrier's level of satisfaction from electronic data exchange with others supply chain participants

Road carrier opinion on electronic communication with:			
level of satisfaction	intermodal train operator	rail carrier	container terminal
Satisfactory	66%	31%	19%
NOT satisfactory	22%	19%	25%
NOT existing	13%	50%	53%

Over the next dozen years, in line with the EU development policy, the main modernization effort will be aimed at removing barriers to the development of intermodal transport, which in practice will require numerous infrastructural investments aimed primarily at modernizing all modes of transport and increasing mobility and spatial integration of regions. Among many projects planned for implementation, it is necessary to emphasize the urgent need to expand the existing network of handling terminals. Investments related to the development of offshore point infrastructure and road and rail terminals within the TEN-T network should be considered as particularly important.

Turning to the results of the survey, it should be emphasized that respondents, regardless of the nature of their activity, to the main barriers hindering the development of intermodal transport (though not as strongly as initially assumed) included: high operating costs (including those related to the use of railway infrastructure) and too long delivery time. Only in the case of the assessment of the importance of the underdeveloped network of onshore container terminals was it noted that the opinions of the respondents are quite diversified depending on the type of business. It turns out that the above factor is a much more important development barrier for road hauliers and forwarders than for container terminal managers. It can be assumed that in the case of terminals there is a fear that the further development of point infrastructure (adding new locations) will lead to the appearance of alternative cooperation offers on the market, which will significantly exacerbate the current fight for the client.

In the light of the above, it is worth pointing out some additional weaknesses, which obviously limit the development potential of this market. We are talking here about both a small number of carriers who specialize in this type of service, as well as about the aforementioned high costs of their provision, especially in comparison to road transport. These two factors seem to be particularly important if we take into account the concerns raised by the shippers themselves.

6 Current trends in the development of ICT solutions

Identified participants in the supply chain perform specific roles depending on which they have a different range of activities, and also their expectations towards software. Each of them will use the IT system best suited to the tasks performed by the company. Therefore, IT systems of various classes are used in the supply chain: related to customer service, container reloading, transport ordering, tracking of deliveries, etc. Therefore, a wide range of ICT tools is available, adapted to the functionality required by the user related to the position in the logistics process.

However, when analysing the current trends related to the development of ICT tools supporting intermodal transport and the results of surveys, 6 significant software identifiers common to all participants in the supply chain were identified, they are intensively developed by solution providers in this area. Details are provided in the following sections.

6.1 Electronic data exchange

The efficiency and reliability of logistics processes of supply, production and distribution to a large stage depend on the speed and efficiency of information processing, which nowadays is determined primarily by the possibilities of modern computer technology.

Every day, business partners in the supply chain exchange innumerable information, which until recently were sent in paper form, currently progressing digitalization significantly influenced the way of data exchange, i.e. orders, orders, invoices, demand data.

Efficient exchange of information between supply chain partners is currently in line with the expectations of the participants of the supply chain, the base of solutions provided by the developers of IT tools. At the same time, a large variety of programs to handle processes enforces the introduction of effective communication and data exchange at all stages of the logistics process. That is why it is important to use advanced IT technologies operating in a standard electronic data exchange environment.

6.2 Integration

Integration is the next step in the exchange of data between logistic partners. During the flow of goods in the supply chain information is very often modified. For this reason, the IT systems of individual business partners supervising the flow of information and goods must guarantee the integrity of all of its links. Integration enables data exchange between partners in real time, which affects the optimization of the entire supply chain.

Integration of internal processes in enterprises is now becoming a standard, many companies use ERP or SCM systems, which is the starting point for consolidation within the whole supply chain. Therefore, in line with current company trends, there is interest not only in the internal integration of

processes, but integration between partners throughout the supply chain is becoming more and more important.

Thanks to the integration of logistic processes, it is possible to achieve synergy effect, for example by mutual adjustment of processes related to the container movement between participants of the intermodal supply chain, achieving a higher level of customer service, higher and even use of resources, while optimizing the time needed to perform activities. As a result of joint planning of processes and scheduling the use of resources in the supply chain, it is possible to reduce the time of logistic processes and the response time needed in the situation of variable demand.

Currently, many ICT tools are standardized for integration between business partner systems. Way of communication, changes very dynamically, for example integration by EDI between two partners, is still popular, but it gives way to other solutions, like communication platforms. Because if companies have a lot of cooperative partners (customers, suppliers, LSP) integration with each will be time-consuming and expensive, so better solution is to use an external EDI platform, which provide one connection standard to all players.

6.3   Clouds solutions

Cloud solutions include alike disks in the cloud for storing files, but more and more often solutions based on cloud computing.

Cloud Computing is a business model whose main advantage is the provision of IT services and solutions via the Internet. It is a very popular form of IT outsourcing and its main advantage is that there is no need to purchase your own infrastructure and software. Data processing in the cloud allows you to rent all these resources and make them available to end users. Thanks to the cloud, every user can use both e-mail and display documents, settle accounts with contractors, make backup copies and sell their products / services from any place and at any time.

The advantage of solutions in the cloud is its flexibility and security. It is a set of IT tools that allows you to increase work efficiency while significantly reducing costs. Data processing in the cloud also means increasing data security, full availability, regardless of where the user is. All you need is access to the network and computer. The provider of this solution ensures full support to all system users, quick implementation and flexibility in adapting to the growing number of users of the solution. The advantage of solutions in the cloud is access to all online applications using any web browser. The most common applications of cloud solutions should be mentioned: website hosting, data security services - backup (backup), CRM, e-commerce services, bookkeeping, settlements with contractors and many others.

The offer of many companies such as SAP, Oracle, Inttra or Comarch, offering standard solutions implemented on the client's server, are also available in the Software as a Service model (cloud computing). The products available in the cloud include software supporting logistics processes (ERP, load calculators, electronic transaction platforms) as well as financial and accounting services.

6.4   Complexity

The contemporary market is becoming more and more demanding. The growing expectations of consumers and strong competition are the factors that encourage entrepreneurs to look for new technological solutions that offer fully comprehensive solutions.

Between IT systems supporting management of organizations, especially among integrated systems (e.g. ERP and SCM classes), are dominating standard software packages. They usually have built-in adjustment mechanisms that allow the system to be adapted to the special needs of a specific customer. However, offered solutions always require personalization, in each company, activities performed during the implementation of tasks are customizing to the individual requirements of the company and process users.

Recent, Increasingly, in addition to the standard system configuration for existing processes, entrepreneurs require that specialized systems support the development of the company through easy integration with co-operators, enable work in the cloud, provide the application on the phone. Therefore, IT solution providers develop their products in such a way that the customer, when he's buying a chosen solution, he receives software that fully supports all internal and external processes. As a result, many tools that function independently, such as Load Calculator offering simple functions, become one of the functions of a larger system such as SeaRates.

6.5   User friendly

User-friendly describes a hardware software interface that is easy to use. It is "friendly" to the user, meaning and it's not difficult to learn or understand. A user-friendly interface is not overly complex, but instead is straightforward, providing quick access to common features or commands. While "user-friendly" is a subjective term, the following are several common criteria found in user-friendly interfaces.

- Simple to install - Installation is the first point of contact for users, so it should be a friendly process. It doesn't matter whether it's an operating system or a single-client user application, the installation should be simple and well documented.
- Easy to update - As with the installation, an application's update process should be easy. Updates need to be simple enough to ensure that users continue to benefit from the hard work of the creators of the software. When users don't update, thus exposing issues, the software becomes less and less reliable and secure (as well as missing out on new features).
- Intuitive - In order to be user-friendly, an interface must be make sense to the average user and should require minimal explanation for how to use it.

- Efficient - not only should a piece of software work as expected, it should also be efficient. It should be optimized for specific architecture, it should have all memory leaks plugged, and it should work seamlessly with underlying structures and subsystems. From the users' point of view, the software should be an efficient means to completing their jobs. Software should not get in the way of completing a task, nor should it set up any roadblocks for users. The efficiency of a piece of software is tied up with its intuitiveness.
- Clean – a good user interface is well-organized, making it easy to locate different tools and options.
- Reliable - an unreliable product is not user-friendly, since it will cause undue frustration for the user. A user-friendly product is reliable and does not malfunction or crash.

The goal of a user-friendly product is to provide a good user experience. This may look different depending on the end user for whom the product is designed. For example, a user-friendly shipper's software will have a different interface than a terminal operator. However, the rules above apply to both types of software. Even if a program has many advanced features, it is still possible to make it user-friendly by designing a simple, clean, and intuitive interface.

6.6   Mobile application

Due to the constantly developing mobile technology, which enables quick and easy access to information or tools, an increasing number of IT tool providers also offer a mobile version of software.

Mobile applications support the software regardless of its basic functionality, it can be an ERP system as well as a SAP system, or a Freight Exchange, such as TimoCom or Trans.eu. Mobile devices are everywhere, making supercomputing accessible anytime – often as cloud services and applications – and making high levels of security a standard in this mobile environment. While this mobile trend offers tremendous opportunities, it also increases the pressure on IT providers improve their products.

A lot of companies, are extending a subset of existing applications to mobile devices today. In many cases, these are micro apps that offer a subset of the features found within PC applications. Examples of micro apps include approvals, expense reporting, and time tracking.

7   Summary

Selected and characterized technologies of ICT supporting the management of the intermodal supply chain are examples of currently used tools, the selection and implementation of which depends on the range of business and the level of cooperation with other participants in the logistics process. It's important that individual links in the supply chain are characterized by a high level of integration. This significantly influences the application possibilities of the chosen technology and facilitating contacts with business partners and clients. The development of new distribution channels and the creation of products along with the development of ICT technologies are becoming the driving force

for creating more and more effective innovative solutions, thus determining comprehensive approaches to supply chain management. The application of the technologies discussed may have a significant impact on the functioning of the entire supply chain by streamlining its operation, which allows obtaining benefits in the form of achieving synergy effects.

Increasing number of ICT tools providers, are focus on offering, complex solutions, that allow efficient data exchange, and process integration, not only inside the enterprise, but also between members of the supply chain. Actual many solutions are offered in the cloud, or with using electronic data exchange platforms. It's also important, that the software, need to be customize to user needs, and use of it, should be user friendly.

Today, we are all witnessing a fourth industrial revolution, for which the most characteristic feature is the disappearance of the barrier between people and machines and the use of the Internet of Things and cloud computing. Industry 4.0 is about integrating systems and creating networks and integrating people with digitally controlled machines that use the internet and information technologies - unifying the world of machines and the virtual world of the Internet (including the Internet of Things) and information technology. Virtual reality, the Internet of Things and 5G networks are the trends and technologies that will have the greatest impact on the transformation of the telecommunications sector in 2018.We can expect changes related to the development of standards and testing of 5G systems and the networking of an increasing number of devices and sensors within the Internet of Things ecosystem. Implementation of "software-defined networks" technologies SDN (Software-Defined Networking) i SD-WAN (Software Defined WAN) will bring about the most important market transformations in the enterprise segment and network architectures for many years. Therefore, when discussing current ICT solutions, and recommendations for information system developers it is important to take into account actual trends: Industry 4.0, cybersecurity, Intelligence Automation / Data Science, Analytical Methods Big Data, Cloud Computing, API, Internet of Things, Blockchain.