INNOVATION IN PORTS

Technology, Information and Processes

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PREFACE

Following the success of the 2012 event, the University of Antwerp and BNP Paribas Fortis held a second networking event on Thursday 23 April, 2015 about how innovation allows answering the main challenges of the ports industry, as part of supply chains.

The main objective was to understand patterns and characteristics, success factors and failure factors, taking into account the context of the respective challenges, which prevailed when they emerged, and the goals they were planned to serve (economic, social and environmental)

To do this, an international consortium of universities (including members TransportNET), coordinated by the University of Antwerp (Annex 1), collected data for almost 75 port-related innovation cases. Analysis of these innovation cases provides insight into the maritime and port sector to prepare for new economic, environmental and social challenges. The consortium consisted of experts in sustainable innovation management. The research was carried out under the auspices of the BNP Paribas Fortis Chair for Transport, Logistics and Ports, hosted by the University of Antwerp (Belgium).

Figure 1: Overview of collaborating universities

A unique collaboration of 7 universities located in three continents with 30 private port operators located in 10 different countries allowed investigating, which conditions need to be met in order for such innovations to be realized successfully. The participating actors included shipyards (NL), shipping companies (BE, SG, GR, USA), deep-sea terminal operators (container (BE, IT), multipurpose terminal operators (BE, IT), port authorities (PT, BE, SG, GR), stevedores (BE, NL, ES, FI), inland shipping companies (BE, FR), inland terminals (BE), freight forwarders (BE), rail operators (IT), container leasing companies (BE, NL), land transport companies (BE, USA), agencies (BE), and shippers (BE). This way, the research covered the entire supply chain.

This booklet, therefore, presents the details of the set of cases used in research on port innovation done by different international contributors. The findings give more insight in the processes, objectives

and challenges behind inter-firm and intra-firm innovations, and could support innovators in the further development of their innovations. Moreover, this booklet provides practical guidance for (innovation) managers to support successful implementation of specific innovation initiatives in the port-related industry.

This set of cases and their information as contained in this booklet were used for in-depth analysis in a set of joint papers (Acciaro & Sys, 2020; Vanelslander et al., 2019; Acciaro et al., 2018; Vanelslander, Sys & Carlan, 2016; Giuliano et al., 2016; Sys et al., 2016). From the research, it is clear: 'Co.Innovation will create lots of opportunities'.

A word of thanks is finally in order. First, BNP Paribas Fortis who funded and encouraged us to conduct this research. Next, the partners of the consortium for their enthusiasm, for helping us collect data, the useful discussions, comment and feedback. None of this would have been possible without Valentin, standing next to us during the whole process from the start to the finish and Edwin for his editorial help and contributions in finalizing this booklet. And last but not the least, the industrial community of change makers by sharing their opinions and knowledge of (past, present and future) innovation drives in, which they and/or their respective companies were involved.

August 2020

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She jointly graduated as a doctor in Applied Economics at the Ghent University and the University of Antwerp (December 2010). Her doctoral research dealt with the competitive conditions, the concentration and the market structure of the container liner shipping industry. This research was awarded by the Section of Technical Sciences of the Royal Academy for Overseas Sciences with the General Manager Fernand Suykens Prize for Port Studies.

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INTRODUCTION

Leaving aside containerization – a classic example of radical innovation – the maritime and port industry is known for its rather conservative attitude towards change. In spite of the potential opportunities offered, the sector generally displays poor innovative strength, as demonstrated in a comparative study by the International Transport Forum (2010). However, the present research finds that the perception that the maritime and port sector is less innovative than other sectors of industry no longer holds water. Innovation, it appears, is now generally accepted to be essential maintaining competitiveness.

To understand innovation, following definition is applied within this research: "An innovation is a technological or organizational (including cultural as a separate sub-set) change to the product (or service) or production process that either lowers the cost of product (or service) or production process or increases the quality of the product (or service) to the consumer (Arduino et al., 2013)."

OBJECTIVE OF THE RESEARCH

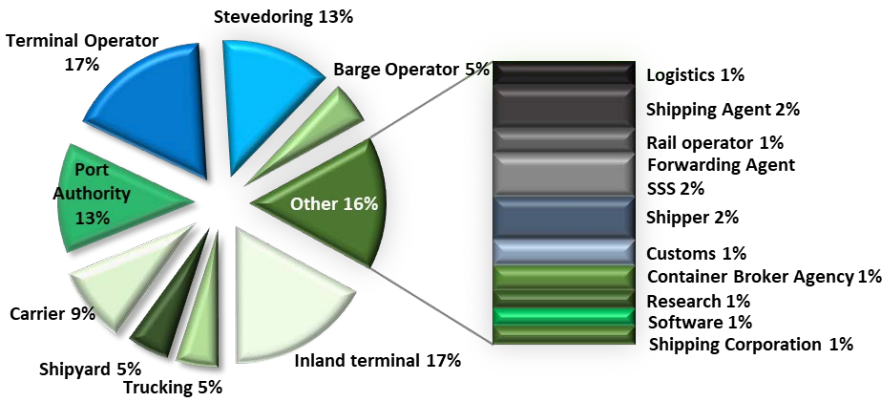
The aim of this innovation research is to gain a better and deeper understanding of the opportunities and future port-related innovation that make transport supply more efficient including their respective industrial and economic impact. The objective is to understand patterns and characteristics in port innovation, as well as success and failure factors.

SCOPE OF THE RESEARCH

Case analyses can provide insight into how the industry is preparing for new economic, environmental and social challenges. Data was collected on 75 different innovation cases, in a research project conducted under the BNP Paribas Fortis Chair for Transport, Logistics and Ports at the University of Antwerp. In two of the cases studied, namely the 3PL Primary Gate and Port Single Window, the researchers also gauged the opinions of multiple stakeholders, resulting in 84 evaluations of innovation projects.

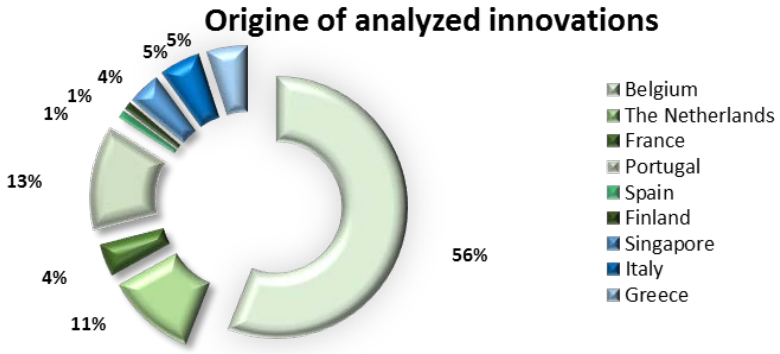
To ensure homogeneous and coherent data collection and allowing for carrying out cross case analysis, an Excel-based template was used during the interviews. During the data collection, it became rapidly clear that if a company invests in innovation, it works on different / continuous innovative initiatives. Within this sample, the innovation champions (or initiators) are the deep-sea terminal operators, stevedores and inland terminals (Figure 2). Most of them target mainly improvements of the cargo flow and ICT, which are put high on the companies' agenda. Furthermore, most case-analyses deal with 'incremental' innovations that are not based on new initiatives. They are rather further developments of existing practices.

Figure 2: Innovation champions of analyzed cases



The most contributed cases in this research are situated in Belgium, Portugal and the Netherlands. The scope of the research gives a broad overview of port innovations in Europe and Singapore (Figure 3).

Figure 3: Origin of the analyzed innovations



STRUCTURE OF THE BOOKLET

Rather interested in the type of innovations, the part concerning the Innovation Monitor gives an overview of the innovation cases, which are clustered in 12 categories:

1. Innovation in dredging
2. Electronic data interchange
3. IT innovation supporting cargo flows
4. Innovation supporting efficiency in (un)loading
5. Innovation supporting container transfer from one mode to another
6. Innovation reducing operating vehicle costs
7. Innovation supporting inland waterways
8. Innovations in monitoring of vehicles & cargo
9. Capacity and area utilization
10. Inland navigation within urban context
11. Container innovation
12. Sustainable Port and Vessels

DETAILED DESCRIPTION OF THE INNOVATION CASES

The selected cases are divided in 12 clusters, which define the structure of this booklet. Every case analysis within a cluster starts with a summarizing table with characteristics followed by a description, the identified objectives and finally the role of the stakeholders. The cases are summarized in Table 1 according to their cluster and contributing authors. Table 2 gives an overview of the innovative concepts per stakeholder.

The first cluster concerns **innovation in dredging**. Sufficient port' accessibility is vital for all economic activities. The dredging industry is constantly looking for improvements and is known as a global capital intensive and innovative sector.

The second cluster focuses on **innovations in the field of electronic data interchange** (EDI). Advanced communication adds to the optimization of port operations and planning. Cooperation communities of logistics stakeholders have emerged around online platforms with the objective to reduce transport and logistics costs. These kind of innovations within this second cluster comprises failure and success factors of paperless administration processes.

A third cluster concerns **IT innovation** with a specific focus on cargo flow. Different from the second cluster, the focus lies here on traffic optimization solutions for both freight and vessels. The main objectives of the innovation cases in this cluster are hence traffic management optimization, development of a planning algorithm and the reduction of possible conflicts between modes of transport.

The fourth cluster concerns **innovations supporting efficiency in (un)loading**. Especially innovations in ship-to-shore operations address a number of aspects regarding labor safety, (cost)efficiency and cargo security. These innovations aim to increase the productivity of terminals and to ensure a high level of service quality on the quayside.

The fifth cluster looks at technological innovations that support **the transfer of containers** from one mode to another. The identified cases within this cluster try to address challenges concerning interoperability and intermodality between different transport modes. Technological achievements, new designs of equipment and new service offers are compared to distillate common failures and opportunities within this segment.

A sixth cluster gives an overview of **innovations with the aim to reduce operational costs of vehicles**. This cluster gives insight into the motivations and constraints regarding to a possible shift away from conventional fuels and the possible reduction of operational costs. This shift represents not only a technological advancement but also a mental shift towards cultural progress.

The seventh cluster entails **innovations supporting inland waterways**. The typology of these innovations is quite divers and goes further than basic waterway traffic. The innovations in this field also address the increasing use of inland navigation instead of other less sustainable modes such as road haulage.

The eight cluster brings innovations together that are focused on improved **monitoring of vehicles and cargo flows**. Real-time information concerning cargo and vehicle (or vessel) is critical for nowadays logistics management systems. Innovations in this cluster aim at improvements in collecting and delivering of information without purging the flow of goods. These innovations allow a closer look on all ongoing supply chain operations.

Cluster nine addresses **capacity and area utilization** for transport and logistics activities. The more these activities grow, the more space they need to be able to expand. Physical space is scarce and often faces limits such as capacity boundaries.

The tenth cluster comprises innovations with regard to **inland navigation within an urban context**. The special settlement of urban surrounding brings new opportunities for the use of waterways as well as challenges and regulation restrictions. These innovations use dedicated equipment to respond to current constrains of conventional urban distribution logistics chains. The main objectives of these initiatives are to address challenges such as road congestion, pollution and traffic time losses.

The eleventh cluster shows a collection of four cases that address **container innovations**. These innovations are strongly connected to the use of containers and their features (exterior dimensions, capacity, location or ownership). The main objective of these innovations is to improve the container capacity usage of transport means and depots.

The twelfth and final cluster collects innovations that address port and terminal management in regard to **sustainable innovations** such as Carbon Footprint Assessments and an Exhaust Gas Cleaning Scrubber onboard of a vessel. These innovations contribute to the reduction of external costs regarding pollutant emissions and greenhouse gases.

Table 1: Overview of clusters and innovations according to author(s)

Cluster	Innovation	Author(s)
1. Innovation in dredging	Dynamic Operations in Dredging and Offshore Wild Dragon Flexible spud wagon Dredge pumps	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
2. Electronic Data Interchange	Port single window JUP	*Rosario Macário and Vasco Reis*
	Port Community System: PORTNET	*Jasmine Lam Siu Lee*
	e-Freight System: e-PORT	*Claudio Ferrari, Alessio Tei and Maria Inès Cusano*
	SEAGHA: Port Community System Antwerp Port Community System Administration to EDI – terminal operator APCS for break-bulk IT data management (Metallo) e-Transit (MSC) Extended Gate (1.0, 2.0, 3.0) BCTN Paperless Customs flow: Import-Extended Gate up to the end customer BCTN Paperless Customs flow: Import-paperless NCTS pilot BCTN Paperless Customs flow: Export-paperless to deep sea terminal Expansion of OCR Capabilities to dangerous goods Pre-notification at deep sea terminals in Antwerp Pre-notification at deep sea terminals in Rotterdam Digital CMR	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
3. IT- Innovation supporting cargo flows	Vado Ligure "port gate"	*Claudio Ferrari, Alessio Tei and Maria Inès Cusano*
	3PL- Primary Gate of Leixões at Port Leixoes	*Rosario Macário, Vasco Reis*
	Container Management System of VIL Corridor Management System of BCTN Port-wide Lighter Schedule of the Port of Antwerp	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
4. Innovation supporting efficiency in (un)loading	Bulk carrier self-loading/unloading cranes S-Bend on LPG carrier	*Athena Roumboutsos and George Sakkas*
	Automated Stacking cranes Heavy cranes All weather terminals (Waterland) All-weather terminal (Wijngaardnatie) All-weather terminal (Grupo Nogar) All-weather terminal (Port of Kokkola)	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
5. Innovation supporting container transfer from one mode to another	Tandem lift operations ECO-Combi Van Hool ECO chassis BCTN Barge slots Intermodal door-to-door transport (Metrocargo)	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
6. Technological innovation reducing operational vehicle costs	Straddle Carriers with CNG Vans from diesel to CNG	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
	CNG Class 8 Heavy Duty Drayage Truck	*Genevieve Giuliano and Geraldine Knatz*
7. Innovation supporting inland waterways	Small barges and reactivation of small inland waterways Barge heavy lift RO-RO hybrid	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
	Pallet Shuttle Barge	*Edwin Verberght*

8. Innovation in monitoring of vehicles & cargo	Weighbridges Advanced Gate Automation and FATS (Full Automated Truck System) Truck Appointment System Autotrakker Platform EuroTransCom BCTN Portal for clients	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
	Offshore Single Point Mooring	*Claudio Ferrari, Alessio Tei and Maria Inès Cusano*
9. Innovation in capacity and area utilization	DP World Antwerp inland terminal (Beverdonk) Container yard of Meerhout Transferium Joosen Transport hub Modal shift through implementation of a local transshipment center (Beerse) Modal shift through implementation of a local transshipment center (Beverdonck)	*Valentin Carlan, Christa Sys and Thierry Vanelslander*
10. Innovation in inland navigation within an urban context	Urban distribution of goods with inland navigation Urban distribution of cars with inland navigation	
11. Container innovation	Foldable container SEA45 10'6" ft. container Empty Equipment Management	
12. Sustainable ports and vessels	The Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber on an APL Containership	*Genevieve Giuliano and Geraldine Knatz*
	Carbon footprint assessment of the Port of Piraeus Carbon footprint assessment of Star Bulk	*Athena Roumboutsos and George Sakkas*

The innovations can also be viewed from the perspective of the main stakeholder. Table 2 gives an overview from this perspective.

Table 2: Overview of innovations and stakeholders

Stakeholder	Innovation
Shipyard	Dynamic Operation in Dredging and Offshore Dredge pumps Flexible spud wagon Wild dragon
Carriers	e-Transit to extended gateway Extended Gate Carbon footprint assessment of the Port of Piraeus Carbon footprint assessment of Star Bulk S-Bend on LPG carrier The Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber on an APL Containership Bulk carrier self-loading/unloading cranes

Deep-sea terminal	Advanced Gate Automation and FATS (Full Automated Truck System) Truck Appointment System Administration to EDI – Terminal Operator Automated Stacking Cranes Weighbridges Tandem lift operations Straddle carriers with CNG Vado Ligure "Port gate" Autotrakker e-Freight system "E-port" Port community system PORTNET Offshore Single Point Mooring
Stevedoring	APCS for break-bulk Heavy cranes Vans from diesel to CNG All-weather terminal (Waterland) All-weather terminal (Wijngaardnatie) All-weather terminal (Grupo Nogar) All-weather terminal (Kokkola)
Port Authorities	3PL - Primary Gate of Leixões at Port Leixões Port Single Window JUP Carbon footprint Assessment of port SEAGHA: Port Community System APCS for break bulk
Inland terminal	BCTN Paperless Customs flow: Import - extended gate to the end consumer BCTN Paperless Customs flow: Import - paperless NCTS pilot BCTN Paperless Customs flow: Export - paperless to deep-sea terminal Expansion of OCR capabilities to dangerous goods BCTN Portal for clients Pre-notification at deep-sea terminals in Rotterdam Pre-notification at deep-sea terminals in Antwerp Port Wide Lighter Schedule Port of Antwerp BCTN Barge slots Corridor Management System Digital CMR Empty Equipment Management Transferium Container Yard of Meerhout
Inland operators	Urban distribution of goods with inland navigation Barge heavy lift Ro-Ro hybrid Urban distribution of cars with inland navigation Pallet Shuttle Barge Small Barges and reactivation of small inland waterways
Land transport modes	ECO Combi Joosen Transport Hub Platform EuroTransCon Van Hool ECO Chassis CNG Class 8 Heavy Duty Drayage Truck
Hinterland	Intermodal door-to-door transport (Metrocargo) 10’6” ft. container SEA45 Modal shift (Beerse) Modal shift (Beverdonk) 4FOLD (Foldable container) IT Data Management

HOW TO READ AND INTERPRET THE SET OF INNOVATIONS?

Most case analyses are built according a consistent structure. Next to the description in general and, if possible, in more detail, the characteristics of the innovation are presented, followed by the success and failure factors, the objectives according to the triple bottom approach and the stakeholders involved, if any. Below explains how to interpret each of these elements.

Characteristics

The case chapters start with the name and the number of the innovation, followed by a summarizing table of characteristics of the innovation (Table 3).

Table 3: Example table summarizing the characteristics of an innovation

Characteristics of the innovation				
Type	Technology – unit change			
Stage	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

The first characteristic is the **type of the innovation**, which can be a technological, managerial, organizational or even a cultural change (Table 4). The change can be focused on a unit within the firm or on a market whereby the firm has a competitive position (Vanelslander et al., 2019).

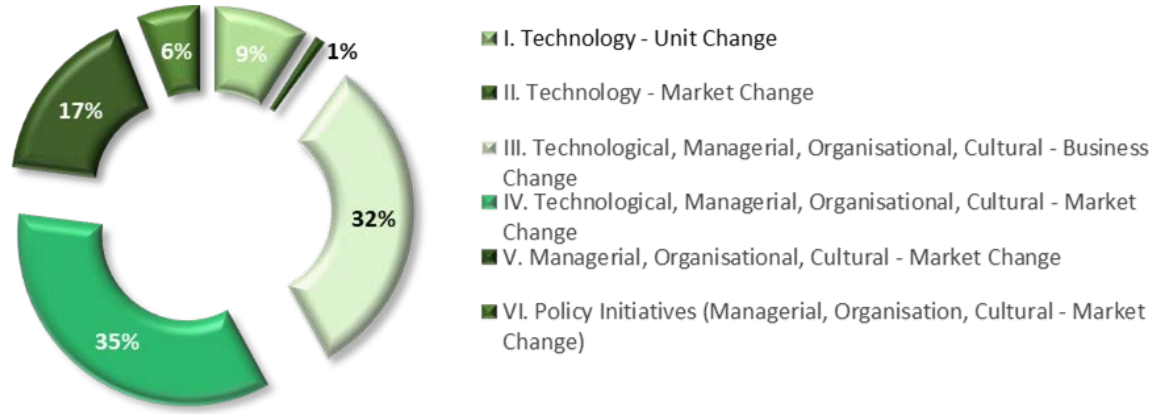
Table 4: Innovation typology and object of change

Nr.	Nature	Object of change
I	Technology	Unit
II		Market
III	Technological, Managerial, Organizational, Cultural	Business
IV		Market
V	Managerial, Organizational, Cultural	
VI		

Source: Sys, et al. (2015)

About 85% of the analyzed cases in this research aim at technological, managerial, organizational or cultural changes at business or market level with an impact across the whole supply chain.

Figure 4: Targeted change of the analyzed innovations



A second characteristic of the innovation shows the **stage** where the innovation currently (when the study was conducted) is located. In one single company many innovation cases can be ongoing and within different stadia. This can be in the initiation, development or in the implementation stage (Sys, Vanelslander, et al., 2015).

The third characteristic of the innovation is linked to **timing**. The Systems of Innovation Approach (SIA) takes the *evolutionary theory as one of the points of departure, to focus on the interactive mechanisms that shape the emergence and diffusion of innovations through the interaction of actors and institutions* (Nelson and Winter, 1982; Innosutra, 2011). An innovation can be situated in the past (already implemented, off-the-shelf), in the present (on the market but not yet commercialized) or in the future (in conceptual phase, or not ready for market yet). Innovation knows more possible distinctions as described in the following paragraphs.

SIA is not built in isolation, it is a network approach where actors interact, cooperate and learn (Lundvall, 1992; Vanelslander et al., 2014). Institutions such as regulations, laws, cultural norms, values, etc. are crucial to economic behavior and performance. The system evolves within these "rules of the game" (Smith, 1997).

Fourth, the **activity** of the innovation can be open or closed. When the innovation is open, the knowhow and more details are relatively easier to identify than when the innovation is closed because it could contain market sensitive information. The innovator can be a public or private actor. This information already partially reveals if social or private benefits are expected to be more important for the innovator.

Fifth, regarding the **source** of innovation, an innovation can be private driven with the main purpose to reduce costs or to improve processes or products at business and even market level. It can be public driven where the main objective is to reduce social costs that have a negative impact on society such as air pollution, accidents and congestion. Another public benefit or incentive for a public innovator, could also be the reduction of costs related to public processes within administrations or other public services. An innovation can also be both public as private driven. Policy initiatives can also be regarded as a type of innovation that brings change or improvement in a market or in society in general.

Last, the **degree** of the innovation can be systematic, radical, modular or incremental. 'Systematic' refers to multiple independent innovations, whereas 'radical' indicates a breakthrough in the specific field. 'Modular' refers to a significant change in concept within a component. The term 'incremental' corresponds to a small change to existing products/procedures.

Success/failure factors

Within the innovation literature, several authors tried to identify the factors behind an innovation that could lead to success or failure. If a failure factor is present such as social resistance towards the innovation, lack of funding or lack of essential infrastructure, the innovation could fail. Failure occurs when an innovation does not lead to market uptake or if the innovation is blocked during one of its development stages. These failure factors or systemic imperfections (problems) can occur but do not automatically lead to failure, even with failure factors an innovation still can become successful.

A failed innovation can also become successful years later if failure factors are removed or decreased in number. Failure can be in this regard not definitive and rather a postponement of later success. These systemic failures mentioned in the literature as summarized by Norgren & Haucknes, (1999), Smith (2000), Woolthuis et al (2005) and Edquist & Chaminade (2006), as shown by Vanelslander et al. (2014), include:

- Infrastructural failures: A lacking of necessary infrastructure to have a successful implementation of the innovation;
- Transition failures: The inability of firms to adapt to new technological developments;

- Lock-in/path dependency failures: Business does not look at evolutions outside the sector and only follows what is known, instead of adapting to new technological paradigms. Old habits prevail even if newer, more efficient products or services become available;
- Hard-institutional failure: Failures in the framework of regulation and the general legal system prevents or slows down the innovation;
- Soft-institutional failure: The failures in the social institutions such as political culture and social values, i.e. informal institutions;
- Strong network failures: The 'blindness' that evolves if actors have too close links and as a result miss out on new outside developments;
- Weak network failures: The lack of linkages between actors as a result of, which insufficient use is made of complementarities, interactive learning, and creating new ideas. The same phenomenon is referred to as dynamic complementarities' failure (Malerba, 1997);
- Capabilities' failure: Firms, especially small firms, may lack the capabilities to learn rapidly and effectively and hence may be locked into existing technologies/patterns, thus being unable to jump to new technologies/business patterns.

The success and failure factors are identified and presented a table in the similar style as Table 5.

Table 5: Example table of identification of success and failure factors

Success	Failure
Alignment of stakeholders	No infrastructure yet

Source: Vanelslander et al., 2016

Profit, planet, people

Based on a set of (economic, environmental, social) objectives, this research assesses the success per innovation case (Acciaro, 2015; Acciaro & Sys, 2020).

The objectives of the innovations are divided in three categories, which are Profit, Planet and People. These objectives can be cost reduction in case of profit, the reduction of emissions in case of Planet and/or the increase of safety in case of People. Table 6 presents a non-exhaustive list of possible targeted benefits of innovation. For every case the objectives are identified according to the explained distinction between Profit, Planet and People (Vanelslander, Sys, 2020).

Table 6: Non-exhaustive list of possible objectives of innovations

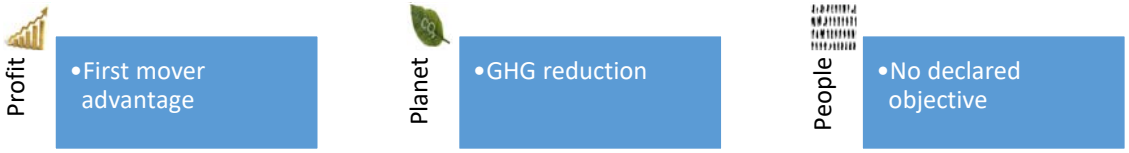
Profit	Planet	People
Minimizing Costs Optimizing operations Gaining market share Obtaining first mover advantage Avoiding depletion of resources Impacting positively on competiveness Growing (marketing) Generating employment (labor becomes capital) Efficient using of resources Differentiating from competitors Increasing scale of operations Improving energy efficiency Integrating with other actors Offering larger & equitable service access Encouraging other investments Facilitating transfer of official documents	Reducing CO_2 emissions Reducing air pollutants emissions Minimizing activity impact on landscape Reducing noise Reducing water/soil pollution Improving waste recycling management Integrating other developments in sustainability Complying with environmental regulation	Offering new employment Retaining human capital Improving relations with local communities Reducing number of accidents Reducing fraud Improving efficiency of security requirements Complying with social and labor regulation Complying with safety regulation

Source: Vanelslander, Sys, 2020

An innovation case is considered successful when it meets its objectives (Vanelslander, et al., 2015). If an innovation case is implemented, the degree of success per subcategory is visualized. However, if an

innovation case is only in the initiation or development stage, the top 3 objectives ranked in terms of importance are displayed. Table 6 presents an example of the most important objectives of the innovative concept. If no objective was declared by the innovator or identified, it is mentioned.

Table 7: Example table summarizing objectives



Stakeholders

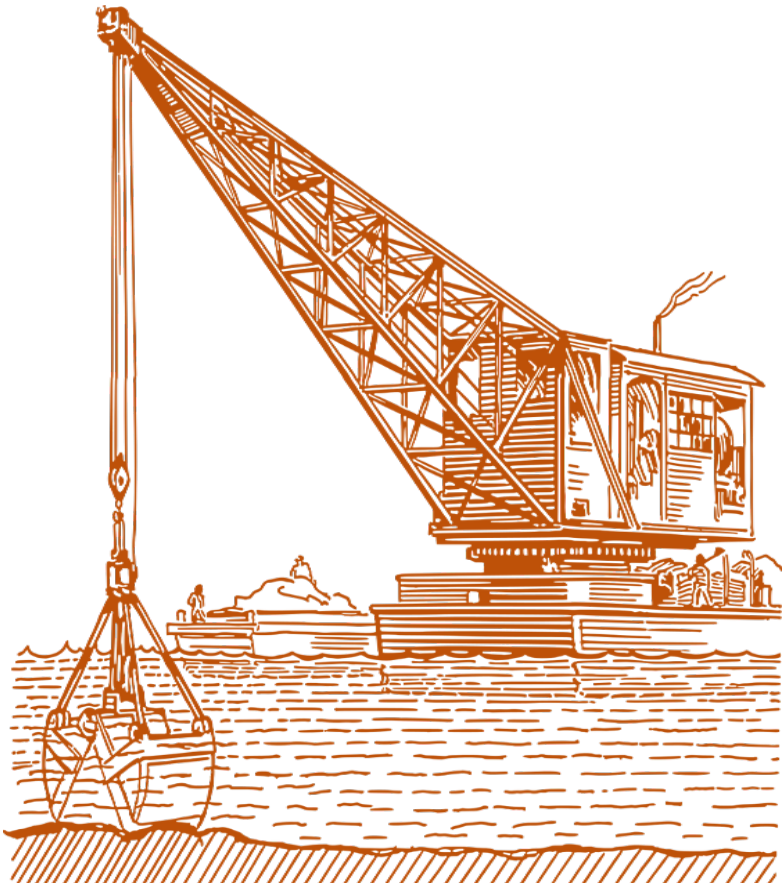
All the stakeholders behind the innovation are identified for each stage of the innovation while following the network approach. However, the name of the stakeholder is not always given (Table 8).

Table 8: Example table summarizing the stages of development of the innovation and stakeholder alignment

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	✓	✓	✓
Engineering company	✓		
Research institute	✓		
Customers		✓	✓

CLUSTER 1: INNOVATION IN DREDGING

The company, Royal IHC (IHC) focuses on the development, design and construction of innovative ships and equipment for the dredging and offshore industries.
The research and development teams of IHC see innovation as the key to success. The continuous development of design and construction activities for the specialist maritime sector is driven by helping sustainable environment, increasing optimum product performance and long-term business partnerships as well as maintaining IHC Merwede's position as a market leader and the technology innovator.
Successively, four innovative dredging technologies are discussed within this cluster.



1. Dynamic Operations in Dredging and Offshore

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Dynamic Operations in Dredging and Offshore, better known by the acronym 'DODO', is a project, which studies vessel dynamics.

This innovation case is studied in the implementation phase. The innovation manufacturing specifics and research findings for this project are kept closed inside the company of the private innovator. The innovation is implemented according to an incremental innovation path. This type of innovation brings technological unite changes.

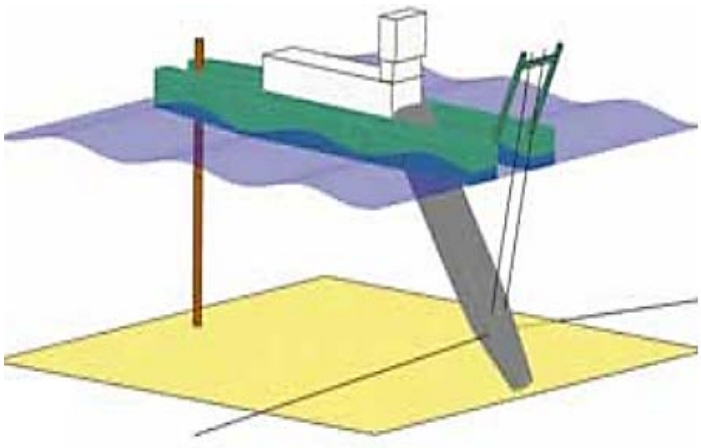
Table 9: Characteristics of DODO

Characteristics of the innovation				
Type	Technology – unit change			
Stage	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The DODO project offers new technological and software products to the operational management. These products solve the following difficulties met during the dredging operations: monitoring of the operational behavior of the vessels, mapping out the problem occurrence by performing predictions of vessel movement, recording the operational window and uptime, protecting the environment by preventing damages and reducing maintenance costs related to the equipment. (IHC, 2010)

Figure 5: Simulation of dynamic forces at sea



Source: IHC Merwede, 2010

The newly developed instruments within the DODO project offer support on the operational side to dredging vessels, which are interacting with the ground or sea floor. The developed software predicts the vessels movement while taking in account the presence of other ships in the vicinity.

The innovative element is the combination of specialized models (e.g. hydro-mechanics, multi-body dynamics and soil mechanics) and commercial software. In contrast to other software tools, DODO can be used for to create reliable and flexible dredging vessels and equipment. Table 10 gives a brief overview of failure and success factors behind this innovation.

Table 10: Success and failure factors of DODO

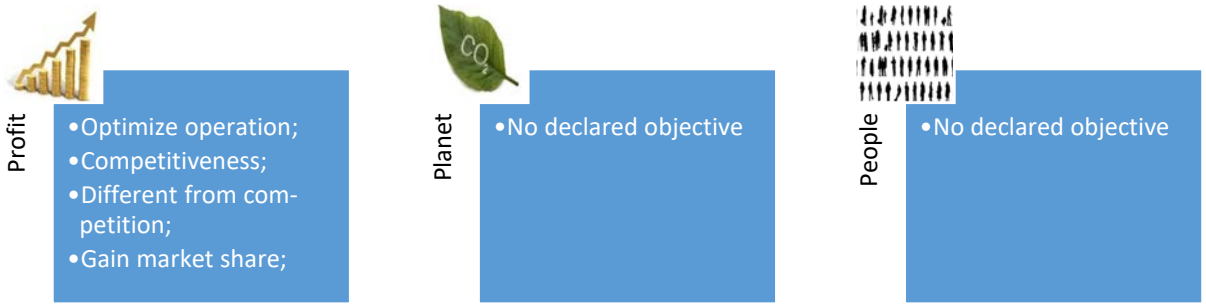
Success	Failure
Positive feedback from clients; Limitation of the uncertainty of operations; Reinforcement of the market share; Risk reduction; Intermediary validation.	Existing model did not match reality and needed to be adapted; A new control software had to be built; Coping with writing errors in the programming; Interface had to be developed; Extra software maintenance had to be provided.

Profit, planet, people

In recent years, due to different economic, social and environmental considerations, the dredging sector constantly strives to offer cost effective, sustainable and clean dredge systems and equipment. According to the European Dredging Association (2012), the dredging fleet is responsible for 0.3% of Maritime CO_2 emissions, while the maritime sector accounts for 2% of the global CO_2 emissions. Reducing the environmental emissions is also a major challenge for the dredging industry.

The International Maritime Organization (IMO) has made 'clean seas and sustainable shipping' one of its top priorities. The rules and regulations, planned by the International Maritime Organization and corresponding governments, are mainly meant to reduce emissions. In response to the emission legislation trends, the shipbuilding sector reacts thus with innovative solutions. The results with regard to the triple bottom line (which refers to the economic, environmental and social performance) for the DODO project are summarized in Figure 6.

Figure 6: Triple bottom approach of DODO



Source: own compilation based on IHC, 2010

Stakeholders

DODO runs by a partnership of MARIN, Xi-Advies and IHC Merwede, whose goal is to investigate soil mechanics and multi-body dynamics. The renowned Dutch maritime research institute MARIN deals with the hydrodynamics. A relatively small engineering company, Xi-Advies, which is known for its graphical interfaces, is managing the data exchange between the models and a sophisticated, user-friendly Human Machine Interface (HMI). The program is supported by the Dutch Ministry of Economic Affairs as part of the Maritime Innovation program (MIP), which is dedicated to make a leap forward in innovation and knowledge management in the Dutch shipbuilding industry. MIP is intended to improve the maritime industry's position in a global economy pressured by low-wage countries, protectionism and subsidized industries (IHC Merwede, 2010).

The development of incorporated IT solution for all type of operations is more and more present in daily activities of the in-house R&D team. The dynamic control of dredging operations is a state of the art development performed by the shipyard itself. This development increases the quality of the equipment that is later provided to its customers. The main actors, which were involved in this innovation process were the shipyard, the research institute, clients and the IT builder of the software interface.

The role of the research institute was to perform analysis regarding the environment and conditions under, which the dredging ships are working. The role of the software builder was to deliver an IT solution that integrates operations, which ought to be performed. The developed software controls dredging equipment through a user interface. This task was the major challenge of this project due to its complexity and low involvement of the IT developers. The clients, the direct beneficiary of the vessels, understood the benefit of the system and became close collaborators of the shipyard.

During the development period, clients allowed access and experiments on board of their ships. The tests, which were performed in real conditions, were a main success for the implementation of the system itself (IHC Merwede, 2014).

Table 11 shows the role of relevant actors during the development stages of this innovation. In all different stadia, the shipyard is considered to be the innovation champion.

Table 11: Development stages of DODO

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	✓	✓	✓
Engineering company	✓		
Research institute	✓		
Customers		✓	✓

2. Wild Dragon

Valentin Carlan, Christa Sys & Thierry Vanelslander

A second innovative case of IHC Merwede is the patented 'Wild Dragon'-concept. The innovation manufacturing specifications and research findings of this initiative are open for other innovators and/or customers. This private innovation is implemented according to an incremental innovation path. The type of the innovation is a technological unite change.

Table 12: Characteristics of the Wild Dragon

Characteristics of the innovation				
Type	Technology – unit change			
Stage	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The 'Wild Dragon'-concept was developed by IHC Merwede as follow-up of a client's request. regarding an unique dredging problem in the Yangtze estuary. The Yangtze River leads to the Port of Shanghai, one of the world's busiest container ports. Some areas of the Yangtze River are known to have very difficult dredging conditions where a number of extraordinary compacted clayish fine-sand banks were signaled. These typical sand banks were generating issues to dredging equipment and could not be removed by standard dredge pumps. This problem was signaled by a customer and owner of an IHC Merwede-built Trailing Suction Hopper Dredger (TSHD).

A newly developed dredge head concept, called 'Wild dragon' offered a solution for this problem. In contrast to other dredge heads, the innovative element of this technical achievement is the fact that it allows dredging in a special type of soil (densely packed sand and other light soil types). This dredge head is equipped with two rows of resistant teeth, supplied with high pressure jet water, which goes through the teeth. The 'Wild Dragon' bites deeper and causes less resistance than other dredge heads. Due to the newly developed equipment, the productivity of the dredging vessels was increased, the fuel consumption was lowered, as well as cost and emissions (IHC, 2004). The initiative was taken after a warranty claim and low performance of the existing equipment. The warranty claim originated from the fact that the initial equipment used in these conditions did not perform according the declared effectiveness.

Figure 7: The Wild Dragon

Source: ICH, 2014

The reason for the low effectiveness of the equipment was the operation in a new environment with soil characteristics that were not expected. For this reason, the shipyard answers to the customer's expectations, earns trust and gains experience in an unsearched field. In the end, this innovation resulted in a 'first mover'-advantage for IHC. Because of this advantage IHC wins over other clients from competing builders of dredging equipment. The competitors reacted and copied the 'Wild Dragon' equipment. The quality of competing products, nonetheless, was inferior. The many failures undermined the confidence of clients in this type of equipment. As a result, the image of the product was also damaged. Lastly, only a few of the Wild Dragons were eventually sold.

Table 13: Success and failure factors of the Wild Dragon

Success	Failure
Client satisfaction; Being able to dredge new type of soil; General applicable for hard packed soils clay rigid sand.	Competition copied the equipment at low quality; Only few items sold.

Profit, planet, people

This innovation case helps the dredging sector to gain more sustainable performance and comply to legislation. Figure 8 summarizes the results from the triple bottom line approach of the Wild Dragon.

Figure 8: Triple bottom approach of the Wild Dragon

Source: own compilation based on IHC, 2014

Stakeholders

The main actors, which are involved in this new development, were:

- The shipyard, which had to redesign a new product by its own resources;
- The customer, Shanghai Dredging Corporation (SDC), which performed the malfunction claim and gave further details. Other contractors, which have blocked the extension of the product.

The following approach was taken to develop the 'Wild dragon': The shipyard representative and the customers (represented by the captain of the dredger) formed a focus group. After an evaluation of the soil, which had to be dredged, a solution was found in the modification of the suction equipment for fine sand. The development process started in early 2003 and by July 2004 the first trials with the new dredging equipment could be set into practice. Finally, the Wild Dragon was tested within a densely compacted sand and clay, and its productivity was 50%-100% higher than the previous standard equipment. Other contractors stopped the development process of other equipment through law suits and claimed the development of similar products. As a consequence, further developments of initial products were stopped and finally only few items were sold. Nonetheless, this collaborative approach was positively experienced by both shipyard and clients (IHC, 2014).

Table 14: Development stages of the Wild Dragon

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	IHC Merwede	IHC Merwede	IHC Merwede
Customer	SDC	SDC	SDC
Research institute	MARIN		

3. Flexible spud wagon

Valentin Carlan, Christa Sys and Thierry Vanelslander

The 'Flexible spud wagon' is an innovation that reached the implementation stage. The manufacturing specifications and research findings are open for compatible technology and further research. The implementation is currently ongoing and is led by a private innovator. This innovation introduces a technological unite change.

Table 15: Characteristics of the Flexible spud Wagon

Characteristics of the innovation				
Type	Technology – unit change			
Stage	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

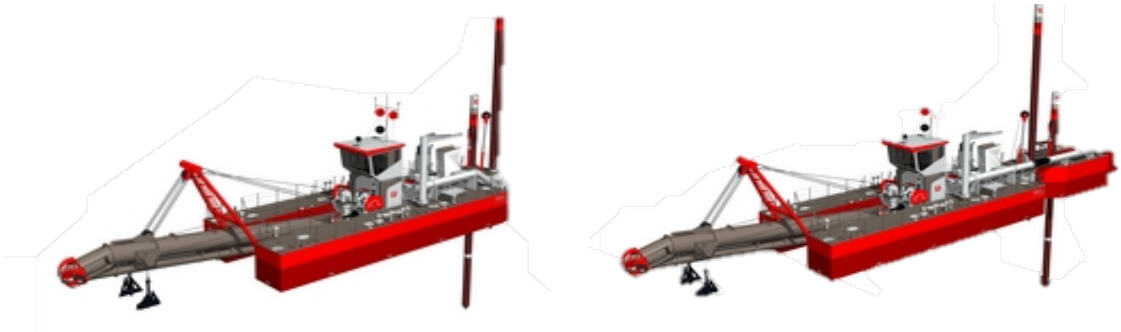
Description

The third dredging innovation tackles a natural problem for the cutter suction dredgers (CSD), viz. strong winds and high waves. A CSD must stop its operation and/or has to shelter in a port under heavy weather conditions, due to the enormous forces on components like spuds, cutter head etc.(IHC, 2008).

Installing a flexible spud carriage system or wagon prevents that the dredger has to stop working. This system moves with the flow of the waves and allows working longer with strong wind or high waves. Hence, this innovation increases the production performance and operational persistence of dredging vessels under increasing harsh sea state conditions.

The innovative aspect of this system is the location of the spud carrier cylinder on the self-propelled cutter suction dredgers (IHC, 2008). The use of hydraulic buffer cylinders for the flexible spud carrier increases its flexibility. The (pressurized gas) cylinders are connected to vessels and they can be set to move at pre-defined forces. This system acts on the spud connected to the sea floor. In this way, the dredger is able to move along with the waves and, in case there is too much force, it prevents the spud to bend or even break.

Figure 9: Dredger with(out) spud wagon



Source: IHC, 2008

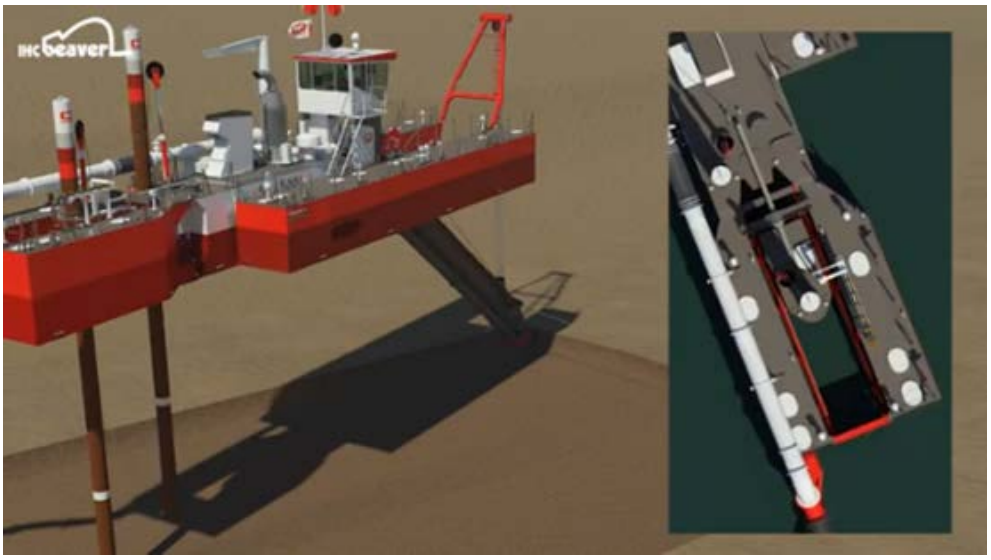
Additionally, the effect of the sea's state on the spud load is visualized. This visualization layer enables the operator to make an informed decision on whether to stop or continue operations. It leads to the increased availability of the equipment (IHC, 2008).

The flexible spud carriage system works as follows:

- In neutral position, both pre-tensioning cylinders put a controllable pre-tension on the wires.
- If the spud force increases, the force in the active wire will also increase, causing a higher pressure at the bottom of the pre-tensioning cylinder. Simultaneously, the tension in the passive wire will decrease.
- Dependent on pressure adjustments, the resultant force in the passive wire will become lower than the corresponding pressure in the minimum tensioning accumulator. The tension plunger can now reach out and maintain in this way a minimum tension in the passive wire and prevent it from falling slack.

If the spud force grows again, the pressure at the bottom of the pre-tensioning cylinder will increase and the load limiter will retract. During the retraction stroke of the load limiter, the wire tension will remain more or less constant. If the spud force increases even more, the pressure release valve activates and the oil flows off (IHC, 2008).

Figure 10: Flexible spud carrier system



Source: IHC, 2011

The success factors behind this innovation are as follows: the client driven approach and the new ability of dredging vessels to predict and anticipate the behavior of wave, and enable interaction between dredging equipment. The failure factors of this innovation are related to the development cost and risks of building this equipment only at the demand of one client. The success and failure factors are shown in Table 16.

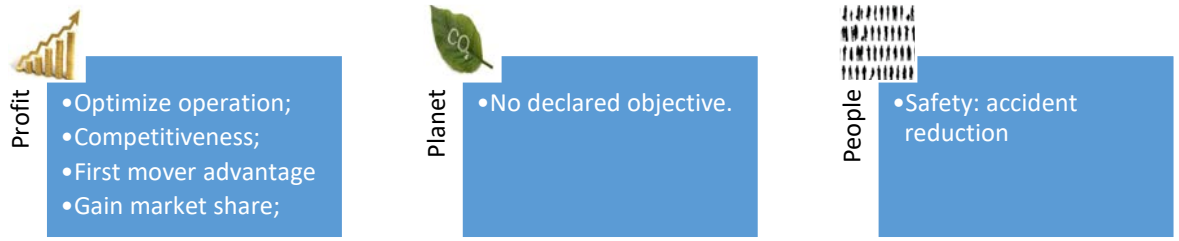
Table 16: Success and failure factors of the FSW

Success	Failure
Client driven; Ability to predict the behavior and interaction in waves (strongly linked with the DODO)	Risk of building full scale prototype is borne by the manufacturer; Risk of reaching technological limits

Profit, planet, people

This innovative project enables existing dredging equipment to be upgraded. Another feature of this innovation is that it replaces human control with more advanced technologies. The latter also includes a reduction in the number of accidents with human fatalities. This accumulated knowledge and experience can be applied to new vessels; and consequently increase the addressable market for this type of equipment. The innovators is ought to have the advantage of being the first mover, which can have a positive impact on the competitiveness of the company (Figure 11).

Figure 11: Triple bottom approach of the 'Flexible spud carrier system'



Source: own compilation based on IHC, 2014

Stakeholders

The flexible spud wagon (FSW) is an initiative taken by the shipyard to provide better service for dredging operations. This technological development benefits from the strong collaboration between the constructor and the final user of the equipment, viz. the client. Both stakeholders had a very high interest in this new equipment and they collaborated on every aspect to successfully deploy this innovation. A research institute was involved during the initiation phase of the innovation.

Table 17: Development stages of the FSW

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	IHC Merwede	IHC Merwede	IHC Merwede
Research institute	MARIN		
Shipping companies	Contractors	Contractors	Contractors
Clients	Port authorities	Port authorities	Port authorities

4. Dredge pumps

Valentin Carlan, Christa Sys and Thierry Vanelslander

High efficient dredge pumps are an important part of the dredging process. The fourth dredging innovation case concerns the production of new dredge pumps series with interchangeable parts. The R&D team continuously improves its knowledge regarding dredge pumps. This innovative dredge pump is in the phase of implementation. The open innovation is led by a private innovator. The type of the innovation is a technological unite change and the degree of the innovation is incremental.

Table 18: Characteristics of dredge pumps

Characteristics of the innovation				
Type	Technology – unit change			
Stage	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

This innovation refers to the development of a series of dredge pumps, which were created to increase the flexibility of dredging equipment that the shipyard offers to its clients. By creating multiple solutions, which can be mounted under the same frame support, the innovative pumps can be easily fitted together with other equipment.

Figure 12: Dredging pump

Source: IHC, 2014

One of the identified success factors that could lead to market uptake of the innovation is the ability to predict pump behavior based on previous experiences, gained knowledge and modelling skills. Furthermore, the fact that it only takes around 6 months to build a new pump even in a special combination, adds to the possible success. Finally, chances of long term abrasion of the material are reduced and performance reliability is increased. Next to these success factors, there are also some

challenges yet to be accomplished such as the interdependence between pumps to guarantee performance and the high wear (tear) due to unpredictable cavitation (Table 19).

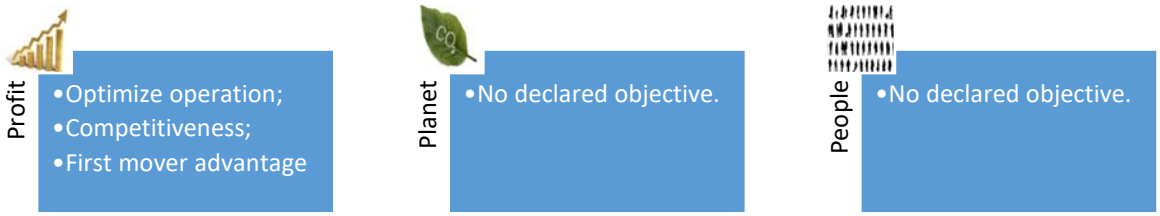
Table 19: Success and failure factors of dredge pumps

Success	Failure
Predict the pump behavior based on knowledge and modelling skills; Flexibility of combinations and lead times (6 months to build a complete new pump); Reliability performance; Reduction of abrasion of the material in the long term.	Dependent performance (if one pump is not working, it ruins the reputation); High wear and tear due to cavitation, which is difficult to predict.

Profit, planet, people

The objective of building the series of different components (that can be fitted within the same physical frame of dredge pumps) is both to reduce the production cost and to increase the flexibility of the shipyard's products. This innovative idea of developing different interchangeable components, which can be assembled together, increases the efficiency of the production process. Through the building of specific type of equipment's, the shipyard managed to differentiate from its competitors. Moreover, besides the cost reduction for the production process, positive effects can be indirectly seen in the improvement of energy efficiency and the reduction of air pollutants.

Figure 13: Triple bottom approach of Dredge pumps



Source: own compilation based on IHC, 2014

Stakeholders

The innovation champion of this series of dredge pumps with interchangeable parts is the R&D team of the shipyard. From initiation until implementation, the collaboration between the different stakeholders, viz. the contractors and the current clients of the company was strong (Table 20).

A lock-in effect was felt by the shipyard due to the specificity of the components. These components could be used only on the developments in of the current series of pumps and could not be incorporated or interchanged with other series. In this sector, the major shipyards faced strong competition from other shipyards and vessels components builders, because of the relative easy-to-copy design of the new dredge pumps.

Table 20: Development stages of the dredge pumps

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	IHC Merwede	IHC Merwede	IHC Merwede
Shipping companies	Dredgers	Dredgers	Dredgers
Clients	Port authorities	Port authorities	Port authorities

CLUSTER 2:ELECTRONIC DATA INTERCHANGE

Electronic data interchange (EDI) changed the way in, which interorganizational transactions are being carried out. EDI is also important to optimise operations within the maritime supply chain. It faces increasing attention because of the many benefits such as reduced costs, better customer service, etc. For some ports and/or port stakeholders, EDI gives a strategic advantage over their competitors. Despite these benefits, some ports and/or (category of) port stakeholders still have problems in implementing EDI. The implementation process takes a lot of time. In this section, different innovation cases of various countries are discussed.

5. Port single window JUP

Rosario Macário and Vasco Reis

The innovation case, Port Single Window JUP (PSW *JUP*) refers to a process innovation or organizational innovation in maritime transport in Portugal. The PSW JUP is a technological, managerial, organizational and cultural innovation that could lead to a change in the market. This open innovation is already implemented by both private and public innovators.

Table 21: Characteristics of PSW JUP

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Stage	Initiation	Development	Implemented	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The need to standardize the proceedings between the national port authorities, was a demand made by the Minister of Economy to the sector. With the collaboration of *AGEPOR* (national association of shipping agents and ship-owners) and the Customs Authority, the Ports drove together towards a solution / protocol where all the agents and stakeholders could have their needs solved according to a harmonize system of data related to port operations.

The PSW *JUP* results on a need to adopt and implement the cargo flow process on these ports and acts as a one-stop-shop, which gathers all the port-operating information required by all intervening agents. The system is common to all ports, However, some specific sections can be tailored to the specificities of each port. Every single port has its own characteristics, which can vary according to geographical and geophysical conditions.

Following paragraphs describe the background and development of the innovation case, together with a list of manufacturers of the innovation and a detailed overview of the technical details. Finally an indicator is described that could measure the impact of the innovation.

➢ *Background and development*

Port operations activity has been for many centuries a very specialize business with many different actors involved together and depending each other for rolling all the actions related to cargo and ships. All those interactions needed documents as a support for confirmation and validation. These actions were performed with considerable paperwork and non-specialized labor that needed to be moved around during port calling and collected documents and authorizations. The outcome was a lengthy and cumbersome process that often took several days to be completed.

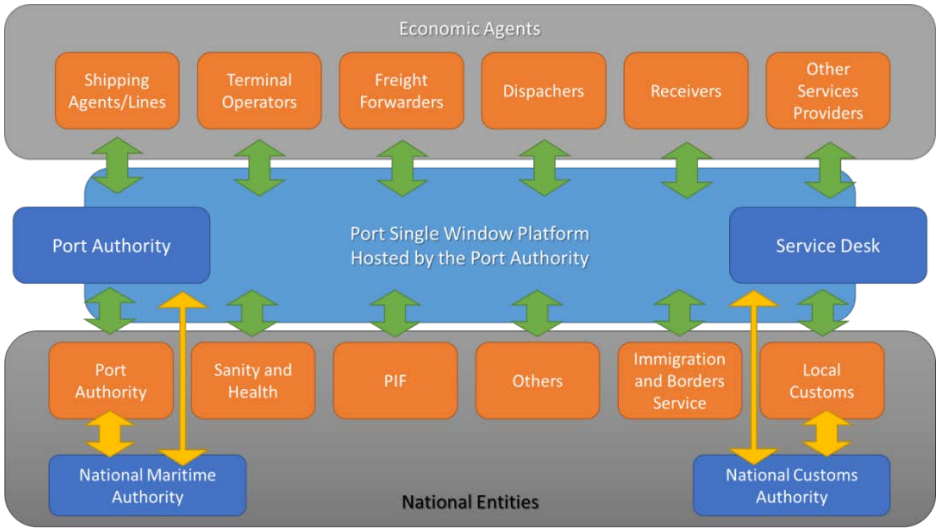
Taking into consideration the recent technological innovations, a decision to introduce an automated processed was taken. In general, the PSW JUP is a system, which provides local level information about each vessel and respective cargo. It is, therefore, a B2A (Business to Administration) technology. In fact, PSW JUP establishes relationships between the public and business domains. It also ensures the connection to other electronic systems such as:

- SDS (*Sistema de Declarações Sumárias* or Fast Form Submission System) of the Customs Authority
- BDNNM (*Base de Dados Nacional de Navegação Marítima or* Sea Navigation National Databases) of IPTM/IMT
- SSN (SafeSeaNet) of EMSA and shipping lines

- PSW JUP's predecessor was GCP (*Gestão Comercial Portuária* or Port Commercial Management) in 1999 and then SCOPe (*Sistema da Comunidade Portuária Electrónica* or Port Community Electronic System) in 2002. In fact, the name PSW JUP refers to the platform that associates PCom (*Plataforma Comum de Gestão Portuária* or Common Platform for Port Management) with SDS, which emerged in 2007. Most recently, in 2012, PSW II, which is a web-based technology platform, allows access from any device such as a laptop, a tablet or a smart phone. The PSW II was no more than an upgrade of the original PSW JUP.
- The PSW JUP is a one-stop shop, which gathers all the port-operating information required by all the intervening agents.

The system (PSW JUP) is common to the Ports of Lisbon, Leixões and Sines and is being gradually implemented in all commercial ports in Portugal, though some specific sections may be adaptable to each ports characteristic such as its layout. Although the information flow is similar in all ports, there is not yet information sharing between them, which, it is considered, may lead to a system improvement in the future. Figure 14 shows the economic agents in interaction with national entities such as the Customs Authority through the PSW JUP.

Figure 14: Economic agents and national entities within PSW JUP



Source: Adapted from Presentation of Leixões Port, Luanda 2013

➢ *List of manufacturers and summary of the technical equipment*

From the point of view of this innovation, it is not an easy task to define or enumerate the list of manufactures, because the platform PSW JUP was preceded by and associated to only a few software applications such as GCP and SCOPe. The PCom was also associated with the SDS. All these systems were developed by the internal departments of each port authority and customs authority and, later on, there was a need to call for system developers and software houses to integrate all these applications into a common one. Among these, we selected two of them - INDRA and J. CANHÃO - for their role and involvement in the recent developments.

Software houses (e.g. MAEIL) were also relevant to develop tailored interface applications to connect the other agents to the PSW JUP. Technical equipment request to run this platform is straightforward, since PSW JUP is a web-based technology that allows access from any device such as a laptop, a tablet or a smartphone.

➢ *Technical details*

PSW JUP acts like an information broker between all agent with responsibilities or interests in port business. It is thus an electronic one-stop-shop, which gathers all the port-operating information required by all intervening agents in port-operating processes. It works as a single point of contact to port where all the economic agents send information on a specific electronic format. It creates a flow

between all the agents and in each phase access is the only requirement. Moreover, it is mandatory to respect all the requirements of safety and confidentiality of the system information.

- *Efficiency indicator*

The measurement of the impacts of PSW JUP in port's performance and economies is a difficult task due to its ubiquity in port's daily activity. One can explain to a certain extent the growth of the Portuguese ports to the implementation of PSW JUP. Nonetheless other factors have also contributed, such as the natural growth of the maritime transport sector and innovations in other port's activities and equipment.

Generally speaking, the implementation of PSW JUP was important for all the agents involved but there were some that took more benefits from it than others. The Port Authority was an agent with major interest in the implementation and that is why the Port Authority started developing this innovation by their own means. Although, agents involved in container transshipment such as the terminals and the shipping lines, got the highest benefits since they took advantage of the platform without any investment and because PSW JUP helps them reduce their operation times and contributes to their growth. Sanitary, Customs, Boarder and Maritime Authorities got their benefit mainly in terms of efficiency.

During the surveys that were made with some of the agents, the general answer was that it is almost impossible to separate the performance of PSW JUP from other indicators or variables that influence their port operations.

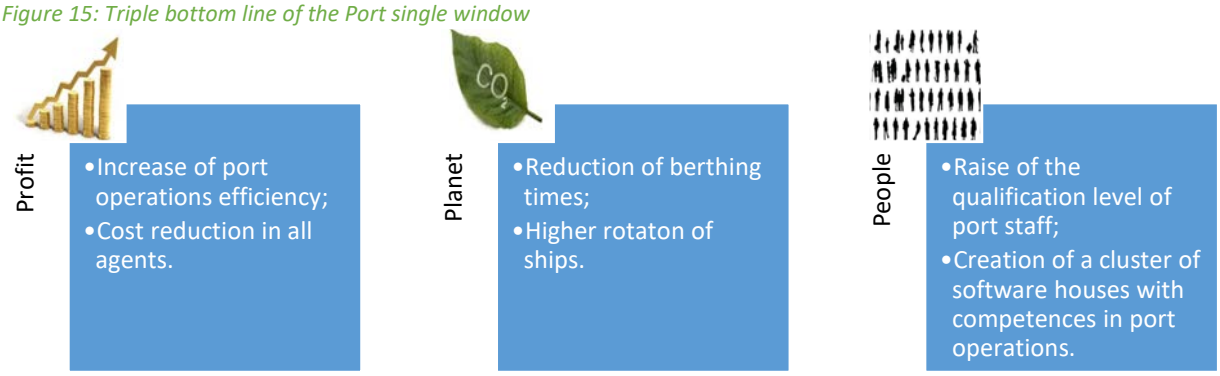
Profit, planet, people

The key objectives of a Port Single Window facility are to, among others: reduce inefficiencies in port business processes; facilitate the smooth flow of electronic data; integrate and achieve compliance with national and EU Directives. These are the three main axes that were taken as a reference point and, which subsequently provide the basis for the identification of the intermediate objectives. In fact, this one-stop administrative shop aims at improving:

- The implementation of standards, techniques and tools for simplifying and expediting information flows between traders and administration;
- The simplification of processes, the data harmonization and the sharing of relevant information across governmental systems;
- Efficiency and effectiveness of control operations;
- Reduction in time and consequently costs for both government and enterprises due to a more efficient use of resources.

Some actors consider that, besides operational and business benefits, the innovation also persecute social and environment objectives as Figure 15 shows.

Figure 15: Triple bottom line of the Port single window



Source: own composition based on interview

Stakeholders

The following paragraphs describe the past and present situation of the innovation and the identified agents that are involved according their level of influence.

- *Brief outline of past/present situation*

In the past, all the information connected with the movement of ships and cargo load in national ports was made with physical documentation that were mandatory to port operations business, after, which it had to be revised and approved manually, obliging the shipping agents to visit all the offices of the agents involved on the port (customs office, foreign and border services, health and veterinary services, etc.). These organizations were obligated to manually check the whole documentation and to give their validation. This manual process was suffering alterations and, in spite of it and with the introduction of computerized systems, some of the processes were allowed to be prepared by electronics means. However, for the revision and later approval, it was still a requirement to present them on paper.

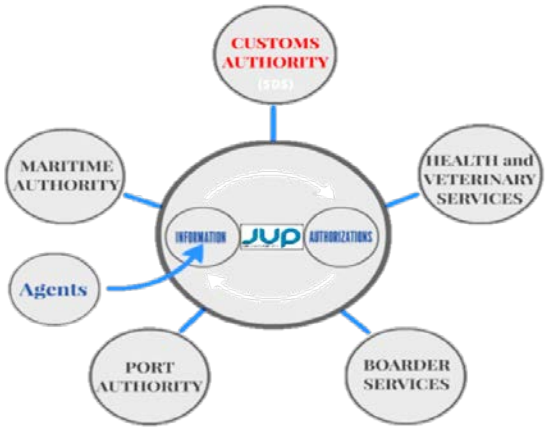
At the present, port authorities are going through a reflection to address an effective implementation of Directive 2010/65/EU, according to, which, member state should deepen the cooperation between the competent authorities, in order to ensure the electronic transmission of data with the objective to a simplification and harmonization of the administrative procedures on the maritime transport. As stated before, it is not simple to make a correct estimative of traffic volume changes influenced by this innovation.

- *Agents involved and level of influence*

It is important to understand that each actor, in each phase, has access to only its required specific information to complete its own tasks, always guaranteeing secrecy of the traded business data. Otherwise, the secret of the trade business of all the involved agents would be lost and the system would not be appealing to any operator. Only the Port's Administration can have access to all the information, but still, the access is segmented through its departments. Through the information processing, several fields have to be updated several times, which are recorded in the system. That means that in any time, the agent is able to see all the previous entries on its notification panel.

Five agents have the biggest share on the control of port-operating processes: the Maritime Authority, the Port Authority, the Foreigner and Boarder Service, the Health and Veterinary Services and the Customs Authority. With the PSW JUP and its electronic format, the shipping agents are now able to provide all the needed information to schedule the customs and sanitary supervision in advance of the vessel's arrival in the port, as well as the visa authorization for the crew members. Figure 16 shows all main actors of the innovation with their relations related to the flow of data on the process.

Figure 16: Main actors in PSW JUP



Source: "Assessing the innovation of Portuguese ports: case study of Leixões, Lisbon and Sines", realized by finalist students on course project of Freight Transport and Logistics, Inst. Sup. Tecnico, Lisbon University, 2014.

Analysis of the innovation periods

The following paragraphs identifies the success and failure factors of the innovation during the different stages of innovation starting from the initiation period, followed by the development period and finally during the implementation period. In every period these factors can alter as failure factors from previous stages can be removed, success factors added and also new challenges could arise.

Initiation period

- **Infrastructure:** The actors involved were the major Port Authorities and the APP (Portuguese Port Association), the Customs Authorities, Terminal Operators and *Agepor*, who all together had a strong relation and commitment to move the process forward. Beside these ones, the Ministry of Economy (Transportation Division) and Statistical Institutes collaborate with the intention of having a solution or protocol between all actors.
- **Hard Institutions:** For the obvious reasons (political and administrative protocols) Port Authorities were as much involved as possible and on the second stage there were the Shipping Agents concerning their necessity to accomplish national and international standards and proceedings. Also, Terminal Operators had a relevant intervention regarding the same requisite as the Shipping Agents, However, with a lower intensity.
- **Soft Institutions:** On this parameter, there was no relevant connections between the actors and the innovation. So, it could be conclusive that there is no application on this innovation case.
- **Weak / Strong Networks:** Throughout this phase there were no important actor outside the process. Nevertheless, Shipping Agents strive on to get a platform to reduce inefficiencies and facilitate the flow of data through an electronic way.
- **Capacities:** Only the three major Ports Authorities had the financial magnitude to fund the project.
- **Lock-in-effects:** In this case of innovation, all actors adapted their systems to the platform.
- **Market Demand:** The three major Ports invested with the objectives of implementing standards, techniques and tools for simplifying and expediting information flows between trades and administration; improve efficiency and effectiveness of control operations and consequently reducing times and costs. On the other hand, this platform could be used as a model to apply on other markets.
- **Competition (innovations):** There is no other product on the market capable to compete.
- **Competition (Port):** This innovation brings the port activity more visibility in terms of efficiency.

Development period

- **Infrastructure:** The actors involved were the major Port Authorities and the APP (Portuguese Port Association), the Customs Authorities, Terminal Operators and Agepor who all together had a strong relation and commitment to move the process forward. The Systems developers and Systems Maintenance firms were participants with strong involvement. Beside these ones the Ministry of Economy (Transportation Division) and Statistical Institutes collaborate with the intention of having a solution or protocol between all actors.
- **Hard Institutions:** For the obvious reasons (political and administrative protocols) Port Authorities were as much involved as possible and on the second stage there were the Shipping Agents concerning their necessity to accomplish national and international standards and proceedings. Also Terminal Operators had a relevant intervention regarding the same requisite as the Shipping Agents, However, with a lower intensity. Maritime Authority and Customs Authority were collaborating strongly on this part to make sure that regulations and legal aspect were protected.
- **Soft Institutions:** On this parameter, there was no relevant connection between the actors and the innovation. So it could be conclusive that there is no application on this innovation case.
- **Weak / Strong Networks:** Throughout this phase there were no important actor outside the process. Nevertheless, Shipping Agents strive on in each phase of the process to get a platform to reduce inefficiencies and facilitate the flow of data through an electronic way.
- **Capacities:** Only the three major Ports Authorities had the financial magnitude to fund the project.
- **Lock-in-effects:** In this case of innovation all actors adapt their systems to the platform.
- **Market Demand:** The three major Ports Authorities invested with the objectives of implementing

standards, techniques and tools for simplifying and expediting information flows between trades and administration; improve efficiency and effectiveness of control operations and consequently reducing times and costs. On the other hand, this platform could be used as a model to apply on other markets. For the same reasons, Systems Developers and Maintenance firms saw this innovation as an opportunity to show their knowledge and expertise to the markets.

- **Competition (innovations**: There is no other product on the market capable to compete.
- **Competition (Port):** This innovation brings the port activity more visibility in terms of efficiency.

Implementation period

- **Infrastructure:** same as initiation phase.
- **Hard Institutions:** same as initiation phase.
- **Soft Institutions:** On this parameter, there was no relevant connections between the actors and the innovation. So it could be conclusive that there is no application on this innovation case.
- **Weak / Strong Networks:** Throughout this phase there were no important actor outside the process. Nevertheless, Shipping Agents strive on in each phase of the process to get a platform to reduce inefficiencies and facilitate the flow of data through an electronic way.
- **Capacities:** Only the three major Ports Authorities had the financial magnitude to fund the project.
- **Lock-in-effects:** In this case of innovation all actors adapt their systems to the platform.
- **Market Demand:** The three major Ports Authorities invested with the objectives of implementing standards, techniques and tools for simplifying and expediting information flows between trades and administration; improve efficiency and effectiveness of control operations and consequently reducing times and costs. On the other hand, this platform could be used as a model to apply on other markets. For the same reasons Systems Developers and Maintenance firms sae this innovation as an opportunity to show their knowledge and expertise to the markets.
- **Competition (innovations):** There is no other product on the market capable to compete.
- **Competition (Port):** This innovation brings the port activity more visibility in terms of efficiency. And for the same reasons, freight forwarders and transport companies became more active actors.

Analysis of success or failure

The results of this implementation in Portuguese ports showed that the system is reliable, safe, simple to use and easy to expand and adapt to other platforms, according to port's requirements. The implementation of PSW brought significant advantages, specially related to the reduction of times, costs and paper documents. For example, before the use of this platform, the flow of ship's information used to be complex and a dispatch implied a lot of calls, change of documents and travels: the movement of the shipping agents through the different involved agents, the collection of authorization documents and its delivery in the ship.

As a complex project with an abundance of details throughout the implementation to the development and implementation, there are always some issues to be solved and standardized; Computer needs are excessively high and, on top of that, the life cycle of product (software) is in average 5 years, which includes the need of upgrading from time to time. Also, the need to have a constant internet connection and the obligation to possess integrated software licenses. Furthermore, all relevant personnel had to be trained to use the software. Despite these failure factors, according to the general opinion of the economic agents, the innovation still seems a significant achievement of an inflexible and close community (Table 22).

Table 22: Success and failure factors of the Port Single Window

Success	Failure
Significant reduction of port processing times (from 2 days to some hours); Capacity to clear cargo with ship en-route; Increased transparency during process improves accountability; Significant reduction of berthing times; Significant increase in the rotation of ships.	Customs kept their own IT system; Absence of monitoring and benchmarking the process; High costs of development and maintenance.

6. Port Community System: PORTNET

Jasmine Lam Siu Lee

The Port Community System PORTNET is a technological, managerial, organizational and cultural innovation that could lead to a change on the market. The closed innovation is already implemented by a private innovator and can be understood as a system change within the market. The next parts explains and analyses the innovation in more detail.

Table 23: Characteristics of the Port Community System PORTNET

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

PORTNET is PSA's flagship product. It is the world's first nation-wide business to business (B2B) port community system. It plays an important role in improving PSA's overall integration and efficiency through providing the port and logistics industries with a single sign-on portal network. By doing so, PSA has been able to connect with shipping lines, freight forwarders, haulers and government agencies, and helping them to better manage information and synchronize their complex operation processes.

PORTNET has over 9,000 users and more than 200 million transactions a year, which depend on the system's unequalled capability to provide the users with real-time, detailed information on all shipping, port and logistics processes critical to their businesses. It is a subsidiary of PSA Corporation Limited. It was formed in 2000 with the objective of helping the port and shipping communities to raise productivity and save costs by making greater use of information technology.

The geographic scope is Singapore. PORTNET is developed in-house by PSA. The system has transformed the industry into a proactive and collaborative port community. Through a unified set of processes, PORTNET creates an environment that optimizes resources by synchronizing diverse business activities and information. PORTNET aims to serve five major communities. These are the hauler and logistics community, the carrier community, the shipper community and government agencies including the Maritime and Port Authority and Immigration and Checkpoint Authority among others.

The Shipper/Consignee transmits electronic Shipping Order via CargoD2D™ to the Carrier. This Shipping Order is simultaneously routed as a Trucking Order to the Hauler through the Hauler Community System. Using the Hauler Fleet Optimization Engine, the optimal truck and driver is selected. The information will also be sent electronically to PORTNET as handling instructions for the port. Various parties can exchange structured trade messages and submit permit (for example outward, inward or transshipment permits) declarations online with TradeNet. Before containers are loaded, shipping lines can ensure the best connecting vessel and allocate vessel space through EZShip® and ALLIES™.

To provide a comprehensive business view, TRAVIS™ is developed as a business reporting and management tool. The system meets organizational and business intelligence needs with reports on throughput, transshipment details, dwell time and vessel performance. PORTNET Mobile further

allows users to access real time information and interface with the community anywhere, anytime through any mobile device. The available real-time inform includes actual container position and container status, which can be automatically transmitted to the customer's mobile device or made available on demand. This allows for more efficient planning of resources and delivers better customer service in cargo handling.

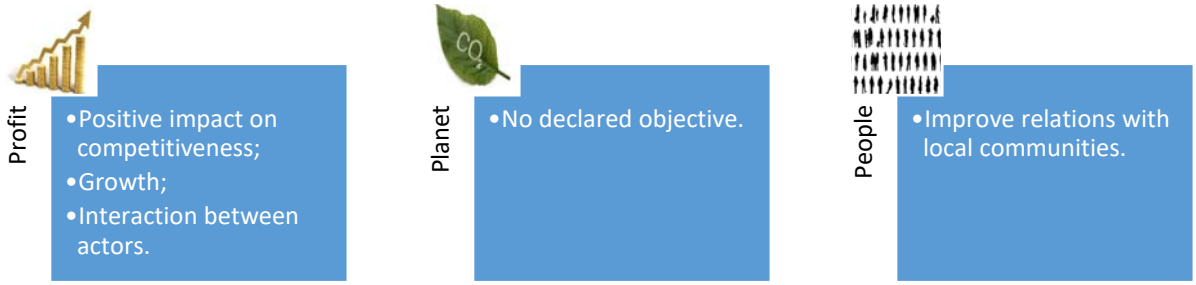
Table 24: Success and failure factors of the Port Community System Portnet

Success	Failure
PSA has empowered the entire port community in Singapore with a comprehensive suite of innovative services to create and add value to their ship operations and cargo handling.	None identified

Profit, planet, people

Through PORTNET, the port community has achieved significant cost savings and operational efficiency of up to 50% via effective use of resources. Overall savings by the industry is estimated to be over S$100 million over a three year period. However, based on Portnet's webpage, the overall objective is improving PSA's overall integration and efficiency through providing the port and logistics industries with a single sign-on portal network.

Figure 17: Triple bottom line – Port community system Portnet



Source: own composition based on interview

Stakeholders

Singapore is the busiest container transshipment port in the world handling in excess of 25 million TEUs in 2013. PSA is the container terminal operator in Singapore. The success is due largely to PSA's capability in providing shippers with the choice of 200 shipping lines with connections to 600 ports in 123 countries. This also means that the scale of operation is enormous. A B2B port community system significantly increases operational efficiency.

The innovation is being implemented. PORTNET is the world's first nation-wide business to business (B2B) port community system and is a key contributor towards Singapore becoming the world's largest transshipment hub. PORTNET's 100% industry participation rate in Singapore further magnifies its reach and impact. PSA is able to quickly adapt to changing industry needs. As such, its constant technological innovation has consistently positioned PSA at the forefront of e-business operations in the shipping and maritime industry. Hence, this allows PSA to be in an exceptional position to develop technology-based operational solutions for its clients in the port and shipping community.

The main actors are the Port Authority (MPA) and the Terminal Operator (PSA). The other actors involved are Shipping Lines, Freight Forwarders/ Shippers, Regulators, Standardization bodies and Research Institutes. The MPA and PSA have stronger linkages. The level of influence is global as many other ports take reference from PSA to develop their B2B port community system. Table 25 shows the innovation actors that are interlinked within the network during the different development stages until the current stage of implementation.

Table 25: Development stages of the Port Community System Portnet

Level	☐ Initiation	☐ Development	☑ Implementation
Port Authority	✓	✓	✓
Terminal Operator 5 PSA°	✓	✓	✓
Shipping lines	✓	✓	✓
Freight forwarders	✓	✓	✓
Regulators	✓	✓	✓
Standardization bodies	✓	✓	✓
Research institute	✓	✓	✓

7. e-Freight System "e-PORT"

Claudio Ferrari, Alessio Tei and Maria Inès Cusano

The electronic-freight system e-PORT is an open innovation, which is during the writing of this analysis in the initiation phase[1]. A public innovator has initiated this innovation that intends to introduce a system change on the market with a technological, managerial, organizational and cultural impact.

Table 26: Characteristics of e-PORT

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Terminal Bruzzone in the Italian port of Genua, is an inland terminal, which provides added value services to the container transport operators and to seaport terminal operators. Recently the terminal has joined the e-PORT system: an electronic system aiming at providing an information platform to all the port stakeholders. The e-PORT project is promoted by a consortium leaded by the Port Authority of Genoa and it is currently in the testing phase. Once completed it will provide information on all the goods moved through the port area and on all freight transport details of the operators working within the boundaries of the Port of Genoa.

e-PORT is an innovative project aiming at systemizing all the information needed by all port users in order to rationalize and optimize the transport flows. Transparency, efficiency and value added services are the main goals of the project.

The project has been developed in order to harmonize the different information systems used by the several private (e.g. terminal operators, shipping liners, forwarders) and public (e.g. port authority, Customs, Sanity Authority) actors involved in the port operations. Once launched the information platform will help to rationalize the in and out flows, to digitize the administrative procedures and to allow new added value services currently not available due to the fragmentation of the information (for instance, the differentiation in booking time services).

The innovation presented is an online system that should make all the information produced within the port related activities available to users. e-PORT is a E-freight system, which is capable to integrate all the information connected to the freight transport passing through the port of Genoa. The platform will be managed by a consortium leaded by the port authority

Currently, the port of Genoa is characterized by a lack of transparency of the information concerning the whole port system and the specific terminal activities. This situation is strongly affecting the procedural times of several procedures and Therefore, also the port productivity (e.g. dwell time is 30% greater than that registered in some North European ports). e-PORT should help to solve this situation.

[1] In respect with the description, the current project (E-port) has been brought forward during the time period 2015-2020 and it is now fully integrated in the Ports of Genoa PCS system and available to all companies operating in the Port of Genoa.

The e-PORT is situated in its testing phase, thus it is only available for some operators who can underline the weaknesses and strengths of the current settings. The system appears as an incremental innovation.

Table 27: Success and failure factors of e-PORT

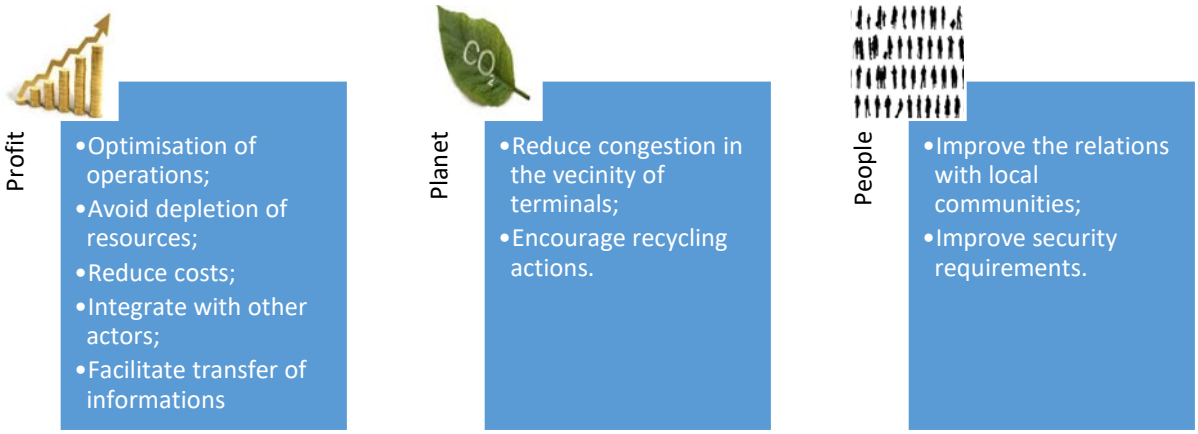
Success	Failure
Improve the shared information among the port-related actors; Open System; Better coordination among port-related companies	Testing phase involves only few companies

Profit, planet, people

e-PORT's goals are related to a better integration of port actors in order to increase the shared information and to optimize transport flows passing through the port of Genoa. Once introduced, several new value added services should be available for the port users. Moreover, indirect innovation goals are related to the reduction of some negative externalities (i.e. less congestion due to a better organization of the flow). e-PORT should also gradually substitute private IT systems, integrating its functions with the systems of the public agency (e.g. customs), which are currently affecting port activities. This integration will allow better management of the information and cargos flows for and to the ports and within the hinterland.

e-PORT will allow port community members to check actual terminal related activities in order to optimize their choices. At the end of the testing phase, the e-platform will be also partially managed directly by the port actor association in order to customize the different companies' needs. During the testing phase, the actors involved (among, which Terminal Bruzzone) already experimented with the possibility to offer new services thanks to real-time information updates.

Figure 18: Triple bottom line – e-PORT



Source: own composition based on interview

Stakeholders

The e-PORT system will create several kinds of connections:

- All port users and stakeholders will be positively affected by the sharing activity, strengthening the links among them. The foreseen increasing relationships may be registered under all the main aspects of the port activity (infrastructure, institutional, competitiveness);
- Being an "open" system – i.e. e-PORT connects the communication systems formerly adopted by each port actor – this avoids lock-in effects and the E-PORT systems should positively push in the reduction of the information gap among the port players.

All the links appear at both local and regional level. These two layers are strictly connected because the impact of e-PORT will be on all the port users and stakeholders, independently on their location.

During the initiation phase relevant innovation actors are identified such as the port authority, the terminal operator, shipping lines, freight forwarders and the regulators.

Table 28: Development stages of e-PORT

Level	☑ Initiation	☐ Development	☐ Implementation
Port authority	✓		
Terminal operator	✓		
Shipping lines	✓		
Freight forwarders	✓		
Regulators	✓		

8. SEAGHA: Port Community System

Valentin Carlan, Christa Sys and Thierry Vanelslander

The System for Electronic Adjusted data exchange in the Port of Antwerp (SEAGHA[2]) was the first collaboration platform that was introduced at the Port of Antwerp in 1986. Based on this initiative, both the private sector and the Antwerp Port Authority (APA) have launched many business-to-business and business-to-government projects, which support, implement and promote the use of electronic messages. Antwerp was the first port in Europe that, already in 1994, made compulsory the electronic declaration of hazardous cargo. The objectives of SEAGHA were: cost and error reduction, protect confidentiality, increase transparency and respect open and international standards.

Table 29: Characteristics of SEAGHA

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

SEAGHA was founded in 1986 by AGHA (the Antwerp private port community), an organization that groups five professional organizations of the Port of Antwerp. Since its inception, SEAGHA 's mission consisted of driving the evolution from paper-based to electronic processes and the communication between the different port stakeholders of the Port of Antwerp Community (Bloomberg, 2007).

A part of the SEAGHA network also provides EDI and EDIFACT software packages for its end users. e.g. SEAGHA-software for the notification of dangerous goods (NDG) to the APA, SEAGHA-software for the customs declarations (SadBel) etc. The SEAGHA platform supported an average of 2.8 million transactions per month (Bloomberg, 2007) and it provided B2B integration solutions for the logistics industry in Belgium. Port stakeholders benefit from a broader offering in terms of functionality, geographical reach and service approach.

Table 30: Success and failure factors of SEAGHA

Success	Failure
Had reached a standardization level within the community	The globalization of both terminal operators and carriers threaten the system

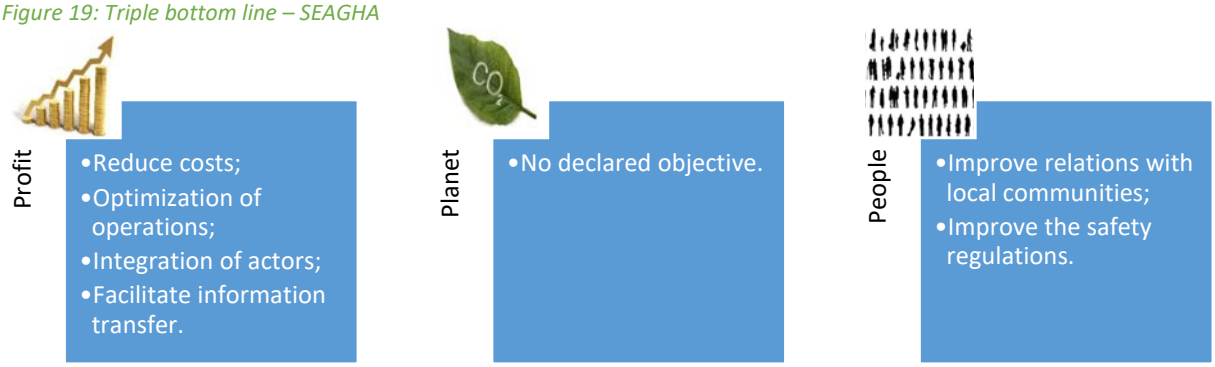
Profit, planet, people

SEAGHA was created on the end of 1986 by representatives of Antwerp private sector in order to set-up an EDI network. The main reasons for this type of implementation were related to cost reduction and optimization of operations for the stakeholders having their activity linked to the Port of Antwerp. The reduction of errors was desired by the port community members, which had benefits on the economic side of their activities. Other indirect benefits generated by SEAGHA are: the enhancement of communication between actors in the Port of Antwerp and their competitiveness increase. Environmental and social objectives were no targets at that moment of the project development. By

[2] SEAGHA stands for "Systeem voor Elektronisch Aangepaste Gegevensuitwisseling in de Haven van Antwerpen"

implementing the SEAGHA platform, it was expected that the relations with the local communities would be improved and that the safety regulations would be better applied.

Figure 19: Triple bottom line – SEAGHA



Source: own composition based on interview

Stakeholders

SEAGHA is the Belgian EDI transport network centerd on the Port of Antwerp and it offers complete EDI connection services with national and international organizations such as:

- The Antwerp Port Authorities, for the exchange of nautical messages and notifications of dangerous cargo.
- The Belgian Customs for the declaration (import, export, transit) of goods and for the exchange of custom manifests.
- Belgian railway for the exchange of the electronic rail consignment note and the follow up of rail wagons on the European railroad network.

The analysis of stakeholders' involvement is made taking a look at PACIT, one single module of SEAGHA. PACIT is a truck pre-announcement system and has the aim to reduce congestion at the terminals' gates. The main actors that created the demand for this innovation were the terminal operators and the trucking companies.

The APA and the software house took the main roles in developing the PACIT platform. This platform could integrate data with regard to all incoming vehicles at each terminal in the port. Throughout all the development periods, the terminal operators feared that they will be too dependent on one system, this reason had become the main argument for, which the initiative was cancelled just before the implementation. Low flexibility and too much dependence had made the terminal operator to stop the collaboration and to not accept the implementation of PACIT.

Table 31: Development stages of SEAGHA

Level	☑ Initiation	☐ Development	☐ Implementation
Terminal operators	✓	✓	✓
Shipping lines	✓	✓	✓
Freight forwarders	✓	✓	✓
Transport operators	✓	✓	✓

9. Antwerp Port Community System

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Antwerp Port Community System (APCS)[3] is an initiative of the APA and Alfaport Antwerp. These two organizations target at capturing and delivering structured information over port operations. The system's main goal is to manage the cargo information avoiding repetitive input of the same data. Therefore, APCS is a central database for stakeholders that have their activity related to the Port of Antwerp and stimulates the development of new ICT-services. Moreover, by adhering to the APCS all participating companies comply with the latest laws and regulations, safety standards and environmental measures.

APCS stimulates companies to use electronic communication in the Antwerp port for their logistics flows, to improve business-processes and to make logistics operations manageable and transparent. Antwerp PCS uses a XTML data format to exchange information.

Table 32: Characteristics of the APCS

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

PCS is a network of systems and solutions for electronic communication in the Port of Antwerp. APCS comprises the exchange of data between business to government (B2G), business to business (B2B) and between government agencies (G2G) (Port of Antwerp, 2014).

The APCS system, with its wide range of modules, is developed through the partnership between the APA and private companies. The electronic communication and message exchange are user-friendly. Equally it guarantees also the security of the information.

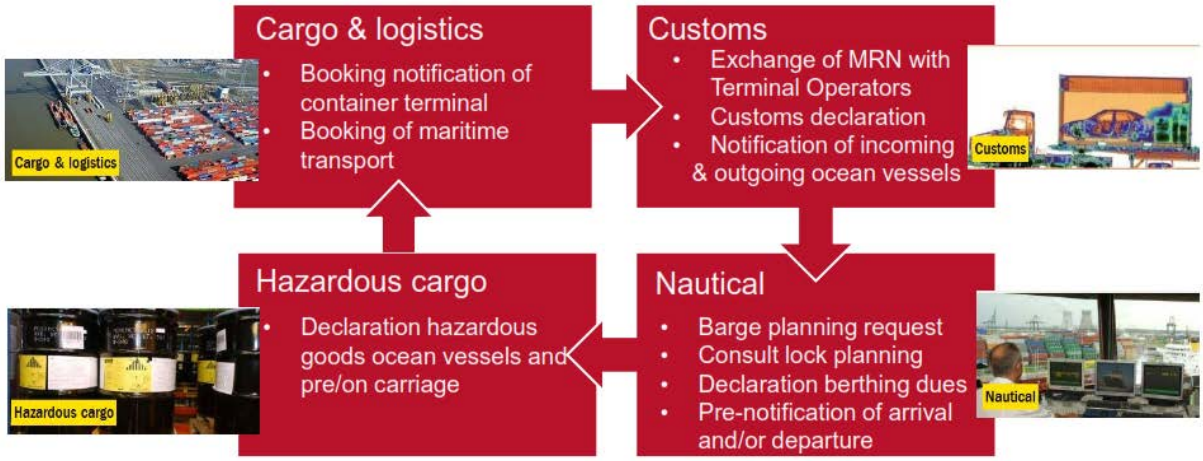
The Port of Antwerp has a long tradition in electronic message exchange. This goes back to the incorporation of SEAGHA in 1986. Both the private sector and the Port Authorities have launched many business-to-business and business-to-government projects, which support, implement and promote the use of electronic messages (the Port of Antwerp was the first port where the electronic declaration of hazardous cargo was compulsory).

The message and information exchange during the administrative and/or operational activities are enabled by APCS. APCS users, which benefit from an unique identification, are able to exchange standardized messages easily with each other via the electronic clearing center, the centralized platform for electronic communication. Via this network, users send and receive electronic messages to their business partners and government-agencies. The clearing center results in lower costs of connection and maintenance per user.

This central platform 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 of documents (scanned or automatically-generated).

[3] The APCS brand name changed in 2018 to C-point, supported by NxtPort (https://www.c-point.be/en)

Figure 20: Antwerp port community system functionalities



Source: (Kerkhof, 2014)

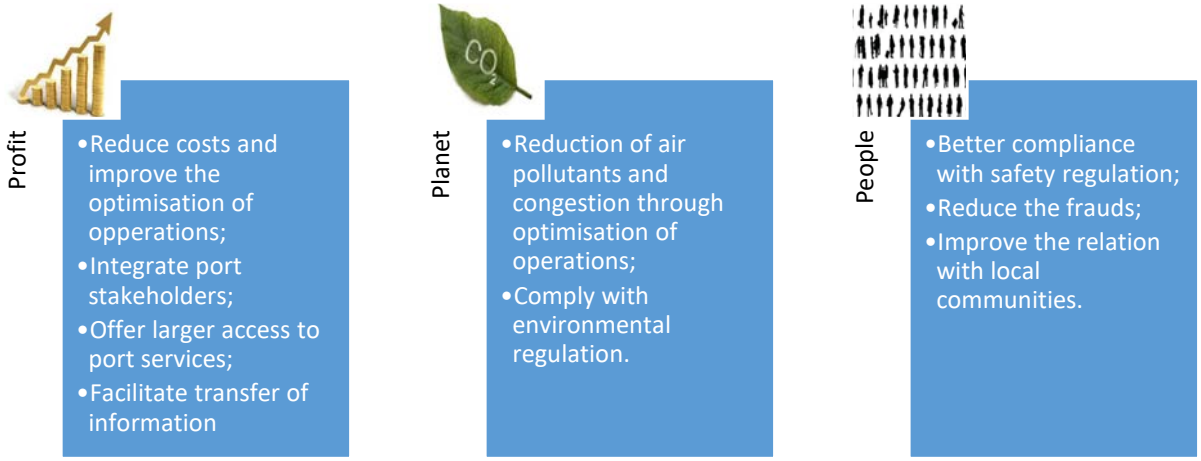
Table 33: Success and failure factors of the APCS

Success	Failure
Makes use of new technologies; receives legislation support; has a wide focus.	Private actions of companies (major players want to develop their own system);

Profit, planet, people

The implementation of the APCS had the objective to reduce the costs of operation in Port of Antwerp. The reduction of these cost becomes possible through the optimization of operations and the integration of data exchange between all the stakeholders in the port. The new platform aims at facilitating a better and fair communication of operational data between the actors. The indirect effects of optimization of operations, are shown in the mitigation of air pollutants and congestion in the port area, both the vessel and road-vehicle traffic.

Figure 21: Triple bottom line – APCS



Source: own composition based on interview

Stakeholders

The stakeholders that took part at developing the APCS are as follows: the APA, Shipping agents, Ship owners, Freight forwarders, Customs and Maritime Police. APCS is steered by the APCS Steering Committee, with representatives from the public and private port community.

The analysis of stakeholders involvement is made from the point of view of the E-desk module. This module has as main scope to enhance the communications between the incoming vessels, the customs and the terminal operator. The goal of this module is to reduce the clearance time. This module is not mandatory as the customs can still be contacted directly, without the use of this intermediate platform. The main driver for the development of the system was the customs legislation, which gave a good starting point to target the digitalization goal. The terminal operators collaborated with the APA and created a common objective for the implementation of this E-desk system.

An important incentive to expand this development within the Port of Antwerp, was also the need to have a similar advancement as in the Port of Rotterdam. Although the fear of competition was not claimed by representatives from the Port of Antwerp, the development of an E-desk was the only option to maintain an equal competitive position between the two ports. Table 34 shows the identified stakeholders during the development stages of this innovation.

Table 34: Development stages of the APCS

Level	☐ Initiation	☐ Development	☑ Implementation
Port authority	APA	APA	APA
Terminal operators	Terminal operators	Terminal operators	Terminal operators
Freight forwarders		Freight forwarders	Freight forwarders
Shipping lines			Shipping lines
Customs	Customs	Customs	Customs
Regulators	European Commission	European Commission	

10. Administration to EDI – Terminal Operator

Valentin Carlan, Christa Sys and Thierry Vanelslander

Electronic Data Interchange (EDI) is a *computer-to-computer* data exchange protocol used to *business documents* in a *standard electronic format*. Enterprises gain major benefits from moving from paper-based data exchanges such as: reduced cost, increased processing speed, reduced errors and improved relationships with business partners. EDI replaces postal services, fax and email.

While email is also an electronic approach, the documents exchanged via email must still be handled manually by data entry operators rather than computers. The involvement of human operators slows down the processing of the documents and it also introduces errors. Instead, EDI documents can flow straight through to the appropriate application on the receiver's computer (e.g., the Order Management System) and processing can begin immediately (GXS, 2004)[4].

Table 35: Characteristics of the EDI - terminal operator

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

EDI services are in use for operations that are deployed when a container enters the Port of Antwerp and needs to be unloaded at the quays of the terminal operators (e.g. DP World Antwerp Gateway). While in the early days a significant paper trail bothered the smooth handling of containers and made it necessary to have a considerable administrative workforce, EDI, and the digital revolution it represents, has made it possible to handle the same amount of business with a team of only 10 people (at the DP World Antwerp Gateway terminal). The workload related to data-entry and faults correction has considerably decreased since the implementation of EDI.

All of this is only possible when customers of the terminal operator agree to join the electronic exchange of data. Successful deals with almost all shipping companies (approximately 30 with different levels of implementation) really gave a boost to the system as a whole and makes a good incentive for barge owners, rail operators and trucking companies to tag along. One could call it a snowball effect. The communicative aspect of EDI is an innovative and welcome bonus, as it is possible for third parties to follow every move a container makes. The next step is to integrate terminal operator's and customer's systems even more to avoid parallel, double and inefficient administrative EDI-work based on different standards. To facilitate this integration, DP World Antwerp has been developing some sort of internet platform, which can be used by the less wealthy companies for whom the full-blown implementation of EDI throughout their businesses is too expensive.

Moreover, the deployment of the Electronic Data Interchange is a necessary step in line with the current capacity expansions made to the terminal. An increase in capacity is expected from 1,800,000 TEU to 4,800,000 TEU. This type of increase is hardly manageable without the digital help that EDI provides.

Table 36: Success and failure factors of the EDI

[4] What is EDI? Accessed on 15.07.2014 from http://www.edibasics.com/contact-gxs/

Success	Failure
Shift from paper to cloud information; less extra workload for administrative staff.	N/A

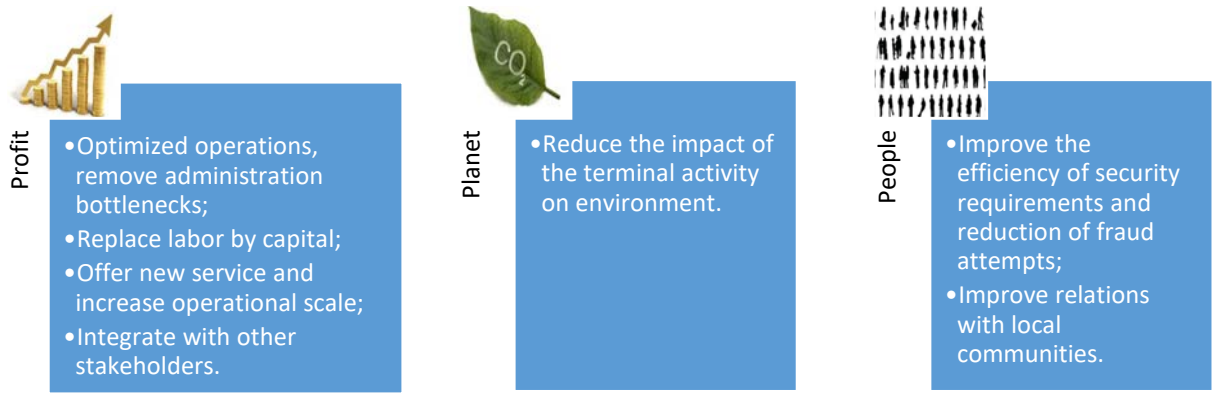
Profit, planet, people

The main objectives of implementing EDI for DP World Antwerp are from an economic perspective. The implementation of the EDI solution provided a standardized system to exchange documents with clients and other partners. This standardization facilitates the transfer of official documents and should result in an optimization of the operations. The exchange of documents takes less time and is more accurate. Furthermore, the use of EDI reduces the workload and it enables the terminal operator to gather more information in one place. This leads to an optimization of the operations and it allows for a more efficient use of the resources. For example, thanks to real time information, cranes can be used more productive and more ships can be loaded/unloaded. Another goal of DP World Antwerp is to reduce the labor cost that otherwise was generated by slow data exchange and errors. The implementation of this system already resulted in a reduction of the employees within the administration department.

DP World Antwerp invested significantly in this project in an attempt to differentiate from the competitors, gain a first mover advantage and attract new customers. Thanks to this standardization, a deeper integration with other actors is possible, which improves the relationships between the different partners. In this way, DP World Antwerp is able to improve their services and ameliorate the relationships with local communities (e.g. customs). The encrypted messages and documents used by EDI, play an important role in improving the security and reducing fraud attempts.

Besides the economic value of the EDI service, DP World Antwerp also attaches importance to the environmental impact. The use of EDI minimizes the use of paper within the company, which results in less CO_2 emissions. This innovation also results in an improvement of the waste management at DP World Antwerp.

Figure 22: Triple bottom line – Administration document replaced by EDI



Source: own composition based on interview

Stakeholders

EDI exists for a longer time and is implemented for several reasons at DP World Antwerp. The main reason is the competitive advantage brought towards main competitors. Costs reduction and quicker handling of paperwork are some of the other reasons. The main struggle of DP World Antwerp is convincing their clients to implement the EDI service. Yet, some of these parties, such as road transport operators and other shipping companies, currently lack from financial capacities to do so.

EDI has to follow specific international standards to work in an efficient and proper way. Yet, this is not always the case. Many shipping companies prefer to use their own standard processes and IT tools,

which is a bottleneck for DP World Antwerp. In that way, the processing of data does not run smoothly and the receiving party is not able to read the data anymore. Another bottleneck for using EDI is cybercrime. Professional hackers could get into the data flows of EDI and would be able to obtain container codes. In that way, containers can skip the customs control. By using AS2, the data flows benefits from a security layer. Security is a high priority, as well for shipping companies, as for terminal operators such as DP World Antwerp (DP World, 2014).

In the next three paragraphs, an analysis is made with regard to the involvement of key stakeholders the initiation, development and implementation periods. A broad cooperation between different clients of DP World Antwerp was necessary to initiate the EDI tools. This means that the right data standards needed to be initiated and defined. During the initiation period, there was a high demand for the use of a IT system that replaces paperwork. The terminal operators and shipping lines were two types of enterprises that were absolutely pushing the innovation forward. The port authority on the other hand, had no involvement in the EDI infrastructure. The software supplier provides the company with an EDI tool, but this is only a standard package. They did not give any advice on how to use it.

Hard institutions (legal institutions) such as the municipal authorities and the standardization bodies have also helped in pushing the innovation forward. The representatives of the firefighters and harbor master require as well that the right information is delivered in real time, so EDI was an option to do so. The soft institutions (political or social institutions), such as the port authority and the other terminal operators, stimulated even more this innovation in its initiation stage. There were no type of stakeholder that slowed down this innovation in its initiation stage. Institutions that were an incentive to the initiation stage are the shipping lines and freight forwarders/shippers.

This innovation was slowed down in its development phase. Shipping lines, especially the smaller ones, and road transport operators were cause of this slow down as they did not have the financial capacities to invest in EDI. Some lock-in effects where generated by this innovation and these effects are linked with the software supplier. The software supplier could not deliver a fully correct working software package. The software is updating every day and corrections need to be made. Moreover, the supplier did not want to help with developing the system further to work in a more efficient way for DP World Antwerp and the customers who are using the EDI. This caused a lock-in effect within DP World Antwerp. During this period, corrections needed to be made every day. This was a significant challenge for the software supplier who has to provide valid software packages that work in a proper way.

In the implementation period, there are no changes made. This can be explained by the innovative characteristic of EDI. In this period, the APA plays a less important role. EDI can be developed and updated every day. Improvements needed to be made in order to sustain the competitive advantage compared to the other terminal operators. In the implementation period, the road transport operators are involved in implementing EDI. The provisional conclusion of this period is that DP World Antwerp has not convinced all their clients to implement the EDI tool, despite the many advantages that are generated by the use of EDI, as explained before. Key to do's remain such as: involving as many clients as possible; and trying to sustain their competitive as of using the EDI technology.

Table 37: Development stages of the EDI

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator	DP World Antwerp	DP World Antwerp	DP World Antwerp
Port authority	APA	APA	APA
Shipping lines	Shipping lines	Shipping lines	Shipping lines
Freight forwarder	Freight forwarder	Freight forwarder	Freight forwarder
Software developer	Software developer	Software developer	Software developer

11. APCS for break-bulk

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Antwerp Port Community System (APCS) for break-bulk was set up by the Royal association of managers of freight flows (Koninklijk Verbond der Beheerders van Goederenstromen, KVBG). This initiative is a technological, managerial, organizational and cultural innovation, which has the potential of bringing a radical change on the market. This open innovation is currently in its initiation phase and is both private and public driven.

Table 38: Characteristics of the APCS Break Bulk of KVBG

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The KVBG-APCS implementation requires the following changes: the implementation of a new IT platform, the restructuring of the information flow and the new management of the newly available information. Based on these changes, this application is expected to introduce a change at the market level. The KVBG-APCS requires the contribution of a group of actors and more specifically the break bulk sector. This stakeholders' desire is to optimize their operational activity. KVBG-APCS is regarded as a private initiative, but it benefits also from the involvement of a public authority (the APA) this combination categorizes the innovation as a joint private-public collaboration.

A terminal operator is the first actor that makes uses of this platform in the break-bulk chain. This break bulk terminal operator digitalizes its data (which is collected from official documents) and offers it in both direction of the logistic chain (upstream and downstream). Normally, it is the first actor of the supply chain, the shipper, who should be the one that digitalizes the information and sends it upstream in the logistic chain together with the cargo. One of the factors that positively influences the KVBG-APCS is the pressure that customs have from the EU to gain better control over the data that flows along the supply chain. This system is a helpful tool that would help customs authorities to comply with the European requirements.

The failure factors of APCS are linked to costs and the lack of flexibility. The flexibility of the system is limited due to the fact that the operative system, which is now being built, starts from a previously used software. Therefore, it introduces technical barriers between the actual business needs and the previously collected data. The system is also rigid due to the advanced notification requirements, as the system does not allow for extra modification to the data. The necessity of shifting the data entry task towards the freight forwarder is also factor that can contribute to the failure of this system.

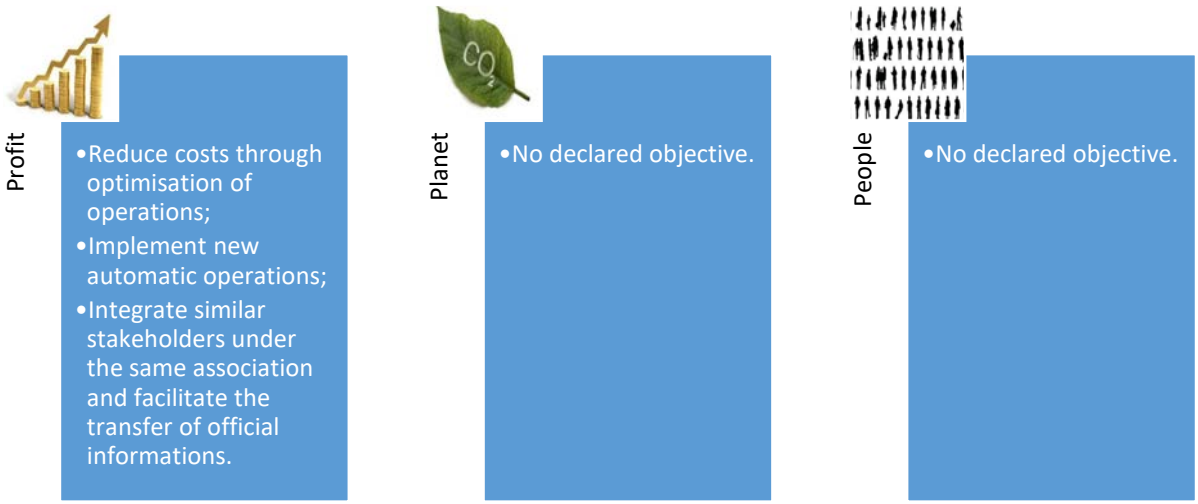
Table 39: Success and failure factors of KVBG-APCS Break Bulk

Success	Failure
Customs driven (pressure to have a better grip on the whole chain)	Cost/flexibility ratio (starting from existing system) is not ideal; Gap between system and business practice; more rigid; need of declaration within 24h in advance; due to cut-off points in administration it reduces the flexibility in the supply chain; it becomes the task of the freight forwarder (capture the order in his system) (mental shift and costs).

Profit, planet, people

The KVBG association had as main objectives the economic performance and not immediately the environmental or social benefits. Getting the first mover advantage was not an objective for the innovation champion in the case of APCS for break-bulk. This initiative already benefit from the involvement and contribution of other stakeholders and competitors. A significant amount of labor will be reduced and information will be process much faster by connecting the two APCS systems. Moreover, these systems will enable the possibility for the association's members to use more efficiently their resources, thanks to pre-sent data regarding the incoming cargo.

Figure 23: Triple bottom line - KVBG - APCS



Source: own composition based on interview

Stakeholders

The KVBG - APCS for break-bulk cluster is a separate IT platform, which came apart from the APCS itself. This platform involves the contribution of all break bulk terminal operators, shipping lines and freight forwarders and benefits from the close supervision of the APA. The latter provides the system-platform and hosts the software. The APA acts in this case as a neutral entity, which sets the ground rules of information security. From a regulatory point of view, APCS for break-bulk implies the involvement of customs. The customs authorities have set the requirements needed to be taken into account for customs procedures.

In the initiation stage the shippers were not involved and their involvement could have positively contributed to fasten up the later development stages for the innovation. From the point of capacities, APCS for break-bulk required the contribution of freight forwarders who need to take over the data-entry process for data related to their cargo. The limited amount of financial capacities for this project and the unwillingness of the break bulk sector to offer extra support for it was experienced as a lock-in for this project.

The KVBG association for break bulk cargo was studied in its initiation stage. The actors, which are involved in the break bulk cluster, are the stevedore companies, the shipping lines, freight forwarder and regulator. The type of stakeholders that are absent from the current network is the shippers. Shippers are considered as an important link within the supply chain that could deliver digital data. Even though the main demand came for this type of innovation came from the shippers (which asked for more harmonized break bulk orders and operations within the port), their lack of involvement determined that this project is on pause.

Table 40: Development stages of the KVBG – APCS Break Bulk

Level	☑ Initiation	☐ Development	☐ Implementation
Port authority			
Terminal operator	Break-bulk cluster		
Shipping lines	Shipping lines		
Freight forwarder	Freight forwarder		
Regulators	Software developer		

12. IT Data Management

Valentin Carlan, Christa Sys and Thierry Vanelslander

The new IT Data Management platform of Metallo is implemented. This is an open innovation with the objective to introduce a technological, managerial, organizational, cultural and market change in a radical way.

Table 41: Characteristics of the IT data management (Metallo)

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The current innovation case is presented from the perspective of a freight forwarder. The IT data management has the aim to exchange data between the business collaborating actors in a smooth and efficient way. The current development first came as an idea of a track and trace tool. This tool evolved further in a more advance development than is currently used as a reliable IT data source. The data, which is now transferred, is been used to reduce delays and enhance cargo transfer. This development came initially as an internal idea. As this idea grew, shipping companies as well as road transport operators became interested into having access to this set of data.

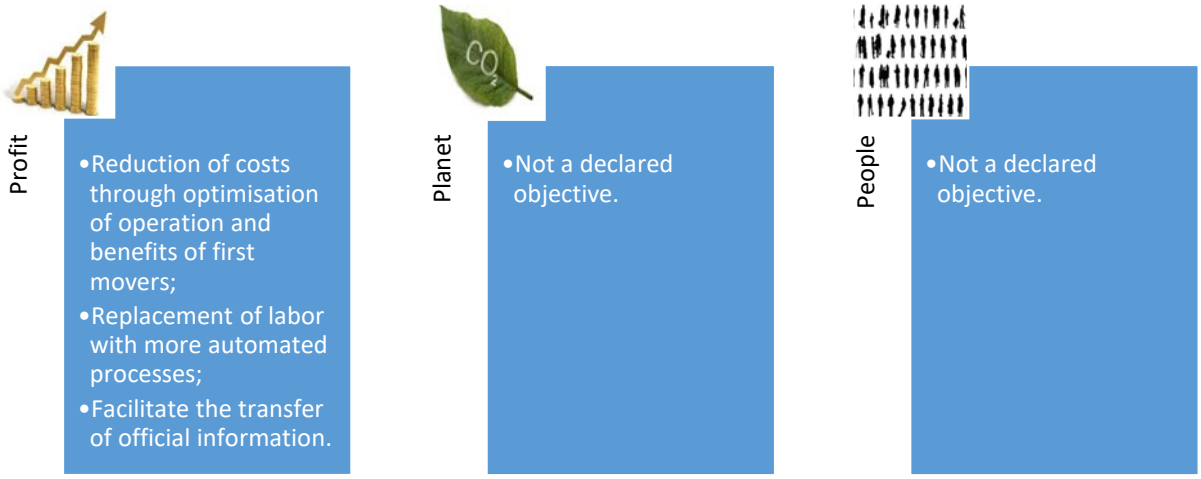
Table 42: Success and failure factors of the IT data management (Metallo)

Success	Failure
It changed from a monitoring tool to an operational tool; was driven by others actors demand.	It needs the involvement of many actors.

Profit, planet, people

The objectives of the IT Data management are mainly related to gain new profit. Operational costs are reduced through optimization of operations. It was also observed that the innovator experiences benefit from having a first mover advantage on the market. Within this innovation, labor is replaced by more automated processes and the transfer of official information is facilitated. Environmental and social objectives were not declared as target by the initiator of this innovation.

Figure 24: Triple bottom line - IT data management (Metallo)



Source: own composition based on interview

Stakeholders

The main problem regarding the IT solution tool for sharing data was answering to the following questions:, which data should be shared? With, which other stakeholders? Who is entitled to give the best data? and Who should convert this data into an electronic format?

The initiative taken by the freight forwarder, involves all the port stakeholders that were interested in having reliable information regarding the cargo and developed a platform that answers to these questions. This IT data exchange platform involves the contribution of stakeholders like: freight forwarders, shipping lines, terminal operators and cargo owners. The cargo owners have a main role in the data exchange process. The cargo owners are the owners of the data as well and have to make the data available. This innovation benefit from the involvement of an atypical category of stakeholders, namely the software and ICT developers that administrates the individual systems of each stakeholder). These stakeholders need to put into practice the agreements of the logistics actors.

Table 43: Development stages of the IT data management

Level	☐ Initiation	☐ Development	☑ Implementation
Freight forwarder	Arcelor Mittal	Arcelor Mittal	Arcelor Mittal
Terminal operator	Terminal operator	Terminal operator	Terminal operator
Shipping lines	Shipping lines	Shipping lines	Shipping lines
Authority		Alfaport	Alfaport
Software house		Software house	Software house

13. e-Transit to Extended Gate Way (MSC)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Electronic instruction to issue customs transit-document or e-Transit (input = electronically, output = paper) is an implemented and incremental innovation at MSC. This innovation is driven by a private entity. Although this development lead to a failure, the gained experience provided knowledge for the further development of the extended-gate initiatives of MSC. The development of the e-Transit initiative at MSC forms the basis for developing several other concepts of extended gateways (see case 14).

Table 44: Characteristics of e-Transit

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The e-Transit innovation fastens up the administration processes by automatically creating the necessary freight transport documents. This application uses preloaded data in existing systems at MSC and avoids yet another intermediary data entry and processing step. Based on information from other electronic documents (e.g. Bill of lading), the transport documents are automatically created. MSC Belgium is now able to send its import consignments from the MSC Home Terminal in the Port of Antwerp to inland terminals in Belgium and the Netherlands without any accompanying documentation. This is possible because the Belgian agency has its own Extended Gate license, permitting much faster throughput of containers.

The MSC home-terminal located in the Delwaide dock, Antwerp was already operating at full capacity in 2010, so no further capacity growth has been possible as of 2011 in this Antwerp location. After that date MSC was forced to divert a large part of its container growth to other ports in the Hamburg-Le Havre range, so that the level of container activity around the Antwerp region remained constant. Nevertheless, other solutions had to be found, so the development of the Extended Gate concept together with an communication platform with the customs were pursued.

The development of an electronic transit system was pushed by other market developments and the need to avoid extra costs (caused by waiting time). The e-Transit innovation has suffered from a combination of short-comes such as: lack of support from other logistics actors and the presence of competition from the APCS. The latter presented a mismatch in technology with the e-Transit platform. Furthermore, there was also a shortage of knowledge for developing such a platform and limited available financial resources. These two aspects lead to the failure of this innovation.

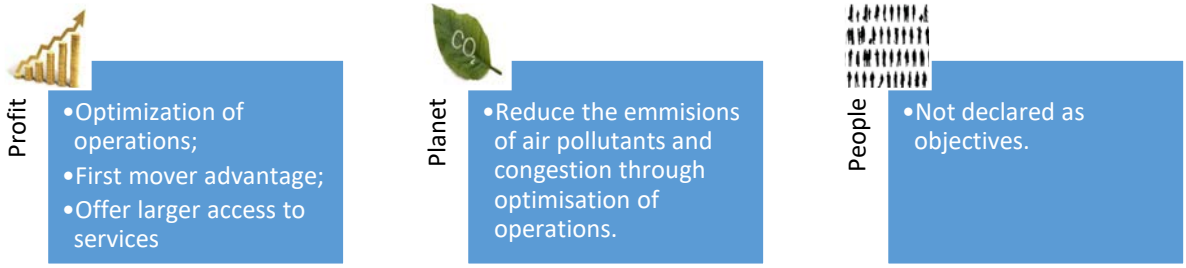
Table 45: Success and failure factors of the e-Transit

Success	Failure
Less administration documents that have to be handled; optimized operations.	Competition of other systems Lack of actor support No knowledge capacity No financial institutions

Profit, planet, people

The main benefits of the e-Transit application are as follows: there was a significant reduction in the time needed for information processing, time spent in error correction and having a final transport document with reliable information.

Figure 25: Triple bottom line approach of e-Transit



Stakeholders

This innovation benefited the involvement of two type of stakeholders: the sea carrier (MSC) and the software developer). Yet, the lack of involvement of any other supply chain actor (like terminal operators, freight forwarders, information service providers, infrastructure managers, shippers or consignee) in none of the development phases of this innovation and the presence of port competition from the APCS, lead to its failure. These other stakeholders could improve the performance of their activity and eliminate bottlenecks, if involved.

Table 46: Development stages of the e-Transit

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator (Innovation champion)	MSC	MSC	MSC
Port Authority			
Software developer	Software developer	Software developer	Software developer
Shipping lines			

14. Extended Gate

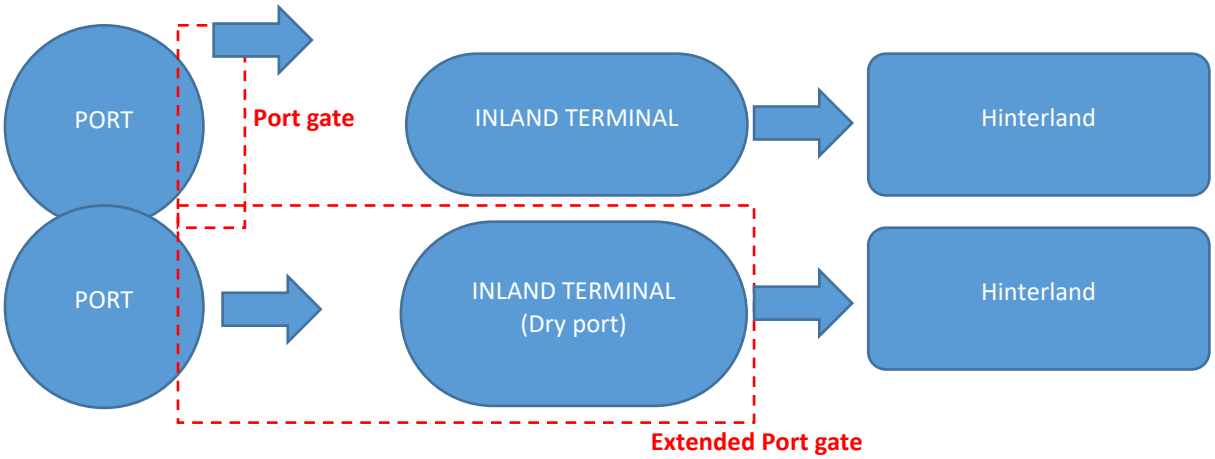
Valentin Carlan, Christa Sys and Thierry Vanelslander

Extended Gate programs or e-Gate (input + output of electronic customs clearance document = electronically) are being applied more often with the aim of reducing the clearance time for freight imports or exports at deep seaports. Freight flows present increasingly challenges for hinterland transport networks, especially in the proximity of large hub areas like deep seaports. The extension of physical capacity for such nodes has reached its limits and improvement measures have to be done at management and organizational level.

The Extended Gate concept represents a more advanced development that increases even more the container operations activity in the port area. By applying the extended-gate concept, the freight custom clearance is being dislocated from the port area to other container terminals (hence, paperless transport to the inland depot). The most important objective that the Extended Gate concept addresses is the reduction of road congestion inside and around the ports areas. It also facilitates the exploitation of economics of density, reduces the environmental impacts of transport activity and increases the use of capacity for deep sea shipping as a complementary mean of transport.

The issues that are usually associated with the Extended Gate concept are terminal location decision, coordination of freight movements, connection with additional means of transport, information flow design and administrative procedures.

Figure 26: Extended Gate concept



Source adaptation after Acciaro and Mckinnon, 2013

The *Extended Gate* concept represents a natural consequences of the implementation of the Dry Port model. This concept permits integrated network developments and direct operational control in the transport network between the Seaport and the Inland terminal (dry-port). A dry-port is an inland intermodal terminal directly connected to seaport(s) with high capacity transport mean(s), where customers can leave/pick up their standardized units as if they were directly at a seaport (Roso, Woxenius et al. 2009). Therefore, the purpose of the dry-port is to act as an extension of the seaport, both for export or for import traffic, while the Extended Gate is a necessary developed concept that aims to overcome the administration limitations.

The economic benefit of both are pointed as developments of hinterland networks as a new dimension of competition between seaports (Notteboom and Rodrigue, 2005). The central idea is to extend the delivery point from the perspective of the shipper/receiver from seaport terminal along a corridor to an inland multimodal terminal and, possibly, the final destination such as a distribution center of a logistics service provider or shipping. Practically the gate of the sea terminal is being placed at the inland terminal. This delivery at the inland terminal, or even at the distribution center, is offered as an additional service to the customer (Veenstra and Zuidwijk, 2016), which offers extra advantages.

One of the crucial conditions for the development of efficient hinterland networks in Europe is the availability of correct information on goods that are arriving from overseas. This includes information on nature of the goods, quality, health and origin certificates, safety and other handling instructions, destination, shipper, receiver, intended mode of hinterland transport, and required arrival date and time. Currently, such information is not regularly available to container terminals, or hinterland transport operators, until the very last moment. Information is usually in the hands of freight forwarders and of the owners of the goods (Veenstra and Zuidwijk, 2016).

The Extended Gate concept has to rely also on the connecting modes of transport that link together the seaport with the inland terminal. The advantages and disadvantages are underlined by Visser et al. (2007). The discussion regarding the Extended Gate features pointed out the following items:

- Road transportation is quite flexible, but is not very reliable due to congestion on the roads to and from the ports and is not suitable for the Extended Gate concept;
- A situation with dedicated lanes for trucks, multi-trailers or rail lines to/from the additional terminals, can be an interesting option.
- Transportation by barge and rail is based on providing large capacity services and is in line with Extended Gate concept needs;
- Large capacity services focus on low frequent pickup and delivery of containers in large batches and at low speeds are not the most suitable characteristics for an Extended Gateway concept. Rail and barge are limited by their speed. At short distances and smaller batches, transport services by barge and by rail can be interesting too. Smaller batches and short distances lead to shorter turnaround times, which saves time and costs.

Existing infrastructure needs administration procedure that should not limit its capabilities. Extended Gate represents an extension of dry-port concept that facilitates the use of external port infrastructure and transport modes when the capacity of Seaports are meet.

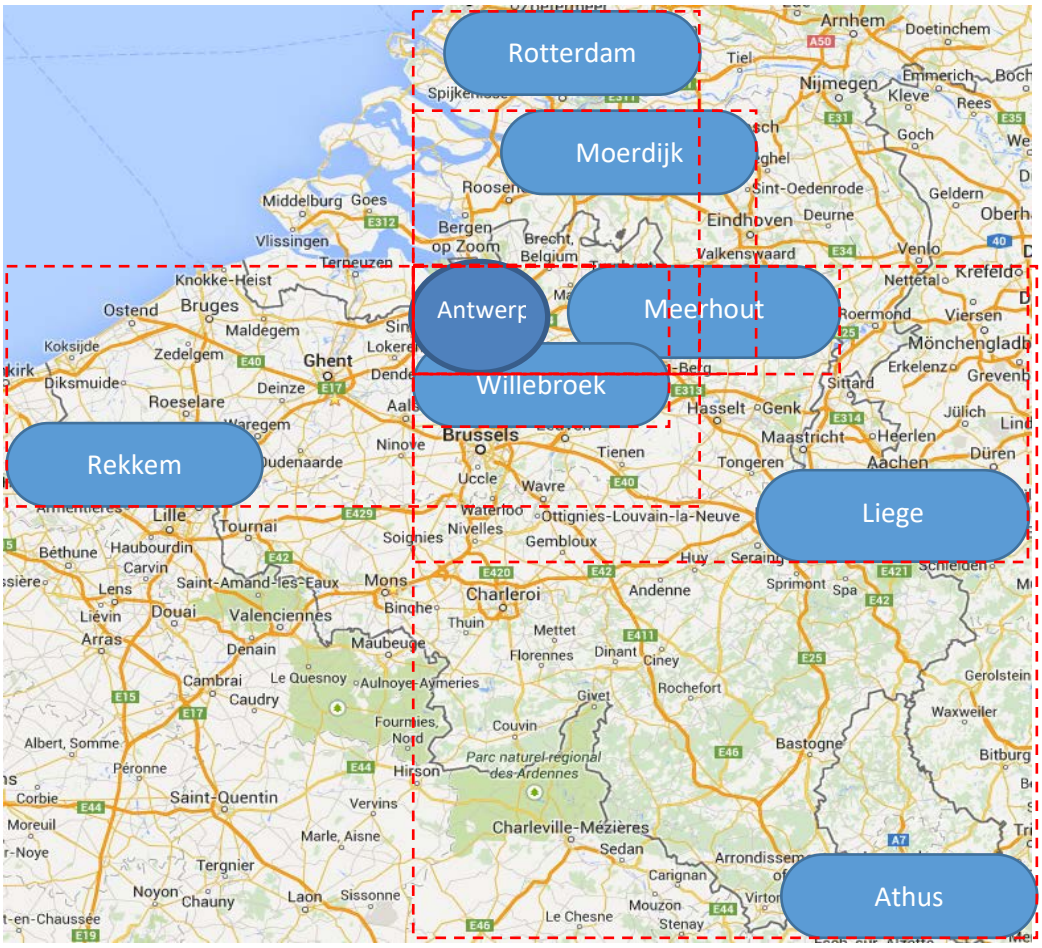
Description

The use of this Extended Gate concept started with a temporary permit to import goods and transfer them to the inland terminal of Meerhout along the Albert Canal. Since then other terminals in Liege, Athus, Willebroek, Rekkem, Moerdijk and even Rotterdam have received their Extended Gate statute and have started to play an important role as Extended Gateways for MSC.

Development of the Extended Gate system has the objective to fasten up the container throughput process for terminals, which have reached already their capacity limit. In most cases ports infrastructure is limited and further extensions are not possible anymore, the only viable solution to continue the growth of container throughput is by using the extra capacities provided by the proximity infrastructure and apply the concept of dry ports. Nevertheless, together with physical capacities, administration process have to be update and customs clearance need also to be fasten up.

The innovation process of implementing the Extended Gate concept is still under development. Nevertheless, there can be three versions of these concepts distinguished, which have particular features, hurdles and learning processes. The involvement of the port stakeholders in the Extended Gate development process has not been fluent. Actors like MSC personnel and APA representative pushed the innovation forward, but customs officers had to be convinced of the success of the Extended Gate concept. Moreover, unexperienced software developers slowed down the progress process. In this context, the innovation champion had to eliminate several lock-in situations.

Figure 27: Extended Gate terminals of MSC Belgium



Source: own composition based on interview

Next to the Extended Gate statute of the mentioned terminals, another experiment took place in June 2014. The subject of the new situation was the fast transshipment of reefer containers and another application of the Extended Gate concept had to be implemented. Immediately on arrival, containers with bananas are loaded directly from the sea-ship into barges at the MSC Home Terminal and rapidly transferred to the Belgian New Fruit Wharf refrigerated warehouse in the Leopold dock. This warehouse is treated by the Customs Service as an Extended Gateway of the terminal. After this success, the container carriers have seen their market share significantly increased for the expense of the traditional reefer fleet.

The Extended Gate license allows much faster container operations, due to the fact that custom clearance and several transit documents are no longer necessary while transporting goods from Antwerp port to certain inland terminals. As an example, a container that arrives in Antwerp and has Rotterdam as its final destination, had to wait in our MSC Home Terminal for 2.6 days on average. This was reduced in 2014 to 1.3 days (Port of Antwerp, 2014).

The new Extended Gate concept allows containers to immediately be unloaded from the ships and transferred to the inland terminal where they will be custom cleared. Besides the time savings MSC thus achieves, it also takes the pressure off at the terminal in Antwerp, where capacity can now be used more efficiently (De Vos, 2013).

The shipping company sends barge consignments from Antwerp to Rotterdam on a daily basis, and these can now reach their destination more quickly as Rotterdam already has the necessary software for the implementation of the Extended Gate concept and no additional transit document were necessary.

Recently, there has been also a "breakthrough" in talks with the German customs, so that the Neuss terminal is shaping up to become an MSC "Extended Gateway." Once it is, all the containers arriving at the MSC Home Terminal bound for this destination in Germany will no longer have to go into the stack but can be loaded in the trains and shipped immediately" (Port of Antwerp, 2014).

Table 47: Success and failure factors of the Extended – Gate

Success	Failure
Change from paper to cloud. Offer better access to information. Used for imports. Software developer was integrated in-house. Possible extension to export activity	Reluctance form customs; change opinion and delayed the process. Few knowledge from software developer/ It needs to have contribution of many actors

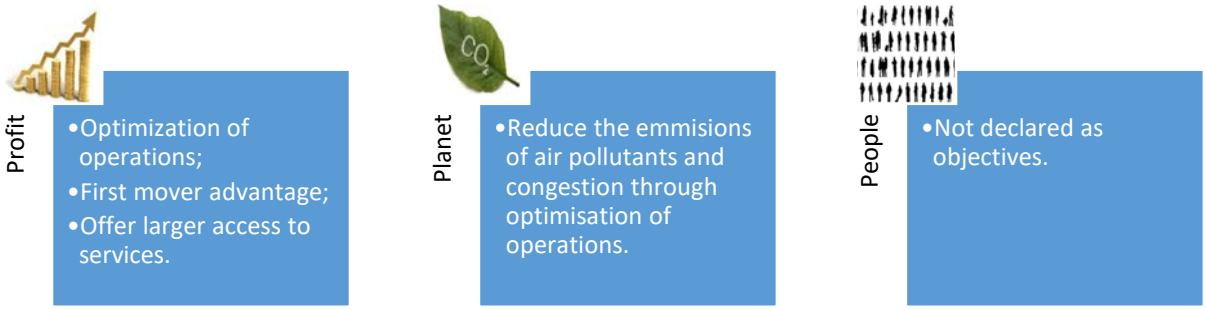
Profit, planet, people

The objectives of implementing the Extended Gate concept for MSC are mainly orientated on economics. Due to the fact that the capacity of the MSC Home Terminal has already reached its limit, the only possibility left to handle more cargo is to improve the administration and complementary services. The importance and the success of these objectives where similar, meaning that the company achieved in reaching its objectives. These objectives were the direct consequence of the implementation of the Extended Gate concept. The environmental set of objectives stands out from the perspective of the reduction of CO_2, air pollutants and congestion, which where the most important goals for the company. However, the social benefits are not immediate goals of the Extended Gate implementation.

By implementing the Extended Gate concept, the company will benefit of efficient use of resources by improving the dwell time. The gain of market share had a medium importance level and the success in achieving it was lower than expected. The impact on the company's competitiveness as well as differentiation for competitors, were very important to be achieved by this innovation and the success was even higher. The development of the first Extended Gate version enabled the consideration of incorporating new features and Therefore, to perform other investments that could enable these features.

Other objectives, which were important and were achieved by the extension of the Extended Gate concept, were to retain the current customers by providing new improved services and paperless efficiency by the use of online IT solutions. An important and successful objective was to gain trust from both customs offices and clients. This could be done on one side by offering more transparency for the import cargo and on another side by providing more reliable faster services.

Figure 28: Triple bottom line approach of Extended Gate



Source: own composition based on interview

Stakeholders

The Extended Gate concept for MSC started to be developed in 2012. Initially, this concept was designed to be used for import containers custom clearance, which represented the first two stages

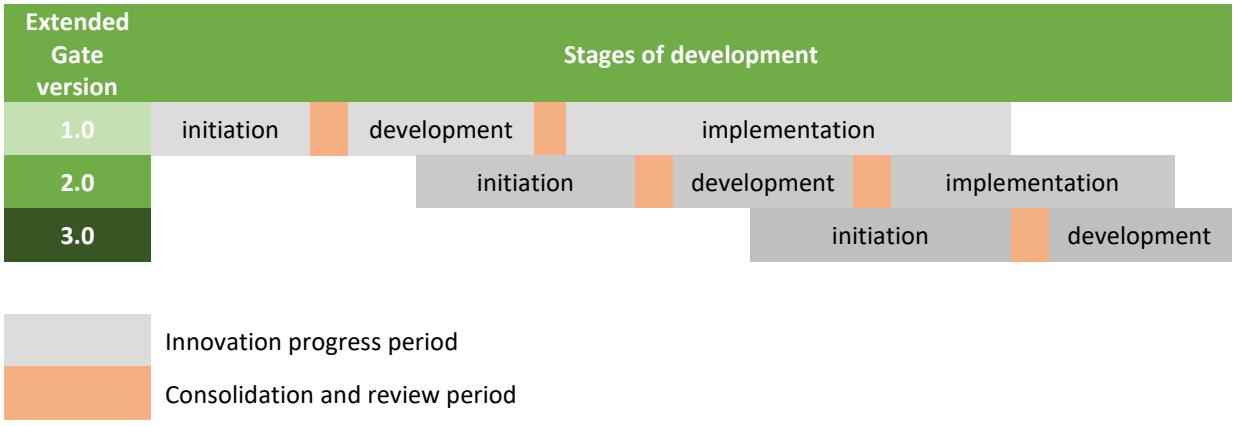
of this development. A third stage of the Extended Gate concept represents a new version of the concept, which is addressed to export containers. The custom clearance process for the two types of flows are different. Although the learning process could be transferred from the first developments to the last one, a new application concept had to be build up for the custom clearance of export containers.

The main two issues, which had to be overcome for the implementation of the Extended Gate concept, were to develop an IT platform, which allows the transfer of containers between terminals without transit documents or custom clearance and in the same time clear the official framework where within these container transfer will have to take place.

The Extended Gate is still under development and it consists of three stages. The first stage represents a fist version of the concept and it is orientated towards only certain clients. This stage is already implemented and was more a learning process for MSC. The second stage of the Extended Gate concept is a second version of the same application and is now in the development period. The more advanced version is based on a cloud application, is still orientated to MSC clients, but extra entities can be added much faster. Furthermore, it has added more customs alignments and has an open visibility for customers and customs offices. The version three of the Extended Gate system is not anymore an incremental change of previous developments, but represents a radical development dedicated to export containers. The version three is only in the initiation stage but it benefits of all the previous learning processes.

The evolution process of the three versions is complex and while further steps were done, the need remained to have some periods of feedback and knowledge consolidation. Each version is being described from the perspective of the three evolution stages: initiation, development and implementation. The initiation process for each following version overlapped with the development stage of the previous version. This overlap needed to take place due to new ideas, which were brought up within the previous versions, but these new features could not be initiated anymore without delaying the whole initial process. Table 48 presents schematically the evolution process for the three versions of the MSC Extended Gate.

Table 48: Development stages of the Extended Gate



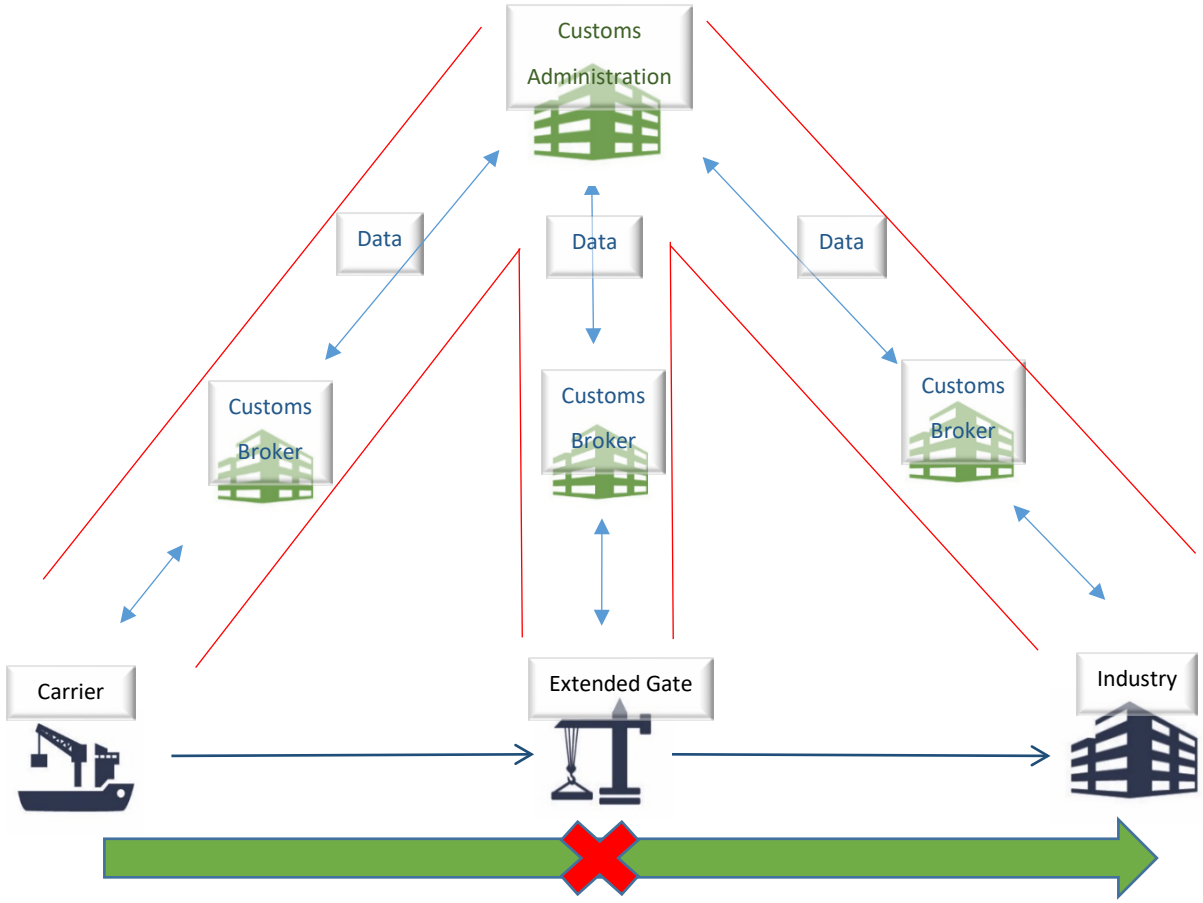
The innovation champion in this case took the decision to keep the objectives of the initial version and integrate the new ideas separately in a new version. For this reason, features and clear objectives had to be defined for each version for the development process to continue. Moreover, after each stage, a period of knowledge consolidation and reviews achievements were very beneficial for the development of the Extended Gate. The success and failure factors for each of the Extended Gate versions are different. For the Extended Gate version 1.0 the success was driven by the company's insights over their own processes and that the company could develop the application with their own knowledge.

The failure factors were the technological hurdles and the lack of experience of partners. For the Extended Gate 2.0 previous version's, failure factors became reasons of success. The technology was already available and building new extensions or other functionality for the existing application was not a problem anymore. Another success factor was represented by the benefits of using the cloud environment. This new operational technique provided much more flexibility for both developers and users.

A failure factor was the change of legislation during the development process. Nevertheless, this change did not lead to lock-in effects for the system's functionality. The only failure factors for the Extended Gate 3.0, which represented the adaptation of the previous achievements from import administration practices to export containers, were the difficulties in changing the customs policies.

The development of the Extended Gate concept was realized by the common efforts put together by actors such as MSC, which is the innovation champion, customs offices, which is the regulator and the IT company, which can be considered as the capacity builder stakeholder. These actors' involvement and their adaptation of own capacities sustained the innovation progress. The evolution of the Extended Gate concept stages will be described from the perspective of each involved actor in the following sections.

Figure 29: 1.0/2.0 Standard import flow



Source: MSC, 2015

Extended Gate 1.0

The initiation period of the Extended Gate 1.0 focused on gathering technical documentation and on building the regulatory framework. The actors involved in this stage were MSC and the Customs offices at the level of the Antwerp region. There was a strong network between the two actors, even though on infrastructure and legal aspect the customs offices were neutral. The innovation champion made

an application to obtain the Extended Gate agreement and several efforts had to be done in order to clarify the envisaged working framework for this concept. The competition from other ports regarding the new concept was present, the port sectors itself, the customs authorities and from the other shipping companies as well.

In the development period, a new actor was involved and took the role of capacity builder stake holder. Although, the software builder had a strong relation with the Innovation champion, the main disadvantage was the lack of knowledge and experience in the maritime sector. On the infrastructure level the relationship with the customs was fruitful, even though they were not fully acquainted with the system. They provided sufficient feedback and guidelines for the regulatory framework of the new application. The innovation champion had to provide more financial support and time capacities in order to keep the development process ongoing, due to the lack of experience of the software provider. As a consequence, the innovation champion found itself in a lock-in effect because of the relatively high investments that already had been made.

In the implementation period, the relation with the previously involved actors remains the same. The headquarters of the customs offices were involved and brought a new hurdle in the innovation process. Due to the fact that on local level (Antwerp region) the customs offices were acquainted with the change that MSC wanted to bring in for the import of containers, the relations on local level were strong. Nevertheless, on federal level the entire process of explaining the new proposal and exposures about the benefits of the concept had to be retaken. Moreover, an external former customs officer had to be recruited in the process and smoothened up the process. Because of the misunderstanding created between the two level of customs offices, a conflict started and escalated to high political level. For this reason, the port authority and society represented by the press, had to step in to encourage the implementation process.

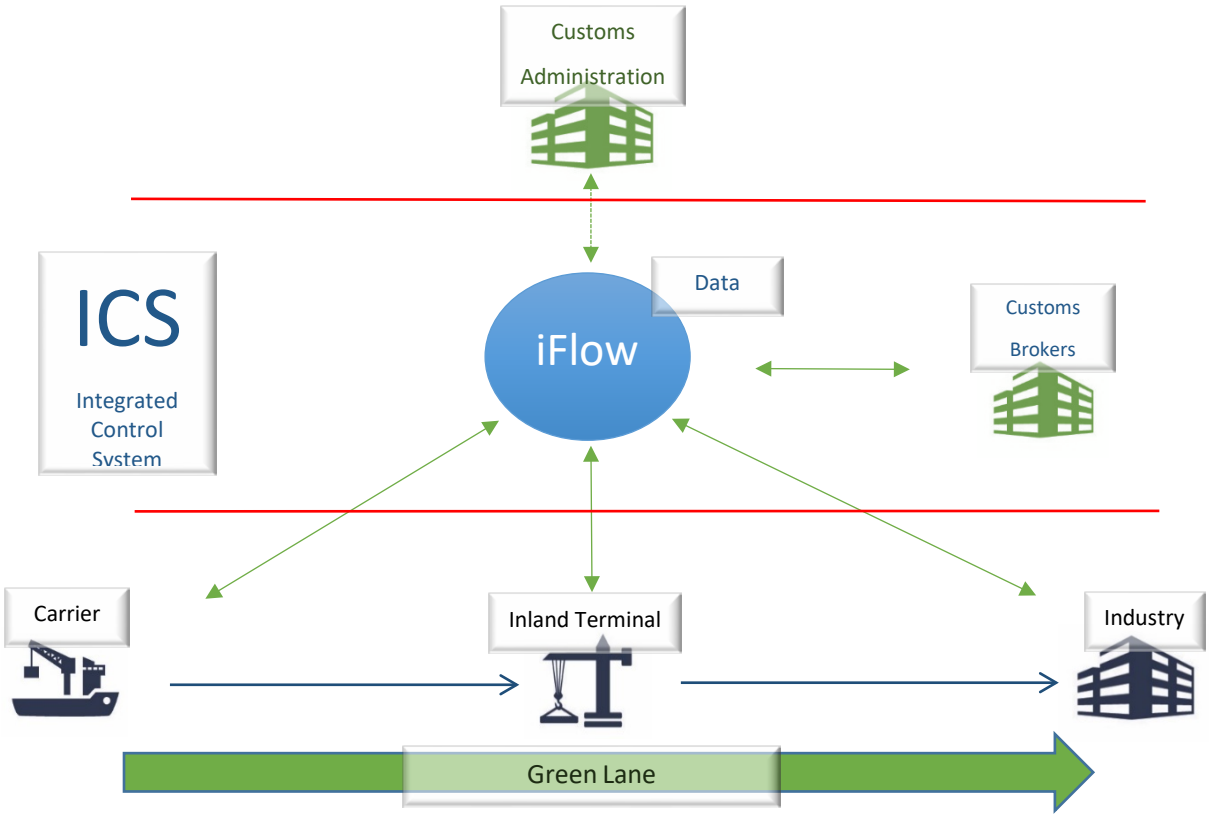
Extended Gate 2.0

The initiation period of the Extended Gate 2.0 concept, already started during the development process of the Extended Gate 1.0. The innovation champion collected all the features that could not be incorporated anymore in the previous development. this features were the starting point of the new developments and by taking benefit from the previous the initiation of Extended Gate 2.0 was started.

The actors involved in the initiation period were the innovation champion and the software provider. Their relations were strongly build from the beginning of the process. Due to the fact that the version 2.0 was only an upgrade of the previous application, customs were not involved anymore in the process. The software provider company was internalized by the innovation champion and the further development was an in-house process.

Shippers had seen their own benefit from the new improved paperless services and they brought in their capacities in the process. During the development period, the Extended Gate licence was extended to other terminals. This extension provided also a benefit for the Port of Antwerp itself, facilitating the transfer of cargo and attracting more flows. Starting from the extended gate 2.0, the name iFlow was given by MSC (Figure 30).

Figure 30: iFlow



Source: MSC, 2015

Extended Gate 3.0

The Extended Gate version 3.0 is addressed to the export of containers. For this reason, a new regulatory framework had to be defined and other features than in the previous version had to be considered. Even though the innovation champion benefits from previous experience, a completely new set of regulation had to be handled and a new administration process had to be redone.

The actors involved in the network for the development of this case is much more extended. Besides the innovation champion, customs and the software provider, actors such as the APA, terminal operators, shippers and research institutes are now involved in the process. Terminal operators and shippers are the main actors, which provide information related to the transport of export containers. The role of research institutes is to provide a market demand evolution study and to assess the benefits of the Extended Gate concept for the export cargo.

Strong networks are also created for the new application development stage. The involved actors understood the value added brought by the freight consolidation in the hinterland and the more strict control of containers, which arrive at the port to be exported.

Table 49: Development stages of the Extended Gate 3.0

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator (Innovation champion)	MSC	MSC	MSC
Customs	Belgium customs	Belgium customs	Belgium customs
Software developer		Software developer	Software developer

15. BCTN Paperless Customs Flow: Import-Extended Gate to the end customer

Valentin Carlan, Christa Sys and Thierry Vanelslander

The BCTN paperless customs flow in relation to the import containers of the Extended Gate concept, is a closed innovation that is within the development phase. The public innovator aims at an incremental, technological, managerial, organizational and cultural market change.

Table 50: Characteristics of the BCTN paperless customs flow: import-Extended Gate up to the end customer

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The documents needed for custom clearance according to European Commission Trade-Export Helpdesk are: Commercial invoice, Custom value declaration, Freight documents, Freight Insurance, Packing list, Single Administrative Document (SAD) (European Commission, 2015). Also the procedure for EU import stipulates the all imports should respect the EU customs code, the economic operator should be registered and have a EORI number. Then the procedure stipulates that the carrier of goods must lodge an Entry Summary Declaration (ENS), containing advance cargo information, at the first customs office of entry to the EU.

The deadline for lodging the ENS depends on the mode of transport and for the maritime sector, it is at least 24 hours before loading for container maritime cargo, at least 4 hours before arrival for bulk maritime cargo and at least 2 hours for short sea shipping. The next step of the procedures is that imported goods placed into temporary storage under customs supervision (no longer than 45 days in the case of goods carried by sea, or 20 days in other cases) are assigned with one the following customs approved treatments or uses: 1. Release for free circulation; 2. Transit procedure; 3. Customs warehousing; 4. Inward processing; 5. Temporary importation; 6. Entry into a free zone or warehouse.

As a final step, the goods are placed under a customs approved treatment or use using the Single Administrative Document (SAD). The SAD can be presented to the customs authorities by the importer or a representative, either electronically (each EU country has its own system) or by delivery directly to the premises of the customs office.

In cooperation with Portmade, BCTN Meerhout develops for their customers (import industries) a completely paperless procedure from deep-sea terminal to the warehouse. The current commonly used method of Extended Gate works paperless to the inland terminal, where (in the case of transit goods) a new document need to be made. This last part, BCTN also want to make it paperless. As it can be seen for this case of Extended Gate the customs has itself no procedure / method, so the innovative approach of BCTN will control/take preparation/tests the documents for transit good that are handled through Meerhout terminal.

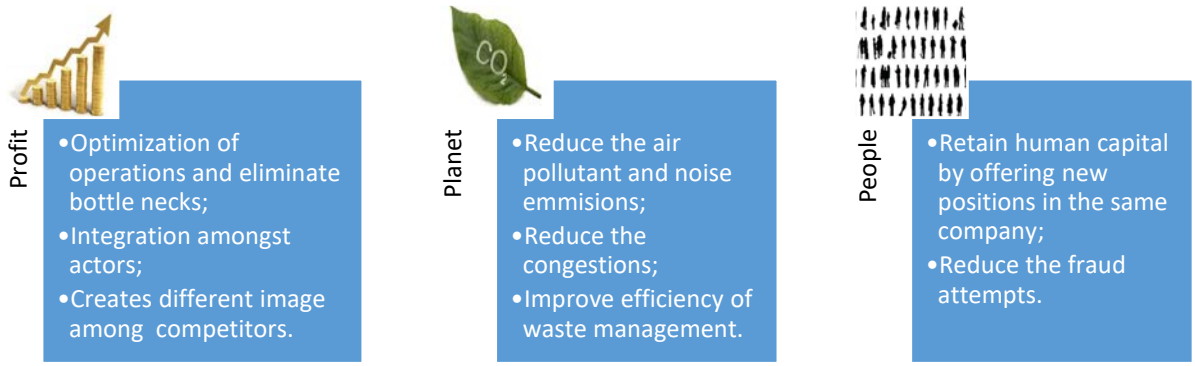
Table 51: Success and failure factors of the BCTN paperless customs flow: import-Extended Gate up to the end customer

Success	Failure
Less administration documents that have to be handled; optimized operations.	Need to change/adapt the legislation.

Profit, planet, people

The extended gate up to the end customer offers a series of benefits such as time saving, lower emissions and more flexibility for the supply chain. Although just in the development stage, the objectives of the extended gate are to optimize the operations and fasten the cargo movement procedure. On environmental benefit is the improved level of emissions. Although the environment is not a primary objective, by increasing the cargo transfer procedure and demising the delays, there will be less pollutions and other external benefits can be gained such as a decrease of congestion and a more efficient waste management.

Figure 31: Triple bottom line – BCTN Paperless customs flow: import-Extended Gate up to the end customer



Source: own composition based on interview

Stakeholders

The stakeholders, which are involved in the development process, are mainly the inland terminal, which is the central link of operations and the customs declarants. The involvement of the customs authority is very important, although they are considered to be conservative and sometimes reluctant to changes. On the infrastructure level, communication links were created between the seaport terminal operator and the customs declaratory as well as between the inland terminal and the customs. The extension of the gate offers the same monitor and cargo check possibilities as before and complies with customs regulations. On the regulatory side, a new set of procedures has to be defined in an agreement, which serves the interests of each involved party.

Moreover, in the development period, the software development task was taken over by an external IT provider. The advantage of the external developer is that it provides a trustful output that incorporates all the parties' requests and eliminates the remaining doubts.

Table 52: Development stages of the BCTN paperless customs flow: import-Extended Gate up to the end customer

Level	☐ Initiation	☑ Development
Inland terminal operator	BCTN	BCTN
Port Authority	APA	APA
Terminal operator	Deep sea terminal operators (PSA, DP World Antwerp, MSC)	Deep sea terminal operators (PSA, DP World Antwerp, MSC)
Customers	Nike	Nike
Shipping lines	Barge operators	
Customs	Belgium customs	Belgium customs
Software developer		Port made

16. BCTN Paperless Customs Flow: import-paperless NCTS pilot

Valentin Carlan, Christa Sys and Thierry Vanelslander

The BCTN paperless customs flow also introduces an import-paperless technology such as the New Computerized Transit System (NCTS). The innovation has the same characteristics as the BCTN paperless customs flow in relation to the import containers of the Extended Gate concept as discussed before and, which is now further analyzed.

Table 53: Characteristics of the BCTN paperless customs flow: import-paperless NCTS pilot

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

A few years ago deep sea terminals started to complain about all the paperwork that needed to be processed at their offices. After long negotiations with the customs, the Port of Antwerp launched the project of the APCS E-desk. The goal of this project was among other things to facilitate the exchange of data between companies and the customs.

In line of this project, BCTN Meerhout negotiated in the beginning of 2015 with the APA, the customs and the main deep sea terminals (PSA, DP World Antwerp and MSC) to work out a paperless Customs flow for the import of goods.

The idea is to make the T1 documents electronic. A T1 document is a transit document that applies for goods produced outside the European Union, but, which are actually physically present within the EU borders and have not yet been cleared or re-exported. Such a T1 document is currently obliged to be physically on board of the transport mode. Of course, this produces a lot of paperwork for BCTN Meerhout as well for the different deep sea terminals. BCTN Meerhout wants to achieve the replacement of this printed T1 document by an electronic form for all the barges and trucks between its inland terminal in Meerhout and the deep sea terminals in Antwerp.

The geographical scope of the project is at the moment limited to the transport operations between Meerhout and the deep sea terminals in Antwerp. If the project is successful in Belgium, BCTN will try to expand it to their inland terminals in the Netherlands. At the moment, there is no similar project in the Netherlands. The overall objective is to introduce it in the whole European Union, which is, of course, relatively difficult because of the different custom practices throughout Europe.

The pilot project currently started with one customer: Neovia located at Houthalen and Lummen. After the trial period, it will of course be opened for all the customers who demand this paperless documents flow.

The goal of the innovation is to lower the amount of paper that is generated with the import flow. In the best case, when the project is fully operational, all document flows between the deep sea terminals in Antwerp and the inland terminal of BCTN in Meerhout will be completely paperless. It may not be a surprise that the success of the paperless NCTS will depend on the decrease in the amount of documents printed in the part of the process that is digitalized. There are also a few derived effects that can be determined. First of all, there is a decrease in costs, because BCTN does not need as much paper and ink as before. Second, there will be a decrease in time needed for the processing, especially

if BCTN combines the paperless NCTS with OCR (optical character recognition) for the input of data by scanning them.

It can be said that custom offices still work old-fashioned. All custom documents are printed for handover and have to be kept on board during transit. Most offices work autonomous: they have their own rules and they use their own procedures. Therefore, the demand for paperless custom flows comes from the terminals and not from the custom offices themselves. In other words the unwanted paperwork, manual processing, etc., which the terminals had to do themselves, were the main triggers for the project.

In the first stage, all custom documents will be covered. Other documents (e.g. dangerous goods) are planned to go paperless too in the future. So up till now all transit documents had to be available on board of the transport mode at all time in printed form. This asks for a good coordination of document transmission. One also has to pay a custom fine if the hard copy does not travel along with the goods. When using NCTS with electronic files, this fine will not have to be paid anymore, which is one of the main purposes of this project. Optimal time savings can only be achieved when also using OCR (optical character recognition), which is presently not implanted in the project.

Chances of success are relatively high, given the fact that many of the hurdles are already overcome. In the initiation stage, it was of paramount importance to convince Port authorities and custom agents to take part in the project, for they are the key players with whom BCTN has to deal with when declaring their goods. After long negotiations BCTN, Port authorities and customs finally reached an agreement to proceed with the project.

During the development stage, it was up to seaport Terminals such as PSA and inland terminals such as BCTN to finalize all technical and organizational details. If everything goes as planned, this stage should end at the beginning of May of 2015. The big advantage of this project is that there is no need to invent something new or to use specialized technical equipment. This means that no big changes are needed during the implementation false. Combining this with the decrease in paper flow and added efficiency, makes the system not only very appealing but also very easy to implement. This is not only true for PSA and BCTN, but for every seaport and inland terminal who is willing to partake in this project. In sum, prospects are that the pilot project will be a success.

Table 54: Success and failure factors of the BCTN paperless customs flow: import-paperless NCTS pilot

Success	Failure
Less administration documents that have to be handled; optimize the operations.	Need to change/adapt the legislation.

Profit, planet, people

The New Computerized Transit System (NCTS) is a system of electronic declaration and processing that enables traders to submit community transit declarations electronically. The procedure allows certain duties and taxes to be suspended. These duties and taxes are applicable to goods on import into the Community, or between the European Community, the European Free Trade Association and the Visegrad countries or among the States that are now contracting parties to the IR Convention.

During the last few decades, practice has shown that the systems used in the past and present show many weaknesses:

- The paper-based system is not regarded to be fraud-proof;
- There is a lack of clarity in procedures and different administrative burdens are not complementary to each other;
- There is an incapacity to deal with specific situations, which results in higher risks;
- Administrations are lacking behind because of insufficient administrative communication and cooperation.

Freight forwarders and exporters are more and more complaining that the high administrative burden at ports, causes additional costs and significant delays. Ships sometimes need to wait for hours, days even, in ports for customs clearance.

In a press release made by the European Commission on 8th July 2014, the Commission refers to information supplied by the European Ship-owners Association (ECSA), stating that: "savings from simplifying administrative procedures can go up to around 25€ per container. Apart from saving money, saving time is even more important. Today, a lot of customers (e.g. exporters) choose road transport over maritime transport because of the time constraints." In its communication plan with a view to establish a European transport space without barriers, the European Commission identified the complexity of administrative procedures as one of the key bottlenecks for the development of maritime transport.

The fact that shipping does not reach its full potential due to administrative red taping cannot but be considered as a failure in policy. Even though many of these procedures are required for economic, safety, security and financial reasons, they lead to an excessive burden and increasing costs, which ultimately has a relatively great effect on the competitiveness of the maritime sector. These disadvantages make all efforts to create a level playing field between different transport modes seem meaningless and null.

The efficiency of customs clearance procedures is of the utmost importance because of the effects it has on the overall efficiency of general flow of goods between Member States. Any additional costs due to waiting times and extra costly administrative procedures must be paid by one party or another.

This means that either the shipping company, which in an ever changing and more global competitive market wants to hold its competitive position, is confronted with costs, or the customers are. In the latter, customers will undoubtedly be looking at different kinds of transport modes. The effect is two-fold: for customers currently using maritime transport will be faced with the question whether or not to make a modal-shift when transporting goods and users of road haulage will be confirmed in their choice of road transport. This will effect congestion on roads, which is already rising and as a consequence pollution will only increase. NCTS could make it possible to increase the efficiency and effectiveness of transit procedures, improve both the prevention and detection of fraud and accelerate transactions carried out under a transit procedure.

The main goal is to improve quality of service due to the decrease in time spent at custom services. Currently (before implementation of the program) there is still too much unwanted paperwork and processing, which needs to be done manually in inland terminals and deep sea terminals. Service will undeniably improve when the number of printed documents decreases. If NCTS is further combined with OCR, there will be a larger time benefit.

All this will result in a much faster and more cost effective procedure without any negative backlashes. Consequently, maritime transport will again be an attractive alternative for road transport. This will eventually decongest inland roads and have a positive effect on the environment. The pilot project "Paperless Customs flow for the import" also fits in the strategy of the company of Corporate Social Responsibility (CSR).

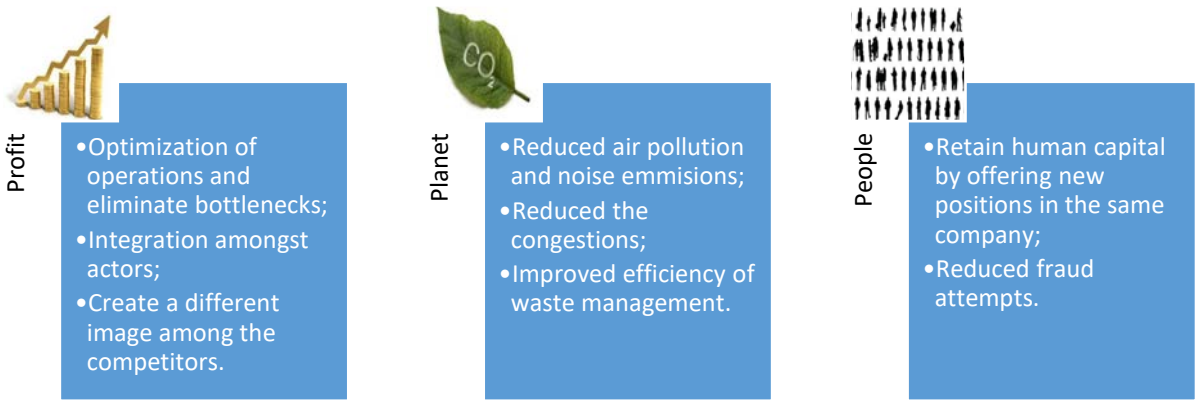
The European Commission has defined CSR as "a concept whereby companies integrate social and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis.[5]" BCTN attaches a lot of importance of dealing with the environment in a conscious way. BCTN tries to cope with environmental issues such as biodiversity, climate change, resource efficiency and pollution prevention. An example of the importance that BCTN attaches to the environment can be found in the online CO_2 calculator. Customers can make an easy online calculation

[5] European Commission (2002), Communication from the commission concerning corporate social responsibility: a business contribution to sustainable development, https://ec.europa.eu/europeaid/sites/devco/files/communication-corporate-social-responsibility-sustainable-development-com2002347-20020702_en.pdf

of how much emission intermodal transport can save. On the 29th of October 2008, BCTN even acquired a "Lean & Green award" for their efforts to reduce CO_2.

By reducing printed copies in transport between the inland terminal of Meerhout and the deep sea terminals of Antwerp, BCTN reduces their CO_2 - footprint even further and saves trees. Assuming that on average 8,333.3 sheets of paper can be made out of one tree (Kyocera, s.d.), the saving is quite remarkable. If without paperless NCTS on average 5 sheets of paper are printed per container that arrives at the inland terminal in Meerhout, this means that one tree is saved from being cut for the paper industry per 1,667 containers. If paperless NCTS is implemented in other BCTN terminals too, and if it is in the end implemented in more terminals, this innovation could have a significant positive impact on the environment.

Figure 32: Triple bottom line –BCTN paperless customs flow: NCTS pilot



Source: own composition based on interview

Stakeholders

It is the European Union who decided to start up NCTS, the New Computerized Transit System. It encourages the system but leaves the choice of how to implement it open. NCTS can be used between the different transport modes: road, water and rail. It is not yet possible to connect it with air transport too. The documents flow between the customs, deep sea terminals and inland terminals, shipping lines, shippers, …etc. are the drivers of transport flows. The APA has the overall control over the actions in the port. In the initiation phase of this specific project all these port actors (in the Port of Antwerp) were involved in the first conversations, but it is BCTN with its inland terminal who took the leading role. This is also the main reason why this project is innovative: the customs did not develop any method or procedure to go fully paperless, BCTN takes control.

When all actors acknowledged their interest for cooperation, BCTN started up the project. The conversations already lasted for some years when in the beginning of 2014 the decision was made to set up the pilot project. The strongest connections during the development and implementation phases are between the deep sea terminals (PSA and DP World Antwerp) and the inland terminal of BCTN at Meerhout, because the aim of the project is to go fully paperless between those. PSA already made adaptations to step in the project.

There is also a very strong connection with the custom offices in the Port of Antwerp and abroad. Since every office has its own working principles, good contact is important together with clear statements, description of needs and specified expectations. The paperless NCTS project was initiated a few years ago. The reason for the initiation of this project was the amount of unwanted paperwork and processing required for the declaration of import goods to the customs.

This paperwork and processes that had to be done at the inland terminals of BCTN as well as at the deep sea terminals in the Port of Antwerp were very time-consuming and generated high costs. After a few complaints of the deep sea terminals in Antwerp, who had started with e-Desk 1 in 2012, it was

decided to work on an electronic system for the communication between the deep sea terminals and the inland terminals of BCTN.

The development period started in March 2014 when BCTN commenced to prepare the pilot project, after discussions between deep sea terminals, APA, port community, inland terminals and customs. The duration of the pilot project is approximately 4 weeks. The first intention was to start the pilot on the 8th of April 2014. Afterwards it was delayed to the 2nd of May, because of non-compliance with the law and because the Easter break would have interrupted the test phase. The customs proposed this because they could not offer full participation during the Easter weekend. The project will not suffer any influence of the elections at the end of May. The evaluation will be performed immediately after the pilot project has been finished. If it turns out to be successful (or at least be able to be successful), the paperless NCTS can be fully operational at the end of May 2014 or the beginning of June 2014, depending on if the pilot evaluation points out that any adjustments have to be made. BCTN is already training its personnel to prepare them for the implementation of the innovation. The implementation will start at the end of May 2014 or the beginning of June 2014. BCTN will provide paperless NCTS to its customers as a service, the customers will not be forced to exchange the customs documents electronically.

In the beginning paperless NCTS will only be implemented for the inland traffic between the Port of Antwerp and their Belgian inland terminal in Meerhout, but later on BCTN wants to expand it to their terminals in the Netherlands and, if it turns out to be very successful, maybe to the rest of Europe. The problem is that in e.g. Rotterdam the customs offices are not really interested in cooperating with BCTN to make the import flow of goods completely paperless. The APA is much more concerned about it and is willing to be involved in the project.

Table 55: Development stages of the BCTN paperless customs flow: import - paperless NCTS pilot

Level	☐ Initiation	☑ Development
Inland terminal operator	BCTN	BCTN
Terminal operator	Deep sea terminal operators (PSA, DP World Antwerp, MSC)	Deep sea terminal operators (PSA, DP World Antwerp, MSC)
Customers	Nike	Nike
Customs	Belgium customs	Belgium customs
Software developer		IT provider

17. BCTN Paperless Customs Flow: Export-paperless to deep sea terminal

Valentin Carlan, Christa Sys and Thierry Vanelslander

The innovation in this case consists of making the document flow for export documents fully digital. This means that the physical paper document that now accompanies the container is going to be replaced by a digital one. This digital version will be a pdf file that will be sent to an email address. The same principle is also applied for the import document flow. The type of innovation can be described as technological, managerial, organizational, cultural and market change. The project had just been implemented so all three stages (initiation, development and implementation) are discussed.

The innovation takes place in the present and is closed, so not everyone can access it. The source of innovation is as well public as private because not only BCTN is involved in the project. Also other actors like the customs are involved. The degree of innovation is rather incremental because everyone needs to get used to the adjustments step by step. It cannot be said if the innovation is fully implemented with success or failure. This is an answer that will become clear in later stages of the implementation.

Table 56: Characteristics of the BCTN paperless customs flow: export-paperless until deep sea terminal

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

In the past situation truck drivers arrived at BCTN with their cargo and necessary papers. The papers were given to an employee from BCTN who then manually entered the required information in the TOS (terminal operation system). The papers are then put in a folder and are stored. When a barge is ready to sail to the deep sea terminal, a voyage list will be printed and all needed documents that are stored in folders will be collected. After this has happened a document manifest will be printed, which is a document listing all the cargo for the use of customs and other officials. The documents from the folders are then checked with the document manifest to see if all necessary papers are present to accompany the barge. After this is done, the captain of the barge is ready to sail to the deep sea terminal.

In the new system, the truck drivers that arrive with the cargo at a terminal, do not have to handle paper documents anymore. These documents are sent via e-mail to BCTN. The system then automatically transfers the information in a XML-file in the TOS. If there are some problems with the data, it is still possible to do this manually. In the TOS it is possible to add and change information. When a barge is ready to sail, all the required information will be sent to the deep sea terminal (*e-balie*). The document manifest and other documents that are obliged by customs to accompany cargo physically will be printed and given to the captain.

Through barcode scanning all the required data can be entered automatically into the terminal operating system. From this point, the information is communicated to the deep sea terminal. Until now this process of entering the data into the system was done manually. This new system makes the information entering easier, faster and with less faults. No more manual input, everything is inputted in a digital way. The export containers are then mainly transferred to Asia, North America and Europa.

The success of the innovation was high in achieving cost minimization, integration with other actors and facilitation of the transfer of official documents. Optimization of operations was also successful, but slightly less as BCTN hoped. There are two reasons why there is some doubt about the success. The first reason is the short time (2 weeks) BCTN had to analyze the success, more time is needed to fully analyze the project. Secondly, at the start of the implementation there have been some bugs in the software. The system had some problems with accepting empty containers, IT-technicians had to be called to fix the problem. For now, this is not a big problem because both the new and old systems are being used next to each other, to facilitate the transition from old to new. If in the future more bugs occur, when the old system is decommissioned, it will have a negative impact on the operations.

Table 57: Success and failure factors of the BCTN paperless customs flow: export-paperless until deep sea terminal

Success	Failure
Less administration documents that have to be handled; optimize the operations	Need to change/adapt the legislation

A good efficiency indicator for this innovation is throughput. Throughput is the rate of successful messages over a communication network. There are two important factors, speed and the correctness of delivered messages. The innovation paperless customs flow is a automation of 'manual' labor. Automation should normally lead to a faster and more correct process. For this reason, the new innovation should be more efficient than the old way of working.

Profit, planet, people

The objective of the innovation is very clear, namely the BCTN wants to digitize the paper flow of non-phase-digitized documents. There are three main objectives why a firm would invest and innovate. If there is economic added value, if the investment has an impact on the environment or/and if there is social added value.

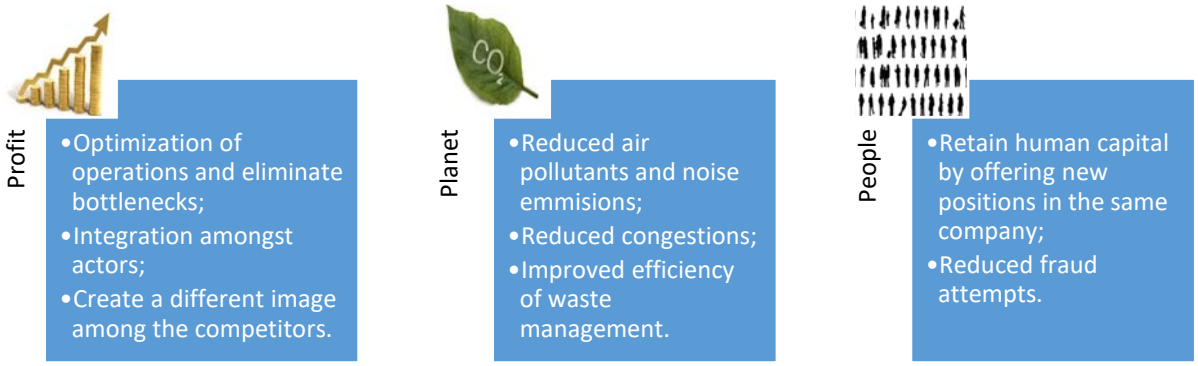
In this case, the economic added value was the main reason why BCTN implemented this type of innovation. There was also another important reason, namely the improvement of service towards the customers. Service will be better because incoming documents will be processed faster, employees at the counter do not have to manually enter the data. This will also lead to less mistakes, which also benefits the service.

The most relevant factors related to the economic added value are optimization of operations and the facilitation of the transfers of official documents. Slightly less important, but still relevant factors are cost minimization, efficient use of resources, differentiation from competitors and integration with other actors. Cost minimization is the result of fewer fines that will have to be paid due to errors in the documents, because digitization leads to less human errors. Integration with other actors is important because the system that BCTN uses, has to be compatible with APCS. APCS is used in the Port of Antwerp by the port installations, customs, private companies, etc. Currently, there are only 2 companies, from, which BCTN receives goods to ship, that also use a similar system. BCTN hopes that in the future more customers will install a similar system, which will obviously benefit the whole supply chain. To our knowledge BCTN is the first to implement this type of innovation in its field of action and this is how they differentiate from other competitors and how they hope to create a positive impact on competitiveness.

Social added value is not a very important objective for this innovation. However, it is important for BCTN to retain human capital. The employees who had to manually enter the data before will not be laid off, instead they will be trained to work with this new system or transferred to another division in the company. The name of the innovation is paperless customs flow, paperless means that no more papers will be used to transfer data.

Although it is not a priority objective for this project, the innovation will have a positive impact on the environment. Less paper leads to less trees that will have to be cut down. Indirectly this will lead to reduction of CO_2, reduction of air pollutants and minimize the impact of the activity on the landscape.

Figure 33: Triple bottom line – BCTN paperless customs flow: export-paperless until deep sea terminal



Source: own composition based on interview

Stakeholders

In the initiation period, the ideas for the innovation are defined and the desired results and objectives are made up. The initiation period has the most actors for the innovation.

The identified active port actors in the initiation period are:
- Port authority: There is a very strong linkage with hard institutions and strong networks.
- See port terminal operator: There is a very strong linkage with hard institutions and strong networks.
- Inland terminal: There is a very strong linkage with hard institutions, strong networks, capacities and with market demand.
- (Possibly) customs: There could be a linkage with competition, if they would be willing to organize their system of transmitting documents differently. If the documents go through fewer systems they are transmitted quicker and a competitive advantage could be created. For the time being this is not the case.

The identified relevant actors amongst the external stakeholders during this stage, are:
- Regulators & regulations: There is moderate linkage with hard institutions.
- IT department: A very strong linkage is required with hard institutions, strong networks and with capacities.

Due to difficult reorganizations, it has taken a long time to go from initiation period to the development phase. The reorganizations were not easy because it was not very clear, which task belonged to, which function. And in addition to this difficulties, the tasks and functions also changed over time so everything needed to be reviewed all over again. But eventually these problems were solved and the innovation went from initiation to development phase. During this period, the plans for the innovation are elaborated and further developed.

For the development period following active port actors were found:
- See port terminal operator with a moderate linkage with hard institutions.
- Inland terminal with a linkage with infrastructure institutions, a moderate linkage with the strong networks and a strong linkage with market demand.
- Customs (possibly)with a potential impact on competition if customs would be willing to reorganize their documents transmission system. If fewer systems are used, documents are transmitted faster and a competitive advantage could be created. For the time being this is not the case.

The relevant actor that is viewed as an external stakeholders is the IT department whereas a very strong linkage is needed with hard institutions, strong networks and capacities. After the development stage, the innovation was implemented in practice. The relevant port actors in this phase are:

The relevant actor amongst the external stakeholders is again the IT department, whereas a very strong linkage is still needed with hard institutions, strong networks and capacities. In this first stage of implementation, the documents that can be sent digital, are digitalized but a paper copy is also still sent with the barge. Currently, there is a digital flow of documents parallel to the former paper document flow. This way everyone can get used to the new system but the paper flow is provisionally and will disappear once everyone switched to the digitalized system. After the first two weeks of implementation a bug was discovered in the OCR system. The system gave unjustified errors for some container items. It was a technical issue that has been fixed in the meantime by the IT department.

Table 58: Development stages of the BCTN paperless customs flow: export-paperless until deep sea terminal

Level	☐ Initiation	☐ Development	☑ Implementation
Inland terminal operator	BCTN	BCTN	BCTN
Port authority	APA	APA	APA
Terminal operator	Deep sea terminal operators (PSA, DP World Antwerp, MSC)	Deep sea terminal operators (PSA, DP World Antwerp, MSC)	
Customs	Belgium customs		
Software developer	IT provider	IT provider	IT provider

18. Expansion of OCR Capabilities to dangerous goods

Valentin Carlan, Christa Sys and Thierry Vanelslander

Optical Character Recognition (OCR) is a closed private innovation that incrementally aims at a technological, managerial, organizational, cultural market change. The innovation is currently initiated and will be implemented in the future.

Table 59: Characteristics of the OCR capabilities expansion

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

ORC is the process of converting a hand-written or printed text in computer-readable text. This can be helpful for text input or for the capture of texts. The performance of the OCR reader depends upon the quality of the written text. The better readable the text is, the more accurate the results of OCR will be. Of course, OCR will never be 100% accurate, but most devices that use OCR claim to be more than 98% accurate.

The OCR process consists of three different steps. First the scanning process, where the document is scanned. The next step is the recognizing process, in, which the characters are compared to machine editable ASCII characters. The last step, the verifying process, is a human process, in, which a person has to verify that the characters match. This can be done randomly or systematically (Charles, 2012).

An OCR (optical character recognition) system consists of a few parts. First, there are the cameras, which register the characters. These cameras are being connected to a server, which saves the data. The saved data is then being translated into information that is useable for a company or organization by a software program. For document flows, the camera is actually a scanner, which scans a document. The scan is then saved on a server and translated to the right information through an OCR software program (Lagey, 2014).

OCR applications are being used on container terminals for different purposes. In this case, it is used for monitoring document flows. Every document that accompanies a container during transport is being scanned, stored and processed by an OCR system. All information that is extracted from the documents is then further processed by the terminal operating system (TOS). This process consists out of four steps (Magsoft, 2014).

The use of OCR will contribute to a more efficient and effective way of working. Due to the OCR technology, an electronic database of digital files will arise. This will make it possible to quickly search through the numerous digital files. Employees will also be able to edit the files. There will no longer be the need to manually input the hard copies into the system, so employees can spend their time on more meaningful tasks. All this makes that OCR is accurate and time saving.

An important issue by evaluating the project is an analysis of success or failure. The intended achievement of the expansion of OCR capabilities is that the DGD document workflow will proceed more efficient. The extension of the OCR application also needs to be integrated with the other existing applications. The OCR application will work correctly when a couple of factors are realized. First of all a DGD list for incoming barge with present and missing DGD declarations and a DGD list for outgoing

barge with present and missing DGD declarations is needed. A second important factor is that the DGD declarations are received on time. The next relevant factor is the accuracy of the container number. There is also the need to check whether the booking is done correctly.

Table 60: Success and failure factors of the Expansion of OCR capabilities

Success	Failure
Transport of dangerous goods will be benefit out of faster procedures; less cost for terminal.	N/A

Two European treaties regarding the transportation of dangerous goods are applicable on BCTN Meerhout, being transportation on the road (ADR) and on inland waterways (ADN). The United Nations Economic Commission for Europe (UNECE) executes the governance of the treaties who ensures a regular update. Latest versions are dated in 2013 (UNECE 2014a and 2014b). Both treaties are imposed on the EU Member States through directive 2008/68/EC. Belgium has executed the directive for ADR in the Royal Decree of June 28th, 2009 and for ADN in the Royal Decree of August 30th, 2013. The main characteristics of these treaties are that the cargo must be correctly labelled, and documentation is kept accurate and up-to-date. The cargo should not exceed the maximum amount for the current transportation unit and it should be positioned correctly on the vehicle or ship and kept segregated at a sufficient distance from another hazardous substance. Containers must carry the correct class label, showing the nature of the hazard by color and symbol, and the class of the goods by number. The responsibility for the classification of products lies with the manufacturer or person packaging the products. The shipper has the responsibility to fill out a DGD form that accompanies the dangerous goods on their voyage. These forms are required for both containers containing cargo and not cleaned empty containers.

Next to these European treaties, each international organization governing a transport mode has created a dangerous goods code. For shipping, the International Maritime Organization has created the International Maritime Dangerous Goods (IMDG) code. In this perspective, the IMO has created a multimodal dangerous goods form (added in annex). Shipping companies are providing to their customers a dangerous goods checklist to fill out the forms. In annex, the dangerous goods checklist of MSC Belgium has been added.

Profit, planet, people

The environmental impact is irrelevant. The physical DGD document will continue to exist, but OCR will facilitate the administration process.

The most relevant subject is the economic added value. The main objective for the expansion of OCR capabilities is improving the service quality. Due to OCR, it will be possible for BCTN Meerhout to optimize their operations. Thanks to the digitalization of the DGD documents through OCR it will be easier to transfer official documents. Other advantages are the fact that documents can be found faster and there will be less chance to lose documents. When BCTN Meerhout will have OCR for the DGD documents, they will efficiently use their resources. As a result of all reasons above, BCTN Meerhout can use OCR to differentiate from their competitors.

When BCTN Meerhout uses OCR, integration with other actors will be simplified. An example is that it will be possible to send DGD documents through e-mail. Also integration with EDI documents will be possible. Due to the integration and the efficient use of their resources BCTN Meerhout will be able to minimize their costs.

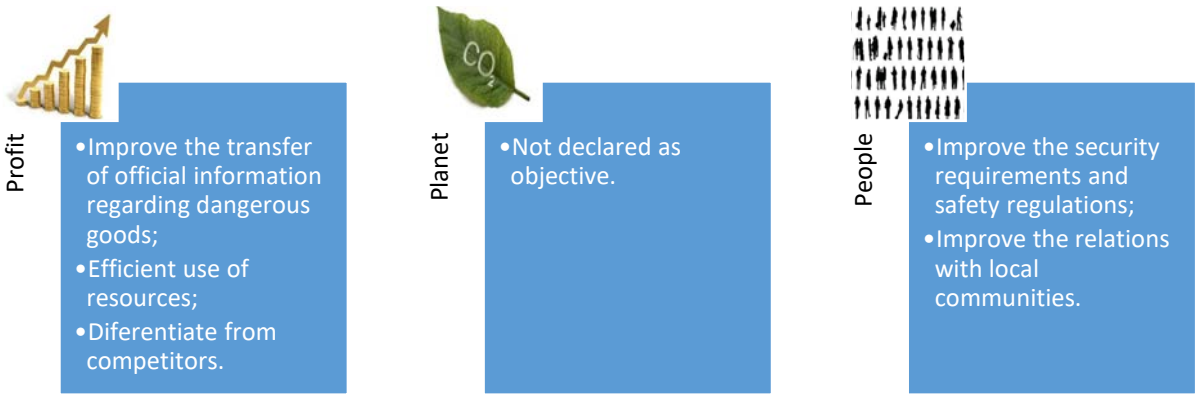
Another subject is the social added value. The main objective in this category for using OCR is to comply with the safety regulation and improve the efficiency of the security requirements. BCTN Meerhout also wants that OCR contributes to the improvement of the relationship with local communities. When OCR is introduced, communication with those communities will be a lot easier. Another benefit will be

in case of an emergency. Due to OCR, documentation can be communicated faster. Therefore, there will be a higher level of safety.

A last factor is that all documents can be sent by e-mail and no confusion can arise when the responsible does not have the DGD document with him/her. The working method will be more comfortable through, which BCTN Meerhout can retain human capital.

All the factors discussed above are related to the importance of the selected innovation case in achieving the objectives. The discussion of the success of the innovation in achieving the objectives is not relevant, because the OCR expansion is still in the initiation phase.

Figure 34: Triple bottom line – Expansion of OCR capabilities



Source: own composition based on interview

Stakeholders

There are only a few actors involved in the expansion of the OCR technology at BCTN. The reason is that the expansion is just limited to BCTN and has no huge implications for other players. The actors that are involved are the terminal operator BCTN and the company that provides the necessary IT for the further expansion. Other involved actors that have a minor but still very important role, are the customers and local authorities. In the following paragraphs, the role of each actor will be discussed. BCTN is the one that wants to implement the OCR technology for scanning the dangerous goods declarations of the containers. BCTN is also the most important actor in the whole innovation due to the fact that it will be implemented at their company and Therefore, have the biggest impact on them. BCTN acts in this case as the “innovation champion”.

Another necessary actor that should be and is involved in the process of expanding BCTN’s OCR is the IT-provider. This actor has to deliver the IT programs necessary to implement the expansion. This will probably be the extension of the OCR software to scan dangerous goods declarations.

Actors that could have been involved in implementing the OCR expansion are the customers. The customers are obliged to send the dangerous goods declaration to BCTN so it would have been helpful to involve them in the innovation. When their customers are involved in the implementation they might have a larger commitment to send the declaration faster to BCTN and more accurate. Now when the dangerous goods declaration is not 100% correct, BCTN needs to request a new correct declaration, which takes time and money. When the customers of BCTN are involved they may have the incentive to check if they have sent the right and correct declaration, so the process can go faster and more accurate. It is important that this process is fast and accurate, so employees of BCTN do not have to ask the declaration once again and when it is accurate it can be helpful in case of an emergency or accident on the BCTN terminal. When something happens, BCTN can send the declaration directly to the fire department, which then knows what the possible dangers are. In this case, also local authorities enjoy benefits from the innovation.

The case of the implementation of dangerous goods documents as an extension of OCR applications is still in the initiation period. BCTN is investigating whether the addition of the dangerous goods

documents to the existing paper flow processed by OCR is economically interesting. In this stage BCTN wants to monitor what the benefits are from the innovation. The purpose of the innovation is rather internal. BCTN seeks to optimize their paper flows to avoid defaults, to speed up their processes and to improve the safety on the terminal by having all data directly electronically available. This should save them costs.

BCTN Meerhout would like to have a list for incoming and outgoing barges with present and missing DGD declarations. This list contains all containers and if needed the corresponding DGD declaration. BCTN prefers to work with a Y/N list so it is possible to quickly oversee if there are any DGD declarations missing. For BCTN a first efficiency indicator will determine how many times (percentage) they succeed in getting the list and can quickly oversee if there is the need to request some DGD documents before the shipment can be completed. A second efficiency indicator will show how many times 'yes' is marked on the list.

The goal is to add the processing of Dangerous goods declarations to the existing OCR processes. On the collect side, BCTN receives already lots of physical documents including DGDs. This changes nothing to the process. At the process side, BCTN is already scanning lots of document via OCR. It should not be that hard to collect and scan also the DGD documents. By adding DGD to the process BCTN would like to avoid missing DGD's and in that way avoids waiting times.

Incoming transport documents, which are processed via OCR, are being stored per container number. It is the goal to do this also for a DGD, which includes already a container number. In this way, it is simple to add the DGD and store it in a file contributed to a container number. The main reason to implement OCR for the DGD document is to optimize the current paper flow process. With OCR, defaults and losses can be avoided, safety can be guaranteed and the process can be accomplished faster. Another important factor is safety. When an accident occurs, security services will be immediately updated. There will no longer be the need to search for the physical DGD document.

The information distracted from transport documents needs to be translated to useable information for the TOC. Also for the DGD's this will be important. It becomes possible to distribute containers over the terminal via the information on the DGD's so that dangerous goods are stored in a safe place with the right safety measures. Safety managers have a direct overview on the amount and nature of the goods shipped in the container with the help of the DGD's. In this way, BCTN always knows how to handle the goods. These are the possible benefits from this innovation. Moreover, having DGD's there could be lower waiting times for road transport operators and mistakes could be avoided.

Table 61: Development stages of the Expansion of OCR capacities

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminal operator	BCTN		
Shipping line	Barge operators		
Regulator	Customs offices		
Freight forwarders	Trucking companies		
Software developer	IT provider		

19. Pre-notification at deep sea terminals in Antwerp

Valentin Carlan, Christa Sys and Thierry Vanelslander

The open innovation in this case and as further analysed, is currently in the development phase. The public innovator aims at an incremental technological, managerial, organizational and cultural change on the market. The last market change is cultural innovation. Cultural innovation can also be a part of managerial innovation. The core questions here is how the management shapes innovation, and how it will be influenced by cultural conditions inside the organization and how the organization reacts to the introduction of the new innovation? Because this innovation is still in the developing phase and thus has not yet been implemented, the answer to these questions cannot be given (yet). After the implementation it is possible to see how the organization will react to these new developments.

Table 62: Characteristics of pre-notification at deep sea terminals in Antwerp

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The pre-notification works as follows: the vessel will send a COPINO[6] message to the terminal operator in advance, in return the container terminal will send an APERAK[7] message (this is not the case in Antwerp, the APERAK message is not implemented at this moment). Eventually the vessel will send a CODECO message[8] to say that it is loaded. The pre-notification system at deep sea terminals in Antwerp uses electronic data interchange (EDI) through specialized software, which is developed for the COPINO messages on an UN/EDIFACT based platform. The EDI software is not new and it is used in different kinds of sectors but the fact that it is used for the pre-notification development is innovative and even more so when it is specially developed for the case. Pre- notification is a new innovation and it is not an improvement from an innovation from the past so by definition it is unprecedented. The innovation will also induce new management activities as well as a change in the organization itself (Birkinshaw & Hamel, 2008).

This part could be viewed from two different angles. On one side, it is possible to analyse how EDI can work efficiently. On the other hand, there are efficiency effects that come into play after EDI has been implemented. The main focus of this chapter will be on the latter.

To determine the efficiency of the EDI-system, there are several factors that could possibly play a role. Since it concerns an immaterial innovation, the efficiency effects are slightly different here. Most of the configurations to an EDI-system will not have an impact on the efficiency of the system. In essential, it was and will be nothing more than an expensive communication device. The EDI-system itself could However, have an impact on the efficiency of other factors when it is integrated in other applications. A company's efficiency would greatly improve if for instance the system is capable of integrating outgoing ship notices with accounts receivable (MIRL, 2014).

[6] Container pre-notification message
[7] Application Error and Acknowledgement message
[8] Container gate-in/gate-out report message

The importance of integration in such a system will have an impact on the human involvement necessary for such a system to operate. It will impact the speed, the costs and a lessened amount of errors will take place. For example, employees are no longer required to read orders and make their decisions accordingly when the EDI-system can do that for them. The process that used to take that employee days or weeks can now be handled by the EDI within several hours. But if no attention was paid to the integration of EDI within the entire data procession of the organization then, as previously stated, the EDI system would become nothing more than an expensive fax machine (MIRL, 2014).

The two organizations who are dealing with the innovation at this moment are PSA and BCTN. In the future, however, more and more container operators are expected to use this innovation, that way everyone will benefit from it. The innovation is incremental: there will be a few advantages once pre-notification is implemented but it is not a major change in organization.

The reason why the innovation is needed is because there is a problem with the container handling on the inland terminal. There are a lot of unwanted container moves and also a lot of containers are lost or stacked wrong on the quay. Because of the latter, a lot of time and efficiency is lost. Nowadays the process is as follows: 48 hours in advance, BCTN has to declare, which barges are going to arrive to plan the organization. Another 24 hours in advance BCTN will send out the instructions (which containers have to be loaded or unloaded). The problem is that in 90% of the cases the barges are already discharged and the containers are lost or the wrong containers get picked out. This is why pre-notification is needed, so they can stack all containers together on the quay. The barges will be handled faster and they have less unwanted moves. The difficulty to obtain this, is that it is fairly new so it is very innovative. The instructions that are sent are in the form of an UN/EDIFACT message and are, as previously stated, called COPINO.

In the past, people had to print and write what they had to charge and discharge and put it on a fax, a few years later email was used. At this moment specialized EDI software (COPINO,…) are used and the pre- notification system as described will be implemented as soon as possible.

There is a difference between the system in Antwerp and Rotterdam. In Antwerp BCTN works directly together with PSA Antwerp (BCTN is an inland terminal operator and PSA is situated at the port itself where the deep sea terminal is located). Both actors have worked out a system by themselves and the other terminal can adapt this system. In Rotterdam it is the other way around: pre-notification is being handled by the port community system. If a container operator wants to make part of the new system they have to go through the port community system. Also, as said before, the APERAK return message is used in Rotterdam and not in Antwerp.

BCTN works directly with PSA Antwerp. The deep sea vessels arrive in the deep sea terminal of PSA were they unload their containers. Afterwards a barge will pick-up the containers and discharge them to BCTN in Meerhout. The process goes both ways, the barge can also pick up the containers in Meerhout, discharge them at PSA were they will be picked up by a deep sea vessel.

Table 63: Success and failure factors of pre-notification at deep sea terminals in Antwerp

Success	Failure
Optimized operations within the deep sea terminals	N/A

Profit, planet, people

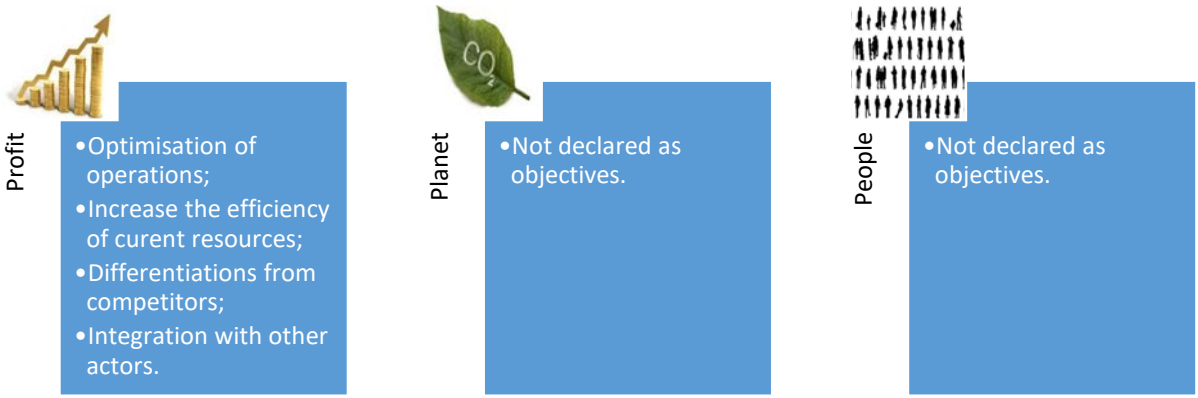
The optimization of the operational processes and the more efficient use of resources seem to be the two most important reasons why the initiative for this project was undertaken. If the terminals can succeed in loading the containers the right way with the correct information that was sent in time, then they will optimize their operations and put their resources to more efficient use because of the amount of handlings and shuffles that can be saved.

Differentiation from competitors and integration with other actors are two reasons of equal importance to BCTN. Communication will go a lot easier now that a pre-notification system has been established and integrated within the deep sea terminal. BCTN will also be able to differentiate itself from its competitors and use this pre-notification innovation as a competitive advantage.

The scale of operations can be further increased as a direct result from the optimization of the operations. This allows operations to extend further on a larger scale. Cost minimization has a positive impact on competitiveness and a larger and more equitable access to the service. Surprisingly enough, cost minimization was not one of the main objectives for BCTN. For PSA this factor can be translated into reduced costs through the reduced amount of shuffles that take place.

Obtaining the first mover advantage and encouraging other investments were less important objectives. Nevertheless, the first mover advantage gives BCTN the benefit of being the leader and the one player in that market with such a technology. An opportunity lies here for BCTN to capitalize on this advantage. The success of this innovation and the efficiency that was achieved can also influence other investments to take place.

Figure 35: Triple bottom line – Pre-notification at deep sea terminals in Antwerp



Source: own composition based on interview

Stakeholders

This innovation is the result of a close collaboration between deep sea terminal operator (PSA) and the inland terminal operator (BCTN). Both terminal operators felt the need to increase the efficiency and productivity of their operations by developing an integrated communication network. Different from other foreign ports like Rotterdam, the port authority was not involved in this innovative development.

Started with the initiation phase, BCTN took it upon herself to take the first steps to a more efficient way of pre-notification between inland and deep sea terminals. After BCTN took the first steps in this innovation, they had to find a suitable partner to turn the innovation into a success. After a short period, BCTN could convince PSA to go along with their pre-notification innovation. From that moment on, both companies have been working intensively together and discuss the various outlines of the pre-notification concept. The linkage between these companies can be defined as the next level in the container handling supply chain. PSA is not a client for BCTN, they load and unload containers from inland transportation modes to deep sea vessels. Basically, PSA and BCTN are working for the same clients with the mission to deliver containers in the right place at the right time. Because both companies are strongly linked to each other they can only experience benefits from pre-notification. Through this close collaboration, it is desirable to create a customized solution adapted to the specific needs of both partners.

During the initiation phase, MSC, one of PSA important competitors in the Port of Antwerp, started to develop a similar pre-notification innovation process. Because of the potential cost and time reducing outcome of a pre-notification solutions other deep sea terminals are interested. In this phase, only

MSC started to develop a similarly pre-notification solution. In the near future, more deep sea terminals are expected to follow.

During the development phase, the IT departments of BCTN and PSA were involved to design and develop the EDI. The communication between BCTN and PSA remained very positive. Both companies were able to communicate clearly about the operational issues concerning the pre-notification. The communication between BCTN and her own IT department experienced some difficulties. EDI projects are complex engineering endeavours. IT experts working on such projects must first become well informed about the operational issues. They need to clearly understand what is expected from the EDI network before they start to design it. Although the operational department and the IT department are part of the same company they may experience difficulties to communicate efficiently.

Because the collaboration between the two companies is focused on the Port of Antwerp, the level of influence in this stage of the innovation is limited to a regional influence. In the near future, other deep sea terminals may be interested in a similar pre-notification solution.

Table 64: Development stages pre-notification at deep sea terminals in Antwerp

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminal operator	BCTN	BCTN	
Terminal Operator	PSA	PSA	
Software developer		IT provider	

20. Pre-notification at deep sea terminals in Rotterdam

Valentin Carlan, Christa Sys and Thierry Vanelslander

The pre-notification system at deep sea terminals in the port of Rotterdam is in its initiation phase and is a closed public driven innovation, which aims at technological, managerial, organizational and cultural changes in the market. The innovation is expected to be implemented in the future and follows an incremental path towards implementation and change.

Table 65: Characteristics of pre-notification at deep sea terminal in Rotterdam

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Pre-notification is based on import. Import containers, coming from overseas, are discharged at deep sea terminals. Afterwards these containers are transported to the hinterland using trucks, barges or rail. If the deep sea terminals do not know in advance where the containers will be going, or with, which type of transport mode, they will just stack the containers at a certain place at their terminal.

For the moment, deep sea terminals in Rotterdam receive a COPINO, 24h before arrival of a barge or truck. A COPINO is as previously mentioned, a discharge or loading list, which used to be sent in readable format, but is now sent in a digital format, so the information can be automatically processed by computers.

Currently it is only allowed for the terminal operators to send one COPINO to the deep sea terminal. This implies that the deep sea terminal only receives information concerning the loading or unloading of containers, 24hrs in advance. Because of this, containers are very often scattered around the terminal, which causes unprofitable extra shuffles.

If one for example supposes that the containers are stacked 3-high in Rotterdam, and the specific needed container is stacked underneath the other two, these other two containers first have to be moved aside, before the straddle carrier can take the specific container and take it to the loading key. The other 2 containers have to be moved back to the original spot. Repeating this handling for each container causes an important time loss because of the many movements. Keeping in mind that the number of movements at a terminal is the key indicator of efficiency, one might conclude that this way of operating is not the most efficient solution. For example in the Port of Antwerp, one extra shuffle brings an extra cost of €20 to the operator, the straddle carriers need to cover longer distances, which means more time loss, fuel consumption and emissions. It goes without saying that terminal operators want to minimize these unwanted moves as far as possible.

To tackle this problem and make the communication between the inland terminal and the deep sea terminal more efficient, deep sea terminals need information from BCTN before the deep sea vessel arrives and is unloaded. The provided information contains a list with all containers that have to be picked up by a specific barge in a given time window. With this information known, specific containers can be strategically stacked together in front of the loading key. This means a shorter travel distance for the straddle carriers and less unwanted shuffles on the terminal. As a consequence the handling times for BCTN as well as the fuel consumption and emission will be reduced significantly. However,

there are some difficulties in achieving this new information exchange: the operating systems used by deep sea terminals, and the ones used by BCTN are not aligned for this operation and need to be unified.

As a solution to this problem, BCTN is currently developing an innovation to make earlier communication possible. It is of course necessary that all the sent information is accurate and previously checked. By sending this information, the deep sea terminal will get a clearer image concerning the discharged volumes of the ocean carriers and the loaded volumes of the inland barge or truck. Therefore, containers will be stacked efficiently and have to be moved over shorter distances, as a consequence, crucial time and costs can be saved.

A COPINO can have different qualifiers, for example 1 means new information, 9 stands for deletion of information. The COPINO 13 that will be developed by BCTN exists of qualifier 1 and 3, with 3 as a new qualifier, meaning pre-notification information.

Rotterdam wants a standardized solution that will be implemented by all terminals and forces BCTN to adapt to this system. In contrast to Antwerp, where BCTN only negotiates with PSA who has developed another solution, based on a combination of standard COPINO - and IFTSAI messages[9]. IFTSAI is essentially a sailing schedule of a vessel. BCTN will send IFTSAI messages to PSA in Antwerp, concerning the planned voyages. In the next step, BCTN will send COPINOS to PSA whenever they receive information about incoming containers.

This means that BCTN will be allowed to send many COPINO messages. Adjustments to previous COPINO messages will also be possible. PSA will combine the information of the incoming barge voyages and containers to plan how they will stack the containers (Port of Antwerp, 2014b).

In Rotterdam, BCTN does not possess the negotiating power to implement the same system; they have to negotiate with the port authority and multiple container terminals.

This project targets an incremental change on the organizational level: terminal operators will have to adapt their systems to connect to the overarching system. For now, this case is still in the innovation phase; different parties are still discussing the exact functioning of COPINO 13 and BCTN is still not sure how and when it will be developed and implemented. However, because of the important possible reduction of unwanted moves and costs, there is no doubt that it will be implemented in the near future.

Table 66: Success and failure factors of pre-notification at deep sea terminal in Rotterdam

Success	Failure
Optimized operations within deep-sea terminals	N/A

To examine the benefits of the pre-notification system, one must also analyze the benefits of implementing EDI software. The efficiency indicators will be determined from two perspectives: the inland carrier and the deep sea terminal. Namely, both the inland carrier as the deep sea terminal experience an impact from using the innovative pre-notification system.

From the perspective of the inland carrier, the innovation will have an impact on an operational level. To investigate whether the innovation will provide the expected results, the inland carrier will need to look at the difference in waiting time at the deep sea terminal. Indeed, is it to be expected that the deep sea terminal operator will be able to stack its containers in a manner that will lead to more efficient and faster loading of a barge ship. Furthermore, there will be less errors in terms of loading or discharging containers onto or from the barge ship. This is a consequence of EDI, which makes human involvement redundant and eliminates human errors. Unnecessary trips will also be avoided

[9] IFTSAI = Forwarding and transport schedule and availability information message

as EDI provides constant feedback of the container's status. Essentially, using the pre-notification system should allow the different supply chain partners to coordinate their activities. Therefore, should the delivery time to the end-user be a good indicator of the efficiency of pre-notification.

As stated before, pre-notification will allow the terminal operator to stack containers in a way that will lead to faster and efficient loading and discharging of the barge ship. Via EDI, the inland carrier will also be able to check whether the containers are unloaded onto the quay or are still in transit. This information gives the inland carrier, the opportunity to arrive at the deep sea terminal, right after the containers have been unloaded from the deep sea vessel. Therefore, measuring dwell time will be an indicator to see if the innovation will be successfully implemented. As a consequence, one must also examine the deep sea terminal's capacity as it should increase when dwell times are lower. Due to the pre- notification system, a terminal operator can be notified about, which containers have to be loaded onto the barge ship, before the containers have reached the deep sea harbor. This allows the terminal operator to group the containers on the quay. Thus, we can expect that the number of shifts will lessen when loading the barge vessel.

The most obvious and outstanding result of pre-notification via EDI is the increase in speed and accuracy by, which barge ship handling is executed. The deep sea terminal operator can take precautionary measures as the inland carrier informs the deep sea terminal when a ship will arrive and, which containers should be loaded or discharged. Ultimately, the barge ship will spend less time at the deep sea terminal as it has been notified when the ship will arrive. Further, the deep sea terminal operator can take the necessary precautions to ensure a fast handling of the barge ship. Unnecessary trips will also be avoided as EDI provides constant feedback of the container's status.

Profit, planet, people

The main objective of BCTN is to optimize operations. The pre-notification will eliminate unwanted moves at the deep sea terminal, so containers can be ready at the loading key when the barge arrives. Therefore, the handling time will be reduced significantly. Shorter handling times means that the barges will have a smaller average waiting time with a smaller variance. As a consequence, BCTN will be able to assure higher service levels to the final clients. This will deliver BCTN a competitive advantage on other inland terminals. Therefore, BCTN expects a positive impact on competition by differentiation through higher service levels. Gaining market share and growing are no bullet points for BCTN, but differentiation through higher service levels in comparison with competitors, could be used as a strong marketing tool to attract new clients and traffic. BCTN can gain market share if pre-notification is implemented and applied optimally combined with the right marketing steps. Fast and reliable deliveries are very important for many companies, especially for those who are applying Just-in-Time principles.

Integration with other actors is another very important objective of BCTN. This innovation will cause increased advantages for the deep sea terminals and, indirectly, to the ports and port authorities (this will be explained later). BCTN will be favoring many parties (primarily the deep sea terminals) and will obtain the leverage to ask some favors back in the future.

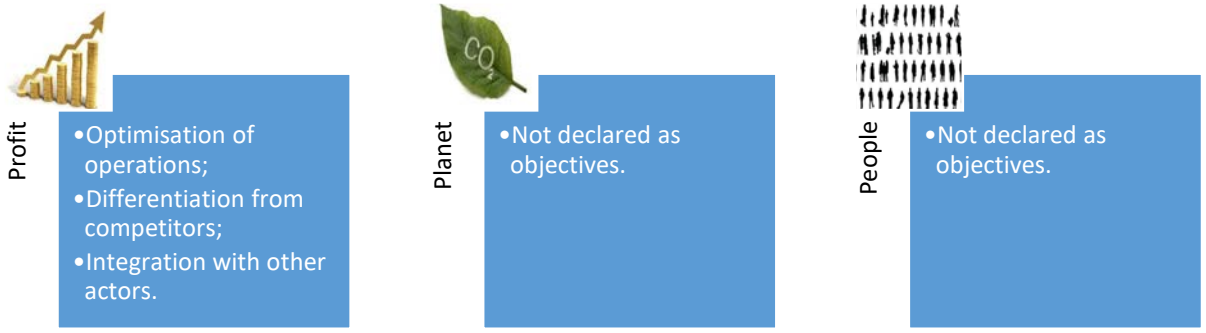
BCTN will reposition itself within the supply chain through multiple advantages delivered by the pre-notification initiative and will become a bigger player. As pointed out before, the deep sea terminal will benefit a lot of this innovation. The main effect is the drastic reduction of the number of movements, so operations can be optimized. The number of movements is the most important cost factor for a deep sea terminal. Large and many movements mean high costs. Straddle carriers consume a very high amount of fuel, Therefore, the innovation will cause an important cost reduction. The resources will be used more efficiently. The increase in operational and energy efficiency and the decrease in operational costs will increase the profit margin of the deep sea terminal. The deep sea terminal could also lower its prices to attract more traffic. This cost advantage will have a positive impact on competitiveness and can cause a gain in market share. Each movement takes a couple of minutes. Reducing the number of movements will also cause a large time advantage. A lower handling

time, caused by better organization, will lower the waiting times of other ships. The deep sea terminal will deliver higher service levels. The innovation will help the deep sea terminal to differentiate in terms of costs (read lower prices) and service level. The combination of these two could deliver an important competitive advantage.

Pre-notification can also be implemented for different purposes. Containers, which are going to be picked up by a specific train, can be stacked together at a loading key. It could also work the other way around. Deep sea vessels could pre-notice the containers that they are going to load. These containers could be bundled too. If each deep sea terminal at a port applies pre-notification in all its forms, the aggregation of all handling time reductions will have a significant effect on congestion. Less congestion at a port means less waiting times. More traffic will be handled and capacity will increase due to optimized operations. The scale of operations on port base will be increased. The port will also be more attractive for shipping companies. The port, that has implemented pre-notification applications, will benefit from a competitive advantage.

The innovation will also have an environmental impact. This is not an objective of BCTN, but will be a spillover effect. A much more efficient use of straddle carriers will lower fuel consumption. If many deep sea terminals and ports start to adapt to this innovation, it will have a significant effect on reduction of CO_2, air pollutants, noise and congestion.

Figure 36: Triple bottom line – pre-notification at deep sea terminal in Rotterdam



Source: own composition based on interview

Stakeholders

There are different actors involved in this innovation case, it is important that these actors communicate and work together so the development can be as efficient as possible. This specific innovation case started with the request of the inland terminal BCTN for a change to optimize their current activities. BCTN is the requesting party together with the deep sea terminal. As a consequence, the port authority and the deep sea terminal are now working together towards an organizational change to lower the number of shuffles and increase the stacking efficiency. When these two actors have completed the innovation, the terminal operators will only have to connect to the new general system. This means that the inland terminal, although requested and benefiting from the change, will not influence the new development; this will only be a cooperation between the port authority and the deep sea terminal.

Because the development of COPINO 13 is still in the initiation phase and is a technical development concerning software, no physical infrastructure is currently needed. The terminal operators will have to connect to the overarching port community system, which will be regulated by the port authority; Therefore, this can be seen as a hard institution relative to the terminal operators. When this new innovation will be implemented, it will be important that the terminal operators are willing to adapt, they will have to use the information in a different way. However, this relation to such soft institutions only becomes important during the implementation phase.

To be able to work efficiently on this innovation case, all parties need to be strongly involved. This means that the needs of forwarders, shipping companies, terminal operators, port authority and the deep sea terminal all need to be included, for the moment this cooperation between all parties is not strong enough. Improvement in communication and consultation is needed. For example, a possible negative relation can be identified between the shipping companies and the terminal operators, because of the fact that these shipping companies have to supply the necessary information concerning the loaded containers in time. When the information about the containers is not available, pre-notification information cannot be delivered on time. At the moment, this is not a major problem, but it should be concerned as a critical link in the chain.

The most important network for this innovation case is the partnership between the port authority and the deep sea terminal. This relation has to be strong to be able to develop a useful solution. Currently, the cooperation is not moving as expected, because the port authority has to adapt its operating system to receive the information. At the same time, it is also important that these two actors are willing to cooperate and communicate enough with BCTN, when this relation is weak, the innovation cannot be developed exactly and efficiently enough.

It is very likely that COPINO 13 will be used port wide. Rotterdam will use Port base, a coordinating port community system for all logistical information in the port of Rotterdam, as a platform to process COPINO 13. As a consequence, terminal operators will only have to adapt their system and connect it to Port base. By this overarching cooperation, Rotterdam will probably become generally faster compared to the Port of Antwerp where terminal operators are currently faster, but information is not centrally controlled. The city of Rotterdam is shareholder of Port base and will Therefore, probably also invest in the innovation. Because of this cooperation between the deep sea terminals and the port community system, the inland terminal is not directly included in the project.

Lock-in effects are currently not present, but as previously mentioned these can become more important when the terminal operators have to start implementing the new system. Another important factor is competition, in case of the innovation there are no real competitors, but between ports the competition is very strong. Antwerp is the main competitor for Rotterdam, they both want to become the most efficient port so they can attract the highest number of customers. One research institution can be related to the development of COPINO 13: ORDINA is an ICT provider that is contacted concerning the next logic system (COPINO 13 is part of this system). This system is briefly explained in the next paragraphs.

When a barge needs to be loaded or unloaded in Rotterdam, a request for every terminal separately needs to be sent. Every terminal individually replies whether this is possible or not. The problem concerning this system is that terminals do not communicate with each other. Because of the latter, the schedules are often not matched to one another. The operators can only react when the schedules are already made and adaptations are a lot harder. Another problem can be found when for example loading is started on time but has a half hour delay. When the barge goes to the next terminal with this delay, it is possible that the terminal is already processing another task. Because of this first delay, the whole schedule can get mixed up. The next logic system wants to tackle these problems by bringing all the information together: when a barge is ready to enter Rotterdam, they have to be able to say, which terminal can help the barge right now. Capacity can be scheduled in advance, but the location will be decided at the time, so unnecessary delays can be prevented.

Table 67: Development stages of pre-notification at deep sea terminal in Rotterdam

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminal operator	BCTN		
Port Authority	Rotterdam port authority		
Regulator	Customs offices		

21. Digital CMR

Valentin Carlan, Christa Sys and Thierry Vanelslander

The CMR Convention[10] in Geneva on 19 May 1956 is an international agreement whereby the signing parties have recognized the desirability of standardizing the conditions governing the contract for the international carriage of goods by road, particularly with respect to the documents used for such carriage and to the carrier's liability. The CMR Convention applies to every contract for the carriage of goods by road in vehicles, whenever the place of taking over of the goods and the place designated for delivery, as specified in the contract, are situated in two different countries, of, which at least one is a contracting country, irrespective of the place of residence and the nationality of the parties.

The development of the digital version of this Convention is considered as an incremental and private driven innovation that contains technological, managerial, organizational and cultural impacts on the market of international road haulage. The analyzed innovation is situated at the moment of writing in the initiation phase and strives to be implemented in the future.

Table 68: Characteristics of Digital CMR

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

Present needs have been evaluated, which shows that the need of integrated processes and information flow between stakeholders becomes more and more important. Carriers want to invoice immediately when the goods reach their destination. Today this is not possible because the CMR convention delays it. Changing to electronic e-CMR eliminates waste like: Missing Errors in Documents; redundancy of paper; poor customer service; poor communication, and allows immediate billing. Transport companies are convinced of the possible benefits but a lack of the necessary legal framework blocked the adoption so far. This legal barrier is going to be eliminated and e-CMR is going to enter into force. Nevertheless, the human errors that can occur by using the traditional CMR still remain. Table 69 shows the improvements that the Digital CMR can bring forward.

Table 69: Success and failure factors of the Digital CMR

Success	Failure
Less administration documents that have to be handled; Optimized labor tasks.	Need to change/adapt the legislation; it requires similar actions from the side of other terminals too.

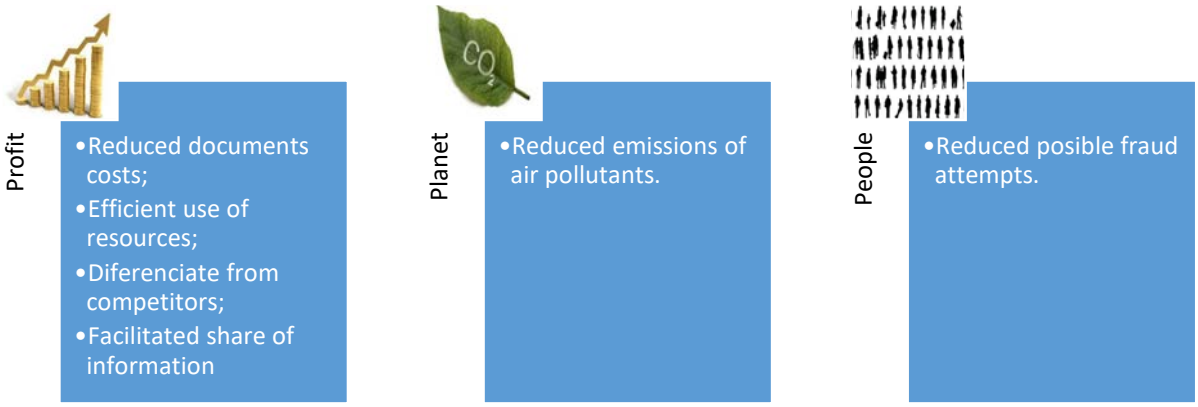
This cost-saving simplification saves time and, in addition, reduces the risk of errors and clarity issues. Via the Internet, it is also possible to provide all parties involved with direct access to the complete file from any working location. You can choose to send your documents to a printer or fax machine, to send them via e-mail, XML or HTML. Digital CMR takes care of the entire process of managing, updating and backing up of the SaaS application.

[10] CMR or Convention Relative au Contrat de Transport International de Marchandises par Route; International agreement concerning the contract of international freight road haulage.

Profit, planet, people

Although still in the initiation stage, the success of the digital CMR is comparable to the success of other innovations, which are orientated towards the shift of paper information to digitalized one. The success of this innovation case is measured through the perspective of other similar implemented initiatives. The main objectives, ranked by their importance, are to optimize the costs and to efficiently use resources. The CMR document is used to accompany the goods for the period that there are transported while containing information with this regard. This action can be also performed using other new technologies. The innovation will also have an environmental benefit as less natural resources are consumed. From the social perspective, there will be less positive effects, as it will imply less people that are handling the documents. As a backup plan for this draw back, the offering of new employment opportunities for personal is highlighted as to be considered.

Figure 37: Triple bottom line – Digital CMR



Source: own composition based on interview

Stakeholders

The process of establishing of link for, which only a digital CMR should be issued is only in the initiation stage. The inland terminal took initiative and stat the discussion to elaborate a legal framework, which can make this happen. The main issue in this process is the trust of electronic support and authenticity of data. One negative aspect for this innovation case is that other terminals, although interested to paperless transport, are not involved in the development process. It is truly believed that a greater involvement of many terminal will created the specific market demand, which will create a change also in the regulation. The main beneficiaries of this innovation case are the terminal operators and the freight forwarders, which will have less documents to handle, so less personnel to handle a too "bureaucratic" process.

Table 70: Stages of development of the Digital CMR

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminal operator	BCTN		
Freight Forwarder	Trucking company		
Regulator	Customs offices		

CLUSTER 3: IT INNOVATIONS SUPPORTING CARGO FLOWS

The innovations in this cluster are more focused on terminal activities whereby innovative containers and corridor management systems, improved scheduling of barges and optimized lane systems, try to improve terminal stacking of containers and processing of flows of goods.

22. Vado Ligure "Port Gate"

Claudio Ferrari, Alessio Tei and Maria Inès Cusano

APM Terminal is a global stevedoring operator belonging to the APM group. The innovation case introduced here below is connected to the new container platform under construction at the Savona-Vado port and it is represented by a new port gate system that should integrate different procedures for all the terminals located in the Vado Ligure seaport area. It is an open and private innovation, which is currently in the initiation phase and, which aims at a future incremental, technological, managerial, organizational and cultural business change.[11]

Table 71: Characteristics of the Vado Ligure Port Gate

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – business change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The APM terminal, which is currently under construction, represents one of the biggest Italian investments in new terminals. The foreseen terminal will be able to handle more than 700,000 TEU in about 210,000 sqm of operational area. It will be directly connected to both the national railway and motorway networks.

Table 72: Success and failure factors of the Vado Ligure Port Gate

Success	Failure
Improves mobility, reduces the waiting times and reduces the demand for physical space	Low involvement of freight forwarders and trucking companies

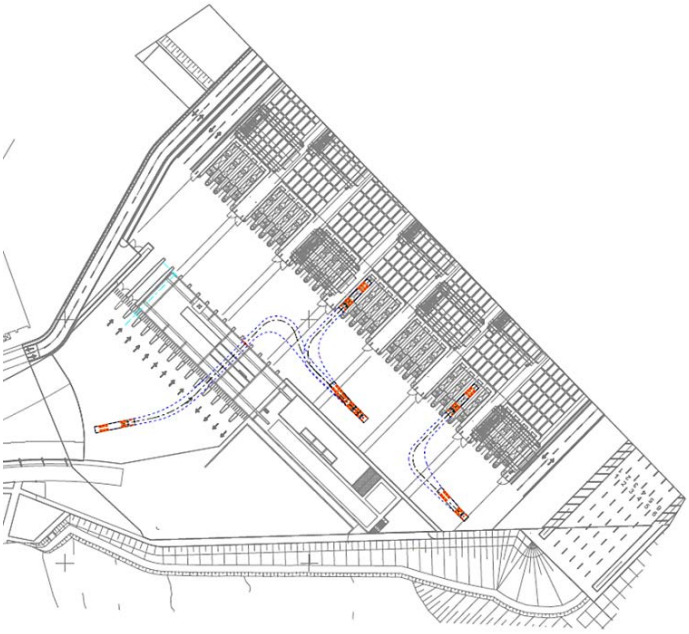
Together with the terminal project, several port improvements are currently under construction or are planned to be built before the opening year. One of these improvements concerns a new approach to the port gates that will help to manage the new coming cargoes, not only for container flows. The new port gate will be characterized by 15 (as foreseen in the preliminary project) reversible lanes dispatching trucks 'in line' both at Port and Terminal Gate, assuring safety and efficiency improvement compared to the traditional gate set-up. The blue dotted lines in Figure 34 show the lanes of the trucks at the terminal. The port truck-turnaround time is expected to be on average around 30 min (45 minutes during peaks) using a window appointment system that will facilitate trucking company deployment planning ("Pit Stop approach").

The innovation presented is an integrated gate that should optimize the traffic of all the cargoes managed by three different terminals (handling container - Ro Ro - bulk) in the port of Savona-Vado. Main goals are the optimization of physical spaces and administrative processes/procedures through the implementation of a technologically advanced Port Gate.

[11] In respect with the description, the "APM terminal" has started operations, in the meantime (since 2019), as the first automated terminal in Italy. The container terminal represented one of the biggest investments of the APM Group (together with other investors that took partial ownership of the new infrastructure) in Italy.

One of the success factors is that the innovation reduces the demand for physical space, waiting times and improves terminal mobility when compared with a more conventional way of handling. An identified failure factor is the low involvement of freight forwarders and trucking companies.

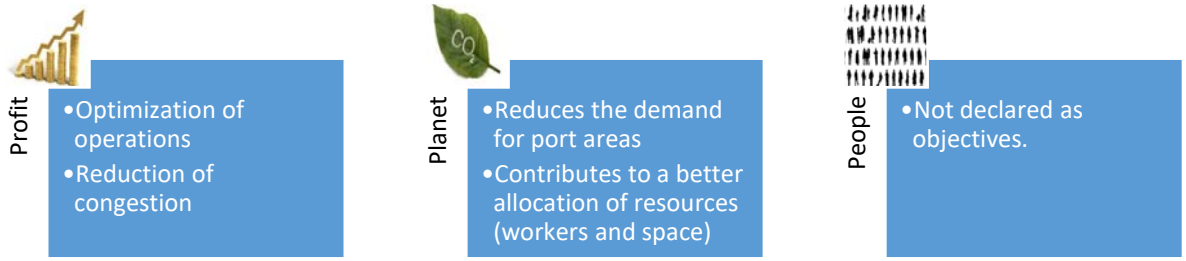
Figure 38: The Vado Ligure "Port Gate"



Profit, planet, people

The Port Gate goals are related to the optimization of the in-out flows of trucks with effects in the reduction of congestion and in the inefficiency related to the truck waiting time at the entrance (exit) of the terminal area. This innovation should then positively affect the cost of the trucks' movement and the negative externalities of the increasing freight traffic passing through the city of Vado in order to reach the motorway tool booth.

Figure 39: Triple bottom line – Vado Ligure "Port Gate"



Source: own compilation based on interview

Stakeholders

The Port Gate system will create several kinds of connections:

- The innovation will help to integrate and optimize the truck turnaround within the port areas, improving the interconnection among all the actors involved in the goods' arrival/departure planning operations. In particular, the port authority, port players, terminal operators and local authorities will be involved all together in order to achieve the foreseen goals. Concerning this aspect all the infrastructural and planning activity has to be shared by all the actors involved;
- The port gate will push also Regulation authorities and port stakeholders to improve collaboration in terms of procedure handling in order to achieve the foreseen optimization level. This mainly because of the needed organization of the flows and the timing importance in the "window appointment system";

- From a coordination point of view, the new port gate will also push new kind of collaborations among the terminal operator and its main partners (i.e. shipping lines and truck companies).

All the links appear at both local and regional level. These two layers are strictly connected due to the impact of the Port Gate on the operations inside the port and on the efficiency of the transport through the hinterland (Table 73).

Table 73: Development stages of the Port Gate

Level	☐ Initiation	☑ Development	☐ Implementation
Port authority	✓	✓	
Terminal operator	✓	✓	
Shipping lines Innovation sponsors	✓	✓	
Regulators	✓	✓	
Innovation sponsors	✓	✓	

23. 3PL- Primary Gate of Leixões at Port Leixoes

Rosario Macário, Vasco Reis

The 3 Party Logistics (3PL) Primary Gate concept in Leixões (Portugal) is a technological, managerial, organizational and cultural business change, which is currently in the implementation phase. The innovation is closed and privately driven while aiming at a system change. It is considered to be a process change in maritime transport.

Table 74: Characteristics of the 3PL - Primary Gate of Leixões

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

This innovation case acts as a one-stop-shop for truck drivers that deliver cargo to or pick up cargo from the port. The main objective is the elimination and optimization of the paperwork related to administrative and bureaucratic procedures on the access of the port by the road freight companies.

This is a subsystem integrated with the processes on the Port Single Window *JUP, which* is another port innovation in Portugal as analyzed in the previous cluster. Beside the gates for the entrance / exit and the dedicate road channel of the port, there was also a building on the same place that could be used as a command center to control the port in case of an emergency as a contingency plan.

This innovation case was driven by the necessity to change the entrance/exit of the port since the older solution conflicted with the urban space and created huge congestion and other externalities within the metropolitan area.

Location of the Port and the Primary Gate of Leixões

The port is surrounded by the cities of *Leça da Palmeira* to the north and *Matosinhos* to the South and, for the last decades, the growth of the population living near the port has been significant. The investment on road infrastructure did not anticipate the increase of port activities. As a consequence, the municipalities were suffering an enormous pressure from citizens to solve these problems.

Municipalities, Port Administration and Terminal Operators worked together to a solution where the other stakeholders could have their issues solved by an harmonized system that would control the entrance/exit of the port and improve performance of port operations, which an efficient port requires. Every port has its own characteristics. It has to be a place where maritime and land accesses find each other, which makes it an important interface in the multimodal transport chain while providing the link between foreland and hinterland.

Port of *Leixões* is located in the north of the country and is the biggest infrastructure on the region and second largest artificial port in the country, after Port of *Sines*. The port is located in a highly industrial and heavily populated area near Oporto City, which has good road links to some of the main Portuguese roadways. The area also benefits from a good air link due to proximity of an international airport. Moreover, the port is connected to the national and international railways network. The port receives passenger and freight ships, including every type of cargo such as containerized merchandise, liquid bulk (like crude oil, liquefied gas or wine) and dry bulk (like timber, cereals, sugar, etc.) The port also provides fishing and recreational harbors for the community.

Figure 37 illustrates part of the road infrastructure and buildings that hold the technology and the systems created for this innovation. On top, there are the gates where the verification of the truck driver is taking part. The central building with the command / control room and the different classified working stations are also shown. The right side of the figure shows an aerial view with the *Portico* where the weighting of the truck and freight happens together with the gathering of all data and information concerning detailed truck and container identification.

Figure 40: Port of Leixões

Source: Presentation of Leixões Port, Luanda 2013

Figure 41 shows the dedicate road access, which is built for the new gate entrance/exit of the port (within the yellow hexagon) and the location of the infrastructure that brings a great advantage to the all-around process. The VILPL (Via Interna de Ligação ao Porto de Leixões or the Internal roadway to access the Port of Leixões) is a dedicated roadway (3 km) that links the national highway network with the Port of Leixões.

Before the existence of the Main Gate (3PL), all the entrances /exits of containers to the landside where located in the surrounding port area. The electronic verification and identification of containers were not possible and, as a result of it, there was a massive truck congestion, waiting to receive all the needed authorizations.

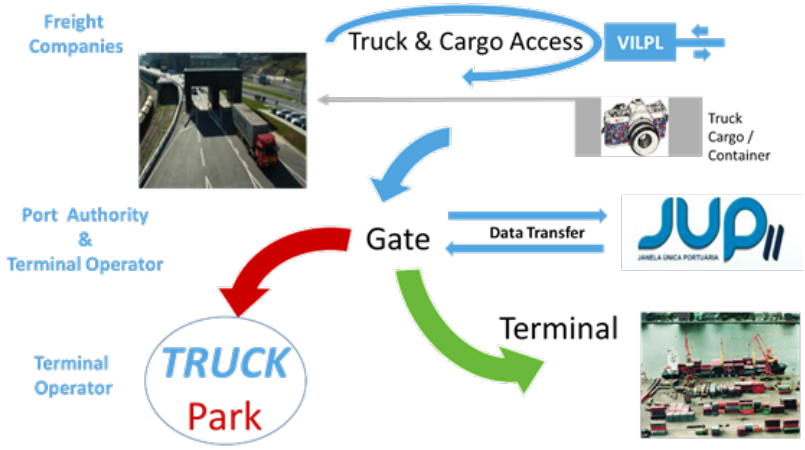
Figure 41: Air and hinterland links of Leixões Port

Source: Port Administration of port Leixões website adapted, 2014

The integration of procedures through the information flow produced by the Port Single Window JUP (a platform that allows the electronics transmission of data and the standard information of the administrative procedures applies to maritime transport functioning in Portuguese ports) brought, literally, a new breath to the surrounding area and eliminated some inefficiencies that were felt by the port community.

The technical details were not available. However, in general, what the 3PL Main Gate allows, is the identification and control of the vehicles and the containers while gathering all the particular details recorded by the images taken on the *portico*.

Figure 42: Schematic of the 3PL - Primary Gate



After viewing the information coming from the PSW JUP, the designated person (worker of Operators Terminal) gives the clearance to the driver to move into the terminal to unload the container. Simultaneously, the driver receives an indication from the terminal operator to move and place the container on the right place. This is possible because the systems are integrated with the container park management system. All of this avoids paperwork and makes the process reliable, safe and simple, while bringing large advantages, which are related to time reduction, costs and paper documents. On the reverse way (exit from the port), the same verification is made to allow the driver to leave with the container.

Brief outline of past/present situation

In the past, the entrance and exit points within the port were situated near the urban area. All the manual operations in retrieving information and documentation from truck drivers were also located in this area. The slower processing times resulted in relatively large waiting lines that made the trucks "invade" the urban area. Truck drivers needed to visit a few offices to unload /load the cargo in the port (customs office, foreign and border services, health and veterinary services, etc.), which caused delays and losses both economic as operational. The organizations that were obligated to effectuate the checking, were operating manually and the whole documentation had to receive their validation. Nowadays things flow very fast with all the paperwork available on the platform, which is easily accessible to check.

Success and failure

The port authority and the terminal operators achieved advantages because of the improved flow of trucks and road freight, which turned the operational space more organized while bringing efficiency to the whole port. For the community (municipality and citizens), the main benefit was that all the traffic was moved from the city roads. On the other hand, the freight companies have some issues to find this an improved solution, mainly because the parking place needed to solving unclear situations, is not enough. Drivers in such situations have to move far away to park and stop while waiting for new instructions.

Table 75: Success and failure factors of the 3PL - Primary Gate of Leixões

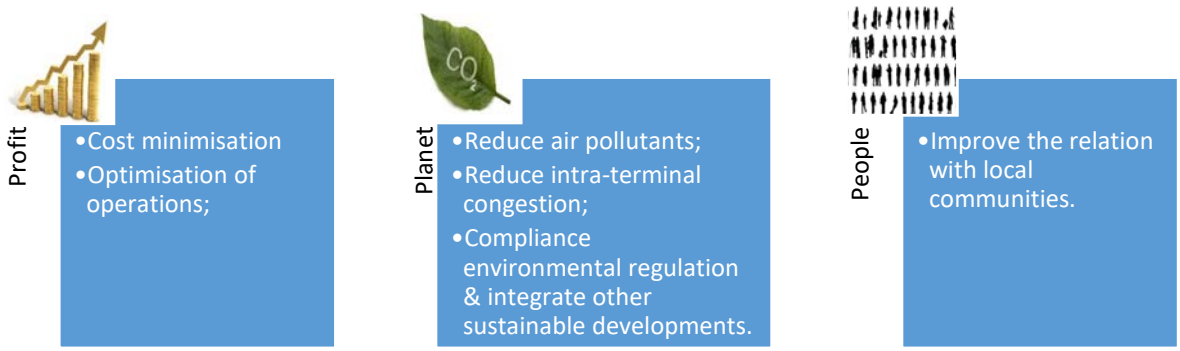
Success	Failure
Improved flow of trucks and road freight	Special situations where problems arise in truck clearance, force drivers to park far away

Profit, planet, people

The objectives of the 3PL Main Gate are, among others to reduce inefficiencies in port business processes, to facilitate the smooth flow of electronic data on the entrance/exit process, to integrate and achieve compliance with national and EU Directives, and to reduce the social and environmental impact on the community carried by the intensive port activity. Pursuing its objectives, the one-stop administrative shop for truck drivers tries to implement the following improvements:

- Reduction in time and costs for both government and private or public companies due to a more efficient use of resources;
- The simplification of processes, the data harmonization and the sharing of relevant information across governmental (customs) systems;
- The implementation of standards, techniques and tools for simplifying and expediting information flows between agents and port administration;
- Efficiency and effectiveness of control operations on terminals and on the surrounding area of the port;
- Elimination of congestion in the urban area.

Figure 43. Triple bottom line – 3PL – Primary Gate of Leixões



Source: own compilation based on interview

Stakeholders

The actors involved are the port authority (innovation champion), Terminal Operators TCL (Terminal de Contentores de Leixões) and TCGL (Terminal de Carga Geral de Leixões). The Customs Authority is also quite involved and responsible. The freight transportation companies represented by ANTRAM (Portuguese national association of road freight transporters), are present by a seat in the initiation and development stage of the innovation. In order to collect information about this innovation a number of interviews were performed, which gave insight on the innovation factors and the role of the involved actors during the developments stages.

In the initiation phase, the following factors were identified:

- **Infrastructure** – The involved actors were the major Port Authorities and Municipality, the Customs Authorities and Terminal Operators, who all had a robust relation and commitment to move the process forward;
- **Hard Institutions** – Because of political and administrative reasons, the Port Authorities were involved as much as possible. On a secondary level the Terminal Operators were involved because of their need to receive national and international standards and proceedings;
- **Soft Institutions** – On this parameter, there were no relevant connections identified between the actors and the innovation;
- **Weak / Strong Networks -** Throughout the initiation phase, there were no important actors outside the process. Still, Freight companies in each phase of the process, strive to get a platform to reduce inefficiencies and facilitate the flow of data through an electronic way;
- **Capacities –** Only the Port Authorities and Municipality have the financial capacity to fund the project;

- **Lock-in-effects –** All actors adapt their systems to the platform;
- **Market Demand** - The port authority invested with the objectives of implementing standards, techniques and tools for simplifying and expediting information flows between trades and administration; improved efficiency and effectiveness of control operations and consequently reduced times and costs. The innovation works along the PWS JUP platform and is able to be replicated as a model to apply on other markets;
- **Competition (innovations)** – There is no other product on the market identified, which is capable to compete with this innovation;
- **Competition (Port) –** This innovation brings to the port activity more visibility on the subject of efficiency. For those reasons Freight Forwards and Transport companies are the main active actors to move the innovation forward.

In the development phase of the innovation, the following factors and actor involvement were identified:

- **Infrastructure** - Still the same actors and the interaction is quite similar too as in the initiation phase;
- **Hard Institutions** – Similar to the initiation phase;
- **Soft Institutions** – Concerning this parameter, there were no relevant connections identified between the actors and the innovation;
- **Weak / Strong Networks -** Similar to the initiation phase;
- **Capacities –** Still only the port authority and the municipally have the financial capacity to fund the project;
- **Lock-in-effects –** All actors adapt their systems to the platform;
- **Market Demand** – Similar to the initiation phase. Systems Developers and Maintenance firms see this innovation as an opportunity to show their knowledge and expertise to the markets;
- **Competition (innovations)** – There is no other product on the market identified, which is capable to compete with this innovation;
- **Competition (Port) –** This innovation brings to the port activity more visibility on the subject of efficiency. For those reasons Freight Forwards and Transport companies are the main active actors to move the innovation forward.

Finally, during the implementation phase the following actors and innovation factors are identified:

- **Infrastructure** - Similar to previous phases;
- **Hard Institutions** – Similar to previous phases;
- **Soft Institutions** – On this parameter there were no relevant connections identified between the actors and the innovation.
- **Weak / Strong Networks -** Similar to previous phases;
- **Capacities –** Only the three major Ports Authorities had the financial magnitude to fund the project.
- **Lock-in-effects –** Similar to previous phases;
- **Market Demand** - Similar to previous phases;
- **Competition (innovations)** – Similar to previous phases;
- **Competition (Port) –** Similar to previous phases.

Table 76: Development stages of the 3PL - Primary Gate of Leixões

Level	☐ Initiation	☐ Development	☑ Implementation
Port authority	✓	✓	✓
Customs authority		✓	✓
Terminal operators	✓	✓	✓
Municipal Authority	✓	✓	✓

24. Container Management System of VIL

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Container Management System (CMS) of the Flemish Institute for Logistics (VIL) is a public driven open innovation with technological, managerial, organizational and cultural changes within a business unit. The innovation will introduce a systematic change but is still in the initiation phase.

Table 77: Characteristics of the VIL Container Management System

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The DP World Antwerp terminal is in a continuing expansion and anticipates a growing business. The ever increasing size of vessels is demanding more efficient and faster turnarounds. Antwerp Gateway, with its automated stacking cranes in the yard, is generating unrivalled productivity for its customers. As an expansion for its business, DP World Antwerp desires to have a better control over the containers, which are arriving/departing from its yard.

With the help of the VIL, DP World Antwerp has put together the basis of creating its own container management system. This system development has the aim to improve the efficiency of container management, while satisfying increased security, in global door-to-door intermodal container transport chains management.

In more practical terms, mobility is expected to increase and waiting times are expected to decrease. The system is offering the possibility to monitor the containers within the terminal, to help improve the clearance times on customs checks and access the information regarding the containers from different sources for better planning and operation management.

Table 78: Success and failure factors of the VIL CMS

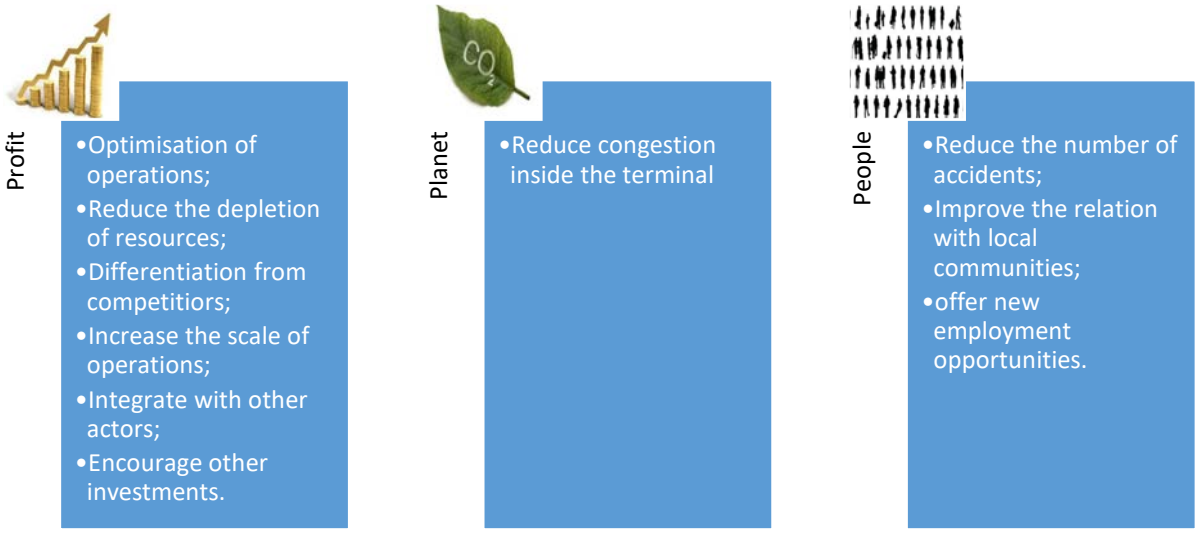
Success	Failure
Improves mobility and reduces the waiting times.	Low involvement of freight forwarders and trucking companies

Profit, planet, people

The current innovation case mostly aims at economic benefits. The most important objectives are to optimize the operations within the terminal and to avoid idle times for the available equipment. By increasing the availability of data regarding the containers, it is expected that more container operations will be possible. Therefore, even more transactions will be operated.

Another important point for the container management system to accomplish is to benefit more out the integration with other actors as well as to encourage other investment in related system. From environmental point of view, the congestion inside the container terminal will be reduced with less emissions as an indirect result. From social point of view, some positive effects are expected to be achieved by reducing accidents due to human errors. Also new employment opportunities and certification of current positions are viewed as important social objectives.

Figure 44: Triple bottom line – VIL CMS



Source: own compilation based on interview

Stakeholders

The container management system is currently only in the initiation stage. The proposed system is due to be integrated within the expansion of the current container terminal. Discussions regarding further developers have brought up together the following stakeholders:

- The innovation champion position is taken by the terminal operator, DP World Antwerp, which pursued latest technological achievement to be integrated within its terminal;
- The port authority, which is the concessionary of the land for the new developments and has the interest for encouraging developments, which are aiming for increased efficiency;
- The shipping lines for, which the waiting times due to slow procedures will be considerable reduced, so are taking primer benefits;
- Software providers, which have to put into practice, which the terminal operators and the other port stakeholders demand;
- And finally the European Commission as an institution with vested interests contributes by financially supporting the development through funding programs;
- Freight forwarders and road transport operators have an important role in the development process, but nonetheless they are not part of the initiation process (yet).

Table 79: Development stages of the VIL CMS

Level	☑ Initiation	☐ Development	☐ Implementation
Terminal operator	DP World Antwerp		
Port authority	APA		
Other terminal operators	PSA, MSC		
Shipping lines	CMA		
Freight forwarders			
Software developers	IT company		
Research institute	VIL		

25. Corridor Management System of BCTN

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Corridor Management System as developed by BCTN is a closed private-driven innovation, which aims at a radical managerial, organizational and cultural market change. The innovation is currently situated in the development stage.

Table 80: Characteristics of the BCTN Corridor Management System

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Cooperation between inland terminals can lead to the bundling of freight flows within the hinterland of major ports. A service network design model for intermodal barge transport is developed and applied to the hinterland network of the Port of Antwerp in Belgium. Selected cooperation schemes are simulated by means of a discrete event simulation model for intermodal barge transport and compared with simulation results of bundling in the port area. Cooperation between inland terminals offers an opportunity to attain economies of scale, but may not be perceived as a sole solution for reducing waiting times of inland barges at sea terminals.

The scope of this solution is to manage in an efficient way the barge traffic of the *Albertkanaal*, by integrating the locks and the barges that are requested in one single system. The aim is to reduce congestion and enhance the schedule of barges along the canal. The *Albertkanaa*l is categorized as a core inland port node within TEN-T. In reality, it is a stretch of waterway connecting Antwerp and Liège. Within the corridor, it is Therefore, considered as a cluster of freight facilities, implicitly including the canal itself and the area enclosed by the *Dessel-Kwaadmechelen-Bocholt-Herentals canals*.

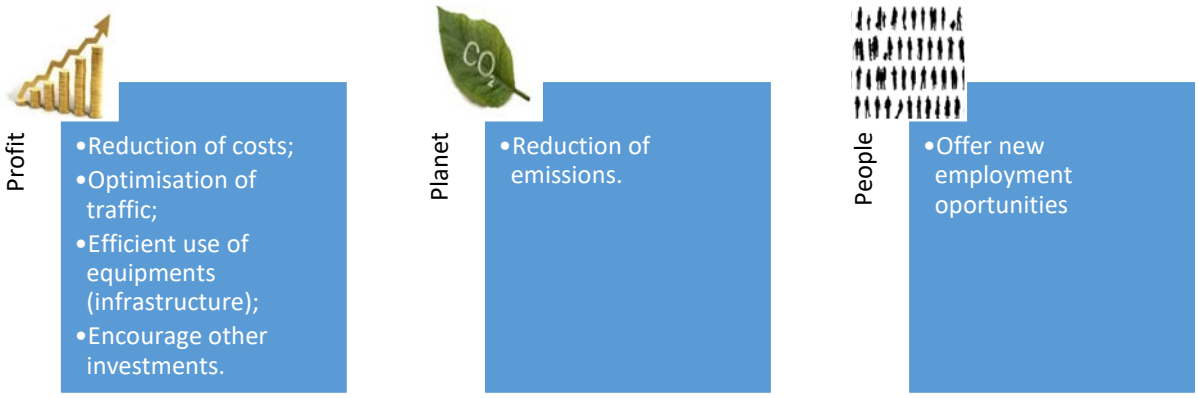
Table 81: Success and failure factors of the BCTN Corridor Management System

Success	Failure
Improve barge traffic on inland canals	Need the cooperation of all the inland terminal from a certain area in order to work effectively

Profit, planet, people

The main objective is to reduce the cost of navigation and minimize the travel time within the canal as well as to increase the efficiency of lock usage along the canal. The differentiation from competitors and the increased competitiveness of the inland waterway, were also important drivers for this initiative, but due to the intermediary development stage and current lack of involvement of each inland terminal operator, most of these objectives are not yet achieved.

Figure 45: Triple bottom line – BCTN CMS



Source: own compilation based on interview

Stakeholders

The initiative was taken among the inland terminals operators located along the *Albertkanaal* and it has the purpose to reduce traffic congestion and reduce the waiting times for passing through the locks. Due to the fact the initiative requires involvement of many operators, which in theory are competing with each other, there is the need of a central referee and financing institution for the project itself. A strong network was created with the IT providers and the shareholders. Research was also included in this action in terms of different projects, which resulted in an output that was used to estimate the traffic flow coming and going to each inland terminal.

Table 82: Development stages of the BCTN CMS

Level	☐ Initiation	☑ Development	☐ Implementation
Inland terminal	BCTN	BCTN	
Research Institutes	Range of different studies were consulted	Range of different studies were consulted	
Software developers	IT company	IT company	
Share holders	Other inland terminals	Other inland terminals	

26. Port-wide Lighter Schedule of the Port of Antwerp

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Lighter schedule of the Port of Antwerp is an open innovation that is public-driven. The innovation entails a number of technological, managerial, organizational and cultural impacts together with a targeted incremental market change. The innovation is currently in the development stage.

Table 83: Characteristics of the Port-wide Lighter schedule of the Port of Antwerp

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

In this analysis the Port-wide lighter or barge schedule in the Port of Antwerp is pushed forward by the Antwerp Port Authority (APA), which tries this primarily by improving the previous barge traffic system (BTS), which started two years ago, and the interaction level between the different terminals.

In this innovation case, actors of different levels are involved: people from a technological, managerial, organizational and cultural level were asked for their cooperation. The innovation case itself is open, but only for related parties. The implementation process has been incremental so far, which means that different aspects are implemented and developed step by step.

The APA heavily invested in an IT logistics system to improve the daily operations of the Port. In the past, all barges requested a call at their desired terminal at a moment when it suited them best. On top of that, there was little to no interaction between terminals, which often resulted in idle time of cranes. Moreover, the use of false figures resulted in inaccurate performance rendering and increasing waiting time when a barge is several hours late.

To deal with these problems during the barge planning process, the APA decided to start the project of port---wide barge planning. In this process, four different actors were involved: the inland terminal operators (BCTN), deep-sea terminal operators (PSA, MSC, DP World Antwerp), Combined Barge Operators (CBO) and the port authority.

At first, the former version of the Barge Traffic System (BTS 2.4) was updated to version 3.0, making it possible to calculate, which sequences a barge can do. This was a tremendous improvement since it enables the communication between the different terminal operators and between barge operators and terminal operators. It also provides the possibility for barge operators to know what the current capacity of each terminal is. This is important information for barge operators because it all depends on, which (free) capacity a terminal has at a given period of time.

If a terminal for example can only do 50 moves during a specific slot and 200 moves are needed to unload the barge, the barge operator better looks for another slot to pick up or drop off his load. The calculation of terminal sequences and the communication of terminal capacity are the two main ‘ingredients’ of the port---wide barge planning at the Port of Antwerp.

Besides the updated version of BTS, the port---wide barge planning system also involved a port--- wide terminal planning system. At that time, this was not an entirely new concept; PSA Antwerp was already

working with a comparable system. They had gained the experience by optimizing the planning of operations at their own terminals. PSA's system was designed by Ordina and based on technology from Quintiq, and uses all the information from BTS to generate an optimized barge planning from the perspective of the terminal operator.

In the future, barge operators will have to make a mind-switch in the way they are operating. Instead of requesting a specific time of arrival for each of the terminals, it would be far more efficient if the barge operator could provide his ETA and ETD and the sequences of the different terminals at the Port of Antwerp. In that way, barge planning can further be optimized because terminal planners are now able to give each barge its best suitable (un)loading program. It would also be possible to use BTS 3.0 for other types of ships and not only for containers. Implementing this technique is already possible for container vessels and is starting for ships transporting break bulk.

Table 84: Success and failure factors of the PWLS of PoA

Success	Failure
Improve the traffic within port, less waiting times, better use of port equipment/infrastructure.	Need to integrate all actors in one single communication platform.

Profit, planet, people

All of the most important innovation objectives for BCTN can be situated in the economic added value category. The first objective is the optimization of operations. The Port-wide barge schedule will provide more stability for terminal and barge operators, which will allow them to further optimize their operations.

Secondly, this innovation will have a positive impact on BCTN's competitiveness towards primarily trucking companies, in, which the stability factor plays a significant role. With the removal of uncertainty – such as delays at terminals and extra loadings and unloading of containers – barges will spend less time in port and the chance of delays will lower significantly. This increase in stability will increase on its turn the attractiveness of barge transport. A third major objective for BCTN was the efficient use of resources. The implementation of the Port-wide Barge Schedule would imply a reduction in the number of labor hours put into the planning of the container barges.

Besides these top priority objectives, two objectives were added to the list, namely stability and trust of the service providers. As already pointed out, stability is essential for barge transportation. With stable barge transportation, barge operators can guarantee their customers' the arrival times of goods. This allows them to create good relations with their customers, which will in addition increase trust in the barge sector.

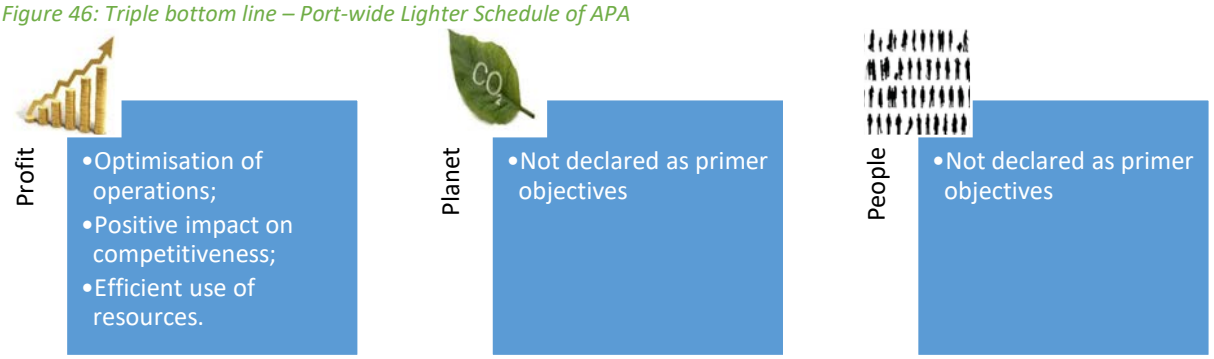
Furthermore, there were some objectives that were valued as significant in this research, namely cost minimization, integration with other actors and the encouragement of investments. The integration with other actors is an important objective for BCTN but their role in the integration process is rather limited to provide accurate information necessary to set up the planning. In terms of encouraging investments, BCTN's goal is to increase investments in barge planning and Therefore, BCTN is hoping to convince other operators that group benefits do not directly imply losses for the individual parties.

Besides the major objectives, there are also some expected side effects of the innovation like for example the reduction of congestion. Since this was not one of the main reasons of BCTN to participate in this innovation, these objectives were lower valued.

Since the innovation is still in its development phase, it is extremely difficult to analyze the success of the innovation in achieving the objective. Furthermore, the different tests that were performed were of inadequate length to claim whether the innovation will be successful. However, for some objectives, signs of success were already observed. For example, the integration with other actors has been very successful up to this point due to the willingness to cooperate. Furthermore, out of the tests that have

been done, the efficient use of resources proved successful with considerate reductions in the use of labor.

Figure 46: Triple bottom line – Port-wide Lighter Schedule of APA



Source: own compilation based on interview

Stakeholders

The APA, as well as the barge operators and the terminal operators needed to be – and also were – involved in this technological creation. The implementation of the new technology process can only succeed when all applicable parties work together and form a solid team that wants to reach an optimal solution for their problem.

After receiving feedback from the BCTN---representative, it became clear that cooperation between the different actors was convincingly present during the set---up of the Internet application, called BTS 3.0. The initiative---taking party – the Port of Antwerp – is, of course, the most present and leading actor in this process. This is the reason why BCTN labels the Port of Antwerp as a very reliable and co-operating partner.

Hard institutions that created rules to fall back on and created results, and soft institutions, who have the ability to create interoperable solutions, were contacted and convinced by the Port of Antwerp. Besides these institutions, also a strong network of people, knowledge and infrastructure was made available by the Port of Antwerp. However, the port was certainly not the only important player during this process. The terminal operators and the barge operators were also crucial in the initiation phase, since the Port of Antwerp needed cooperation from companies like BCTN.

BCTN experienced the regulation---creating and lobbying institutions from the terminal operators and other barge operators as positive just like the infrastructure that was provided. This is not surprising, since it is known that the strength of the links between the actors needs to be very high in order to become a successful process. This results in the fact that BCTN experiences almost all institutions and their actors to be successful in the initiation period.

There were rules needed to fall back on, if the new BTS would not be well implemented by the shipping companies. The APA, terminal operators and barge operators were the important players for this matter and are considered as the hard institutions. Concerning the soft institutions, only APA and terminal operators were involved. The APA and the harbormaster were the most important actors within the strong network. Barge operators and terminal operators were also important but less than the former two. Concerning the capacity, the APA was the most important actor and their job outcome was seen as very successful.

Concerning the market demand, the various actors had different goals. The APA saw BTS as another competitive advantage for the Port of Antwerp. The terminal operators on the other hand aimed at minimizing idle time for the cranes and barge operators at reducing inefficiencies when loading/discharging.

It is already mentioned that rules were needed to create a structural and understanding environment. These rules, that had to be established during the process, needed to be supervised and enforced on its turn. Everything that would have been invented or agreed upon during the development of the BTS-

--system would not be worth anything, if there was no organization that would be able to control the accomplishment of these new rules. The harbormaster was and is the ideal partner to enforce these rules and also hand out fines in case of violations.

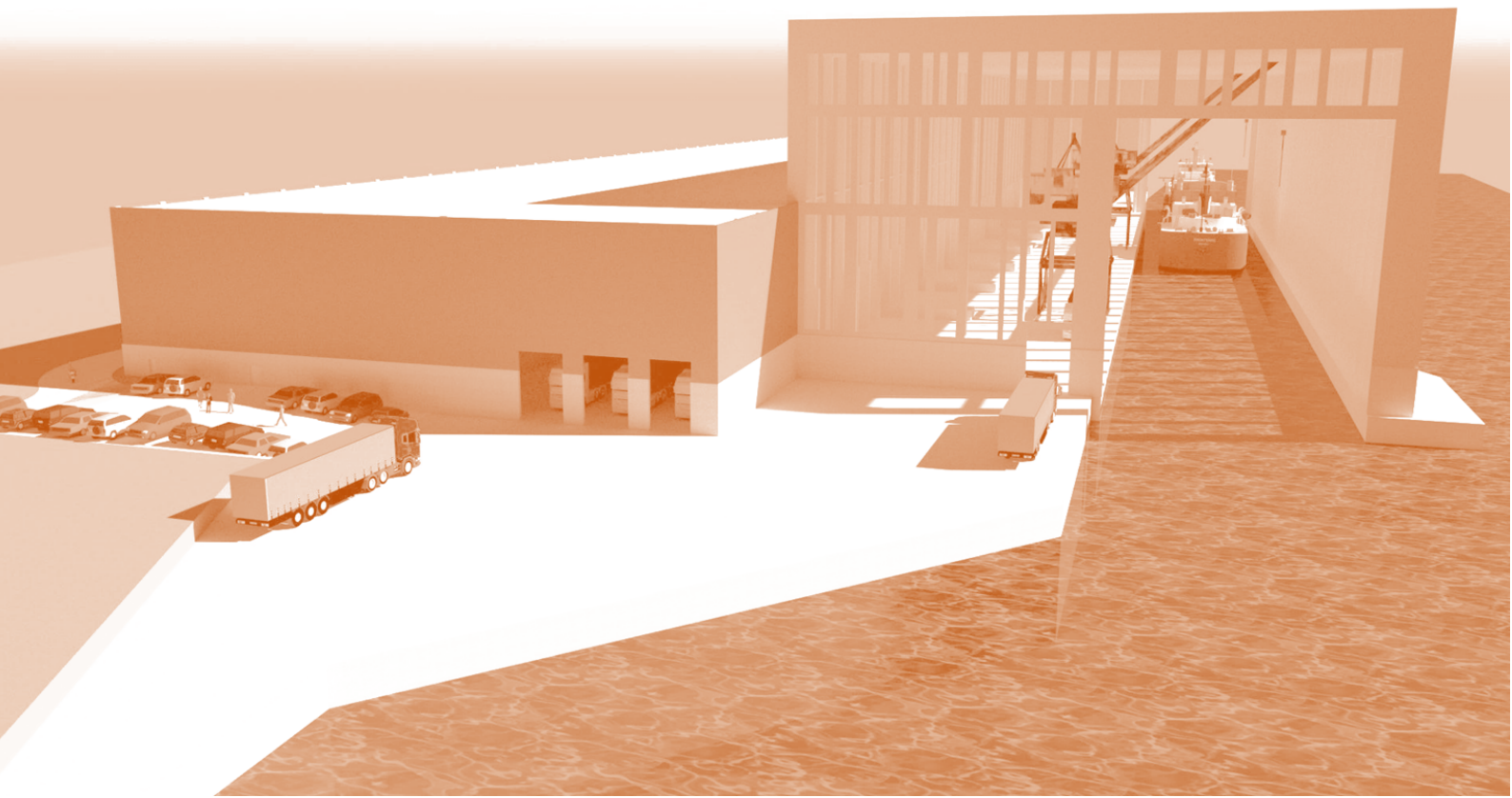
Finally, the competition aspect of the Barge Traffic System has to be covered. Regarding the provided data---sheet, competition---strengthening only occurs within the field of the APA. This is important because of the competition of 'Nextlogic' in Rotterdam in the near future. The Port of Antwerp will certainly benefit from this new BTS system because communication to its users will be much faster and clearer. Because of this efficient relation, the port will also be able to operate its cranes and other facilities much more efficiently, which –at its turn – creates new cost advantages regarding other important ports.

Table 85: Development stages of the Port-wide Lighter Schedule of Port of Antwerp

Level	☐ Initiation	☑ Development	☐ Implementation
Inland terminal	BCTN	BCTN	
Port authority	APA	APA	
Transport operators	Barge operators	Barge operators	

CLUSTER 4: INNOVATION SUPPORTING EFFICIENCY IN (UN)LOADING

In this cluster, the cases are mostly related to innovative equipment to facilitate loading and unloading of cargo such as automated stacking cranes or infrastructure such as an all-weather terminal. A more specific innovation, such as the S-bend on LPG carriers, tries to improve the compatibility between the LPG vessels and the terminal manifolds.



27. Bulk carrier self-loading/unloading cranes

George Sakkas and Athena Roumboutsos

The self-loading/unloading cranes for bulk carriers of the Chartworld Shipping Corporation (CSC) is a technological unit change, which is currently in the implementation stage. It is an open and private driven innovation that targets a modular change.

Table 86: Characteristics of the self-loading/unloading cranes of CSC

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Chartworld Shipping Corporation is a Ship-management Company that provides ship-owners with ship management services following their needs and expectations. The Company's ability to manage all types of vessels is known worldwide. Chartworld Shipping Corporation carried out the ship management of approximately 26 vessels (2014) at the moment of the innovation. The fleet consists of Bulk Carriers, Refrigerated carriers & General Cargo. The Company employs about 100 office staff and around 600 sea staff. The company's key objective is the minimization costs related to operations.

The innovation of the bulk carrier self-loading/unloading cranes consists of installing cranes on bulk carriers with the purpose of self-loading/unloading in ports with insufficient services. In the particular case, the innovation was required when serving ports in the Persian Gulf.

Table 87: Success and failure factors of the self-handling cranes of CSC

Success	Failure
More ports can be served More reliable and manageable labor force Cost reduction because of self-handling	Charterers and shipping companies were initially opposing

Profit, planet, people

Figure 47 shows the benefits of the innovation for the environment (planet), society (people) and for the private innovator (Profit). Port operations are targeted to be optimized by making the vessels less dependent of the availability of sufficient infrastructure in ports. Waiting time in ports can be reduced and resources can be much more efficient allocated.

Also because of the reduced time that is needed for the operations, the amount of emissions is also reduced, which decreases the impact of the activity on the port surroundings. By making self-handling possible, the training and skills of the handling personal are more reliable and manageable, which reduces the number of accidents.

Figure 47: Triple bottom line - of self loading/unloading cranes for bulk carriers of CSC

Source: own compilation based on interview

Stakeholders

Following the systems of innovation approach (as explained in the introduction), key actors or stakeholders were identified that were involved in adopting the process. The actors are the CEO of CSC, the head of the technical department, crew members, the shipping companies, charterers, loading/unloading terminals and a number of institutions.

The following innovation factors were also identified, which can be linked to the key actors:

- Infrastructure: Adjustments and additions to vessel infrastructure (cranes);
- Hard institutions: There is no obligation (at present) to adopt the innovation;
- Soft institutions: The company has a hierarchy according to, which employees of all levels are obliged to conduct activities;
- Strong Networks: Strong networks within the organization were in place;
- Weak networks: Between the company and the shipping companies and the charterers;
- Capacities: Crew members had the required capacities to undertake the loading/unloading operations;
- Lock-in effects: Charterers were in the initial stage opposing as this approach was against the "norm";
- Market demand: This could not be identified as available;
- Competition (innovation): This factor is regarded as not applicable because no other similar innovations were identified. There is However, a competition identified on the level of the Shipping Companies: Other vessels serving the Persian Gulf were applying the technique.

The CEO and the company understood the importance and benefits of carrying out the innovation for the company. Charterers and shipping companies were opposed initially, but were, then, stimulated and convinced by CSC to persuade the profitability of the innovation, especially as time in ports would increase. The profitability of the innovation is considered to be proven.

Table 88: Development stages of the self-loading/unloading cranes for bulk carriers

Level	☐ Initiation	☐ Development	☑ Implementation
Innovation champion (CSC)	✓	✓	✓
Charterers			✓
Shipping companies			✓
Terminals	✓	✓	✓

28. S-Bend on LPG carriers

George Sakkas and Athena Roumboutsos

The S-Bend on LPG carriers is an implemented innovation, which is private driven by a company called Eletson. The innovation is modular and was developed in an open approach to improve the technology of an equipment unit.

Table 89: Characteristics of the S-Bend on LPG carriers

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

During the last decade, Eletson has invested in LPG (Liquefied Petroleum Gas) vessels. The design of these vessels was not compatible with the loading/unloading equipment in certain ports. The vessels 'cargo manifold has to be connected with the shore by pipeline arms for transferring liquid cargo from ship to shore and vice versa. In some ports, the shore equipment is constructed to a specific and fixed height, which explains the mentioned compatibility problems. Because of this issue, the LPG vessels were limited in the number of ports they could operate. This restriction limit has an impact on the trading options of the vessel and consequently on the potential earnings.

The S-bend is an equipment that improves the compatibility between the LPG vessels and the terminal manifolds, which allows the LPG vessels to remove the restriction limits and gain access to more terminals and ports. The innovation has an "S" – shape and links the pipeline arm with the pipelines on the vessel (Figure 48).

Figure 48: S-Bend on LPG carriers

Success factors for the innovation are the number of ports and terminals than can be served and the fact that the innovation solves existing compatibility issues (Table 90).

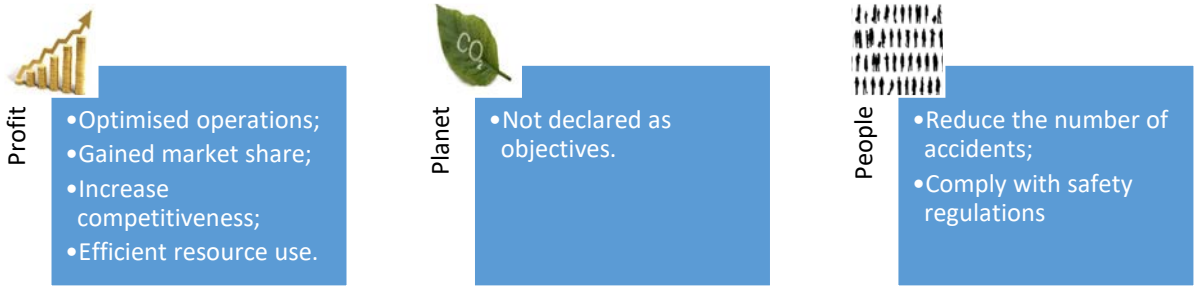
Table 90: Success and failure factors of the S-Bend on LPG carriers

Success	Failure
More ports and terminals can be served Solves compatibility issues	Not applicable

Profit, planet, people

The innovation was in line with the stated strategies as proclaimed by the Eletson Corporation. The optimization of operations of the LPG tankers and the increased compatibility with on-shore facilities increases the market share and operational area of the vessels. The solution increases safety and complies with the existing regulations.

Figure 49: Triple bottom line –of the S-Bend on LPG carriers



Stakeholders

The identified actors within the innovation network are next to the CEO of the company, also the head of the chartering department, crew members, shipping companies, charterers/clients, port authorities/terminal operators, manufacturers and financial institutions. The following innovation factors were identified:

- Infrastructure: Adjustments and additions to vessel infrastructure (S-bend)
- Hard institutions: There is no obligation to adopt the innovation;
- Soft institutions: The company has a hierarchy according to, which employees of all levels are obliged to conduct activities;
- Port Authorities/ Charterers/Clients pushed for the innovation;
- Strong Networks: Strong networks within the organization were in place;
- Weak networks: Between the company and the shipping companies and the charterers;
- Capacities: Crew members had the required capacities;
- Lock-in effects: Not identified;
- Market demand: Clients demanded this innovation;
- Competition (innovation): Not Applicable;
- Competition (Shipping Companies): Other vessels had already applied the technique.

Table 91: Development stages of the S-Bend on LPG carriers

Level	☐ Initiation	☐ Development	☑ Implementation
Innovation champion (Eletson)	✓	✓	✓
Charterers	✓	✓	✓
Shipping companies	✓	✓	✓
Terminals	✓	✓	✓
Port authorities			✓
Manufacturers	✓	✓	✓

29. Automated Stacking Cranes

Valentin Carlan, Christa Sys and Thierry Vanelslander

The automated stacking cranes (ASC) of DP World Antwerp Antwerp Gateway is a technological, managerial, organizational, cultural change of the business. It is already implemented as an open and private-driven innovation and aims to bring a radical change.

Table 92: Characteristics of the automated stacking cranes of DP World Antwerp

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The present concept of DP World Antwerp gateway at the Deurganckdock contains 14 automatic stacking cranes designed for a total capacity of 1,800,000 TEU. The envisaged capacity of the stakeholders for this terminal is to reach a total capacity of 4,800,000 TEU with a total of 96 operating automatic stacking cranes.

Figure 50: The present and envisaged situation of the DP World Antwerp Gateway stacking yard scheme

Present situation

Envisaged situation

Source: DP World Antwerp

The ASC innovation was privately developed within the terminal, together with the manufacturer and research institutes as a private technological achievement. Regarding the fact that every transport operator, shipping company or freight forwarder can have access to it, classifies the innovation as open.

The ASC are now being used in parallel with straddle carrier and stacking activity. The utilization share between those two types of equipment has a ratio of approximately 50-50 percent. The reason for the present share of operations inside the terminal is the unusual shape of the stacking area. As it can be seen in the figure below, the terminal is narrow in the north part and wider in the south and ASC could not be installed in the narrow area. Another thing that constrains stacking activity of DP World Antwerp in the northern part of the terminal is the presence of the chemical manufacturing plant, which for safety regulation does not permit high stacking in that area. Nevertheless, it was mandatory for the

terminal to improve its stacking capabilities and to implement a solution, which can offer high stacking density like automated stacking cranes.

The DP World ASCs are equipped with a rigid load guidance system, consisting of fixed portal legs on both sides and a vertical beam. This concept provides high positioning accuracy in severe conditions, without the need for visual positioning facilities.

Implementation of the present technological change is radical. The replacement of straddle carriers need a whole new infrastructure within a special designated area, installation of rail tracks, rail mounted gantry cranes and a new IT system that could coordinate the stacking activity.

Figure 51: Container stacking areas of DP World Antwerp at Deurganck Dock

The innovation introduces a better use of the stacking capabilities of the terminal through a semi-automated and iterative development process while making an interchange of operating technologies possible. These factors support the innovation to become successful. The fact that it still needs assistance of a human operator or special training of truck drivers can be considered as a failure factor. In addition, the difficulty to self-operate in bad weather conditions, presents challenges.

Table 93: Success and failure factors of the ASC

Success	Failure
Better use of stacking capabilities of terminal; Semi-automated process; Iterative development process; Easy interchange of operating technologies (video cameras, laser sensors…);	Still need assistance of human operator Need to train truck drivers; Difficult to self-operate in rain/snow conditions

Profit, planet, people

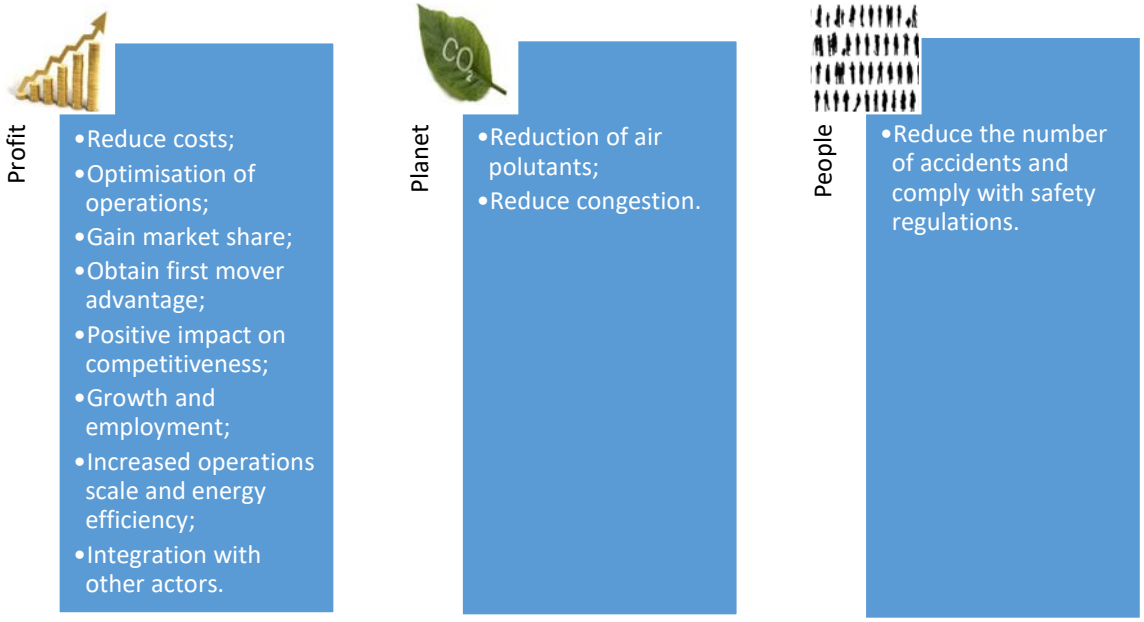
The economic set of objectives were all rated as highly successful. With the exception of objectives that where not targeted by the shareholders, the innovation case accomplished the desired goals. The only hesitation was shown on the benefit of “gaining of market share” due to change of economic background in the development period and economic crisis that overlapped with the implementation period. Another uncertainty concerns the possible “positive impact on competitiveness” and “growth”. A statement about these latter benefits could Therefore, not be made. Because of the overlapping of the economic background, actions of other competing terminals in the port and the development of other innovations, there was an influence upon the activity of the terminal itself.

The second set of objectives targeted by DP World concerns the environmental impact. As it can be seen from Figure 52, the main environmental objective was the reduction of congestion, which was

also successful. The new technological innovation reduced congestion on the stacking yard and optimized piling operations. Two other objectives, which did not represent the main target of the present innovation, were the "reduction of CO_2" and the "reduction of air pollutants". The latter were also successful. The environmental effect of lower emissions derives from the improved piling operations, which is provided by the new ASC.

The third set of objectives was centered on social added value of the present innovation case. In this case, the only two main objectives were to "reduce the number of accidents" and "comply with safety regulation". These objectives were also considered to be successful. In this field, there was also pointed out that non targeted objectives like "new employment opportunities", "reduce fraud attempts" and "improved efficiency of security requirements" were achieved. The present activity of the ASC is not fully automated because they need at least one person to supervise and correct their movements when necessary. Fraud attempts and security requirements where achieved by the nature of the ASC system as a whole. This concept lowers the contact with the human factor and the operations are only being undertaken inside an enclosed area.

Figure 52: Triple bottom line - of the ASC



Source: own compilation based on interview

Stakeholders

The first initiative, which was taken in the process of development of this new technical solution for the improvement of stacking density for the DP World Antwerp container terminal, was taken by the fifth party shareholders consisting of: DP World Antwerp, COSCO, ZIM ports, Terminal Link/CMA-CGM and Duisport.

In general, along with the shareholders initiative, a significant influence for this innovation case is held by the shipping lines, financing institutes as well as engineering and manufacturing companies, which all contributed to the success of the current innovation case.

DP World Antwerp has the position of the innovation champion, being the one who triggered the start of the present technological achievement and, which was an active actor on every level of interaction.

The APA had its involvement only in the initiation stage. The APA had to give its approval for implementation of the ASC project for DP World Antwerp as the new innovation was in line with its objectives of ensuring a more efficient container throughput. For a better stacking yard capacity usage, DP World Antwerp finally got the approval to start the initiation process.

The connection with other terminal operators was identified as weak. The ASC concept was not developed for the first time by DP World Antwerp. Therefore, important steps of the process could have been learned from other past experiences. Lack of knowledge did not played a crucial role in the beginning of the initiation process.

The shipping lines showed also a positive attitude regarding the infrastructure view of the ASC project and had also an encouraging push forward in the initiation period. A strong network was created in this way with the terminal shareholders. The access conditions to this terminal for the predicted capacity were established both from the sea-side. It should be mentioned here that there is a wide access to the Westerschelde and of course to the inland-side to the R2 highway.

Road transport operators' unions played an important role in the initiation period of the ASC project for DP World Antwerp. Due to the fact that the supposed system was not entirely automated, truck drivers had to be trained and tested in order to have access to the new loading and unloading equipment, which meant extra activity for them.

A wide range of institutions represented the capacity-building stakeholders that contributed to this technological innovation. Here can be mentioned TU Delft and TBA Rotterdam as commercial research institutes and financing institutes; ARCADE as a civil engineering company and Gottwald as the manufacturer of the equipment. They all had a strong implication in the project. For example, there were also other long term interests for Gottwald to have the certitude of implementation of this new kind of equipment among DP World Antwerp in order to duplicate the same system and transfer the knowledge to other DP World Antwerp terminals.

In the initiation period, a strong competition was sensed form the direct competitor of DP World Antwerp in the Port of Antwerp from PSA and MSC. During the development stage of the ASC the implication of the initial actors did not change. The beginning of the development period meant the beginning of the ASC installation within DP World Antwerp.

The attitude of the unions changed from being against the installation to being indifferent at the change that was about to happen. The implication of shipping lines also decreased due to periodical technical adjustments that had to be made in order to overcome a set of difficulties that were not predicted during the initial planning.

A safety and technological issue that had to be overcome was the wide range of trailer chassis dimensions. A fixed algorithm could not be created, Therefore, the constructors of ASC had to think of a solution and came up with the use of video cameras in order to locate the twist locks for the container drop-off/pickup on/from the truck trailer. During the installation of the video cameras, it appeared that unfavorable weather conditions could reduce the success rate of fully automatic operations.

Another safety issue that had to be overcome were human errors together with a backup system. For example, some truck drivers forgot to open the twist locks that fix the container on their trailer and in some cases, the containers ended up being lifted together with the truck trailer. To back up the possibility of human error potential, the manufacturer of the ASC introduced a pause in the lifting procedure so that drivers can check if the container is loose from the trailer and if not to immediately stop the lift.

The involved stakeholders are convinced by the productivity of the automation stacking process and they are currently thinking of enlarging the number of the ASC. The past experience has proven not only a better yard usage but also in combination with FATS (Full Automated Truck System), it also optimizes the piling of containers while contributing to less fuel usage and time savings in operations.

The current performance of the ASC at DP World Antwerp is 85% fully automated pickings and 65% fully automated putting on the chassis. The present ratio is due to the use of a video camera, which detects the position of trailers twist locks. A valuable feature of the present system is that it is not fully dependable of the video system as it can be replaced with a laser solution for better accurate and independence in relation with elements for example the DP Word London solution. As it was expected,

the manufacturing company Terex Gottwald obtained the safety certificate for the ASC operation in fully automated mode and the manufacturing process is still in progress.

Table 94: Development stages of the ASC of DP World Antwerp

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal Operator	DP World Antwerp	DP World Antwerp	DP World Antwerp
Port authority	APA		
Shipping lines	Deep sea shipping lines	Deep sea shipping lines	Deep sea shipping lines
Unions	Dockers union, Road transport operators' unions		Dockers union
Research Institute	TU DELFT (TBA)	TU DELFT (TBA)	TU DELFT (TBA)
Engineering developer	ARCADE	ARCADE	
Financing institution	Banks	Banks	Banks
Equipment manufacturer	Gottwald	Gottwald	Gottwald

Deploying the ASC automated stacking cranes in container stack yards in large terminals provides increased stacking density and, as a consequence, reduced land use, high-speed access, and rapid container storage and retrieval.

The success of this innovation was proven all around the world and not only by the specific actors, such as DP World Antwerp shareholders or Terex Gottwald as manufacturers, but also by other terminals, companies and developers. The success of the present innovation case of using ASC by DP World Antwerp, was pushed forward by the good collaboration between al the actors involved in all process stages, the constant concern on operational improvement and the safety requirements. DP World Antwerp has the position of innovation champion, which started from a practical concern regarding the stacking area. The optimization started a trend amongst DP World Antwerp terminals.

The economic success of ASC is ensured by low maintenance and operating costs. Even though the capital cost for implementing a technical innovation like ASC is relatively higher, the benefits, which are experienced are even better. Comparing the classical yard stacking system by using straddle carriers for piling, the new innovative ASC disposes a lot of additional costs like crane operator training, diesel in exchange for electricity consumption, extra container shuffling due to un-automation of piling and others, which results in more claimed benefits than costs.

30. Heavy Cranes

Valentin Carlan, Christa Sys and Thierry Vanelslander

The installation and development of heavy cranes at a terminal is considered to be a private - driven closed innovation that aims at a modular and technological unit change, which is already implemented.

Table 95: Characteristics of insourced Heavy Cranes

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

Instead of hiring heavy cranes from a port company, a company can decide to invest themselves in specialized terminal equipment, viz. 2x 200 tons G HMK 8710 Terex Gottwald cranes. This type of cranes, when compared to 800 ton cranes, is mobile shore crane, which increases the flexibility of the terminal's operations.

The use of heavy cranes represented an important breaking point as the company could organize the operations internally and there is no need for hiring and scheduling the stevedore operations according to the availability of external equipment.

The success factors for using the heavy cranes are the increased flexibility, doubling of the capacity that could be handled and the avoidance of the extra margin that had to be paid for external equipment (now due to insource it is not cashed out). The identified failure factor appears when the cranes operations reach the critical mass that can be handled. This limiting factor can be surpassed by strict planning. Furthermore, due to the new technology, own employees need special training.

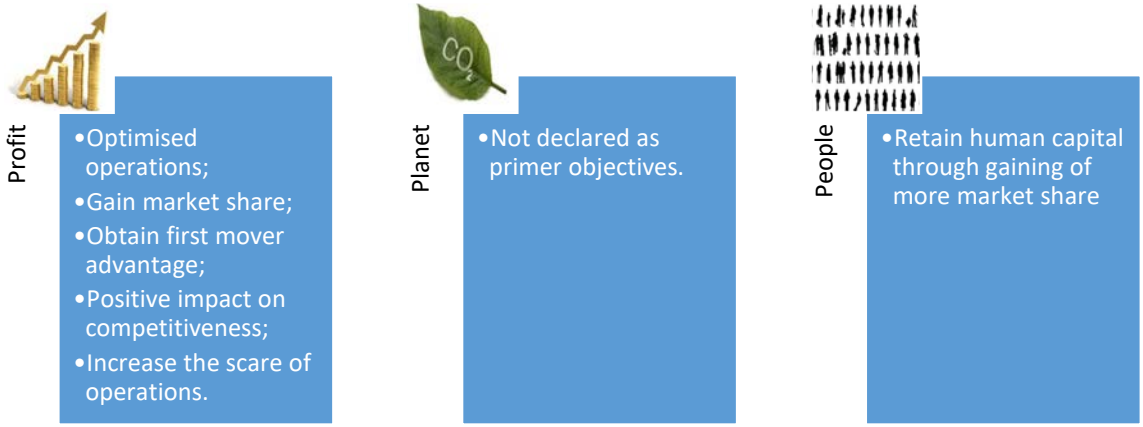
Table 96: Success and failure factors of insourced heavy cranes

Success	Failure
More flexible operations (not hiring other equipment beforehand); More autonomous; Capacity increased form 224 - 400 t (two cranes combined) Avoid part of margin to external equipment (insourcing/stay internal --> no cash out; Accountancy point of view: improve cash flow)	Critical mass handling; need to train the employees for the new technology.

Profit, planet, people

The main objectives were to minimize the cost of operations by internalizing the use of equipment. Moreover, efficiency of stevedore operations and more market share was possible through this innovation due to in-house operations and flexibility of the new acquisitions. On the social level, new employment opportunities could be offered. As well as the risk and number of accidents was lowered. Other objectives like the improvement of service, increased the satisfaction of clients and gained trust of collaborators through more reliable operations.

Figure 53: Triple bottom line - of Heavy Cranes



Source: own compilation based on interview

Stakeholders

The change of operation of the stevedore company was done through the acquisition of two Gotwald heavy cranes. The cranes are designed to perform loading and unloading operations together and manipulate oversized cargo. The main stakeholders who demanded for a change in operations were the shipping lines, which wanted to enhance the berthing process and improve the usage of their vessels capacity. The communication during the building and acquisition process was done between the stevedore terminal, which was the direct beneficiary of the new equipment, and the manufacturer company. The main benefit of this initiative is for the break bulk terminal operator, which managed to internalize its cost and improve its cash flow.

Table 97: Development stages of insourced heavy cranes

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk terminal operator	Zuidnatie	Zuidnatie	Zuidnatie
Shareholder	DP Break-bulk	DP Break-bulk	DP Break-bulk
Equipment builder	Gottwald	Gottwald	Gottwald

31. All-weather terminals (Waterland)

Valentin Carlan, Christa Sys and Thierry Vanelslander

This is actually not one case but four different cases of all-weather terminals that are examined together. The installation and development of all-weather terminals by Waterland is considered to be a private – driven innovation that aims at a modular technology – unit change, which is already implemented.

Table 98: Characteristics of the all-weather terminal of Waterland

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The Waterland terminal in Amsterdam was the first company, which upgraded the stevedore operations from working on weather dependent conditions to a controlled environment. The purpose of the covered terminal is to provide a completely covered logistics chain for all moisture and weather sensitive cargoes.

The development of the all-weather terminal took place over several stages, which expanded the covered area to four different terminals.

The first all-weather terminal was operational in 1998 and was developed to increase the quality of services of the terminal towards its clients. The main product, which was handled by the terminal in that period was iron. The first hurdle to overcome was finding the financial support. Due to this problem the construction process was prolonged until the end of 1997. The main reason of this hurdle was the low volume of iron that was contracted until that time. After the opening of the terminal, more cargo was attracted. As a result, the terminal became more flexible regarding the operations and finding sufficient financing for the next initiatives was no longer an issue.

The second all-weather terminal of Waterland was inaugurated in 2002. This represents a breaking point of the period of low trust of financing institutes towards covered terminal developments. On top of extra capacity, under controlled weather conditions, the new terminal could incorporate other features that were regarded as bottlenecks during the development and operation of the previous initiative. Moreover, one of the main purposes of the second terminal was to ensure transshipment operations between different modes of transport and also between barges or other vessels. The financing issue was no longer a hurdle and the terminal was completed in the initial due time.

The third all-weather terminal, developed within the Waterland side, was finalized by the end of December 2007 after the building of the second one. The same reasoning of extra capacity insured the success of the third terminal development. Similar with the previous scenario, new features where incorporated and also transshipment operations could be performed within controlled conditions. The development of the third Waterland terminal set the basis of an all-weather terminal network, to, which several stevedore companies from Western Europe adhered, although they were in competition with each other.

The fourth all-weather terminal from Waterland is currently in the development stage. The same reasons of extra capacity and gaining market share applied also for the fourth development. The

expansion of the covered terminals within the same stevedore company, proves the success of performing loading and unloading operations under a controlled environment. Lessons, which have been learned from one terminal development to another, have been applied. The necessity of specific width or height, as well as indoor crane capacity, have been upgrades, which improved over time.

Table 99: Success and failure factors of the all-weather terminals of Waterland

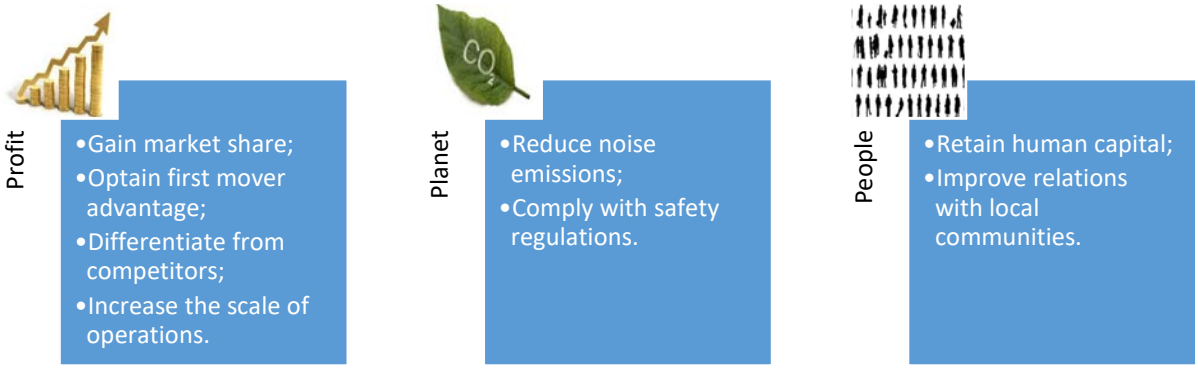
Waterland terminals	Success	Failure
All-weather terminal 1	Attract more volume; more flexible; being more efficient;	Too narrow; trouble with finding financing at the beginning
All-weather terminal 2	Reasons for building it: extra width needed, used for transshipment operations. Banks show more interest	n/a
All-weather terminal 3	For extra capacity reasons; Banks show more interest	
All-weather terminal 4	For extra capacity reasons;	

Profit, planet, people

The objectives for building the all-weather terminal were mainly economic, through the new facility the company could have improved its competitiveness and earn more market share. The economic gain in this case is mostly due to the increase of scale of operations and differentiation from competitors. The new services provided by the terminal were tailor made, accordingly to the requests of the steal market.

The optimization of operation was not a direct objective, but it was gained through the warehouse, which was built on landside. From the environmental perspective the terminal lowered the emissions through new environmental technologies use, reduced the noise impact moving the activity indoors and was integrated with other sustainable developments by using energy coming from solar panels installed on the building's roof. From a social point of view, the terminal offered new employment opportunities after it increased the activity of the company. It also improved the relations with local communities because of building an enclosed space for metal process. Moreover, the all-weather terminal had the main objective to reduce the damage of the cargo during its handling. It can also be used as an advertisement to attract the client's attention towards port of Antwerp.

Figure 54: Triple bottom approach of the all-weather terminal



Source: own compilation based on interview

Stakeholders

The initiative of building a controlled environment for loading and unloading operations, was taken by the terminal operator itself and involved the commitment of the port authority, shipping lines and financing institutes. Labor unions had a positive involvement and supported the development of each terminal, because it brought several benefits such as: improved working conditions, increased number of employees, gained market share and insured long-term contracts.

Financing institutes were skeptical regarding the new covered terminal, because of lack of previous experiences regarding this type of development. This incertitude caused delays to the first terminal, due to lack of funding. This gap was overpassed with the help of the port authority, which understood the benefits that the port itself could have, due to the increased scale of operation. Collaboration of shipping lines was a key aspect for the technical specifications of the new terminal development, the size and requirements of each ship were taken in consideration when the development of each terminal was taken into account.

Table 100: Development stages of the all-weather terminals of Waterland

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk terminal	Waterland	Waterland	Waterland
Port authority	Amsterdam Port Authority	Amsterdam Port Authority	Amsterdam Port Authority
Shipping lines	Barge operators		Barge operators
Unions	Dockers union	Dockers union	Dockers union
Municipality & Society	Amsterdam municipality	Amsterdam municipality	Amsterdam municipality

32. All-weather terminal (Wijngaardnatie)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The all-weather terminal of Wijngaardnatie in Antwerp is a technology - unit change that is currently implemented. The innovation is open and private-driven. The all-weather terminal followed an incremental innovation path.

Table 101: Characteristics of the all-weather terminal of Wijngaardnatie

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The implementation of the all-weather terminal did not only represented a change within the business, but also a market change by bringing new types of cargos to Port of Antwerp through the extra services that were provided. For example, there are customers, which specifically request for their cargo to be handled in a controlled environment without assuming any risk, together with transshipment services loading to trucks, rail or barges. The innovation itself needed new technological developments, a new managerial and organizational supply chain approach. Also the loading and unloading of ships within an enclosed environment needed a change in mind sets and culture of stevedoring. The all-weather terminal is a recent innovation, which is continuously improved and upgraded with new equipment (overhead crane from 32 tons to 50 tons). It is open as it can be implemented in any other port or location. It represents a private initiative and it was developed incrementally. The incremental degree of the all-weather terminal is seen from the present perspective while evaluating the new features and services that it can provide (controlled temperature and humidity, crane upgrade, new space being added…etc.).

The success factor of the all-weather terminal is the unique service that it can provide in the port area of Antwerp. Other success factors are service quality; the effective response on customer demand of the steel sector, which needs this specific type of facility; the use of overhead cranes instead of the shore cranes, which fastens up the process; less damaged cargo; suitable for other types of cargoes than steel; and the hub function due to the location in the Port of Antwerp.

A possible failure factor was the economic crisis. The terminal was put into service just at the beginning of the crisis. Therefore, its economic efficiency was questioned and the company felt that the investment would not bring the estimated turn back. The drop in the steal market had the most influence on the terminal usage, because most terminal users are active in this market.

The all-weather terminal of Wijngaardnatie encouraged the start-up of a new activity in the proximity of the warehouse. By discharging the steal in an enclosed area, the steel could also be processed on the same place of discharging. This shortens the logistic chain and brings added value to the initial products. This is the reason why the steel service center was brought up as an idea and afterwards implemented.

Table 102: Success and failure factors of the all-weather terminal of Wijngaardnatie

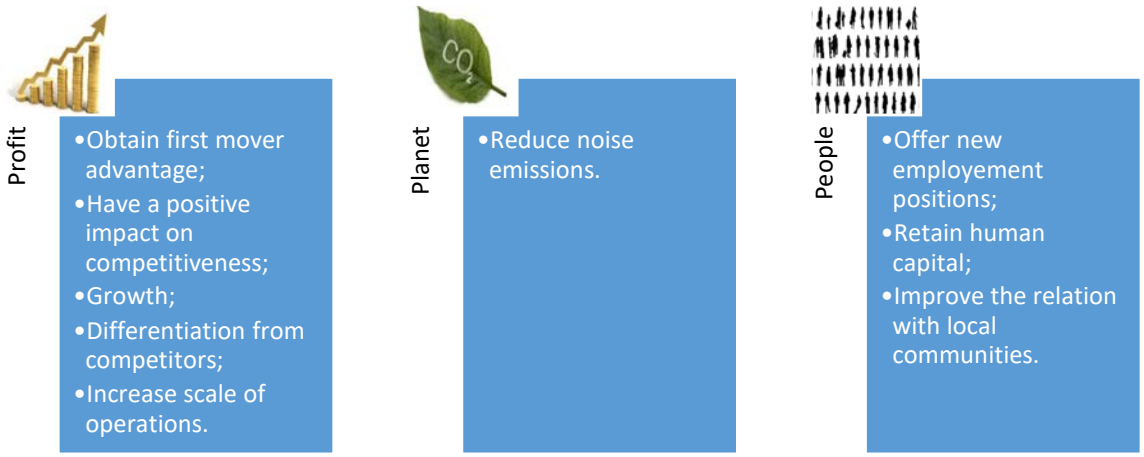
Success	Failure
Increase quality level of service Less damage on cargo New customers Control of humidity and temperature features Hub function, due to position in port	Crisis in steal market at the beginning of construction.

Profit, planet, people

The objectives of the all-weather terminal were mainly economic. Through the new facility, the company improves its competitiveness and can earn more market share. The economic gain in this case is mostly due to the increase of scale of operations and differentiation from competitors. The new services provided by the terminal were tailor made accordingly to the requests of the steal market. The optimization of operation was not a direct objective, but it was gained through the warehouse, which was built on the landside.

From the environmental perspective the terminal lowers the emissions through the use of new environment-friendly technologies. Furthermore, it reduces the noise impact by moving the activity indoors. The terminal is integrated with other sustainable developments by using solar energy, which is generated by panels on the building's roof. From a social perspective, the terminal offered new employment opportunities because of the increasing activity of the company. It also improved the relations with local communities because of the enclosed space for the metal process. Moreover, the all-weather terminal had the main objective to reduce the damage of the cargo during its handling and also to be used as an advertising to attract the client's attention towards Port of Antwerp.

Figure 55: Triple bottom approach of all-weather terminal of Wijngaardnatie



Source: own compilation based on interview

Stakeholders

The development of the all-weather terminal within the Port of Antwerp needed the initiative of Wijngaardnatie; the contribution of the APA for the land concession and support for building the necessary quay infrastructure; and the feedback of shipping lines regarding the specific requirements that they needed to benefit from. On the infrastructure level, an engineering company together with a financing institution, were involved during the initiation and development phases. From a legal point of view, the insurance company needed a fire safety certificate, which slightly hardened the process and involved also an agreement with the APA. The market demand was driven by the shipping, freight forwarders and by the APA, which had their interests in building up new services and in improving the marketing image of the port.

The port owns the land and can give it in concession to terminal operators. This means that everything, which is built near the quay and under the water, is done by the APA. Wijngaardnatie has to pay for the concession for the construction itself, while the utilities and equipment are brought up by the Port of Antwerp. This indicates that a strong relation exists between the two actors.

In the initiation phase, there was no engineer expert. The expert was only involved in the development period. The contribution of the expert was needed to certify that the use of the overhead crane would not damage the structure and harm the safety of the workers.

During the development phase, the shipping lines were not actively involved anymore on the infrastructure level, but they still demanded for the construction of the terminal. Also during the development period, a subsidy from the Flemish government was requested and received. Moreover, shipping lines and the APA started to show more interest for the status of the project and to realise that the all-weather terminal could be of competitive advantage for the port itself.

During the implementation period, the APA was no longer involved in the infrastructure, but remained in the network that was created with the innovation champion. An external company joined the network for the maintenance of the terminal. On the level of legal aspects, insurance companies were involved with regard to equipment such as cranes or new solar power stations, which had to comply with special legal requirements. The building of the terminal did not create any lock-in effect. As a result, new features could be added at any moment without problems. All involved actors acknowledge the success of the terminal and its positive impact on port competitiveness.

Table 103: Development stages of the all-weather terminal of Wijngaardnatie

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk terminal	Wijngaardnatie	Wijngaardnatie	Wijngaardnatie
Port authority	APA	APA	APA
Shipping lines			
Research Institutes	Construction builders	Construction builders	Construction builders
Financing institutes	Bank	Bank	Bank
Engineer expert		Consultant	

33. All-weather terminal (Grupo Nogar)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The all-weather terminal of Grupo Nogar is private-driven innovation, but with a contribution of the public port authority. As an innovation, the all-weather terminal follows a an incremental path towards a change in used technology. The terminal is already implemented and operational.

Table 104: Characteristics of the all-weather terminal of Grupo Nogar

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Grupo Nogar is the terminal operator of Port of Coruna. The initiative to build the all-weather terminal was developed by the consortium of the stevedore company and the port authority. The main goods that are transferred through the terminal are wood pulp. The terminal increases operating time and avoids. Another aspect, which was considered to be relevant to construct the terminal, was a better and clean service for loading and unloading operations.

The terminal was finalized in 2002 after a process of approximately 2 years. The main success factor is that the ships do not have to wait for better weather conditions to open their hatches or that they have to be deviated to other terminals. After the construction of the All-weather terminal, the company gained more market share by attracting new customers. Another important decision that changed the development process, was to adhere the all-weather terminal network, which offered the opportunity for the developers to visit and learn from other developments in Amsterdam and Rotterdam. No failure factor was identified that could be of any hurdle for the all-weather terminal construction.

Table 105: Success and failure factors of the all-weather terminal of Grupo Nogar

Success	Failure
No need to close the hatches of ships or deviate from the schedule (- 40%); Attracting extra companies.	N/A

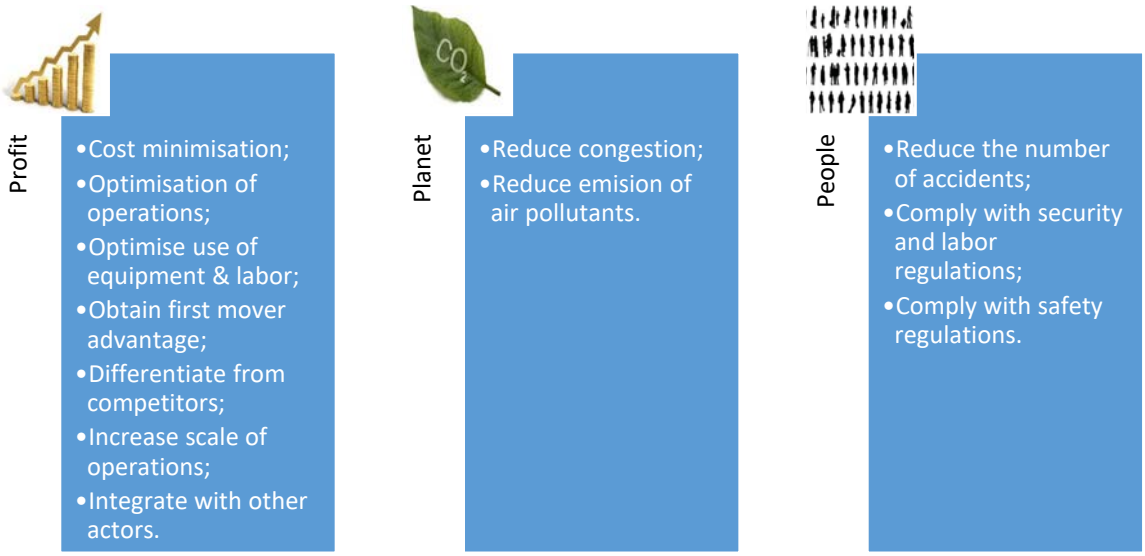
Profit, planet, people

The main objective of the all-weather terminal development in port of Marin was to improve the cargo handling environment and to improve the planning of the working schedule. The stevedore company often dealt with the situation that ships had to be deviated or directed to other terminals due to weather conditions. Moreover, the working conditions for the employees were unsafe and they were exposed to bad weather.

The benefits of the terminal were new market share, improvement of the reliability of the terminal and a complete service in contrast with other terminals. On the environmental level, the terminal is complying with current regulations in order to reduce the emission and impact of the activity on the environment; it reduced the congestion within the port thanks to longer operation hours and also reduced the noise of operations. Socially, the covered terminal managed to reduce the number of

accidents and cargo damage while offering a better working environment. Due to a more reliable activity, the terminal retained its human capital during the crisis.

Figure 56: Triple bottom approach of all-weather terminal of Grupo Nogar



Source: own compilation based on interview

Stakeholders

The main contribution for the construction of the terminal came from the port authority and the terminal operator. These two port stakeholders are the main beneficiaries of the terminal construction. The shipping lines were involved in the initiation and the development phase to determine the ships sizes. They also helped to estimate future demand. The municipal authorities were involved as infrastructure concessionaries and had to give specific authorizations while monitoring the building up the process. A special stakeholder, which was involved in the process, was the minister of defense due to the location of the nearby army barracks. The minister had to agree with the construction of the covered terminal.

Table 106: Development stages of the all-weather terminal of Grupo Nogar

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk operator	Grupo Nogar	Grupo Nogar	Grupo Nogar
Port authority	Port of Marin	Port of Marin	Port of Marin
Municipality	Marin municipality	Marin municipality	
Research institutes		Civil Engineers	

34. All-weather terminal (Port of Kokkola)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The all-weather terminal in the Port of Kokkola is a public-private driven innovation with a 50% contribution of the public port authority. As an innovation, the all-weather terminal follows an incremental path towards a change in used technology. The terminal is already implemented and operational.

Table 107: Characteristics of the all-weather terminal of Grupo Nogar

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The development of the new covered terminal within the Port of Kokkola was the first development of this kind in the north of Europe and Baltic region. The all-weather terminal was built in collaboration with the municipality. The local municipality paid half of the total amount. The foreseen period for the investment was estimated at 30 years. This relatively long period brings a great amount of incertitude, but which, after all, was transformed into a success factor by the Port of Kokkola.

A great threat was the incertitude of demand of cargo that was expected to be handled. The capacity of the terminal is now being used at a rate between 75 and 90%. The great advantage, which was valued by the port authority, is that, in contrast with other terminals, the loads that are handled at the Port of Kokkola, do not usually need to be maneuvered in a controlled environment, as for example containerized cargo.

Due to the harsh conditions of extended winter with strong winds and ice, the port had to be closed in the past. Nowadays, thanks to the all-weather terminal, the port is being kept open throughout the entire year. The covered terminal made it possible to perform constantly loading and unloading operations. Therefore, the navigable routes are always in use and are kept clear. The flexibility of the terminal proved to be a success factor, even though the goods for, which it was originally built, are not handled anymore. For example, in the early beginning the terminal was used for loading and unloading of steal, cupper and fertilizers, while nowadays it is used for the transfer of containers, chemicals and general cargo. The failure factors are not identified, due to the constant marketing and the need for an controlled environment to load and unload ships.

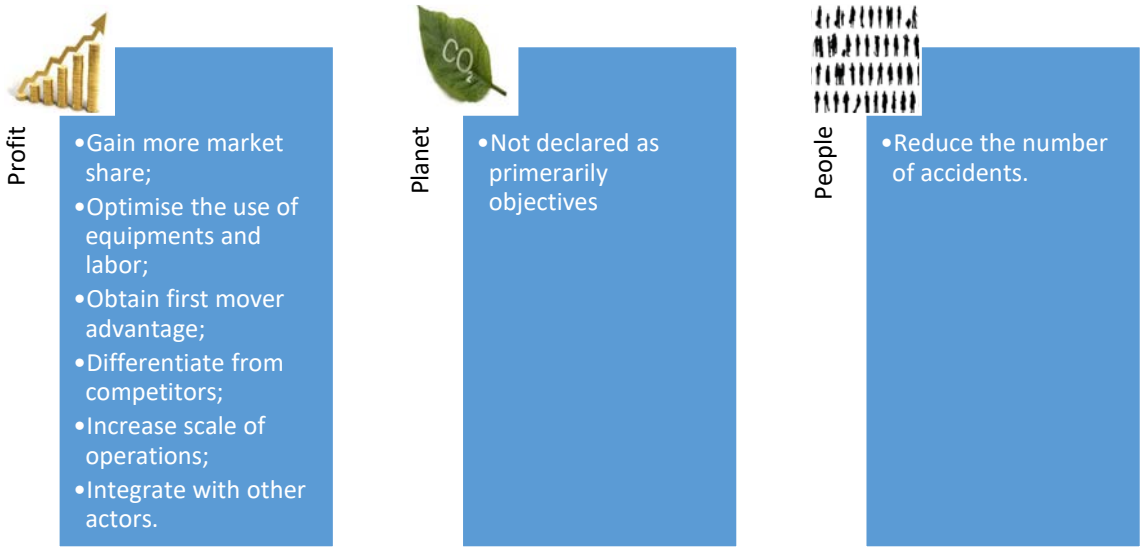
Table 108: Success and failure factors of the all-weather terminal in the Port of Kokkola

Success	Failure
Full capacity of operations in port; Need to keep the track clean; Used for all types of ships (liner ships have priority); Better working condition for employees; Demand from the client of steal factory close-by; Pragmatic approach towards vessels, which use the terminal; Suitable for timber, now used for chemical, containers and general cargo.	N.A.

Profit, planet, people

The objective of the covered terminal in Kokkola, was to set a steadier position of the port within the local supply chain. Due to bad weather conditions, the port itself, the workers and the market were suffering. Although the main objectives were economic growth through increased size of operations performed within the port, the covered terminal aimed also to increase the quality of working conditions and to mitigate some external effects for the environment such as noise.

Figure 57: Triple bottom approach of all-weather terminal of Kokkola



Source: own compilation based on interview

Stakeholders

The Port Authority of Kokkola plays the role of terminal operator. A separate port stakeholder are the stevedores. The municipality had an important role and supported the construction of the all-weather terminal, close to the lobby that was created together with the port authority the municipality also supported half of the investment value. The financing institutes approved the financial support and did not interfere with the development process.

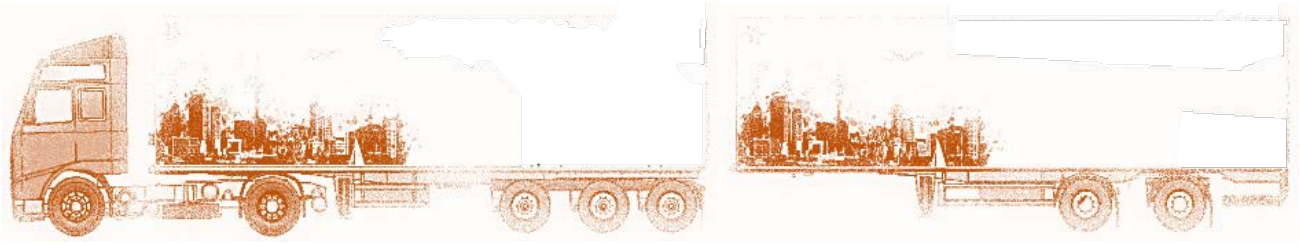
Looking towards the soft institutions the port authority, the stevedore and the unions created the environment to present all the positive aspects of the building of the terminal. The port authority uses the terminal in publicity campaigns and the unions are please for increased quality of working conditions. Another success factor was that the municipality was involved to guaranty the loans for the constructions. The main market demand for the development of the terminal came from the port authority and the stevedores, the two stakeholders, that wanted to use as much as possible the capacity of the port, to increase their scale of operations and to increase the reliability of the port activity.

Table 109: Development stages of the all-weather terminal of Kokkola

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal Operator	Stevedores	Stevedores	Stevedores
Port authority	Kokkola Port Authority	Kokkola Port Authority	Kokkola Port Authority
Municipality	Kokkola municipality	Kokkola municipality	Kokkola municipality
Financing institutes	Bank	Bank	

CLUSTER 5: INNOVATION SUPPORTING CONTAINER TRANSFER FROM ONE MODE TO ANOTHER

Transferring containers from one mode to another can be a relatively costly and time-consuming process. The past decade innovators have tried to reduce costs and to facilitate transshipment as much as possible with the implementation of new technologies. A major success factor of the container itself, was that it made it possible to relatively easy transfer cargo from one mode to another in a much faster way than through more conventional means. In this cluster a new way to lift containers (Tandem lift), to transport them (ECO-Combi and ECO-chassis) or to organize intermodal transport (New Logistics; BCTN Barge slots) are being examined. The last case within this cluster focuses on the new logistics intermodal door-to-door concept of Metrocargo.



35. Tandem lift operations

Valentin Carlan, Christa Sys and Thierry Vanelslander

The tandem lift is an innovative technology unit change, which is presently implemented by a private innovator. The innovation is open and follows a modular path.

Table 110: Characteristics of the Tandem lift

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The DP World Antwerp container terminal is currently serving approximately 2.5 km of quay, operating six post-Panamax cranes with an outreach of 22 containers and a combination of automatic stacking cranes and straddle carriers.

The previous six post-Panamax cranes, which were capable to provide an outreach of 20 TEU, were also equipped with spreaders designed for the tandem lift technique. The new acquisition of quay cranes brought a major upgrade to the terminal, which was equipped with a double hoist with a double spreader.

The new spreaders combination is capable of handling four twenty foot containers or two forty foot containers at a time, which doubles the quay crane's capacity for moving containers. By enabling this feature of the tandem lift technique, the terminal reached a handling performance on the quay of up to 35-37 containers per hour per crane. The most important technical characteristics of tandem lift operations are the features of the used spreaders, the capabilities of lifting and side movements of the crane.

Characteristics that are taken into account to measure the productivity of container loading and unloading, for lifting operations in general and tandem lifting in particular, are: lifting capacity, spreader weight, telescopic motion, flipped arm speed, twist lock rotation, tandem container height difference, lifting and side crane speed.

Tandem lifting represents a step forward in ships loading and unloading operations. The efficiency and performance of tandem lifting is directly linked with the time cycling of container movements. The time cycle of loading one container on board of a ship, contains both time to load the container and the return time of the spreader to the next loading point. By performing a tandem lift operation, the time spent to reposition the spreader for the second container is not consumed by the second cycle anymore. Efficiency and performance of tandem lifting operations are directly linked with the time saving and the duration of a loading/unloading cycle. Table 111 shows the technical features of most recent developments in lifting equipment and shows a comparison between different types of spreaders characteristics.

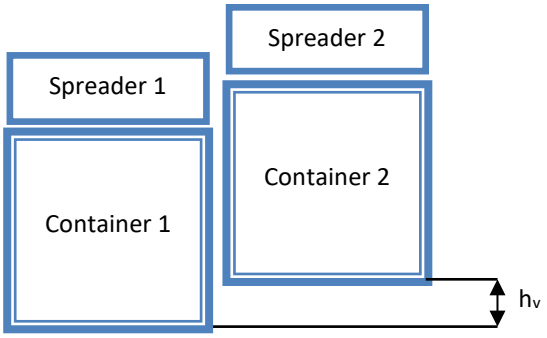
Table 111: Comparison between different types of spreaders characteristics.

Features	Performance range for spreaders			
	Single lift spreader 40ft	Single lift spreader 45ft	Tandem lift 40ft	Tandem lift 45ft
Lifting capacity	41 tonnes 2x25 tonnes	51 tonnes 2x32 tonnes	2x41 tonnes	2x51 tonnes 4x32 tonnes
Spreader weight	5.8 – 9.5 tonnes	9.6 – 12.7 tonnes	23.5 tonnes	25 – 31 tonnes
Telescopic motion	20" to 45" approx. 28 seconds	20" to 45" approx. 30 seconds	20" to 45" approx. 28 seconds	20" to 45" approx. 30 seconds
Flipped arms speed	180^0 in 3 to 5 seconds	180^0 in 3 to 5 seconds	180^0 in 3 to 5 seconds	180^0 in 3 to 5 seconds
Twist lock rotation	90^0 in approx. 1 s	90^0 in approx. 1 s	90^0 in approx. 1 s	90^0 in approx. 1 s
Total power consumption	7,5 kW	7,5 kW	15 kW	15 kW

Source: Broma, 2014

Looking on a larger scale, the reduction in number of loading/unloading operations or the energy consumption to perform to load/unload a ship or even the berthing time, can be indicators of the performance of tandem lifting operations. Different container types and in some cases the usage of different type of trailers for bringing/taking away the container to/from the quay area, represent a burden for lifting operations, especially when it comes to tandem operations. Containers being lifted in parallel need special handling and for this reason, in order not to reduce the efficiency improvement brought by tandem operations, special features needed to be developed. The relative movement between the individual spreaders is critical to optimize the operations. The spreaders need to be able to move relatively to each other in the vertical, horizontal and some cases in rotational direction. These movements allows the operator to pick and release the tandem containers. The vertical movement allows the operator to handle uneven stacks without uncoupling the spreaders.

Figure 58: Vertical height difference in tandem container lifting



The innovation can be successful because of the benefits of faster loading/unloading rates of ships with smaller berthing times for each vessel and the fact that the innovation can also be used as an independent or even a back-up solution. Threats or failure factors of the innovation during this phase is that the terminal personnel need additional training and the one tandem lifting consumes proportionally more fuel. Finally, the loading/unloading cycle can last longer in some cases, especially when different sizes are used of containers or trailers.

Table 112: Success and failure factors of the Tandem lift

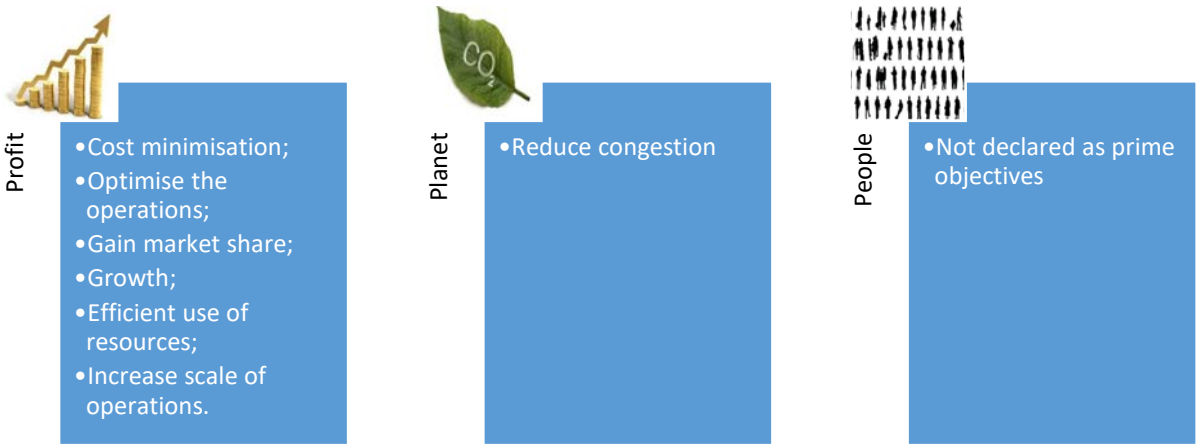
Success	Failure
Faster loading/unloading of ships; decreased berthing time; also independently use (back-up solution)	Loading/unloading cycle last longer; need special training/skills of employees; more energy consumption

Profit, planet, people

The objectives of adopting the tandem lift with separate spreaders for DP World Antwerp are purely economic. During the initiation stage the perspectives were very optimistic and every objective was rated with a high importance. The usage of the new technological development was expected to have a positive economic impact on the company. The environmental impact of the tandem lifting had been important for the reduction of congestion on the terminal by increasing the number of containers handled on quay to the shore area. The implementation showed that success in reducing the congestion was lower than expected, due to the issues that have to be overcome with vessel type and vessel stowage programs. From the perspective of social benefits, tandem lifting represented an important success by reducing the number of involved personnel in loading/unloading operations and, which reduced the number of working accidents.

In general, the success of the tandem lift operation implemented within the DP World Antwerp container terminal is lower than expected than at the beginning. The reasons of the non-use on a larger scale of this type of operations, are that container terminals positioned on the other end of the supply chain are not used for parallel lifting and shipping lines care less about container arrangement.

Figure 59: Triple bottom approach of Tandem lift



Source: own compilation based on interview

Stakeholders

The current innovation is strictly orientated to facilitate the cargo flow. The speed of container transfers is because of the loading/unloading processes considerably fastened up. The tandem lift operation is rated strictly as a technological change, which represents an upgrade of the equipment in order to increase the handling capacity. In DP World Antwerp container terminal, tandem lifting operations passed the initiation and development period and are already implemented. Tandem lift spreaders are developments of crane manufactures that offer an open, public solution for the container lifting industry. The only drawback of the general concept of tandem lifting operation, which is still an issue for DP World Antwerp, is that it depends on the type of vessel and also on the ship's container loading arrangement.

In the initiation period of the tandem lifting operation of DP World Antwerp, several actors were involved such as: the terminal operator, shipping lines, manufacturer, regulator and a financing

institution. The terminal operator has the main role in using the tandem lift operations and the new equipment, while the shipping lines could benefit of reduced berthing time. The infrastructure in this case are the spreaders themselves, which allow tandem operations.

In the initiation period, strong relations were built between all the involved actors. Labor unions were also involved in this stage but their feedback was neutral regarding the new use of tandem spreaders. Competition from other innovations was present, even from the beginning of the initiation stage, due to the fact that DP World Antwerp terminal has his main competitor PSA Antwerp nearby at the Deurganckdok, which was already been using tandem lift spreaders for their loading and unloading operations.

The development period brought no important changes for the involved actors due to the strong relations from the beginning of the process. The benefits of tandem lifting to increase terminal's productivity, were seen as an advantage for all actors. Moreover, labor unions, due to the fact that this innovation brings an increase in safety of dock side operations, became positive and also a strong network was created from their perspective.

During the implementation period, financing institutions were no longer involved in the DP World Antwerp initiative of performing tandem lift operations. Another important change, regarding the involvement of the shipping lines, was also made. Because of the need of advanced notification and special container arrangements regarding their position of vessels, the shipping lines became neutral. Despite of the strong connection with the terminal operator, shipping lines are not positive for the use of tandem lift operations to be done on a larger scale.

Table 113: Development stages of the Tandem lift

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal Operator	DP World Antwerp	DP World Antwerp	DP World Antwerp
Shipping Lines	Deep sea shipping lines	Deep sea shipping lines	Deep sea shipping lines
Labor	Crane operators	Crane operators	Crane operators
Innovation sponsors	Shareholders	Shareholders	Shareholders
Financing institutes	Bank	Bank	

36. ECO-Combi

Valentin Carlan, Christa Sys and Thierry Vanelslander

The ECO-Combi or LHV use of Transport Joosen, not only introduced the use of a new technology but also a new organization and cultural change. The effect of the use of LHV helped the company to expand its business and had an important impact on its marketing image as well. Due to governmental issues, the concept in Belgium is still under debate and the use of it is not yet well spread. The ECO-Combi chassis has an incremental evolution due to the variety of forms that it can take by adding only new dolly and extra chassis or by building a completely new truck that fits the LHV transports.

Table 114: Characteristics of the ECO Combi

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

ECO-Combi or LHVs (Longer Heavier Vehicles) as it known in Flanders, Belgium is a modular concept that by coupling of two to three trailers to the same truck gives the opportunity to transport heavier loads with less increase in fuel consumption than use of conventional trucks for transporting the same loads.

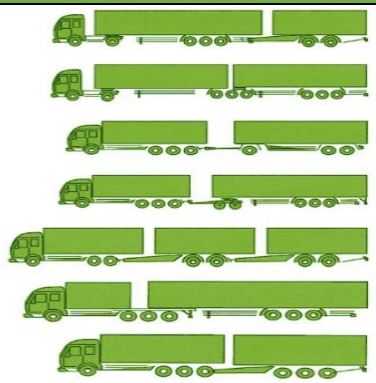
The maximum allowed dimensions for LHVs are 25.25 meters carrying loads up to 60 tons. In some EU Member States, (such as the Netherlands, Denmark, Belgium, France, Sweden, Finland, etc.) the use of Longer Heavier Vehicles is already permitted. In other Member States, tests and trials are being prepared or being done.

The legislation history of LHVs in Europe started with directive 96/53/EC on weights and dimensions (known as LHV-001) and its revision (known as LHV-002) allows Member States to authorize the circulation for national transport on their own territories of vehicle combinations exceeding the maximum dimensions laid out in the Directive, such as this modular concept.

Furthermore, the European Commission carried out more studies and continued the assessment of environmental, economic and social impact of vehicles such as the modular concept having as output LHV-003, (EU 2011).[12] In 2013, the EU published directive 2013/105/EC in which the community amends the directive 96/53/EC and authorizes new dimensions and the maximum authorized weights within (inter)national traffic.[13]

[12] http://www.vlaamsehavencommissie.be/sites/default/files/documenten/LHV-003%20EN.pdf
[13] http://ec.europa.eu/commission_2010-2014/kallas/headlines/news/2013/04/doc/com(2013)195_en.pdf

Table 115: Accepted combinations as LHV in Europe

Type	Combinations	
A	Tractor + trailer + middle axel trailer	
B	Tractor + trailer + trailer	
C	Truck + trailer (>18,75m)	
D	Truck + dolly + trailer	
E	Truck + two middle axel trailers	
F	Truck (+extra turning plate)+trailer	
G	Truck +middle axel trailer (>18,75m)	

Source: Van Hool, 2014

The aim of LHVs use is to tackle two issue, one is cost minimization for trucking companies and another is lower environmental emissions, which is the immediate effect of using less fuel for transport the same amount of cargo. Moreover, the Danish ministry of transport states that by using LHV within the agreed framework there is no significant wear effect on the road infrastructure and by diminishing the number of truck on the road there is also a positive impact on safety.

A longer and heavier vehicle indeed consumes more, but this increase is offset by a decrease in the number of tons/km. The Dutch studies indicate a reduction in harmful emissions from 10 to 25% per tons/km. The effect LHV to the road infrastructure is difficult to calculate, theoretically a combination of 60 tons produces less damage to the roads than one of 44 tons, because the weight is distributed over eight or nine axels instead of five.

The LHV according to Dutch studies represents a clear competitor to other competitors and studies showed that there is a risk of modal shift of 0.2% to 0.3% from inland navigation and from 1.4% to 2.7% from rail[14].

The company Kurt Joosen claims that an ECO-Combi of 22.6 m can transport three standard containers (TEU). Although the ECO-Combi weighs then 60 tons, the road will not suffer, the weight distribution over nine axes.

The LHVs also have their disadvantages such as: the requirement of large radius bends, which are not suitable for urban areas; difficulty in turning inside roundabouts or reversing maneuvers; the accumulation of large kinetic energy (can be difficult to handle); and the difficulty to drive on roads with one lane per direction because of the length.

The main conclusion of a study from the European Commission in 2009, states that the introduction of LHVs would be beneficial for the EU economy and -under certain conditions- environment and society as a whole[15]. LHVs can increase the efficiency of the EU transport system and reduce friction.

From an EU policy point of view, facilitating the introduction of LHVs is in line with the objectives of the Common Transport Policy and might help improve the internal market. Naturally, improving road transport would worsen the competitive position of other modes, but a balance can be found through investments and improvements in the other modes as well.

[14] http://www.modularsystem.eu/download/facts_and_figures/3839282_longer_and_heavier_vehicles_in_prakt.pdf
[15] http://ec.europa.eu/transport/modes/road/events/doc/2009_06_24/2009_jrc52005.pdf

Figure 60. Transport Joosen ECO-Combi solution.

Source: Transport Joosen, 2014

The ECO-Combi or LHV offers flexible operations and increases fuel efficiency, but there is a disadvantage of regulation in neighboring countries (Carlan et al., 2019). Still not all EU Member States are aligned on this issue, which threatens the international road haulage with LHV.

As failure factors, which draws back the use of LHVs in Belgium, is the slow administration procedures and too much focus on other means of transport. The use of containers was also not included in the primer orientations of LHVs, which made the concept ineffective due to low market demand and made the project regarded as a failure.

Table 116: Success and failure factors of the ECO Combi

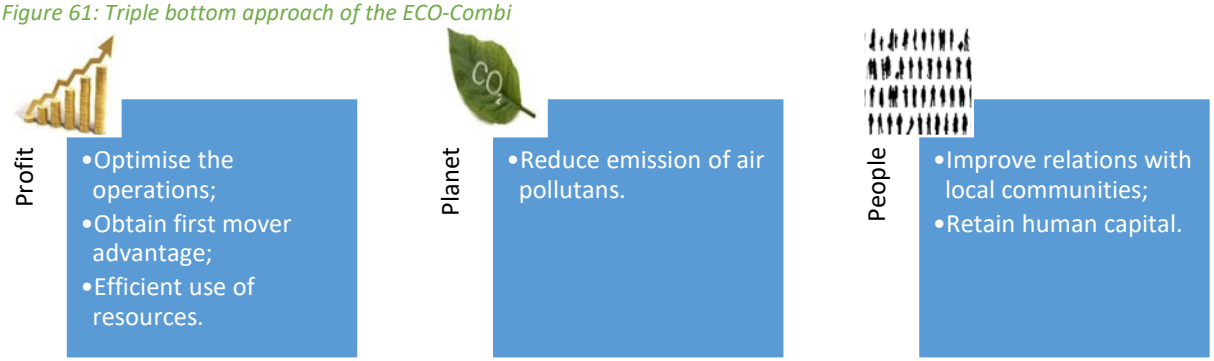
Success	Failure
Increased fuel efficiency; flexible operations.	Process took longer than in neighboring countries; Not all EU Member States are aligned

Profit, planet, people

The utilization of the ECO-Combi is a relatively costly business. The costs add up due to the acquisition of the special chassis, driver training and maintenance. The main objectives of using the ECO-Combi, are not driven by cost efficiency directly, but by more profit from optimizing the operations and better use of resources.

Also an important objective is the vertical integration in the supply chain due to extra capacity carriage, which will make road transport a better competitor for other means of transport. The environmental objectives such as the reduction of CO_2 and other air pollutants are a secondary effect following fuel consumption reduction and further optimization of operations. From a social point of view, the use of LHV does not provide an immediate objective.

Figure 61: Triple bottom approach of the ECO-Combi



Source: own compilation based on interview

Stakeholders

The initiation process for the use of LHV was started as an initiative of Transport Joosen. From the beginning, the APA was interested and wanted to be informed about the operations, which are being performed inside its area of control. However, the APA was not directly involved in the network. Labor unions were concerned about the salaries for truck drivers of these LHVs, which would be proportionally and relatively lower for each ton*kilometer.

Municipalities were not directly involved in the network but their contribution was considered to be important. They play a key role in the decision making process for the routes of LHVs. Social actors such as biking communities and environmental friendly organizations, are also regarded as important. Each actor was informed about the activities performed by trucking companies in order to minimize the effect on environmental and road infrastructure through the use of LHV. They were actively involved in the development but they gave a negative feedback to the use of LHV for freight transport. Research institutes were not directly linked to Transport Joosen Group.

Table 117: Development stages of the container transfer

Level	☑ Initiation	☐ Development	☐ Implementation
Transport operators	Transport Joosen		
Port authority	APA		
Freight forwarders	Other trucking companies		
Municipality, regulators	Road administrator		

37. Van Hool ECO-Chassis

Valentin Carlan, Christa Sys and Thierry Vanelslander

The ECO-Chassis of Van Hool NV is a technological unit change that is implemented incrementally as an open and present innovation. The new solution brings different solutions together on one chassis. All these solutions have been tested and are used individually on other previously advanced trailers, which explains the incremental innovation path.

Table 118: Characteristics of the ECO Chassis of Van Hool NV

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The new Van Hool NV chassis was developed through the collaboration of two companies (Joosen and Van Hool NV) to enable more flexibility in container arrangements on trailers. The new chassis has the aim to enhance the flexibility of the transport orders, which can be handled by Transport Joosen. Due to safety issues, combinations of full and empty containers within the same transport trip were only possible under special arrangements.

The new chassis will enable the possibility for a truck to carry full containers on the back of the trailer by using an extendable turning axel. This project has been developed during the implementation of the Eurotranscon platform. The combination of these two developments (the platform and the new chassis) enabled the opportunity for Transport Joosen to respond to a wider number of transport requests in shorter notice without depending too much on the other previously accepted orders.

Figure 62: New Van Hool chassis

Source: Transport Joosen, 2014

The ECO chassis increases the flexibility in the transport of containers by road, which can be the reason why the innovation could become successful (Carlan et al., 2019). Failure factors were not identified.

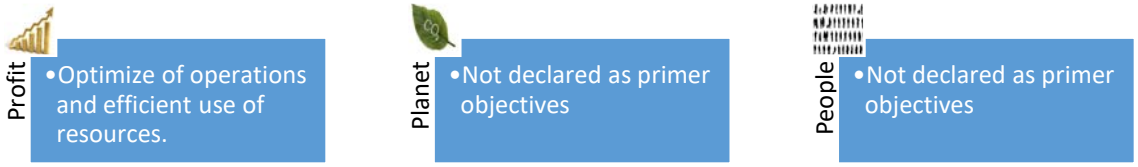
Table 119: Success and failure factors of the ECO Chassis of Van Hool NV

Success	Failure
Increase flexibility in road container haulage	N/A

Profit, planet, people

The new Van Hool NV chassis represents a technical achievement, which had the aim to bring different innovations into one place. The goal of the new chassis is to become more flexible in terms of operational needs. One key objective is to comply with regulation regarding the weight distribution over the motor axel and chassis axels accordingly to safety constraints. These constraints could be met due to the new developed feature, which allows the load to be shifted either to the end or to the front side of the chassis or by installing a free turning axel to the end of the chassis to facilitate the turning maneuvers.

Figure 63: Triple bottom approach of Eco chassis



Source: own compilation based on interview

Stakeholders

The construction of the new chassis was the initiative of Transport Joosen, which needed more flexibility in its transport operations. The closest relation for building the chassis was formed with the chassis builder, the Belgian company Van Hool NV.

The chassis had not only to incorporate specifications and utilities required by Transport Joosen, but it also had to meet the legal specific requirements in order to be used on public roads. For this reason, regulators and standardization bodies for technical inspection were involved. The process of contacting these institutions was regarded as slow and bureaucracy slowed down the process. These institutions where only involved in the initiation and development period before the chassis could pass the technical inspection and before it could be used on public roads.

Financing institutions were not involved in this process, which slowed down the development progress but did not represented a threat for the project itself.

Table 120: Development stages of the ECO Chassis of Van Hool NV

Level	☐ Initiation	☐ Development	☑ Implementation
Trucking company	Transport Joosen	Transport Joosen	Transport Joosen
Equipment manufacturer	Van Hool NV	Van Hool NV	
Standardization bodies	GOCA	GOCA	
Municipality, regulators	Road administrator	Road administrator	

38. BCTN Barge slots

Valentin Carlan, Christa Sys and Thierry Vanelslander

The barge slots at BCTN in Meerhout aim to make berthing for loading and unloading operations of IWT lighters better organized. This open innovation introduces a market change and is being developed by a private innovator. The change is expected to be radical.

Table 121: Characteristics of the barge slots of BCTN

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

BCTN Meerhout wants to offer the opportunity to its customers to respond to the occupancy of a lighter by offering barge slots that are still empty on a last-minute basis. These last-minute offered and bookable barge slots are at a lower price (more or less 46% of the standard price). There will only be a limited number of last-minute barge slots available for every lighter, depending on the agreements between barge operators and terminal operators within the ports. If BCTN Meerhout only fills up five extra barge slots, they do not have to declare anything to the deep-sea terminal operator. If they want to add more additional barge slots, they have to communicate to the deep-sea terminal so that the deep-sea terminal can adjust its planning. If BCTN Meerhout does not declare this on time, they can be b to add that one extra container to the barge, even though there was still room for it.

Because of this, BCTN Meerhout has negotiated a new contract with the port authorities, which lets them add a limited number of containers, about 1 to 5, after a barge is 'closed'. It should be noted that this restriction is per terminal, so it is possible for a barge to visit several terminals in one trip to Antwerp and increase the number of 'last-minute' containers. This would increase the efficiency (though only marginally) since the barge is now operating closer to full capacity. More importantly, flexibility towards clients is increased.

The barge slots project has the purpose of creating a web-based program for their customers. Through the web interface, customers can see, which barges still have a free spot available and reserve such a last-minute spot.

Table 122: Success and failure factors of the barge slots of BCTN

Success	Failure
Profitable if the maximum capacity is used; opportunity for the other stakeholders (trucking companies);	Higher average transport cost per container; firth year not profitable.

Profit, planet, people

The web-application gives the opportunity to the customers/carriers to respond to the occupancy of the lighter by last-minute based container transport that is dedicated to plan or book last-minute rates. This clearly creates economic added value.

The main reasons to develop this application are the possibility to gain market share and the positive impact on competitiveness. Since this kind of application does not exist yet, BCTN Meerhout will have a first mover advantage, which will definitely make their business more interesting for possible customers and differentiate them from other competitors in the barge business. This will hopefully lead to a significant growth of the business opportunities for BCTN Meerhout.

The application also offers an increase in the scale of operation on, which BCTN Meerhout operates. It makes BCTN Meerhout able to offer larger and equitable access to service to all of his customers. Besides all of the positive developments for BCTN Meerhout itself, the application is also useful for an integrated relation with other actors in the logistics process. Thanks to this application, the actors will be able to communicate more easily and accurately about, which slots will be filled and, which ones are still open for cargo.

Other relevant ideas behind the development of this application are the possibility to minimize the costs of BCTN Meerhouts' operations, the efficient use of resources and the avoidance of depletion of these resources. Less relevant in the strategy behind the application, were the growth and employment rate, the optimization of operations and the encouragement of other investments.

Energy efficiency and the facilitation of the transfer of official documents were not taken into account during the development. The innovation has no environmental impact as a main objective, given that there are only economic reasons to create an innovative web application. Nevertheless, it can be pointed out that if the innovation is a success, it will have an impact on climate change in some way. By stimulating the use of inland waterways instead of road carriers, a reduction of CO_2 and air pollutants follows.

It is known that, in comparison to road carriage, inland waterway traffic is much more eco-friendly. Barge ships need less energy, on a ton-mile basis. Barge ships use, in comparison with trucks, three to six times less fuel on a ton-mile basis. Even if the route by barge ship is a lot longer than a similar journey by truck, or if there is on-carriage by another mode of transport, the use of barge ships is still the best option in terms of fuel consumption. Not only fuel consumption but also CO_2 -emissions of barge ships are much lower than the emissions of a truck on a ton-mile basis.

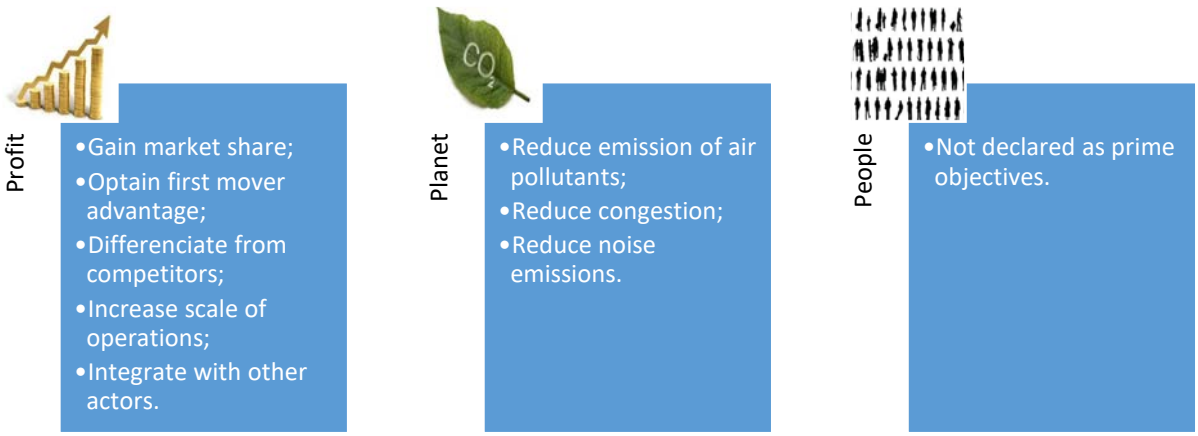
Inland waterway transport has the advantage of being more quiet than road transport, of minimizing impact of activity on landscape (or proximity territory), and of reduction of congestion on roads.

Overall can be said that the external cost of barge traffic is much lower. If the use of barge ships is stimulated, there will be a reduction of this cost. From this perspective, the innovation can have an indirect environmental impact, if the web application is proven to be successful of course.

In case of the social added value, it can be said that if the innovation is successful, it will create extra demand. Extra demand goes together with extra man-hours, which can go together with retaining human capital and even with the need of extra employees. Therefore, it can be said that the impact on employment possibilities will be rather positive, even if creating a customer friendly web application with the possibility of last-minute bookings has not really the objective of creating social added value.

The innovation has no effect on the improvement of relations with local communities. Neither has it an effect on the reduction of the number of accidents and the reduction of fraud attempts. There is also no improvement of efficiency of the security requirements. The web application does not change the way of working, so there are no compliance issues regarding social, labor or safety regulation.

Figure 64: Triple bottom approach of Barge slots



Source: own compilation based on interview

Stakeholders

Since it is mainly an IT project, another important actor is the IT company, which was hired to write the interface that connects BCTN Meerhout with their clients. This is the most significant part of the project. A strong relationship between the IT company and BCTN Meerhout is required to satisfy BCTN's needs regarding the project. The IT company will also be responsible for setting up the hosting servers to run the program, which makes them also responsible for infrastructure.

The innovation case is meant to provide extra service to BCTN Meerhouts clients, and more specifically trucking companies. In order to ensure client satisfaction, the feedback of clients on this new way of working, is also required, especially in the initiation stage of the project. Clients can express their preferences with regards to additional features they would like. Or, with the feedback, the impact of the innovation can be estimated concerning the new volumes that have to be handled and capacity that has to adapt.

The port authorities play an interesting role in this innovation case. They are both required to cooperate with BCTN Meerhout in order to ensure the success of the project by making clear agreements with BCTN Meerhout regarding last-minute containers, but, together with the shipping lines, they are also BCTN Meerhouts main competitors. BCTN Meerhout has to convince clients to use an inland terminal instead of a main port terminal. This makes the main port a competitor, but only from BCTN Meerhouts point of view. BCTN Meerhout is not really considered to be any competition by the ports and shipping lines.

Finally, there are freight forwarders and shippers. They are an actor in the sense that they play a part in the organization of the project, but the changes due to the project will barely affect them. For this reason, BCTN Meerhout did not contact them with regards to this project. As a BCTN Meerhout spokesman put it: "We did not contact them although we could, and maybe should have, but it is unlikely that it would have had an effect in the long run anyway".

The project did not have a significant scope. Furthermore, it is basically just making a web interface once the negotiations with the port authorities are done. There are also not many links between the actors.

During the initiation stage, the most notable links are those between BCTN and the trucking companies, to readjust their capacities and fine-tune their expectations regarding the project. There is also some contact with the IT company to discuss expected cost, infrastructure changes and estimated time for completion.

In the development stage, the communication with the IT company intensifies. There is now a strong link between BCTN and the IT company. The trucking companies no longer play a part in this stage of the innovation case. Since this project has not yet reached the implementation stage, it is difficult to predict how the relations between the actors will change during this stage.

The level of influence for this innovation case is mostly local, since the use of last-minute containers depend on the agreements with the port authorities and is thus different for each port. At the moment, this case only pertains to the Port of Antwerp and BCTN Meerhout. However, should it prove to be successful, the groundwork for the interface can be exported to all BCTN terminals with only minimal adaptations. In the long run, it is possible that the project can have a regional or even global influence. But this would be more by opportunity than by intention. For all intents and purposes, the influence of this project is definitely local for now.

Table 123: Development stages of the BCTN Barge slots

Level	☐ Initiation	☑ Development	☐ Implementation
Inland terminal	BCTN	BCTN	
Transport operators	Trucking companies		
Software provider	It Company	It Company	

39. Intermodal door-to-door transport (Metrocargo)

Valentin Carlan, Christa Sys and Thierry Vanelslander

Metrocargo is an innovative concept for intermodal door-to-door transport (ID2D). It has been conceived by I.LOG, a company operating in innovative logistics, with the engineering support of Metrocargo Automazioni, a specialized firm in design and manufacture of equipment and automated handling system. The company belongs to an integrated group (also comprising a freight rail transport company) operating mainly in the North of Italy. I.LOG is specialized in logistics services for the freight transportation markets. The analyzed initiated private-driven innovative concept is a technological unit change and follows a modular innovation path towards future implementation.

Table 124: Characteristics of the Logistics ID2D transport of Metrocargo

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Rail freight is currently losing market share in favor of road transport in moving cargo originated or destined to seaports. This is a common scenario in Europe even if the distribution of cargo among rail and road is different from a country to another. Among the reasons lies the cost and the time of (un)loading of trains, that restrict rail usage. Only fully loaded trains and transport of certain kind of goods can compete in the market. Moreover, stopping a train to (un)load a few units of cargo is not economically viable using a traditional terminal.

Metrocargo solves the problem of handling goods by road and rail with an economic and faster transfer in horizontal mode that can be built along the rail tracks immediately under the catenary, i.e. without the need for any shunting activities.

Figure 65: example of the Metrocargo ID2D system

Source: derived from companies website, mitproject.eu

The handling time with Metrocargo is approximately 3 minutes for each unit load, while the (un)loading of a freight train takes less than 40 minutes. The Metrocargo system is modular with each module consisting of: four lifting towers, one shuttle, one platform. Each element of the module has a carrying capacity of 40 tons.

Figure 66: number of ID2D systems applied in the Metrocargo terminal

Source: based on image derived from companies website, mitproject.eu

The Metrocargo terminal allows parallel automated operations that will make railway transport faster and more competitive than in the traditional way of composition of freight trains (Figure 66). The innovation allows that trains remain under the catenary and that the highly automated handling avoids accidents with injuries. The handling is faster and happens parallel to the handling on the principal railway. The innovation is adaptable to any kind of train and containers size and no shunting activities are needed.

The light organization of the terminal facilities allows for a fast transit between couples of train shuttles or between trucks and trains, thus fostering also intermodality. Eventually, the current structure of the Metrocargo terminal (parallel structure based on towers and platforms) allows the automated handling to be used between railways, which are characterized by different gauges because of the fast transshipment between different vehicles. Table 125 summarizes the Metrocargo performance indicators:

Table 125: Summary of the Metrocargo performance indicators

Indicators	Intermodal Traditional System	Metrocargo System
Time for train handling operations (hours)	4-8	½-1
Number of loaded/unloaded trains per day	2	12
Time for stop of the train (hours)	12	2
Terminal's loading capacity per day (TEU)	400	2400

Metrocargo represents a radical innovation aiming at improving the loading and unloading system related to the intermodal transport. Currently, the innovation is in the developing phase and only few prototypes (at reduced size) have been built. Metrocargo is in this phase negotiating with some inland and seaports terminals – all located in the north of Italy - the possibility to introduce its system in their terminals.

Table 126: Success and failure factors of the Metrocargo automatic handling

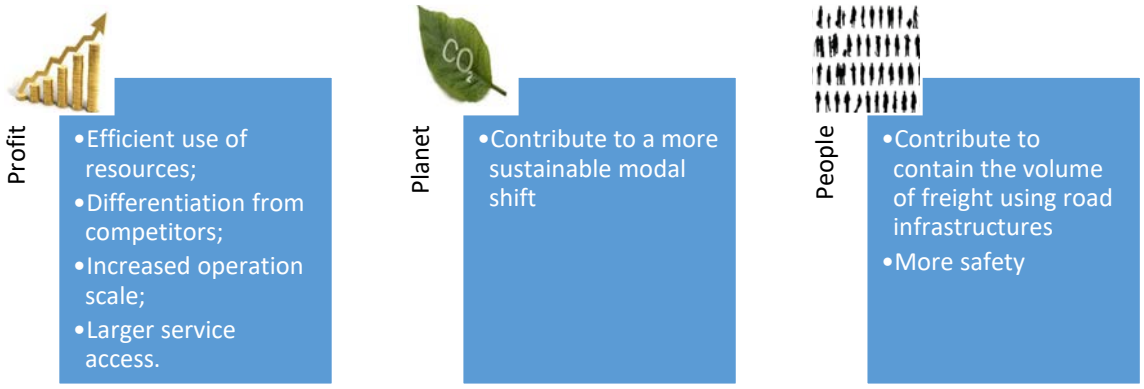
Success	Failure
Faster composition of freight trains Reduction of shunting operations.	It represents a sunk cost for the first developers.

Profit, planet, people

The main objectives of the innovation relate to optimization, environmental and cost oriented aspects. Optimization and cost reduction goals will be achieved through the increasing productivity in

comparison with the traditional rail procedures at Metrocargo. The data seems to confirm the increased handled cargo in this period with the targeted savings. The competitiveness of Metrocargo will also have an impact on the attractiveness of the rail solution as a modal choice and consequently on the overall port-related carbon footprint.

Figure 67: Triple bottom approach of the automatic handling at Metrocargo



Source: own compilation based on interviews and Metrocargo reports

Stakeholders

The Metrocargo system creates several kinds of connections, which benefits a number of stakeholders:

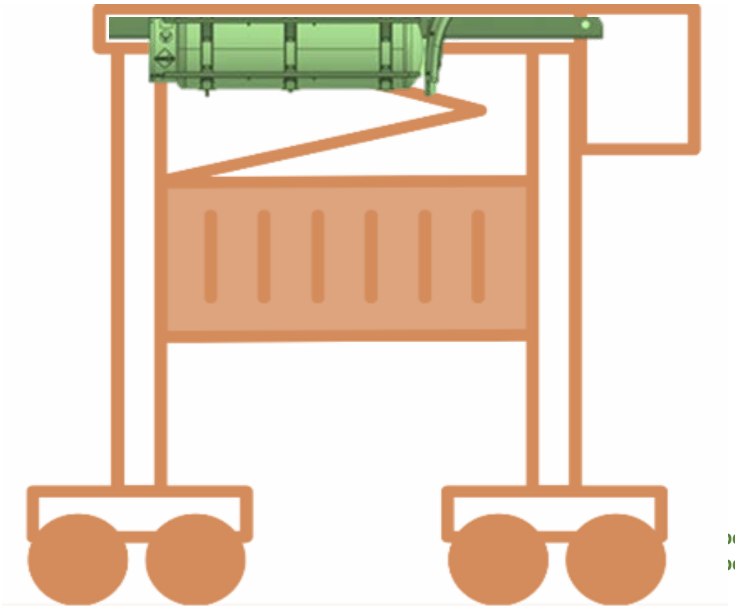
- The Innovation champion (Metrocargo Automazioni / I.LOG) and terminal operators will be pushed to intensify their relation in order to improve the physical connections. Moreover, the Metrocargo concept needs further improvement in terms of infrastructure and technology in order to install the system in the chosen terminals;
- The needed changes in the sea-port terminals would affect the PA-stevedoring operator relationship, mainly because the effects in terms of increasing competitiveness inside the port – and then in terms of intra-port competition – and outside the port, will affect the relations among the terminal adopting the Metrocargo system;
- Reluctance of financial institutions and the high cost of the first Metrocargo application are slowing down the project. This is mainly due to the potential threats of lock-in effects. Similarly, terminal operators can be reluctant or even afraid to replace "traditional facilities" with new ones. This could inhibit the innovation to be tested in a real market situation;
- The recent stress on policies aiming at the improvement of intermodal transport – in, which rail shuttle could play a significant role – is currently influencing projects such as Metrocargo. Shippers, forwarders, local authorities and terminal operators are currently being pushed to collaborate in order to improve new conceptual systems that may increase the use of rail. Nevertheless, the lock-in effect and the path dependence are currently slowing down these strategic links;
- An optimal use and size of the Metrocargo system could positively influence the efficiency of the port and consequently the port productivity. Nevertheless, the needed optimal size pushes away potential investors. All links appear at both local and regional level. These two layers are strictly connected because of the impact of Metrocargo inside the port and on the overall hinterland network.

Table 127: Development stages of the Metrocargo automatic handling

Level	☑ Initiation	☐ Development	☐ Implementation
Innovation champion (Metrocargo)	✓		
Terminal operator	✓		
Freight forwarders	✓		
Municipal authorities	✓		

CLUSTER 6: INNOVATION REDUCING OPERATIONAL VEHICLE COSTS

This cluster of cases describes three cases concerning the shift from conventional fuel to compressed natural gas (CNG) for straddle carriers, vans and heavy duty drayage trucks. All innovations are in the present and most of them are already implemented. The shift to alternative fuels does not only generate social benefits such as a decrease in emissions, it can also lower operational costs because of differences in fuel prices. This clusters goes deeper into CNG fueled class 8 heavy duty drayage trucks, CNG Straddle carriers and the reconverting of diesel vans to CNG fuels vehicles.



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40. Straddle Carriers with CNG

Valentin Carlan, Christa Sys and Thierry Vanelslander

This innovation is a technological unit change, which is in the initiation stage at DP World Antwerp and changes the fuel usage of straddle carriers by replacing diesel with compressed natural gas. The innovation is closed and private. At present, it follows a modular path.

Table 128: Characteristics of the CNG straddle carrier

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Straddle carriers are vehicles, which are used to lift heavy loads on transport terminal sites. They are often used for container loading and unloading or for piling in container yard. The lifting is accomplished by positioning the straddle carrier over the item that needs to be hoisted. A special characteristic is that it must have a high ground clearance and wide gauge. The first straddle carriers were used to move lumber while the recent usage switched to container lifting, steel billets or heavy equipment.

Over the past 4 years the container throughput in Port of Antwerp remained constant (Port of Antwerp, 2014). Nevertheless, the costs and the emissions have to be reduced. Fuel efficiency and environmental issues are the most urge problems of today's industry and solutions in order to mitigate the effects of transport industry have to be taken.

Straddle carriers operate 50% of all container movements within the DP World Antwerp container stacking yard and use Diesel as fuel. Within DP World Antwerp's container stacking yard, straddle carriers are used to bring containers from the quay cranes upon the sea-side of the 9 automatic stacking crane (ASC) areas or to the container storing area. The medium distance travel in one cycle for one straddle carrier is approximately 800m for alimentation of ASCs and 400m to pile the containers within the stacking area. Next to these distances, other operations like shuffling and re-piling, which consume a significant amount of energy, have to be taken in account.

Gasoline and diesel are considered (in general) as conventional fuels. Alternative fuels are considered to be cleaner, more sustainable and in some cases relatively cheaper than conventional fuels. These fuels include natural gas, propane, methanol, ethanol, electricity, hydrogen and bio-fuels. These fuels can reduce emissions of harmful pollutants and greenhouse gases.

Diesel engines are more durable and are more fuel-efficient than gasoline engines in general, but can pollute significantly more. Heavy-duty trucks and buses account for about one-third of nitrogen oxides emissions and one-quarter of particle pollution emissions from transportation sources. Similarly, non-road diesel engines such as construction and industrial equipment emit large quantities of harmful particle pollution and nitrogen oxides, which contribute to ground-level ozone and other pervasive air quality problems (EPA, 2013).

To deal with these problem DP World Antwerp took initiative and began the conversion of the present diesel engine straddle carriers to CNG. The APA has also pushed this transformation forward. In September 2011, companies were invited by the APA to apply for subsidies in order to reduce emissions in port activities done by vehicle and handling equipment. DP World Antwerp was one of the five port

companies, which had been selected and received the APA's subsidy for the conversion of 33 straddle carriers from diesel engines to CNG.

The change will involve transformations of DP Worlds business activity on many levels such as: technological, managerial, organizational and cultural. From the point of view of technological implication, the new change will involve special equipment that needs to be installed on board of the straddle carries. From the point of view of management and organizational factors the CNG fueling systems needs special safety conditions, new fueling stations and special maintenance operation. On the level of cultural change the conversion of the present straddle carriers diesel engine to CNG will comply with the Port of Antwerp policy for a greener future with less environmental emissions.

The present innovation case is in initiation phase, out of the 33 straddle carriers, which are scheduled to be converted CNG fueling system only one is in present converted and it is under testing period. Due to the fact that this change is going to take place only within DP World Antwerp and the new system will need a whole new set of technical equipment, it is categorized as a closed innovation with private development.

A efficiency measurement of the innovation could be done by determining the operational cost for straddle carriers before and after CNG transition. The environmental impact mitigation of stacking activity by upgrading the straddle carriers to CNG fuel, can be calculated from the difference of noxious emission of the two fuel systems. Nevertheless, a more complex analysis to support the efficient or successful transition from diesel to CNG, can be done by a cost benefit analysis, which includes on the one hand the operating and maintenance costs, and in the other hand, the benefits for the environment.

As legislation is moving forward, the use of conventional fueled engines is becoming more and more restrictive. DP World Antwerp container terminal is thinking one step further and is now in the initiation stage to upgrade their container handling equipment to a more cheaper and less pollutant fuel. Diesel engines are well known to need no substantial changes and their performances are not affected if they are powered by CNG. Machines equipped with diesel engines only need new fuel tanks and fueling systems in order to run on CNG.

The conversion of straddle carriers to CNG fuel is not designed for optimizing the cargo flow but the main gain arises from the economic and societal point of view of lowering the operational costs and reducing the pollutant emissions. So far, only discussions, regarding the framework, which the CNG conversion, take place. Feasibility studies and economic analyses have been developed. Furthermore, a pilot project has been developed and the conversion process will continue with the conversion of one straddle carrier, which will operate under testing conditions as a pilot. The collaboration between the involved actors shapes the pathway of success of the present innovation. The interests of these actors are diverse and their collaboration has the purpose to implement the CNG as a fuel for port related equipment. The APA sees their benefit of having a greener image. The DP World Antwerp container terminal will reduce their operational costs by using CNG straddle carriers. FLUXYS, as main supplier of CNG, will also benefit because it can sell its gas at a larger scale.

Table 129: Success and failure factors of CNG straddle carriers

Success	Failure
Lower operating cost; lower environmental emissions.	Reluctance from unions; need to invest in fueling facilities on site.

Profit, planet, people

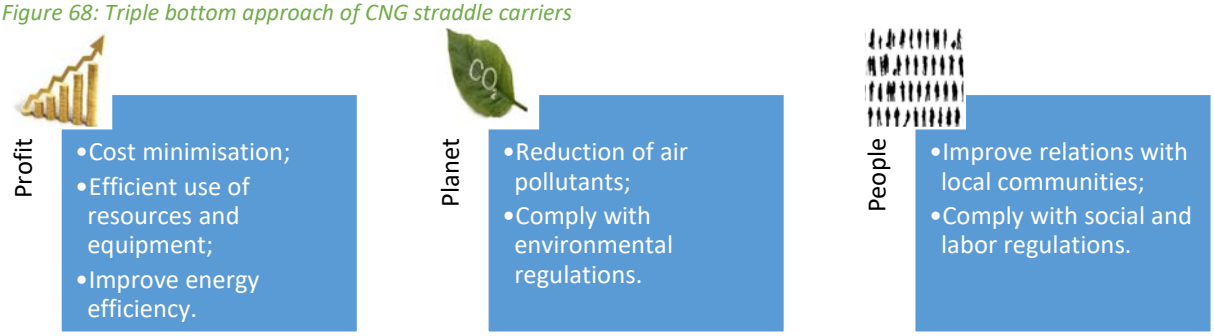
As mentioned, the objectives of implementing Automatic Stacking Cranes are mainly economic and environmental. The importance of these objectives was rated high. Because this innovation case is yet in the initiation period, the success could not be evaluated and the objectives remain unrated.

Use of CNG has implications for the reduction of the operational cost. Furthermore, the reduction of cost will have a positive impact on competitiveness and could lead to a gain of market share. The scale and efficiency of current operations remain the same, so there is no expected economic benefit from this point of view. Differentiation from competitors is also important by improving the image of company, looking more green will be a marketing tool to attract more clients. The encouragements of other investments in this case, refer to the building of adequate fueling infrastructure after the implementation and use on a larger scale of CNG straddle carriers.

The use of CNG always has and always will have an environmental orientation. The shift form diesel to CNG straddle carriers has the aim of reducing the air pollutants as well as compliance with anticipated and probably upcoming environmental regulation.

Social aspects are also playing an important role in the conversion of diesel straddle carriers. Because of decreased emissions, an improvement of the relation with nearby local communities (e.g. Beveren) is expected. Nevertheless, safety and labor regulations remain important and special attention will be given to these aspects. The use of CNG has always been a disputed subject due to safety issues, but by complying with safety regulation the risk of an unwanted accident can be reduced to a minimum.

Figure 68: Triple bottom approach of CNG straddle carriers



Source: own compilation based on interview

Stakeholders

The change in fueling system of the straddle carriers, is an important upgrade, which needs collaboration of many actors from financing institution, research, regulators, and unions to local authorities. Despite of critics that might come from safety point of view, the use of CNG is a viable solution for the benefit of all parties that are involved after and during its implementation.

The conversion to CNG is currently in its initiation stage and it covers the aspect of setting the framework with all the involved actors and the preparation of the first pilot straddle carrier, which is due to be tested during the development period.

The position of innovation champion is taken by DP World Antwerp, which has a close follower. This follower is the DP World Southampton terminal, which is also coordinating a feasibility study in order to perform a similar change.

On the infrastructure level, actors have different points of view, regarding the conversion to CNG. The APA, for example, has its interest and granted a subsidy for a greener operation. The labor unions are rather reluctant to this change and even more averse when safety issues are taken into discussion. The innovation sponsor as well as regulators, standardization bodies and European commission have a positive attitude regarding the innovation, which is about to take place. An important role is also taken by research institutes, which will contribute by offering the testing conditions before the CNG engine is introduced into exploitation. The same actors are playing similar roles on the hard institution level.

As soft institution, the APA plays an important role and shows increased interest when green solutions are discussed to be implemented. Labor unions tend to oppose the innovation because of safety reasons. Municipal authorities, innovation sponsors, regulators and research institutes are showing their support for the innovation to take place.

The capacities, which were being put together during the initiation stage, came from the Innovation Champion, the sponsors, the standardization bodies, research institution and the European Commission by offering subsidies for green orientated investments.

Lock-in effects in the initiation stage are not present. The company always has the option of returning to a conventional fueling system, even for the prototype, which will be set up in the development period. The only exception lies in the risk of the loss of capital, which cannot be returned but, which not represent a burden or failure factor that could stop the project.

The market demand for this innovation arises from the desire of the innovation sponsor (FLUXYS), which sees this project as a tool for publicity and a market tool for their goal of promoting use of gas as a fuel in north-west Europe. It also considers DP World Antwerp terminal as an instrument to lower their own operational cost.

Table 130: Development stages of the CNG straddle carrier

Level	☑ Initiation	☐ Development
Terminal Operator	DP World Antwerp	
Port authority	APA	
Unions	Labor unions	
Regulation, standardization bodies	GOCA	
Research institutes	Constructors	
European Commission	Subsidy for environmental friendly equipment	

41. Vans from diesel to CNG

Valentin Carlan, Christa Sys and Thierry Vanelslander

Zuidnatie implemented CNG fueled vans for the transport of their employees. This innovation is a technological unit change is introduced by a private innovator, has closed stages of development and aims at an incremental change.

Table 131: Characteristics of CNG driven vans of Zuidnatie

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Often the employees need to visit the terminal. The fleet of vans used by personnel to move to different locations inside the terminal are replaced by CNG vans. As the conventional fuel is being replaced the new change came with a mental shift for most of the employees.

The main reasons, which have pushed the change in fueling system from diesel to CNG, are the lower operational costs of the vehicles and lower emissions. The main disadvantage, which is regarded as failure factor, is the CNG fueling system itself. The refueling operation has to be done more frequent (on daily basis), it is Therefore, more time consuming. At the same time, the company had to build its own fueling station.

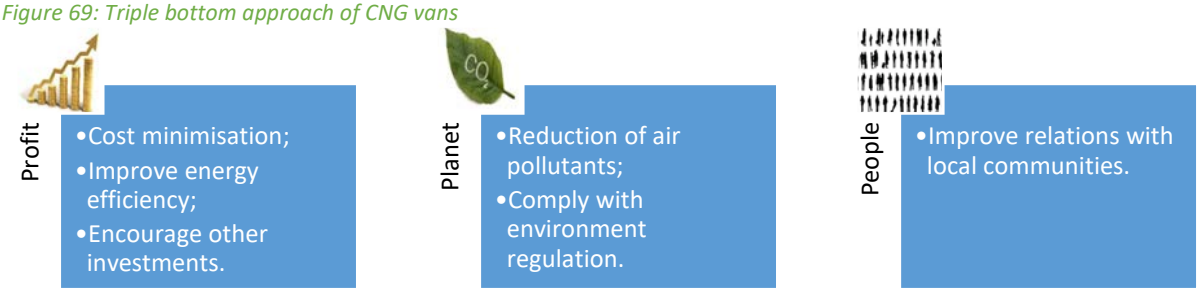
Table 132: Success and failure factors of CNG vans of Zuidnatie

Success	Failure
Lower operating cost; lower environmental emissions.	Refilling: more frequent/time consuming; an extra task for the employees; need to develop a bunkering network.

Profit, planet, people

The two main reasons for the conversion to CNG, were reduction of operational fuel costs of the vehicles and the mitigation of environmental effects (30% reduction of air pollutants) of the activity. An achievement is that, due to zero emissions and relatively clean exhaust, the vans can go inside the warehouses. The installation of the CNG fueling system require additional investments in a fueling station. Although the costs are lower in the current situation the extra time necessary to tank the vehicles with CNG causes unproductive time intervals for employees.

Figure 69: Triple bottom approach of CNG vans



Source: own compilation based on interview

Stakeholders

The conversion of the fueling system from diesel to CNG, involved the efforts of the car manufacturer/car supplier. An important push forwards for this change, came from the government, which offered subsidies for enhancements to lower the emissions. Due to the low range of the CNG fueling system, new orders for the new tanks had to be established, but the main stakeholder received positive feedback. The changes could be implemented within the network.

Table 133: Development stages of CNG vans of Zuidnatie

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk terminal	Zuidnatie	Zuidnatie	Zuidnatie
Government	Subsidy Flemish Government		
Equipment supplier	Fiat	Fiat	Fiat
Fueling Station	Subsidiary of Colruyt	Subsidiary of Colruyt	Subsidiary of Colruyt

42. CNG Class 8 Heavy Duty Drayage Truck

Genevieve Giuliano and Geraldine Knatz

The implementation of CNG fueled class 8 heavy duty drayage trucks at the Ports of Los Angeles and Long Beach, is considered to be a technological unit change, which is driven by a private innovator while following an incremental and open innovation path.

Table 134: Characteristics of CNG Class 8 Heavy Duty Drayage Trucks

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

This innovation case is a demonstration of fuel usage of compressed natural gas (CNG) for heavy duty Class 8 trucks, which are placed in a drayage service at the Ports of Los Angeles and Long Beach. Four trucks were constructed specifically for this demonstration. They were the first CNG-fueled trucks that were produced with an ISL-G natural gas engine of Cummins. The ISL-G was certified three years early to the 2010 NOx emission standard of 0.2 grams/bhp-hr.

The California Cartage Company (CCC) has put the trucks into service and is located in Wilmington, California. The CCC is one of the companies that provide drayage services to the ports, moving containers back and forth between the seaports and local warehouses and rail yards. The CCC services both local deliveries between the port and its yard in Wilmington, which is a distance of about 5 miles. Trucks in this service experience a stop-and-go type operations and travel more on local roadways than on higher speed free-flow highways. Some of the drayage trucks serve longer delivery routes (e.g., Ontario, CA).

The dual nature of the CCC's trucking business provided the opportunity to test the performance of the CNG truck under both stop-and-go and higher speed driving conditions. As the trucks were constructed specifically for the study, they did not have certified horsepower or torque ratings and the specific performance characteristics of the engines in terms of bhp were not provided. However, the engines were rated by participating drivers as having performance characteristics analogous to those of equivalent diesel engines.

The California Cartage Company is one of the largest providers of drayage services in Southern California with 650 trucks with Diesel, CNG and LNG within its fleet.[16] Like all major trucking companies serving the Ports of Los Angeles and Long Beach, the CCC was required to eliminate all trucks with pre-2007 engines from its fleet. The CCC was also an early adopter of both compressed natural gas (CNG) and Liquefied Natural Gas (LNG) as a transportation fuel for drayage trucks.

CNG powered trucks required the development of a refueling infrastructure. This is currently a major hindrance for the broader adoption of natural gas fueled vehicles. Due to pre-existing investments, the Los Angeles area has a significant number of retail natural gas refueling stations that were viable. The CCC petitioned the port to construct a dedicated CNG refueling station at its yard that could further lower the cost of natural gas vis-à-vis diesel fuel. However, permission was not provided by the POLA in time for the study. Therefore, in order for CNG powered trucks to effectively service customers,

[16] http://www.calcartage.com/aboutus/green-initiatives

trucks must be able to effectively pre-plan their refuelling options, given the limited availability of stations and the modest range associated with CNG trucks.

Table 135: Success and failure factors of the CNG class 8 heavy duty drayage trucks

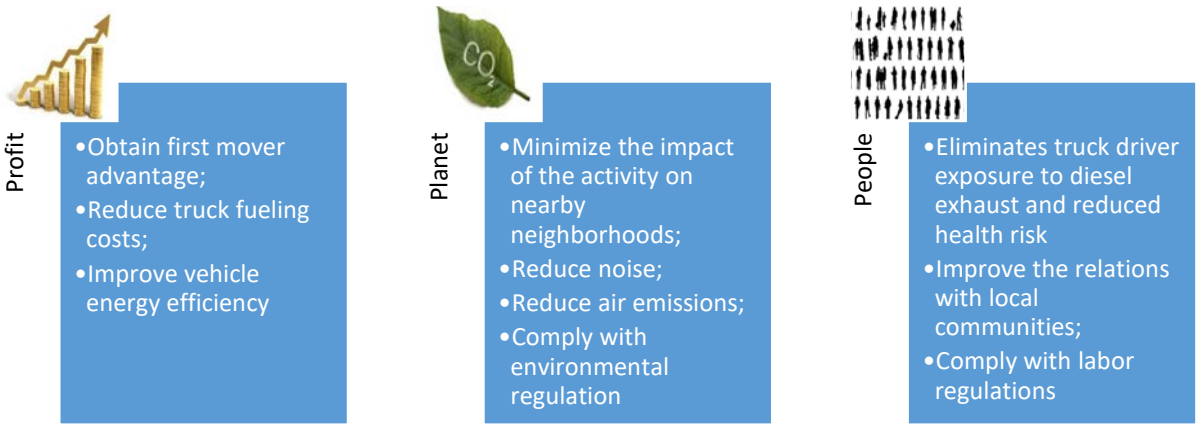
Success	Failure
Lower operating costs (13.9%) for trucking operations over use of diesel fuel; Obtain first mover advantage to gain market share	Some truck drivers felt CNG trucks were underpowered for steep hills; Ability to install fueling station at company site was unsuccessful during the demonstration period; Lack of fueling infrastructure to support wider acceptance of CNG trucks

Profit, planet, people

The Ports of Los Angeles and Long Beach implemented a Clean Truck Program that requires all Class 7 and Class 8 trucks that enter a port terminal, to meet the minimal emission standards of 2007.

In order to assist in the transition to cleaner technologies, the ports created a Technology Advancement Program (TAP) that provides grant funding to test emission reducing innovations. One of the four trucks utilized in this test was funded by the Ports under this program. Because of the public funding and its open procedures, data was collected on operation and performance of the TAP-funded truck for six months. The data was included in the final report CNG Port Drayage Truck Demonstration Program Final Report prepared by Gladstein, Neandross and Associates[17].

Figure 70: Triple bottom approach of CNG fueling system for trucks



Source: Interview with California Cartage Company Robert Lively

Within the field of natural gas vehicles, there are currently two competing technologies – trucks powered by Liquefied Natural Gas (LNG) versus those powered by compressed natural gas (CNG). In general, LNG powered trucks are the closest to the operational performance of diesel powered trucks. Both CNG and LNG trucks are more expensive than diesel trucks. A CNG truck can cost twice its diesel equivalent.[18]

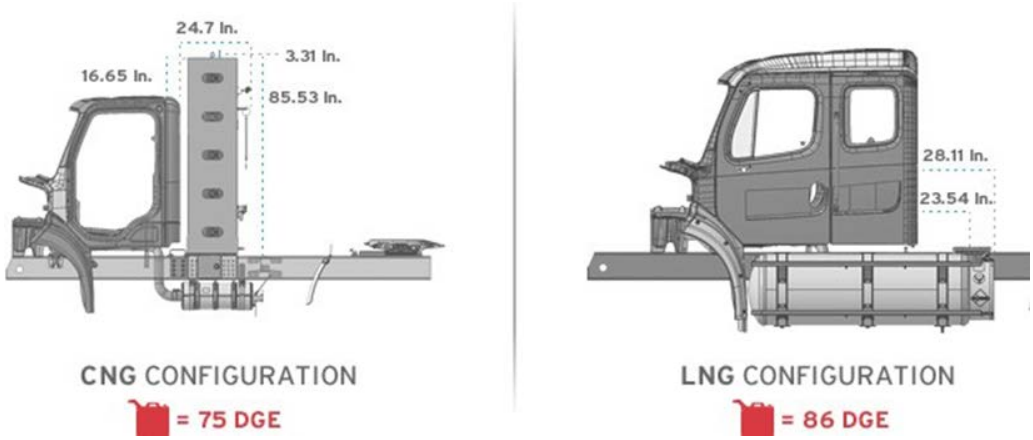
Because LNG fuel is more concentrated, it has a higher energy density. Thus, LNG trucks can have a longer range than CNG trucks and as such, LNG trucks have been seen as the natural substitute for diesel for long haul service. There are also, However, significant disadvantages to LNG trucks. The upfront capital cost of LNG trucks can be higher and fuel availability can be lower. For this reason,

[17] This report is available online at the www.cleanairactionplan.org
[18]www.joc.com/trucking-logistics/trucking-equipment/trucking%E2%80%99s-natural-gas-%E2%80%98highway%E2%80%99-still-under-construction_20140626.html

when vehicles are intended for short haul deliveries, CNG can have a more economical choice. Drayage service has some attributes of short haul delivery service, yet, it is also associated with long haul deliveries. For example, the containerized cargo carried by drayage trucks can be quite heavy – up to the legal limit. For this reason, these trucks are of Class 8, which requires high torque and horsepower in order to properly accelerate and safely operate in mixed traffic. Another key distinction is that these trucks often need to travel significant distances between pickups. For example, the distance between the ports of Los Angeles and Long Beach and the "Inland Empire" where many of the region's major distribution centers are located is over 70 miles from the port complex. Thus, a truck making such a delivery would need a range of at least 140 miles. The capacity of the CNG trucks is measured in terms of Diesel Gallon Equivalents (DGE).

As dedicated drayage trucks do not have sleeper cabins, they have sufficient space for CNG tanks behind the driver's compartment as shown by Figure 71.

Figure 71: CNG and LNG Configuration of the drayage truck



Natural gas engines for Class 8 trucks are now commercially available. The Class 8 engines produced by Cummins are rated at 400 horsepower and 1450 lb/torque.[19] They are designed to handle loaded of up to 80,000 lbs, which is also the legal road weight limit for most highway corridors in the United States. Thus, truck drivers do not need to make allowance for lighter loads to use these engines.

The CNG trucks, which are used in this study demonstrate a fuel economy between 4.16 miles and 5.38 per diesel equivalent gallon (DGE) of fuel depending on the use cycle. This compares to an average diesel fuel efficiency of 5.5-6.00 miles per gallon for diesel trucks involved in drayage service, according to estimates of the CCC. With these comparative efficiency estimates, the cost efficacy of the two engine options would depend on the comparative cost of the two fuels.

Another measure of efficiency for CNG trucks vis-à-vis diesel is their required maintenance costs. Higher maintenance costs for natural gas engines would undermine savings from lower fuel costs. During the testing period, no excessive maintenance was required over and above what would have been expected for equivalent diesel-powered engines. However, the small sample size and limited duration of the study may not be sufficient to conclude that the maintenance requirements of natural gas engines is equivalent to that of diesel trucks.

Almost all drayage trucks that currently serve the ports of Los Angeles run on diesel. The cost of new trucks has gone up substantially due to the requirement that trucks have to comply to more stringent pollution control. In addition, diesel fuel in California has become more costly than the national average due to more stringent fuel standards. The price of natural gas is at an all-time low due to recent domestic production from unconventional sources. Thus, the higher capital costs of the natural gas engines could be offset by lower marginal cost for fuel. Natural gas has inherently lower CO_2

[19] http://www.cumminswestport.com/models/isx12-g

intensity. In addition, the use of natural gas makes it easier for engine designers to meet emissions regulations. If natural gas prices stay depressed, it is predicted that more fleets in the United States will turn to LNG and CNG fuel in the near future.[20]

The demonstration concluded that CNG-fueled trucks successfully completed drayage service equivalent to what would be provided by diesel equivalents vehicles. The fuel cost savings are estimated at $2,085 per vehicle over the six-month period given the existing rates of CNG and diesel fuel. Most drivers rated the performance of the trucks as equivalent to diesel. Some drivers felt that the CNG trucks had less power to climb steep grades. The vehicles may also have required more maintenance.

Stakeholders

This project included a total of seven actors that began working together in early 2008. Southern California Gas used its research and development funding program to finance the project with the Ports of Los Angeles and Long Beach and to pay for one of the four trucks. Autocar LLC, Crossroads Equipment and Lease LLC, and the California Cartage Company (CCC), participated in the demonstration project. Autocar LLC. build the four drayage tractors on its existing chassis, which was used for CNG refuse collection trucks. Crossroads Equipment and Lease LLC. handled the financing of the Autocar vehicles through its existing truck sales/leasing operation.

The California Cartage Company agreed to operate the vehicles in its fleet of port drayage trucks. The consulting firm of Gladstein, Neandross and Associate was selected to manage the implementation of the program along with conducting data collection on performance. Drivers employed by the California Cartage Company that operated the trucks, participated in data collection and monitoring. The project was initiated in 2008 with trucks entering into service in February 2009. Data was collected until January, 2010.

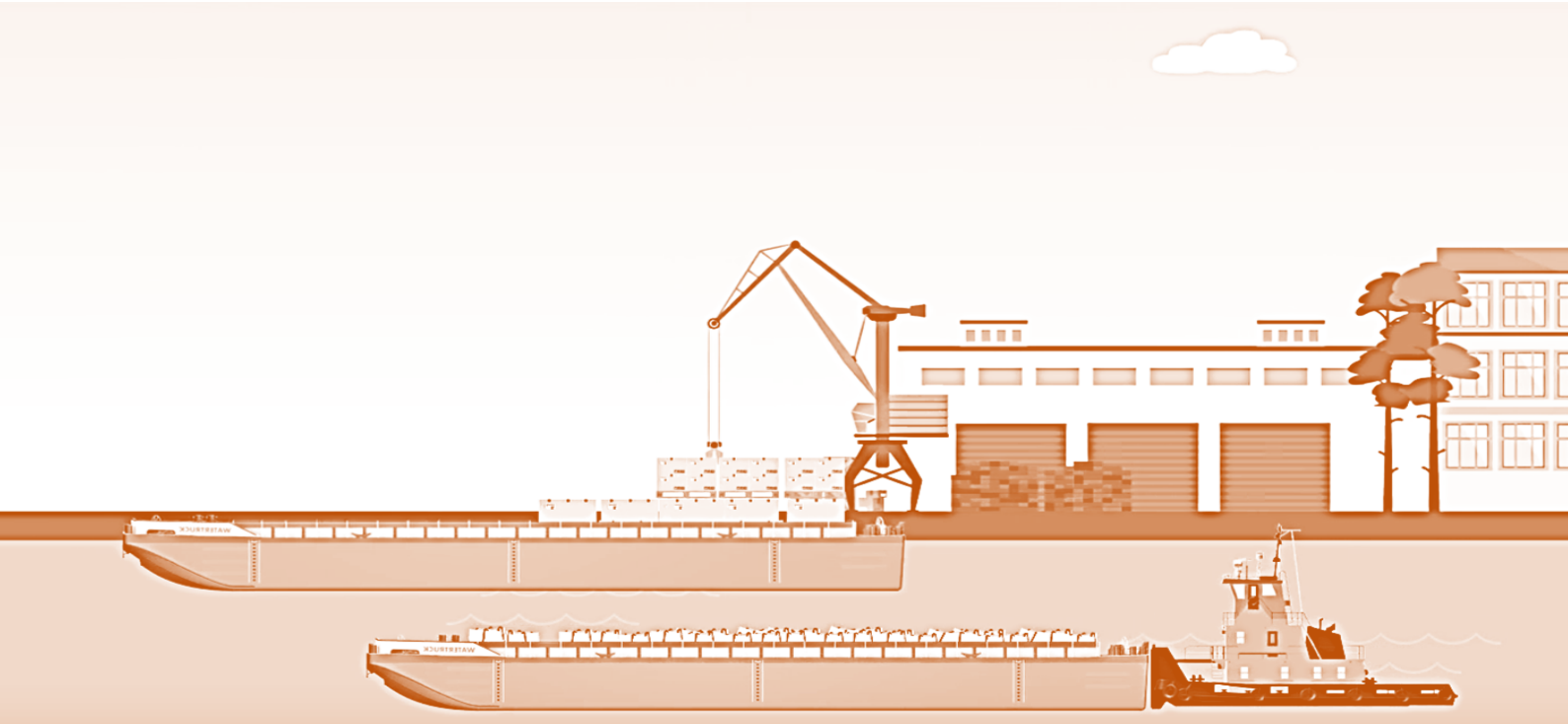
Table 136: Development stages of the CNG Class 8 Heavy Duty drayage trucks

Level	☐ Initiation	☐ Development	☑ Implementation
Southern California Gas Co	✓	✓	✓
Ports of Los Angeles/Long Beach	✓	✓	✓
California Cartage Company	✓	✓	✓
Autocar LLC	✓	✓	
Crossroads		✓	
Truck drivers			✓
Gladstein, Neandross & Assoc.	✓	✓	✓

[20]www.nytimes.com/2013/04/23/business/energy-environment/natural-gas-use-in-long-haul-trucks-expected-to-rise.html?pagewanted=all&_r=0

CLUSTER 7: INNOVATION SUPPORTING INLAND WATERWAYS

The innovations in this cluster are focused on waterways, especially smaller waterways. Despite the success of inland navigation at larger waterways such as the Rhine, activity decreases on smaller waterways. The Pallet Shuttle Barge (PBS) and the small barge convoy (SBC) are innovations that are intended to reactivate this part of the inland waterways. The Barge-heavy lift RO-RO hybrid has a larger scope and is focused on the Rhône.



43. Barge heavy lift RO-RO hybrid

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Barge-heavy lift RO-RO hybrid is a technological unit change that is implemented by a private innovator. The project represents a private initiative from the CFT Group. The innovation has a closed character and follows an incremental development. The incremental degree of innovation is set by the fact that already existing technology was adapted for new purposes.

Table 137: Characteristics of the barge heavy lift RO-RO hybrid

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The aim of the Hybrid heavy RO-RO lift barge is to upgrade the capacities, which can be transported via barges using inland waterways. The innovation combines one RO-RO barge and one submersible barge as a joint tandem. It provides a more flexible solution regarding the facilities offered by the quay infrastructure and offers better safety conditions during loading/unloading and the actual transport.

The concept behind the innovation, offers a wide variety of usages. As part of its main purpose of heavy lift transport, the RO-RO barge can be used as a pontoon and the submersible barge as a dry dock facility.

Inland waterway transport (IWT) offers more benefits than road haulage. The hybrid heavy RO-RO lift barge represents a competitor for road transport for a set of reasons. The first reason is the height and weight limits, which are lower on the public roads than on the inland channels. A second reason is the possibility to transport pre-assembled pieces in specialized locations, which is more cost effective than onsite assembly. The latter has an extra cost for the specialized team and equipment.

The concept is already used on several inland waterways in France on the Rhone, Loire and Seine. The success factors for the Hybrid heavy RO-RO lift barge are: the existing agreements with EDF (Electricité de France) who is the main customer for exceptional cargo transport and for, which the project was initially developed; the possibly to reuse the pontoons and the submersible barge for other purposes; the weight and height limits, which are currently set for the alternative road network

This special transport solution was studied and realized by the CFT Group, which desired to have a versatile barge that was specially designed for the Rhone channel clearance. The hybrid heavy RO-RO lift barge is an innovative concept that is designed to transport exceptional heavy equipment using inland waterways as an alternative for road haulage.

The concept is called a hybrid because it includes the use of two separable parts: one floating pontoon and an immersion barge. The two vessels are designed to complement each other in order to balance and stabilize the loading/unloading operations.

The pontoon is called “LIBECCIO”, is 66 m long and 9.15 m wide, while the barge (SIROCCO) is an immersion vessel, which uses the same principle as a floating dock. This technical solution allows to set up the same level for a barge platform and the nearby quay for loading and unloading. It also allows

dynamic adaption of the ballast in the two units to optimize the ballast capability to ensure stable operations and to increase the level of loading performance.

The "SIROCCO" was conceived, designed and built to meet the needs of EDF (Electricité de France) in the context of securing long-term supplies of heavy components for nuclear power plants in the Rhône basin, which still remains its mission and first priority.

Henceforth, the CFT Group implemented on the Rhone basin the original conventional pontoon Roll On Roll-Off "LIBECCIO", which was already being used for maritime transport leaving the port of Fos-sur-Mer towards various points, including the ITER quay. Occasionally, and if necessary, it can represent an alternative solution for road haulage of heavy loads.

Figure 72: Hybrid heavy lift Ro-Ro barge

Source: CFT, 2014

Table 138 summarizes the success and failure factors of the barge heavy lift RO-RO hybrid that are identified through interviews. The most important success factor is that the innovation offers a flexible and competitive transport service and an alternative for road transport.

Table 138: Success and failure factors of the Hybrid heavy lift RO-RO barge

Success	Failure
Offer a competitive service over other modes of transport (road transport); flexible operations; incorporates the use of two devices.	Locked/operable only in one area (on a certain river).

Profit, planet, people

The hybrid heavy RO-RO lift barge project has the aim to extend the activities of CFT. The initial use of the combination of the two barges is set to be on the Rhone canal in France, a region, which for the moment does not benefit of this type of service.

The main objectives, therefore, are to increase the operations, to gain new market and increase the competitiveness of the company in exceptional transport. From this point of view, economic aspects drive the project.

Less important factors that contribute to the development of the project were related to environmental and social objectives. For example, by shifting the transport of overload goods to barges, there are possible effects in reduction of congestion on the road network and also the security

of transported items is much higher. Looking from a social perspective, this project can have the benefit of offering new employment opportunities.

Figure 73: Triple bottom approach of RO-RO heavy barge lift

Stakeholders

The Hybrid heavy RO-RO lift barge project from CFT has passed the initiation and development stage and is during its exploitation at the moment on the Rhône Channel. The involved actors during the entire process are: CFT as innovation champion; the authority (Direction territoriale de Voies Navigables de France - Rhône-Saône, former Service Navigation Rhône-Saône); the terminal operator, represented by the EDF, which is the main beneficiary of the new service; and Standardization bodies, which were involved for the classification of the barges.

The process and initiatives over the first two stages (initiation and development) were similar. However, poor and unsatisfactory communication has been identified between the port authority due to bureaucracy reasons and other actors.

Concerning hard institutions, the regulation for tugging operation on the inland navigation waterways is quite stringent. The relation between the terminal and the operator changed between the initiation and development stage because of concerns regarding the total costs of transferring heavy equipment being assembled at the production plant before barge transport compared with road haulage costs. The latter mode transports pieces that are finally assembled at the destination point.

After analysis of the road haulage option, the cost for performing the final assemble at the destination point proved to be higher than transporting the heavy equipment in one finalized piece by special barges. The progress of the project was speeded up by the experience of CFT in inland navigation and existing connections. There was no need for the establishment of a new innovation network in every step of the innovation process.

The implementation period still requires the involvement of all actors due to the special status of each transported unit as 'transport exceptional'. Individual planning has to be made for every transport of heavy equipment and it has to be authorized by the port authority.

Table 139: Development stages of the barge heavy lift RO-RO hybrid

Level	☐ Initiation	☐ Development	☑ Implementation
Barge transport operator	CFT	CFT	CFT
Authority	River traffic management	River traffic management	River traffic management
Terminal operator	Riverside port	Riverside port	Riverside port
Standardization body	Classification society	Classification society	Classification society

44. Small barges and reactivation of small inland waterways

Valentin Carlan, Christa Sys and Thierry Vanelslander

The problem of the diminishing activity on small waterways is also the trigger for the following innovation. The development of the concept of the two-stage tug and barge concept is in its initiation stage and different studies and pilots (varieties on the described concept in this case) are conducted to prepare for a future implementation. The innovation is open and mainly public driven. It aims at a system change whereby higher volumes can be transported by a coupled small barge convoy (SBC).

Table 140: Characteristics of the small barge convoy (SBC)

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

In the last 45 years, no new small inland ships have been built and the small inland fleet is diminishing. The small waterways are increasingly losing tonnages to the already heavily congested road network. These extra tonnages and the potential further increase in cargo flows could lead to more investments in the expansion of the existing road capacity while the available infrastructure of the small waterways is abandoned.

Another consequence of the diminishing small inland fleet is that the diversity in the total inland fleet will disappear. The new ships that are being built are increasing in size and Therefore, the available sailing area of these ships is reduced because those large ships can only sail on a limited number of inland waterways. Therefore, there is a large risk that there will be only large inland ships left in the future, while more than 50% of the inland waterway network can only be used with smaller (<600 tonnes) ships.

The small waterway capacity is needed to deal with a part of the total tonnages that must be transported from the seaports of Rotterdam and Antwerp to their respective hinterlands. The new ships that are being built are increasing in size and Therefore, the available sailing area of these ships is reduced because the large ships can only sail on a limited number of inland waterways.

The first objective of this project is to gain insight into the existing problems concerning the diminishing small inland fleet and, as a result of that, a reduction of the use of the small inland waterways. The second objective is to develop a new inland navigation concept that could be used to reactivate the use of the small inland waterway network. The third objective is to determine the optimal design for the concept developed (network and ship design). The fourth objective is to research the possibility of implementing, in an economically viable way, the small barge convoy system via suitable business cases.

The new inland shipping concept has to be further developed, which will imply abandoning of all the former existing solutions. Reflection had been done at an higher level of abstraction and a set of criteria had been defined. The new system must have to comply with this new set of criteria. The main criteria for the developed concept, is that the small barge convoy must be:

- suitable for the small waterways: (Lbarge< 55 m, Bbarge < 6.8 m);
- able to deal with a limited depth of small inland waterways (h = 2.3 meters instead of 2.5 meters);

- able to transport bulk cargo as well as containers so that additional cargo flows can be attracted to the new concept (modal shift of containers from the road to the inland waterways);
- a system where the crew who are operating the barges should not live at those barges so that the total available length of the barge can be used to transport cargo;
- capable of providing a solution for the problem of the small call sizes of inland ships at the deep-sea terminals;
- able to compete predominantly with road transportation;
- a profitable business;
- capable to provide a sustainable transportation solution to deal with the increasing emission problems.

In order to fulfil these criteria a concept has been developed that can be described as a two-stage tug and barge concept. In the first stage, the tug and barge concept sails in its usual configuration with several barges pushed by a single tug and travelling through large inland waterways from seaports to the entrance of the small inland waterway. In the second stage, at the entrance of a small inland waterway, the convoy is uncoupled, and several small barges will sail separately to their different destinations on this waterway.

In the small barge convoy system the barge size will be decreased in order to make such a system applicable for the small inland waterways. The main focus of the concept is to combine economies of scale on large waterways (i.e. tugs and barges together) while the individual barges are small and economically feasible enough to sail on small waterways.

The crew

The concept will have different crews who will operate the tug and the barges. One crew will be operating the tug when the barges are pushed to and from the entrance of the small inland waterways and the seaport. This crew will also deal with the coupling and uncoupling of the barges. This crew will work in a week on/ week off regime on the tug so that the crew will not live on board.

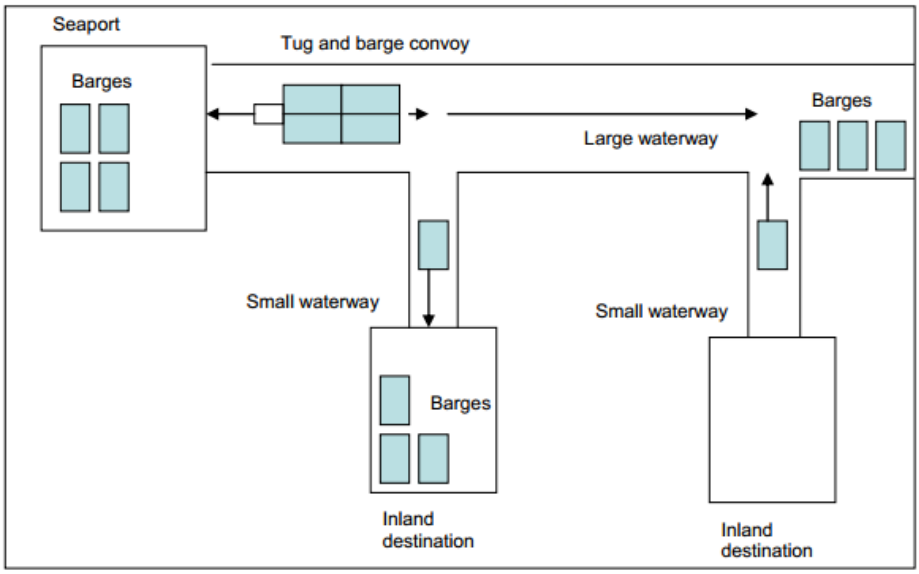
The next crew will be located in the seaport where they will move the barges from the barge collection point to the terminals in the port. The last crew is a flexible one who will sail the barges, if necessary, on the small inland waterways. This new captain gets on board and sails the barge to the final destination. When the barge is moored, the captains will be brought back to the starting point. These captains will go home when the work is done. It is also possible that people can rotate for instance from seaport-duty to small- river duty or from small-river duty to push-ship duty. This will make the work more diverse.

The small barges

For propulsion, the barges use electric engines powered either by a generator set located in the aft of the barge or by batteries located in the double bottom of the barge. Also a combination of the two systems is possible. Several systems could be used to charge the batteries. A power connection to the shore can be used while loading and unloading, preferably using electricity from a grid based on “green” energy such as wind or solar power.

Autonomous; increase the barge transport	Legislation need to be changed

Figure 74: Schematic overview of the SBC concept with a 4 barges configuration (2 different side channels)



Source: Van Hassel, 2011

The small barge convoy system could be used in dealing with the problems of increasing congestion on the road network and growing awareness of environmental care, and the diminished supply on the small inland waterways. Due to the modular character of the concept, potential clients could be even bound to the concept by a system of leasing out barges.

Efficiency and performance of tandem lifting operations are directly linked with the time and cost saving and the duration of freight transport from port to final clients located in the nearby of small inland channels. The present time and cost expenditures can be compared with the ones present in the new proposed study case.

Table 141: Success and failure factors of the SBC

Success	Failure

Profit, planet, people

The objectives of reactivation of the inland shipping are mainly economic. The most important being the cost minimization by turning into an advantage the economics of scale on the main navigation channels and to increase the scale of operation on small channels. Most objectives were rated as 4 or 3 on the importance scale.

Environmental impact of the inland navigation is also an important objective for the current proposal. The main objective as it can be seen form the above figure is the reduction of congestion on the road transport network. Other important objectives are the direct emissions of CO_2 and air pollutants, the reduction of noise and to ingrate with other development and comply with environmental regulation. This objectives can be achieved by the green orientation towards using of electrical engines for self-propelled barges and the joint together of several barges while navigation on large channels.

Social aspects for reactivation of inland shipping are rated as medium on the importance scale. Due to the fact that will require labor work this project will offer the possibility of retaining human capital in the inland shipping industry and maybe even attract more employees. Compliance with social, labor and safety regulation represent also an important factor the current innovation case.

Figure 75: Triple bottom approach of reactivation of small barges traffic

Stakeholders

Small barges for the activation of inland navigation represent a research initiative, which is built in collaboration with University of Antwerp, which has the position of a research institution, together with the waterway administrator and the Flemish government as regulators. An important role in the actors' synergy was made by the Flanders Inland Shipping Network, which had the aim to encourage the water transport and bring together all regularly involved actors in the Flemish inland navigation.

Small barges and inland waterways represent the infrastructure, which is proposed to change in order for the concept to function. The waterway administrator and the research institute put effort into developing the innovative concept to reuse the inland navigation for decongesting the road transport network. Legal aspects were also an important point tackled by the two actors and suggestions are being proposed to make the concept functional. From the soft institutional point of view, labor unions were the most actively involved, which gave suggestions on working regulation and safety requirements that the new system should comply with.

During the initiation process also an important missing actor was the terminal operators, which could have contributed to the development of idea and declare their needs form the infrastructure point of view to make the small barges concept implementable. The network created between the involved actors pushed the innovation further, Nevertheless, there was always sensed room for improvement.

The actors, which contributed thoroughly from the point of view of capacities, were the Flemish government and waterway administration, which invested their capital in the idea development, and research institute, which dedicated time to the same goal. The market demand for the reactivation of inland shipping is in favor of the project due to the waterway administration, which possesses their own database with companies situated along the inland navigation canals and by developing their own promotion project in support of inland navigation.

An interesting aspect regarding the competition is that one actor the waterway administrator was supporting the Small barge for reactivation of inland navigation project in the same time while developing another similar idea, which had the same only that it is slightly different in function. The difference between the two proposals is that the navigation on inland navigation small channels was done by using tugs in Water Truck project while the present innovation case suggests the use of self-propelled barges.

Table 142: Development stages of the SBC

Level	☑ Initiation	☐ Development	☐ Implementation
Research Institute	University of Antwerp		
Authority	Waterway administrator		
Regulators	Government		
Terminal operator	Barge operators		

45. Pallet Shuttle Barge

Edwin Verberght

The pallet shuttle barge (PSB) is an innovative type of vessel that is intended to reactivate small waterways and reintroduce pallet transport in inland navigation[21]. The PSB's that are central for this analysis, refer to the Zulu 1 and Zulu 2: two catamaran freight vessels that are mostly active in Belgium and the Netherlands between Antwerp, Brussels, Amsterdam and Liege.

The Zulu's are vessels of 50m long, 2.2m deep and 6.6m wide and are designed to carry 300 tonnes or 198 europallets. The PSB has a dwt of 323.1 tonnes (IVR, 2017). The PSB was implemented as a modular change.

Table 143: Characteristics of the PSB

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

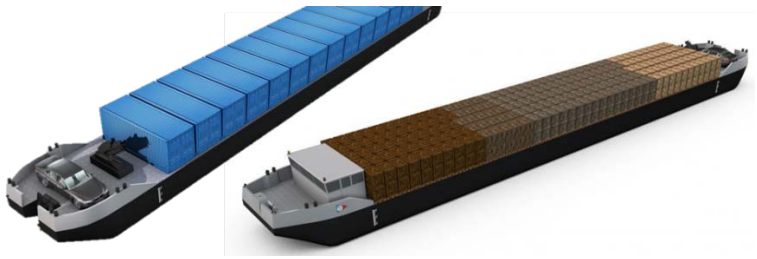
Description

The PSB has its own lifting equipment on board and can position itself dynamically through its rudder-propeller and bow-thrusters. This will allow it to operate in a flexible manner along the waterways.

The catamarans are designed without any accommodation except for a basic wheelhouse in front of the vessel. The on-board crane-rail system is able to lift two tonnes and 9m far. The catamaran design is claimed to give more stability during the crane operations. The operations are manned with a one-person crew. The Zulu 1 was put in service in June 2014, Zulu 2 in February 2015 and two more will be let in the water in 2019. The vessels are very basic and explain the relatively low repair and maintenance costs. The average building period for one vessel is very short and varies between two and three months.

The engine on both ships is a 300 HP diesel with hydraulic propulsion and two bow propellers. The Azimuth thruster propulsion and bow-thrusters claim to use less power than trucks to transport the same quantities. This vessel type has the capacity of ten cargo trucks. Goods are directly placed on deck and the pallets could be stacked up to at least 4m.

Figure 76: Conceptual drawing of the PSB front and rear



Source: Multi Engineering Services, 2017

[21] Verberght E. (2019), Innovative Inland Navigation, editors Vanelslander T., van Hassel E., Antwerp, Strasbourg, 245p.

The PSB is inspired by trucks and catamaran yachts. The lack of accommodation (bathroom, sleeping area, etc.) is comparable with working conditions on trucks (except for the sleeping area). Although the vessel is equipped with AIS, a road haulage track and trace system is more often used by the owner who claims it has more possibilities in real-time to track vessel and cargo.

The first customers were Wienerberger and Beton Coeck. Gyproc joined in 2015 with on average five annual transports to Amsterdam from Kallo. The usage of other types of inland navigation vessels was considered by Gyproc, but the volumes (>700 pallets) were too large to deliver in one time for the logistics system for Kallo-Amsterdam to process. Gyproc demanded a smaller vessel for relatively short distances with less critical mass, which is what the PSB offered (Rommens T., 2016).

Shipit does the manning, operational and technical support. Shipit has a terminal in the Port of Antwerp and together with Delcatrans, they own the River Terminal Wielsbeke. The concept claims to be as lean as possible and cuts down operational costs when compared with a conventional type of vessel with the same dimensions. Also, the costs for the customer are cut because of the ships' ability to load and unload without shore equipment. The absence of accommodation further reduces the costs of the vessels.

The PBS targets the small waterways. The small waterways are defined in this research as class II and below, which builds further on the findings of van Hassel (2011). The PBS competes with the *Spits* and the *Kempenaar* in the segment of big bags[22] and pallets and sails with only a captain according to the respective national legislation and within the regulatory limitations (e.g. no night sailing and not allowed on Western Scheldt[23], Rhine and Seine in Paris[24]). The firm behind the Zulu's is *Blue Line Logistics nv (BLL),* located in Belgium. The ships sail for customers such as Gyproc, Wienerberger, Beton Coeck, ABInbev and even for the rock festival Pukkelpop (stage material to Limburg in 2018).

Thanks to the fact that the PBS is equipped with an on-board crane, only an appropriate quay is required at the location of the customer. As long the waterway manager invests in the small waterways in order to maintain a good navigation status, infrastructure does not present a barrier. As example, the Flemish quay wall program stimulates public-private cooperation to build load and unload installations such as quay walls. This program started in 1998 under the approval of the European Commission (under conditions as set by regulation 1107/70/EC)[25] and is still running.

The idea of a crane on-board of a vessel originates from the Dutch AMS Barge that started operation in 2006. The main issue of an on-board crane is the stability. The catamaran design of the PSB claims to compensate for this[26]. Furthermore, there is no cargo hold beneath deck, as all cargo is put on deck, which makes it easier to load and unload. The basic and cost-efficient design makes it feasible to build the vessel in a relatively short period of time without specialized ship yard and with the possibility to standardize every PSB.

According to the regulations for Rhine navigation personnel (RPN) of the CCNR[27], canal barges are exempted as described in chapter 3 of the regulation (art. 3.21) but need to have at least a boatmaster in possession of a Rhine certificate or a Community certificate and an extra person of not less than 16 years old to help in maneuvering the vessel. In reference with ES-TRIN, a canal barge is defined as *an inland waterway vessel that does not exceed 38.5m in length and 5.05m in breadth* (art. 1.01, 1.8). The

[22] "Big Bags are sack-shaped transport containers of tear-resistant reinforced synthetic web material, which have a volume of for example, one cubic meter and, which are used for transporting pourable goods." (CIBA SPECIALTY CHEMICALS CORP., 2007, IFI Claims Patent Services, New York)

[23] Binnenvaartregeling Artikel 5.15

[24] Order of 2 July 2008 relating to the crew and conduct of certain inland navigation vessels, https://www.legifrance.gouv.fr/affichTexte.do?cidTexte=JORFTEXT000019209512&dateTexte=

[25] https://www.binnenvaart.be/images/publicaties/files/11-evaluatierapport1998-2010_DEF.pdf

[26] Researching innovation in a rapid changing world is challenging. As the research ends, the innovator could have decided to change the vessel. In case of the PSB, the Zulu 3 and 4 were recently constructed and were surprisingly built with a conventional ship bottom and left the catamaran design behind. The flat bottom is now claimed to make the vessel less deep.

[27] The latest edition of the RPN can be found on https://www.ccr-zkr.org

PSB with 50m of length falls outside this regulation and is not allowed within the scope of the RPN (most of the Rhine[28]) and for waterways where national law does not provide exemptions (e.g. Western Scheldt). The ES-TRIN standards also describe sanitary installations where, according to article 15.3, the floor space has to be at least 1m^2, 0,75 m wide and 1,10 m long. On board of the PSB this is not the case.

In a first call for proposals, six companies were selected to receive a total amount of EUR 1,525,000 from the Flemish government. The companies were Isolava, Blue Line Logistics, André Celis, Betonfabriek Coek, M/S Celandro[29] and Wienerberger.[30] These companies received the subsidy spread over three years and were allowed to use it for building a vessel, adjusting an existing vessel or upgrading the needed infrastructure of the company. The objective was that the companies keep on transporting pallets with inland navigation after the subsidy period, otherwise they would have to pay the maximum individual subsidy of EUR 200,000 back. The subsidies are given to support investments with 80% public and 20% private funding. The support to compensate for the difference between road haulage and additional transshipment costs with inland navigation in the first years of initiation lowers every year for every pallet. These costs relate to additional logistics costs, door-to-door logistics and pre-and post-haulage.[31] A second call was organized in 2013. The last call was in 2015 for EUR 1,000,000. The fact that the calls are decreasing in budget, makes it uncertain to predict of they will continue or not and what the behavior will be of individual companies. Changes in this indirect subsidy for the PSB and other pallet transporters in IWT, could have an impact on the business case.

Not all captains are attracted to this exploitation type. According to the interviews, there is a growing labor shortage of experienced captains and the freight market is currently competing with strong growing passenger cabin ships, which offer higher salaries. The inland navigation is typically a family business sector with most of the times a family on board. The lack of accommodation could be less appealing if there is a choice to work on a vessel within a more comfortable working environment or a “truck on the water”. Also the success of cabin cruises, which offers significant higher salaries, influences the total labor supply for freight IWT.

The organization in shifts on the other hand, could attract more people that prefer to work in daily shifts with the opportunity to return home at the end of each shift, which is on other ships and types of operations not always possible. This could perhaps be more attractive for sideways instream of labor forces (on-shore people that are willing to sail). Further research, including an interview sample of operators, can shed more light on the individual preferences of potential and existing crews.

The single crew member does not only have to sail, he or she also has to (un)moor and be trained in manning the crane during (un)loading operations. The impact of these tasks combined, could make the job more demanding than for an operator of a *Kempenaar* where on-shore equipment is needed to unload the vessel and where the operator is only needed to be on board of the vessel but does not have specific tasks during unloading. The impact of additional tasks for the operator, could be examined by further research.

Because of the fact that the vessels are claimed to be clones from each other and the concept is very basic, no specialized knowledge is needed to build the vessels, which makes them more independent of shipyards and increases certainty of operation for charterers and shippers when repair or maintenance is needed. The alignment of the shipyard and shipyard specialization is Therefore,

[28] When navigating downstream of the Spijk ferry (kilometer pole 857.40) and provided that the German-Dutch border is not crossed in either direction, it is sufficient if the requirements of the Dutch law "Binnenvaart wet" (Staatsblad 2007 issue 498) are applied. (art.3.23 RPN, CCNR 2018). This means that only this part of the Rhine allows ‘alleenvaart) "Binnenvaart wet" (Staatsblad 2007 issue 498) are applied).

[29] The motorship Celandro (50m, built in 1960) sunk on 15 March 2013 during unloading operations at Beton Coeck and was total loss and was scrapped later that year.

[30] https://binnenvaartlog.nl/zes-bedrijven-krijgen-vlaamse-steun-voor-palletvervoer-met-binnenvaart/

[31] Crevits, H. (2009), 1,5 miljoen euro ter ondersteuning van palletvervoer over het water, press release, Flemish government, https://www.mobielvlaanderen.be/persberichten/artikel.php?id=355

regarded by the innovator as less important. Nevertheless, this latter claim of the innovator, there were more than two vessels announced during the development period, but they did not succeed in being built because of problems with the shipyard, funding challenges and lack of possible charterers.

The IWT market experienced turmoil in the aftermath of the global economic crisis of 2008, which led, together with relatively high fuel prices, to a period of social unrest in the sector with blockages in Belgium and VO/O's that refused to sail under the conditions [32] of that time. These events and the later recovery of the market could have had an impact on the already vulnerable small waterways and explain why the 3rd PSB was delayed. BLL shows a strong connection with knowledge institutes and regulatory actors at the national level (strong network effect) and is considered as a success factor.

The innovation has the support of the waterway manager and the Flemish government that invest in small waterways, support quay building and subsidize customers to shift towards inland navigation (e.g. pallet subsidies). Also BLL received a crane subsidy. Despite their support, public actors also take initiatives to reactivate the small waterways and are investing in potential competition for BLL and other private actors on the small waterways (e.g. Watertruck + as cited from Verberght et al., 2019).

Table 144: Success and failure factors of the PSB

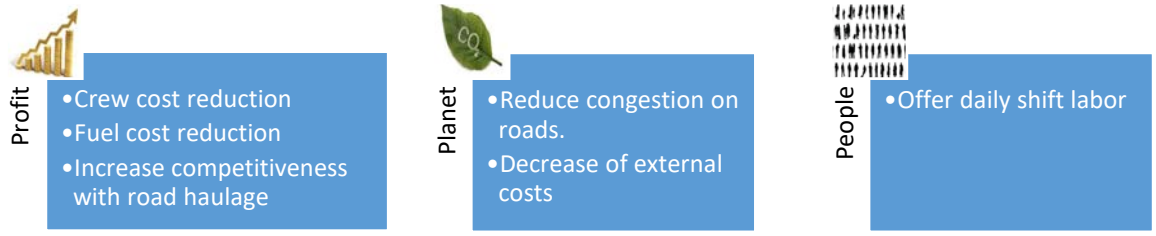
Success	Failure
Self-propelled; self-loading and unloading; designed for small canals; single crew and flexible shift labor; indirect subsidy for customers; quay wall program; public funding of research; attracts people who like to work in shift; mainly pallets but also general cargo (e.g. beer bottles) and containers	Uncertainty of indirect customer subsidies for pallets; Legal limits on single crew ("alleenvaart"); Difficulty to find personnel (higher salaries in cabin cruises, more luxurious accommodation on other ships); possible public competition

Profit, planet, people

The main objectives of the PSB are economic and relate to cost reduction and efficiency. The single crew decreases the personnel cost despite the legal limitations, which does not allow a single crew on several waterways and during night. The basic design and crew configuration would not be allowed if the PSB would be five meter longer.

Next to the single crew and personnel cost reduction, the lack of accommodation also decreases cost because no auxiliary generator set is required for the accommodation area and relatively more space can be used for cargo. A social objective is the reactivation of small waterways, which could lead to volumes being shifted from road haulage towards IWT or an increase in intermodal transport of mainly pallets. This lowers the total external costs of the logistics chain.

Figure 77: Triple bottom approach of the PSB



Source: own compilation based on interview

[32] Conditions were described by the sectoral organizations and referred to low freight rates, enforced unfair pricing, difficulties to receive financial loans and upcoming technical requirements. The freight rate was claimed not to cover the fuel costs. The outcome of the blockage was the postponement of a number of technical requirements (moratorium) and a federal legislation concerning fair pricing in 2014 but, which has not yet been implemented.

Stakeholders

During the initiation phase of the PSB, the following capability and network effects can be observed, which then can be linked to stakeholders:

- Knowledge is available through programs, research projects (e.g. Inlanav) and companies' initiatives in developing the business case (capabilities).
- Sufficient shipyards and expertise are available (infrastructure, third parties).
- Private financial capacity and ship building subsidies are available (capabilities: funding; soft institutions: subsidies).
- Stakeholders are aligned (soft institutions) and sector organizations show no resistance.
- First customers or charterers are found (positive impact of pallet subsidies and quay program for charterers), although the concept is rather unknown during this phase and the customer base has yet to grow (weak network effect).
- Not all potential customers (shippers/forwarders) are waterbound or have quay infrastructure (failure factor).

The development of the PSB followed several other attempts since the Dutch project Distrivaart. The idea for reviving the pallet transport on small waterways grew further during FISN (Flanders Inland Shipping Network), which offered a platform in Flanders for stakeholders, policy and knowledge institutions. In order to strengthen the competitive position of inland navigation on small waterways and for relatively low cargo volumes, the PSB reduces the crew cost to the minimum requirements and adjusts the dimensions of the vessel accordingly.

The vessels are developed according to contracts with customers. Building a *Kempenaar* takes usually longer than a PSB and is less standardized. The PSB's are exact copies of each other what generates overhead efficiencies and economies of scale that grow with every new PSB. After the pilot PSB was in the initiation phase, the second vessel was ordered. During the development of the second vessel, the shipyard went bankrupt what threatened to endanger the building of the vessel. A solution had to be found to finish the second vessel. Because of the very basic concept of the vessel design, it was relatively easy to find a new shipyard to proceed to the implementation phase.

During the implementation period, more investors bought shares in BLL, which can indicate a growing belief in the business case. Sufficient capability (funding success factor) and demand were found to order two more vessels (Zulu 3 and 4), but with a changed concept, leaving the catamaran design behind and going for a conventional flat bottom (Schuttevaer, 2018). The catamaran design was in practice less suitable because of the larger needed depth. The new PSB's will also have a sleeping area.

BLL did not receive subsidies during the implementation of the innovation on the market and does not receive directly public support for their operations. Furthermore, it is not found how many customers still receive subsidies and how they would change their strategy and modal choice if public funding would stop. The subsidized customers are required to be committed to continue with IWT for at least five years after the subsidies as the subsidy policy foresees. A customer indicated that the quay program and the digressive pallet subsidy were convincing enough to choose the intermodal solution. However, how this would influence their future preferences is uncertain.

During the implementation period, interviewees reported that the existing regulation limits further market uptake. However, it was not a barrier for the innovation to initiate and develop operations.

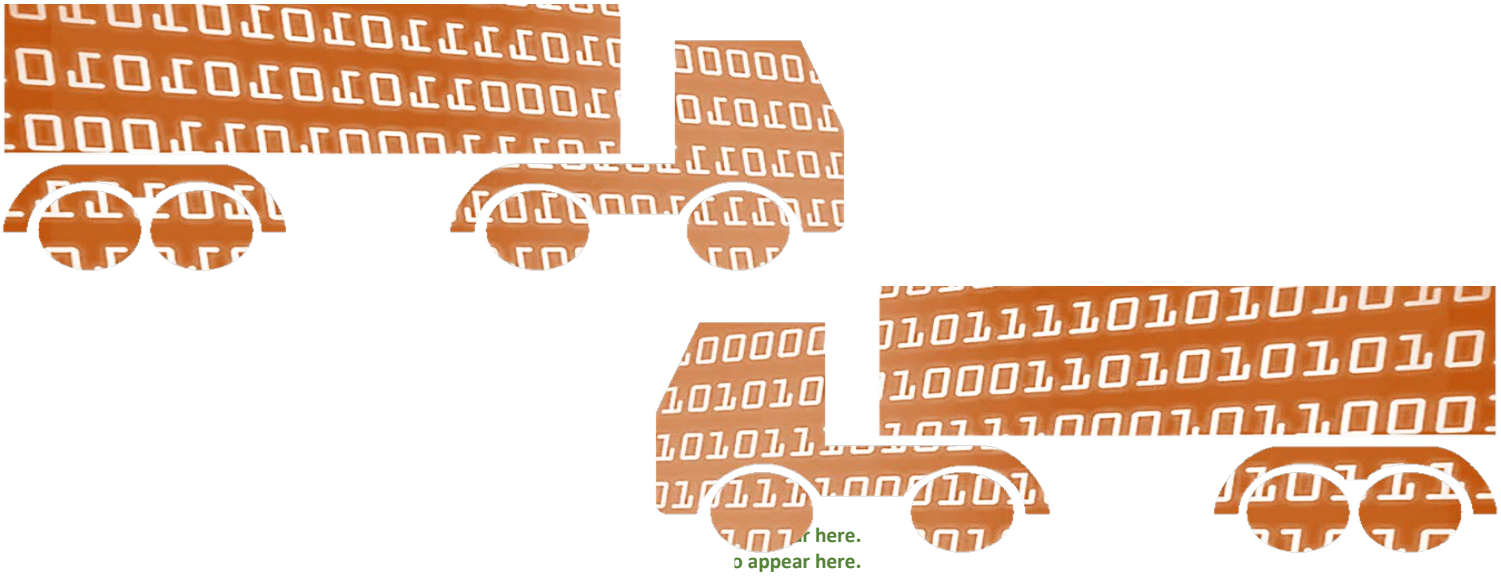
With updated navigation equipment, complying to current requirements, it could be the question if limitations for sailing during night or the prohibition on busy parts of the Seine and the Western Scheldt, still correspond with common practice.

Table 145: Development stages of the PSB

Level	☐ Initiation	☐ Development	☑ Implementation
Barge transport operator	BLL	BLL	BLL
Authority	Indirect subsidy (customers), crane subsidy, research funding of Flemish Government	Indirect subsidy (customers), crane subsidy, research funding of Flemish Government	Indirect subsidy (customers), research funding of Flemish Government
Customers	Companies with pallets at small waterways	Companies with pallets at small waterways	Companies with pallets at small waterways
Infrastructure manager	W&Z nv	W&Z nv	

CLUSTER 8: INNOVATION IN MONITORING OF VEHICLES & CARGO

To improve safety and efficiency to reduce waiting times and operational costs, several innovations are being developed or already implemented such as weighbridges, gate automation, appointment systems to improve slot management and availability, portals, track devices and communication platforms. Some of them are discussed in the following part.



46. Weighbridges

Valentin Carlan, Christa Sys and Thierry Vanelslander

The technic to weigh containers is evolving. This innovation is a technological unit change that aims at a modular change and is driven by a private innovator. The innovation is kept closed and is being initiated at the moment of this research.

Table 146: Characteristics of weighbridges

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Container weight is becoming more and more an actual issue for shippers. A correct weighing can avoid unwanted incidents. Lately IMO (International Maritime Organization), after the proposal of the two organisms ICS (International Chamber of Shipping) and WSC (World Shipping Council), is willing to establish a new regulation that refers to this matter. The new regulation will specify that all exported containers should have their weights verified, and that this information should be confirmed by the marine terminal upon receipt, and before vessel loading. The information has to be made available to the ship operator to allow a better stowage planning (International Chamber of Shipping, 2013).

Although the shipper is considered to be the main beneficial of this innovation, the responsibility and cost lays at the side of the container terminal. The latter will have the responsibility to check the declared weight for each handled container. Moreover, international freight forwarders associations such as FIATA and CLECAT, consider additional legislation without any significant effect on container safety in transport overseas. Instead, they strongly believe that the need for weighing should be based on a proper risk analysis of the quality of the data transferred between shipping lines, shippers and customs authorities (European Shippers Council, 2013).

The IMO- subcommittee on Dangerous Goods, Solid Cargoes and Containers describes the possibility of container weigh measurements in two ways: weighing the container in its entirety to verify the weight; and verification, whereby shippers calculate the weight of all packages and cargo items and add them to the weight of the container (Port Strategy, 2013). Lars Meurling of Bromma Conquip, advises not to underestimate the effort that has to be made and its implications on terminal operations and costs. According to Meurling, weighbridges appear to be one of the solutions without affecting the operations in the terminal (Port Strategy, 2013).[33]

Weigh bridges are a long-established and recognized technology to measure the weight of a vehicle. The measuring accuracy of the weigh bridge is relatively high but the tare weight[34] deduction process might bring additional inaccuracies, complicate the process and introduce time delays.

There is an alternative where one can use a standard tare weight and exclude it from the process. Another more accurate method, might be a second weight measurement of the empty truck to have the exact tare of the vehicle, but it adds steps to the process, which takes time and uses terminal

[33] https://www.portstrategy.com/news101/port-operations/cargo-handling/container-weighing-issue
[34] The weight of an empty vehicle or container

resources. Using weighbridges to weigh containers is likely to result in changes to the internal logistics of most existing terminals. Containers arriving by train or sea would have to be sent to a weighing station, a step, which is uncommon in terminal logistics today (Meurling, 2014). Another special situation, which have to be taken in consideration and needs special attention is the arrival of two twenty-foot containers, which are loaded on one vehicle because weighbridges can only determine combined weight.

Table 147: Success and failure factors of weighbridges

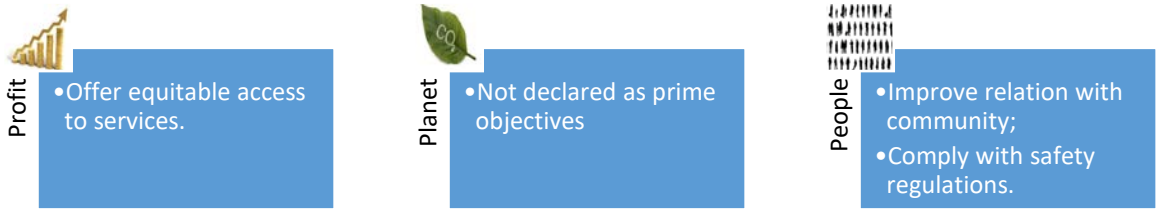
Success	Failure
Need to be implemented because of too many overweighed container arrive in the port; support from legislation.	Might slow down the traffic and cause congestion.

Profit, planet, people

To weigh a container and to use the load information to update the stowage plan, containers need to be preferably weighed at the completion of packing and evidently, before the start of the loading operation. Looking at the entire process, the port is in a prime position to provide this service or, indeed, to verify the documented weight. For containers that arrive at the port by road, rail or river an obvious 'check point' would be during the inward process. Weighing with the quayside crane is too late, since the container position on the ship is determined well before loading (Zwygart B., 2014).

The second most quoted reason for container weight checking, is to comply with the road safety regulation, for containers transported by trucks. Overloaded trucks can damage road surfaces and bridges and of course overloaded trucks are much more difficult to stop and accidents are more likely to happen.

Figure 78: Triple bottom approach of Weighbridges



Source: own compilation based on interview

Stakeholders

The installation of weighbridges at DP World Antwerp is currently in the initiation stage. Discussions regarding the setting up of the managerial scheme, process and technologies are still on going. All relevant stakeholders are aligned in this stage.

Table 148: Development stages of the weighbridge

Level	☑ Initiation	☐ Development	☐ Implementation
Terminal operator	DP World Antwerp		
Other Terminal operators	PSA, MSC		
Shipping lines	CMA		
Unions	Road transport operators' unions		
Municipal Authorities	Road administrators		
Manufactures	Constructor		
Research Institutes	VIL		

47. Advanced Gate Automation and FATS (Full Automated Truck System)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Full automatic trucking system (FATS) of DP World Antwerp is considered to be a technological, managerial, organizational and cultural change that could introduce a system change on market level. The open innovation is being implemented at present and is driven by a private innovator.

Table 149: Characteristics of the Advanced Gate Automation and FATS

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

This innovation case was born out of an actual need to enhance the capacity of the landside operations at the terminal. Due to the nature and limitations of the site, there was an unbalance between the available quay length and the available stacking area. DP World Antwerp wanted to optimize the use of the available land, and implemented the Full Automatic Trucking System (FATS). The use of Automatic Stacking Cranes (ASC) requires less maneuvering space, compared to the radius of the traditional straddle carriers to pick up and load/ unload container on truck. On top of this, containers can be stacked 5 TEU high, compared to only 4 high with conventional straddle carriers. The below graph clearly shows the importance assigned to this objective and the successful implementation of the innovation.

Advanced Gate Automation integrates a wide variety of software and hardware installations that are connected to the Terminal Operations System (TOS). The online truck appointment systems, time slot management and online payment systems are examples of software applications. Advanced gate automation can be divided in different levels of automation. The main purpose of this automation is to reduce human interventions.

In 2004, the DP World Antwerp Terminal Operator came up with the idea to develop advanced gate automation. It took four years of initiation period to create the whole project. The port authority played a role by giving a concession, but that role was less important for this innovation. Due to growing capacity, the shipping lines were interested in an innovation that would lead to more efficient handling of containers. The role of the unions was not that relevant during the initiation period. The research institution TU Delft was an important actor in creating this project. Financing Institutions, Institutions with vested interests (e.g. EC) and innovation sponsors were also active.

When everything was written down in 2007 and the first modules were made, the terminal operator started with the selection of possible manufacturers. The development period took one and a half year. Research institutions and stakeholders were important actors during this stage.

In 2008, the first part of the project was implemented, which marked the beginning of the implementation stage of the innovation. This will be discussed in the next section, which is divided in various developments. But first, the system will be described and how it worked before it was automated. The first innovation was the automated Gate-out, which was introduced in 2008. This application controls whether the right container is put on the chassis or taken out the chassis. The optical character recognition (OCR) system reads and records the containers ISO code number, chassis

number and truck license plate number when the truck passes through a gate complex. The system can also read the rear plate number and IMO label marking information. The OCR system records this information and sends is to the operational system, which controls the data. If the data matches in both systems, then the truck driver receives a ticket as evidence and is allowed to pass through the gate. This procedure was not improved anymore and the former operational system was not up to date to allow a more advanced system.

The second step was the implementation of the new terminal operation system in 2009. This was necessary as an interface for all software including the advanced automated gate system. When a truck driver arrived at the terminal, the terminal operator did not know in advance whether that terminal visit was for collecting or delivering a container. The major problem in this second stage was the manual inspection. The gate-in reads the truck's license plate and checks whether there is a container that is associated with that truck. For this reason, the automation continued development and resulted in an appointment system.

At the terminal, the truck driver registered at the self-service desk with his Alfa-Pass, which serves as a link through the whole process and advanced the identification. Also some data had to be entered by the truck driver, while other data was already recorded by the OCR (Optical character recognition). In this second stage, already some kind of semi-automation is in place, because the income and outcome images made by the OCR are applied for verifications.

The third innovation, the Truck Appointment System (TAS), became operational at the end of November of 2012. Every truck driver has to inform in advance for what purpose he will come to the terminal. He has to prepare his administration by himself and couple his visit to a time slot. It means that when the truck driver has to come to the terminal to collect or deliver containers, he gives notice of his purpose for a particular day on the e-portal[35] and receives an appointment. Each time slot occupies one hour, but with a certain amount of margin. The truck driver receives also a TAS number, which he has to enter at the Self-service Desk on the terminal. Without a TAS number an appointment can still be made at the terminal , but then the possibility of waiting several hours is not excluded. The latter is not preferable because the process will stall if the administrative details are not fully correct. The TAS permits allow more efficient handling. The TAS is further explained in part 48.

The big advantage of this system for the terminal operator is the possibility of planning the container yard operations. Automated stacking cranes (ASC) can manage containers in such a position that at the moment of loading they do not have to be moved anymore. If the truck driver would make an appointment more in advance, then the terminal operator would be able to locate and program the machinery.

Although it is possible to make an appointment ten days before the arrival, most drivers make an appointment just one hour before they come, which leads to difficulties for adaptation and human intervention. When the appointment system was installed, only sixty percent of drivers made an appointment. At that moment, more than eighty-five percent come to the terminal operator with an advanced appointment. In the near future, it will be possible to make the appointment by mobile phone.

The terminal operator prefers fixing an appointment a day or eight hours before the arrival because this allows the operator to program the machinery and to achieve a more optimal time management. However, the terminal operator does not know, which day is a busy one, so they rely on historical data to do the terminal planning. Furthermore, road transport operators would also benefit from the TAS, if they would use it properly.

For example, when a truck driver makes an appointment for a fixed day to pick up a container, but the dispatcher finds out that the container is not yet arrived or booked, then the dispatcher can notice it

[35] www.dpworld.be/eworld

to the driver to make sure he would not come to the terminal for nothing. By booking their job it enables them also to check whether the container has been released and this avoids not only unnecessary trips but also prevents losing time with administrative work at the terminal. According to the terminal operator the appointment system is most useful in avoiding administrative faults that are made at the terminal.

The advanced gate automation includes also automatic recording of the RFID (radio frequency identification) tag of the sealed containers. The number of the seal is read by special receivers on the terminal and sent to the Terminal Operating System. Trucks carrying containers with an e-seal are no longer obliged to stop for a physical inspection. They can drive straight through one of the three “fast” lanes taking them to the truck parking area where the load is handled. The RFID system also avoids human errors in entering the data. DP World Antwerp allows the truck drivers to put the seal number manually in the database at the Self-service Desk if they use an ordinary seal. This enables them to use the “fast” lane.

Convincing customers to use the e-seal is naturally an important objective that has to be achieved. The clients are shipping agents of shipping companies. They have to identify an advantage for their clients to encourage them to use e-seals. The transporters can profit the most from the e-seals, because they can use then the fast lane, which is clearly an advantage. However, it is not the transport company who can choose, which seal to put on the container. The e-seals are ISO certificated and developed according custom rules.

DP World Antwerp wants to install the technology for e-seal. The price for the e-seal reader varies around six thousands euro, which is relative, compared to a gate, which has a price between one and two million euro. But not only the gate has to participate, other actors have to use e-seals as well.

The terminal operator believes that the investments for e-seal are worth it, because human actions will not be necessary anymore for this section, once it is automated. People, who are currently active in this kind of operations, will not be dismissed, but relocated.

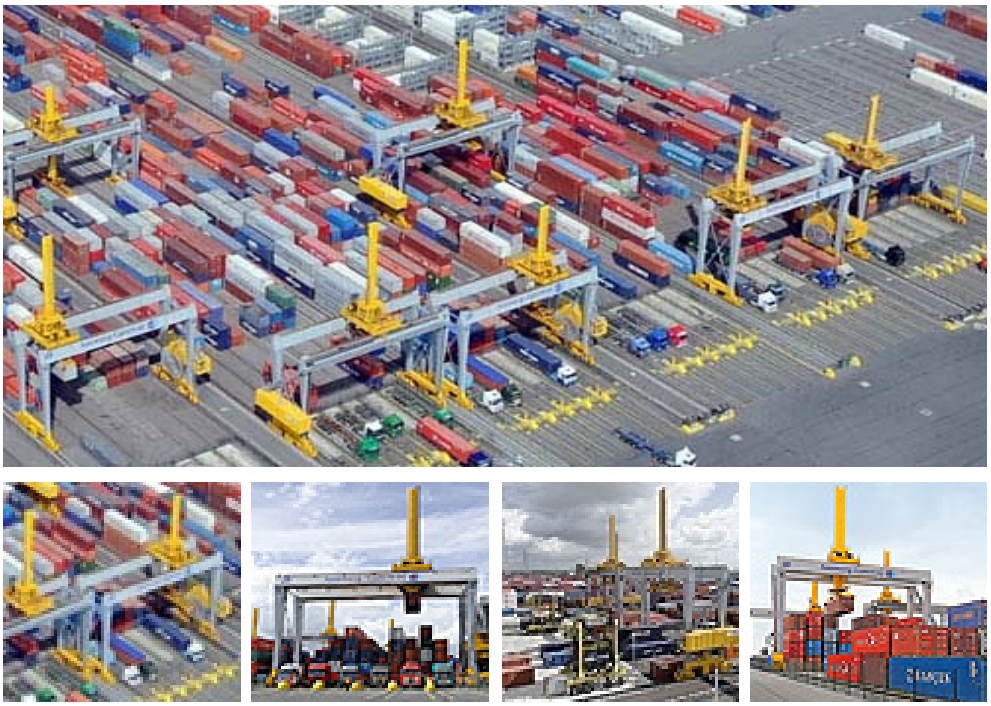
One of the objectives of the innovation is to increase throughput and handled volume. More employers will be necessary, even after automation. For example, when the automated gate receives small volumes, ten persons are active. If the gate had not been automated, it would need thirty people for the same job. With more volume, extra people has to be recruited.

The fully automatic trucking system (FATS) is an automatic truck loading and unloading system that allows truck drivers to load or unload their container on the truck with the help of the Automatic stacking cranes (ASC). All seven ASC’s at Antwerp gateway are equipped with this system. One remote control operator (RCO) – two on peak hours- is present in the remote control operation station to man the helpdesk and to assist truck drivers. When there is a problem with the automatic system, the RCO can take control of the ASC and complete the loading or unloading maneuver manually.

Antwerp Gateway was the first terminal in the world to develop the technology for this system. The ASCs are developed and manufactured by Terex © Gottwald. Camco engineered the human interface through, which the truck drivers can operate the station (GRID Kiosk).

When Antwerp Gateway (P&O terminals at that time) obtained the concession in 2003 for the Deurganckdok terminal, they were looking for a way to enhance the capacity of the landside. This was necessary due to a capacity unbalance between the available quay length and the available stacking area. It was calculated that 7 stacks with a FATS, operated by 2 ASC’s per stack, would equalize this unbalance (Hellebosch & Verdonck, 2014).

Figure 79: Pictures of ASC'S and FATS at Antwerp Gateway



Source: Terex, 2014[36]

There is no significant difference in waiting time or number of truck moves per hour between the straddle carriers and the FATS. The big difference lies in the labor cost. With FATS, only one remote control operator does the job of 7 straddle carriers. Environmentally, there is also a preference for the ASCs/FATS that are electrical equipment, whilst straddle carriers consume a significant amount of fuel.

Ports and terminals represent the intermodal interface between land and sea, and it is in this interface that DP World Antwerp is active. Through successful innovations at their facilities, DP World Antwerp Gateway is able to better anticipate their clients' needs and desires. Table 150 clearly shows that DP World Antwerp evaluates this innovation as very successful. DP World Antwerp is in this case the innovation champion.

Table 150: Success and failure factors of the FATS

Success	Failure
Decreases the labor, cost per box, energy use, everything is electrical driven, power source is much higher, efficiency also. No failures identified, if other systems are developed they can use the same technology.	N/A

Profit, planet, people

Several objectives were identified and measured on their level of success of innovation. Most important objective was to optimize the operations and increase efficiency and performance. Looking at the importance that was assigned to this objective and the level of success, this goal has been achieved. However, if the scale of operations is viewed, the innovation did not fully achieve the desired result. The scale of operations did not increase that significantly, but due to a more efficient approach through automation, the overall labor cost has fallen considerably.

[36] https://www.konecranes.com/investors/combination-of-konecranes-and-mhps

Because DP Worlds' Antwerp Gateway was the first terminal worldwide to implement this new innovation, they have a first mover advantage within the market. However, they did not gain immediate market share over competitors or a notable growth, but this was not a main objective in this case. Despite the latter, the innovator can differentiate from rival port terminal operators, both locally within the Port of Antwerp as well as globally, as a pioneer in this area of automation and as a highly efficient and Therefore, attractive terminal to ocean carriers.

Vessel "turnaround time" during port operations is of paramount importance to the carriers as users of the terminal facilities. Idle time of the vessel in port is very costly and should be avoided as much as possible. The successful and smooth implementation of this innovation encourages stakeholders to make further innovative investments in the terminal. This helps DP World Antwerp Gateway to maintain and secure their competitive edge in the business over other terminals.

At the beginning of the project, neither the CO_2 nor the air pollutants reduction was a significant concern for the terminal operator. However, due to less usage of straddle carriers in the yard area, the CO_2 rate has been remarkably reduced. By improving and well organizing the internal traffic, the amount of air pollution has also been reduced significantly.

Figure 80: Picture of safety procedure for truck driver while loading container at the ASC.

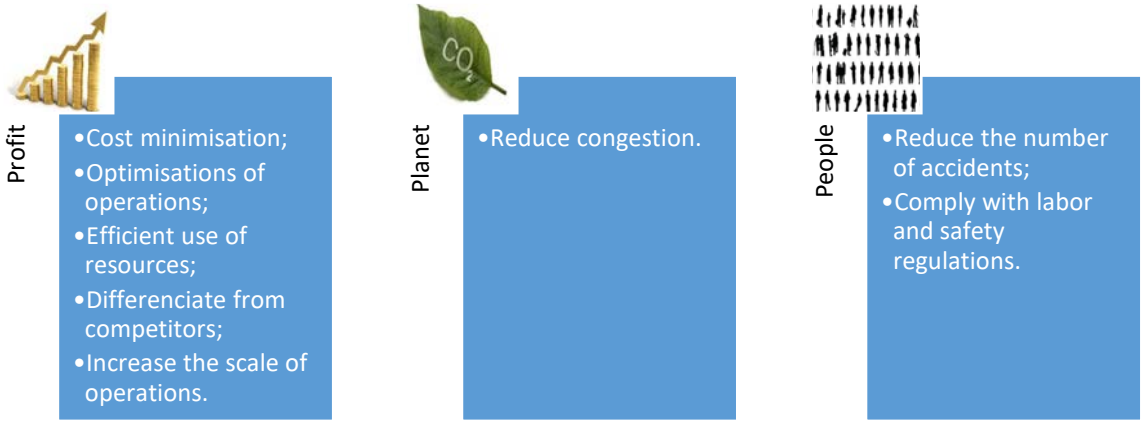
Source: DP World, 2014

All objectives such as the reduction of CO_2 and air pollutants, recycling, minimization of impact of activity on landscape, reduction of noise and water/soil pollution, integration of other developments, comply with environmental regulation etc., have not been important issues for the terminal operator at the beginning of the project. However, the success rate is close to the managers expectations. The level of security was also of less concern of the terminal operator within the development of this innovation. Nevertheless, the level of security has increased by the use of electronic devises and the Alfa pass system at the terminal. This led to a significant reduction in the rate of fraud attempts.

By applying and implementing safety regulations and reducing the number of straddle carriers in the yard area, the number of accidents has been reduced considerably. One of the main aspects of these regulations is that the truck driver needs to get out of the truck and control loading procedure by using his/her monitor, which helps to improve safety. This was one of the requirements to comply with safety regulations as imposed by unions and other regulators.

The identified and declared objectives of the innovation are mentioned by Figure 81 and are mostly profit related.

Figure 81: Triple bottom approach of FATS



Source: own compilation based on interview

Stakeholders

During the different phases of initiation, development and final implementation of the innovation, various actors are involved. Each of them has their own level of importance to contribute to the realization of the project. The main actors next to the innovator, are the APA, shipping lines and the unions. But also other external stakeholders are involved, such as manufacturers of soft- and hardware, regulators and research institutes (e.g.: University). Within this project, there was a smooth transfer from development to implementation, due to close integration with the other actors. During the initiation stage, there was some initial resistance of the labor unions because they feared a loss of jobs. There was, however, no impediment to proceed with the project as such. After bilateral negotiations with the unions, some concessions were agreed on labor statutes and conditions.

There were a number of third parties involved in the different stages of initiation, development and implementation during this project. In the first instance, the shipping lines and their shareholders were main partners, as they demand and require a well performing and reliable terminal partner for their container handling. During the further outlay of the whole innovation process, many other instances were involved, such as local and national regulators and standardization bodies. There was also a constant input and sharing of information with different research institutes specialized in this field of expertise.

According to DP World Antwerp, there was a rather negative attitude from the unions throughout the whole innovation process. The unions fear innovation that could cost jobs. Through intensive talks and concessions on both sides, an agreement was found on the statutes of the active dockers at the terminal facilities. Regulating, standardization bodies (and customs) have had an important impact on the innovation process as well. All terminal operations must comply the proper guidelines and rules of these authorities as imposed, with little or no room for flexibility. Table 151 sums up the stakeholders according their involvement in every development stage.

Table 151: Development stages of the FATS

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator	DP World Antwerp	DP World Antwerp	DP World Antwerp
Shipping lines	Shareholders	Shareholders	Shareholders
Unions	Road transport operators' unions	Road transport operators' unions	Road transport operators' unions
Innovation sponsors	Gottwald	Gottwald	Gottwald
Research institute	VIL	VIL	VIL

48. Truck Appointment System

Valentin Carlan, Christa Sys and Thierry Vanelslander

The truck appointment system (TAS) as described below, is finding its way in several terminals worldwide. The innovation brings changes of technological, managerial, organizational and cultural nature and tries to have an impact on the market. It is an open system innovation, which is privately led.

Table 152: Characteristics of the Truck Appointment System

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Currently, each terminal or port gate has its own appointment system but they are designed to perform the same job. Two Canadian examples are the reservation systems of Deltaport and Vanterm. The first example is built on a Web access module of the Navis Terminal Operating System, which inputs data directly into the Terminal Operating System, permitting reservations of 24hrs advancement. The second one is more similar to the original Vancouver Port Authority model. In this system, there are two classes of appointments: one for import pickups, and one for all other transactions. Currently, the Vanterm allows a total of 980 appointments a day, of, which 280 are for imports with a possibility for reservation with 2 days in advance (Davies, 2009).

DP World at the Port of Southampton introduced a voluntary Vehicle Booking System in 2003, which failed to resolve the problem of congestion. In 2005 they implemented their mandatory Simplified Vehicle Booking System was successful in reducing average turn time and improving reliability. Under normal conditions the system is designed to allocate 120 appointments per hour (Davies, 2009).

The Port of Long Beach uses the VoyagerTrack reservation system, which initially was introduced to mitigate peaking of truck arrivals early in the day, which resulted in long turn times and queuing, which affected the public road network. The VoyagerTrack reservation system at Port of Long beach allows appointments to be made via telephone or on-line 24 hours per day and recommends trucking firms to make bookings 48 hours in advance and to cancel or rebook if necessary (Davies, 2009).

PSA at the Port of Antwerp also uses an appointment system for trucks, which is called the Truck Appointment Management System (TAMS). In order to lower the waiting time at the Gate, visits are more spread, which eliminates dead freights and reduces transit time for truck visits with correct notice or registration. TAMS is operational in all PSA terminals in Antwerp (Churchill terminal, Deurganck terminal, Europa terminal, Noordzee terminal) and is accessible via an ePortal. It is also possible to import data via EDI/XML as pre-announcement and use of offered time slots are compulsory as well as the usage of a truck appointment reference number in order to enter the terminals (PSA Antwerp, 2014).

The Port of New Bedford has also a Truck Appointment System (TAS), which was funded by MassDOT as part of an ITS Congressional earmark for the City of New Bedford. The overall project consisted of five complementary information systems (Video surveillance, construction permit, vessel detection system, truck appointment system, transit management system) that would be operated by the City. It provides real time information to other government agencies or the public through a single web portal. The solution regarding the truck appointment system, was to develop a web-based truck

information sharing system that has SMS and email notification capabilities that will allow truck drivers to subscribe to receive traffic event messages and Port announcements. In return, trucking companies, owner operators and brokers provide estimates of their likely arrival times. System performance measures include availability of data, number of scheduled appointments, delivery data entered and page requests (Kanaan Consulting US, 2012).

The Truck Appointment System (TAS) has been in operation in Melbourne since the mid-1990 (Davies, 2013). The 1-Stop Service was established in 2002 to provide ICT solutions to Australia's two leading stevedoring companies – Patrick and DP World Southampton. Since then, they managed to extend their services to the wider sea-freight supply chain community like: shipping lines, freight forwarders, customs brokers, 3PLs, trucking companies, rail operators, importers and exporters (1-Stop L.T.D., 2010). In August 2005, the Canadian Federal Government requested the Vancouver Port Authority (VPA) and the Fraser River Port Authority (FRPA) to introduce a Truck Licensing System (TLS) (Port Metro Vancouver, 2014). In the same year, DP World Southampton launched the Vehicle Booking Service (VBS), which was a new service with the aim to make the management of containers and bookings easier. In 2013, they also launched VBS Premium as a new upgrade to the old system. It focused on making the transport booking process more productive, and to save time by avoiding the need for the drivers to present their self to an office (Handy Shipping Guide, 2010; DP World Southampton, 2014).

Table 153: First TAS usage around the world

Location	Year of TAS introduction
Melbourbe, Australia	1990
Vancouver, Canada	2005
Southampton, UK	2005

Description

The truck appointment system has the objective to help truck drivers who wish to collect or deliver containers at the terminal to provide their administrative details in advance to the e-portal.[37] (). As well as booking their job, this enables truck drivers to check if the container has been released, thus avoiding unnecessary trips and overtime with administrative work at the terminal, generating queues, congestion and more external effects. The system can be used online and it is also possible to make an appointment at the terminal itself. Once advance notice has successfully been given, an appointment can be made to deliver or collect the container by selecting a particular time slot. Each time slot occupies one hour, but with a certain amount of margin.

The system assigns a TAS (Truck Appointment System) number for each appointment, and this must be entered at the Self-service Desk on the terminal. Together with TAS, DP World Antwerp has also introduced RFID (Radiofrequency identification) tags for sealing the containers. The number of the seal is read by special receivers on the terminal and sent to the Terminal Operating System. Trucks with containers carrying an e-seal no longer have to stop for a physical inspection but can drive straight through on one of the three fast lanes taking them to the truck parking area where the load is handled.

An additional advantage of the RFID system is that it avoids errors in entering the number. The fast lane cannot be used by special containers like for example IMDG (International Maritime Dangerous Goods) containers, tankers and containers with excess height and/or width. Road transport operators who still use an ordinary seal may enter the number of the seal themselves at the Self-service Desk, thus enabling them to use the fast lane. In the future, trucks that use the fast lane and are handled by

[37] www.dpworld.be/eworld

Automatic Stacking Cranes, can also be served during shift changes or even at night, if this is required (Port of Antwerp, 2012).

Table 154: Success and failure factors of the Truck Appointment System

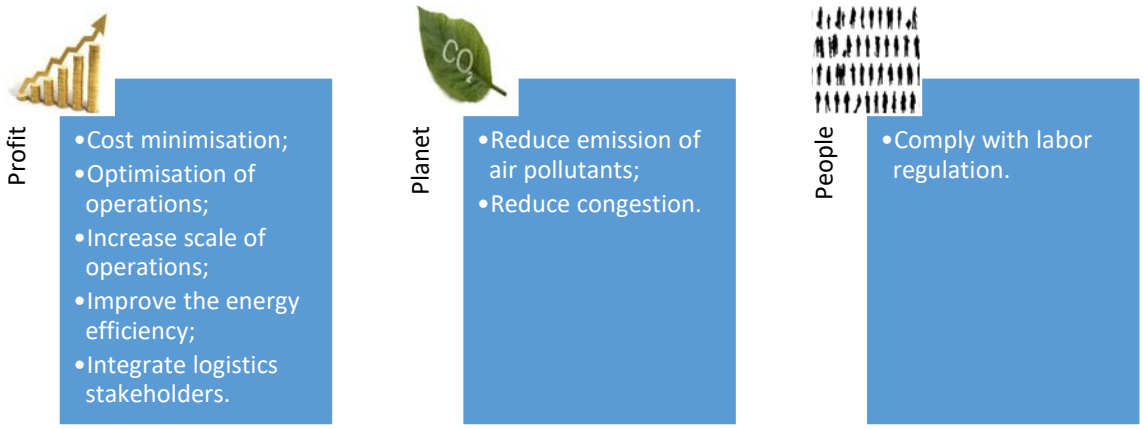
Success	Failure
Reduce the congestion in the port area; better organization of the activity	N/A

Profit, planet, people

Truck congestion at port or terminal gates needed to be stopped. The TAS helped truck drivers to reduce their waiting times and support them inside the terminal by offering extra information regarding the operations that need to be done inside the stacking yard. The latter two are the main objectives of the present innovation.

To measure efficiency of the innovation, the waiting time of trucks at the terminal is counted before and after the implementation. Another indicator of the TAS efficiency is the number of handlings avoided inside the stacking yard after implementation. The number of truck waiting in queues or extra equipment needed for extra container movements, can also be translated in pollution emissions. A relative acknowledgment of pollution before and after the implementation of TAS, can also be significant as an efficiency indicator.

Figure 82: Triple bottom approach of Truck appointment system



Source: own compilation based on interview

Stakeholders

The development of the truck appointment system within the container terminal of DP World Antwerp, involved the implication of different types of actors from local communities to other terminal operators, research institutes and government. The implementation of this innovation has effected not only the terminal itself, but also the market.

Involved actors needed to take decisions at managerial level. The most important aspects, which were pointed out, were: the development of a new truck appointment system should be done at a port level, and at least integrate several terminal operators, or should be dedicated only for DP World's activity. By merging together as partners, the terminal operators had to share information regarding their customers, capacity and container traffic. All the terminal operators, in the beginning, regarded the development of a truck appointment system as very useful, but they never reached an agreement.

DP World Antwerp decided to develop their own appointment system, dedicated only for their customers and integrated with their other terminal management systems. Other terminal operators used their own capacities to developed their own truck appointment system, which are now regarded as competing developments. Deep sea shipping lines were consulted in the initiation stage and are

taking the benefits for improved efficiency in the implementation period. Moreover, their contribution was received regarding restrains that should be taken into consideration when developing such a system.

Involvement of research institutes was represented by VIL and was present throughout the entire progress of the innovation. The society and trucking communities also had an important role imposing their desire for less congestion and few waiting times on the roads in the vicinity of the Port of Antwerp.

Table 155: Development stages of the Truck appointment system

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator	DP World Antwerp	DP World Antwerp	DP World Antwerp
Other terminal operators	PSA, MSC	PSA, MSC	PSA, MSC
Shipping lines	Deep sea shipping lines		Deep sea shipping lines
Innovation sponsors	Shareholders	Shareholders	Shareholders
Manufacturers	IT company	IT company	IT company
Municipality		Antwerp municipality	Antwerp municipality
Research institutes	VIL	VIL	VIL

49. Autotrakker

Valentin Carlan, Christa Sys and Thierry Vanelslander

Autotrakker supports a more accurate measurement of Break Bulk Cargo when it arrives at a multipurpose terminal. Autotrakker is an IT technology option using low-powered (eye safe) laser/scanners. The Antwerp Euroterminal (AET) leads the private and open innovation, but which is not the key beneficiary. The Autotrakker is a system change that is implemented by a private innovator.

Table 156: Characteristics of the Autotrakker

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The main purpose of the application is to give more accurate cargo measurements, to avoid errors in billing and damage for either cargo or ships. Incorrect measurements also can lead to accidents during loading and unloading operations, which leads to delays in vessel departures, customer insurance claims and even in extreme cases to casualties and fatalities amongst involved personnel.

In 2006, the AET proposed to change the way of manual handling of incoming cargo. This new way should increase the efficiency and effectiveness of cargo measurements by switching from manual work to an automated process. AET launched the challenge to Autotrakker ltd., which came, several years later, with different solutions for break bulk cargo measurements.

Since the early beginning, the experiments of cargo measurement were done by using technologies that implies photographic captures and various types of scanning procedures that were still handled by operators. These solutions did not manage to raise the expectations of the AET board, making them still redundant.

The primarily conditions, which had to be addressed, were next to the automation, the stringent weather conditions. Further developments also considered the option of measurement of detachable or flexible parts of cargo (for example car antennas) and provided the option to measure the transported cargo and not the vehicle on, which it was delivered.

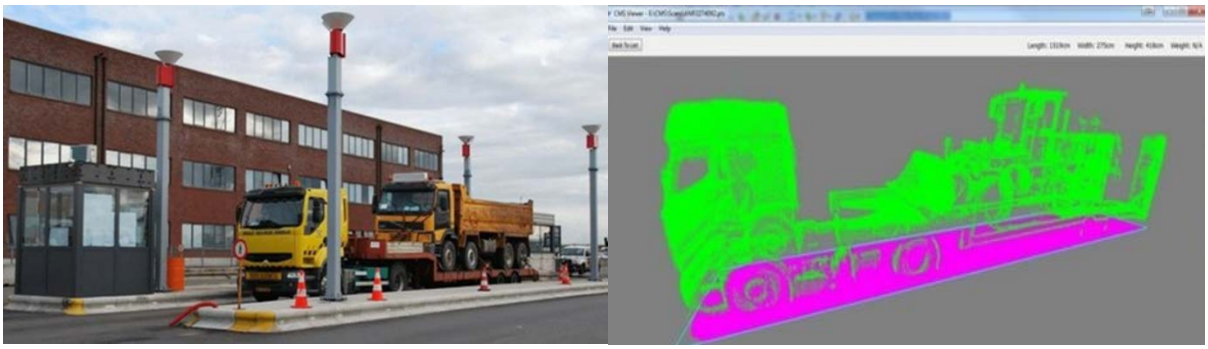
The next generation of cargo scanners include laser technology and they reproduce 2D or even 3D images of the cargo that needs to be measured. By the end of 2012, the new system was implemented and accomplished the requirements of the break bulk terminal.

The features of the automated measuring system are:

- Cargo is driven into the measuring station area (exterior exposure);
- Eye-safe Infrared Scanners automatically scan and measure the dimensions of the Cargo and store it in the local database;
- A digital photograph is taken and stored in the local database;
- The operator may optionally edit the scan image to eliminate unwanted elements such as the tractor and trailer;
- All captured data in the local database is available for further use (e.g. linked with the invoice system or to be at the disposal of customers).

The most recent development was to integrate a new viewer-editing application, which is connected with the cargo measurement system. This recent extensions allow operators to perform more flexible operations regarding the dimensions of the cargo and the billing issue. The latest release of CMS is faster to scan, more accurate and able to work in harsher environmental conditions than the original design specification.

Figure 83: Real and scanned image of cargo performed with the new cargo measurement system



Source: AET, 2014

The success of the current innovation is given by the precise targets, which had to be achieved by the final product. These targets are translated into accuracy, flexibility and independence by environmental conditions.

One of the identified failure factors concerns the reduction of operational personnel, which causes social resistance, although the working conditions of the remaining personnel were significant improved. Another failure occurred at the beginning of the innovation when a different approach and new technology had to be engaged to obtain more cost efficiency and accuracy. Another failure factor was the financial crisis, which lowered the activity of the system and thus the immediate need for extra efficiency.

Table 157: Success and failure factors of the Autotrakker

Success	Failure
Provide an accurate measurement; no discussions with clients regarding the invoices; works in open space.	Did not saved labor; failed at the beginning (due to cost efficiency and accuracy); financial crisis; change of requirement (it needs to work in open space and in all weather conditions)

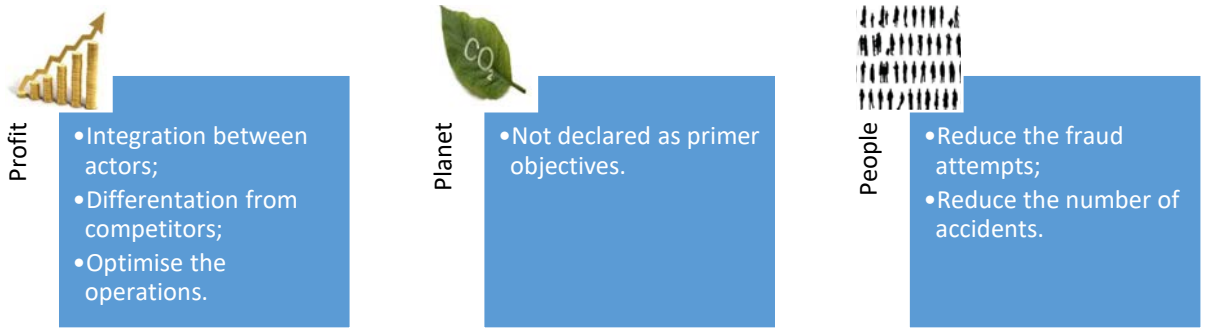
Profit, planet, people

Port authorities and stevedoring companies have the desire to effectively and efficiently manage the movement of bulk break cargo as it moves around the globe. It is vital that the volumetric measurements of break cargo is correctly gathered and used in the process of loading, transporting and unloading of cargo. Measurements must be accurate because it is the basis for customer billing.

The main objective of the current innovation case was to optimize the existing resources of the break bulk terminal and its operations, to replace human labor by automated devices and to create a market difference between the break bulk terminals. Looking from a social perspective, the target was centered on reducing the number of accidents during the loading of cargo on vessels and to reduce the inaccurate measurements that could easily lead to fraud attempts.

Another objective, which was considered to be important, was client satisfaction by offering certified and accurate measurements together with the guaranty of fair billing. Furthermore, this led to an increase of trust among the shipping lines and also from the customer side because of the reduction of the accident number.

Figure 84: Triple bottom approach of Autotrakker



Source: own compilation based on interview

Stakeholders

The actors, which were involved since the initiation process of the cargo measurement system, were mainly the break bulk terminal and the system developer. During the development stage, shipping lines and unions had their position in the process and later on during the implementation, freight forwarders also contributed to the changes that were accomplished. A problem that occurred, happened during the development stage when the intermediate results were not as expected. The system was still dependent of many factors to reach its maximum potential. It was still largely weather and cargo dependent. The break bulk terminal, during the development stage, found itself twice in a lock-in situation because the terminal owner already made investments. The decision was to stop the entire process because of some errors in the development, made the system unusable (due to costs, inaccuracy and incapacity to operate in open space). The entire development process had to be retaken.

The developer was also in a lock-in situation for another reason. The innovator desired to prove that the specifications of the terminal would be met. As a result, the entire system was retaught and finally new technology (low power laser technology) was included for the cargo measuring system. The lock-in effects that are still not solved, are the need of operator assistance and EDI integration. The other problem, which occurred and had to be overcome, was the need for trained personnel to work with the new system. The major disadvantage, which was uncounted, was that some of the work still had to be manually done. The experience with the workers (also with the dockers) evolved in a positive way. After getting acquainted with the system, the workers gave constructive feedback and the system was continuously improved. The implementation stage raised the interest of freight forwarders as well as shipping lines. They became more interested in having accurate info, fair billing and less risk of damage of their equipment.

Table 158: Development stages of the Autotrakker

Level	☐ Initiation	☐ Development	☑ Implementation
Break-bulk terminal	AET	AET	AET
Shipping lines		Break-bulk shipping lines	Break-bulk shipping lines
Manufacturer	Autotrakker	Autotrakker	Autotrakker
Unions		Dockers unions	Dockers unions
Freight forwarders			Trucking companies

50. Platform Eurotranscon

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Platform "Eurotranscon" is an online application for truck planning, which aims to be a radical technological, managerial, organizational and cultural market change. The private and open innovation is already implemented.

Table 159: Characteristics of Platform Eurotranscon

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

Eurotranscon is an online application that allows users to combine truck assignments for transport of import and export containers in order to avoid empty trips. As an extension, it can also be used for orders, which only need to re-use empty containers while minimizing the empty container runs. The platform was initially designed to combine two 20 feet containers (one import and one export) on the same chassis and to transport those containers to the same destination point. The idea emerged to re-use the empty containers for the same shipping line (container owner). A step forward was also made by extending the re-use of empty containers for 40 feet containers.

Nowadays, the extension to re-use empty containers, can only be performed for a fee, which is paid to the container owner or to the shipping line that handles the container. Another similar application was also developed by MSC, under the name of *Avandita*, with the main objective to provide an easy way to avoid empty one-way road trips. In those empty one-way road trips, when transporters need to return an empty container, the system finds a match from another transport request. The *Avandita* application is considered to be a competitor of Eurotranscom, but for only part of the business.

The initial concept of Eurotranscon was to use it manually. The orders for combinations of different types of containers were operated manually. These orders were based on the requests that came by email or by phone. Another step further for the application was made when the partners were able to fill their orders and to store them in a database where every actor could check it. The final goal of the application is to match orders automatically, based on criteria such as destination, container type, estimated types of departure arrivals,…etc. The companies that are active users of the platform, are container transporters, shipping companies and inland terminals.

The Eurotranscon platform of Transport Joosen Group has the purpose of bringing actors together from port related areas in order to optimize their transport tasks. Eurotranscon is the pioneer in re-using empty containers in the Port of Antwerp and is completely separate from Avantida. The platform solution also represents the key motor for other two innovations, which are treated separately within this booklet: the Transport hub and the development of the Multifunctional Van Hool Eco-chassis.

Through Eurotranscon, journeys with containers can be linked to one another. Empty containers are thus not sent back to the inland port depots, but are once again loaded in the vicinity of the place where they were unloaded. In this way an annual saving of 300 000 journeys on Flemish territory can be achieved. Other major advantages for the sector are the reduction in the overall transport costs, in the traffic jams in the port areas and in the waiting times at the deep sea container terminals.

By linking part of the journeys, transport firms can better obtain a profit from their assets and optimise their margins. They immediately obtain an online summary of matching possibilities between container journeys. The developed platform has a search engine, which can be used to search for appropriate journey and service offerings in relation to, for example, specific dimensions, shipping companies, time windows and regions.[38]

Table 160: Success and failure factors of the Eurotranscon platform

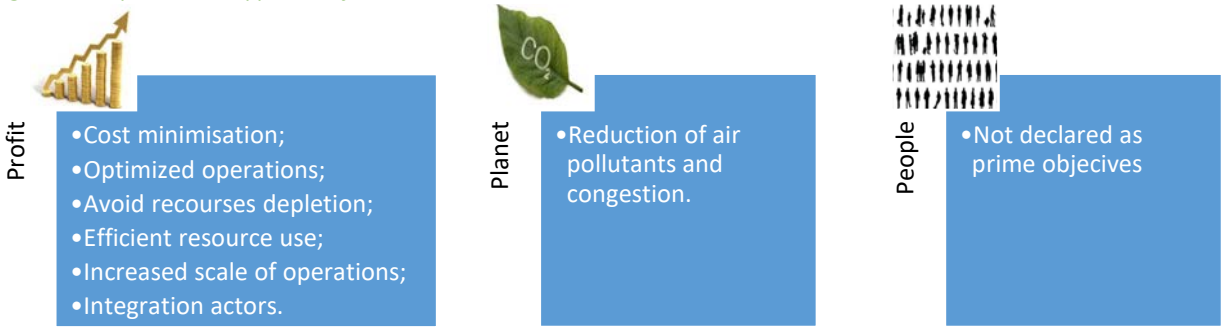
Success	Failure
The more in proper use, the better	Needs the collaboration of other stakeholders.

Profit, planet, people

The relations between logistic players such as trucking companies, freight forwarders, shipping companies and terminal operators, are improved by the application and its development. The platform is based on trust between partners and is meant to optimize the resources that each partner uses to perform its own activity. Integration with other developments was also an important factor. By using the platform it becomes easier to identify transport requests that are suitable for Eco-Combi transport or for a chassis, which were developed. Because it involved the contribution of many actors, it was crucial that Transport Joosen was the first developer of this initiative.

The main objective for creating this platform, was raised more from an economic point of view, than from an ecological or social. The environmental objective relates to less fuel consumption and Therefore, less emissions while performing the same transport tasks (Figure 85).

Figure 85: Triple bottom approach of Eurotranscon



Source: own compilation based on interview

Stakeholders

The Eurotranscon platform involved the contribution and interest of other logistic actors, which could optimize their operations. The platform provides both horizontal and vertical integration, between similar actors or actors present in the same flow inside the supply chain. The port authority had a neutral contribution. It just demanded to be informed about the activities being performed. Shipping lines were also contacted and contributed information. They remained reluctant in sharing information regarding their cargo location and size, due to competitive reasons.

An online platform software company was involved and collaborated through all phases of the project. Strategic interests and unsecure sharing of information, even from the beginning, there was a need for a neutral player in form of a federation, which treats every partner equally.

[38] http://www.vim.be/projects/eurotranscon

Table 161: Development stages of the Eurotranscon platform

Level	☐ Initiation	☐ Development	☑ Implementation
Trucking company	Transport Joosen	Transport Joosen	Transport Joosen
Port authority	Port Authority	Port Authority	Port Authority
Freight forwarders	Other trucking companies	Other trucking companies	Other trucking companies
Manufacturers	IT developer	IT developer	IT developer

51. BCTN Portal for clients

Valentin Carlan, Christa Sys and Thierry Vanelslander

The BCTN Portal is an electronic portal application, which is considered as a technological, managerial, organizational and cultural market change. The innovation is already implemented and was privately driven. The development of the innovation was open.

Table 162: Characteristics of the BCTN Portal

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The e-portal application is primarily used for electronic transmission of documents from Shipping Agents to authorities, to clients or other agencies. Electronic submission of the documents gives more flexibility to shipping agents as they can submit the information faster and from any geographical location. Furthermore, an e-portal application also allows the client users to have access to specific information regarding their transport shipment, container history or programd operations.

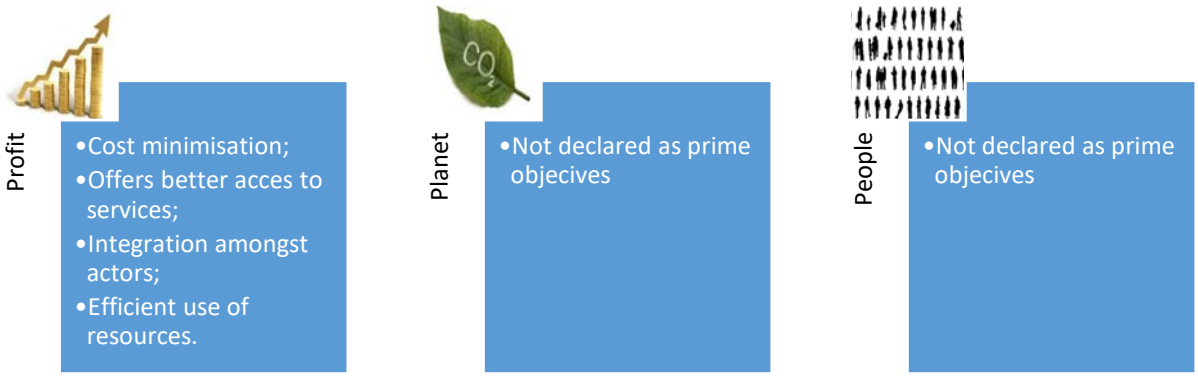
Table 163: Success and failure factors of the BCTN Portal

Success	Failure
Reduced workload; open access to customer information; creates interaction between stakeholders.	N/A

Profit, planet, people

The online platform does not necessarily bring immediate benefits for the company or for their clients. The reason why the current platform is developed, is to strengthen the relations with customers by offering a new track and trace service. From an economic point a view, it only has benefits on the long term by keeping the clients informed and it creates certain more trust in the services that the company is offering.

Figure 86: Triple bottom approach of the BCTN Portal



Source: own compilation based on interview

Stakeholders

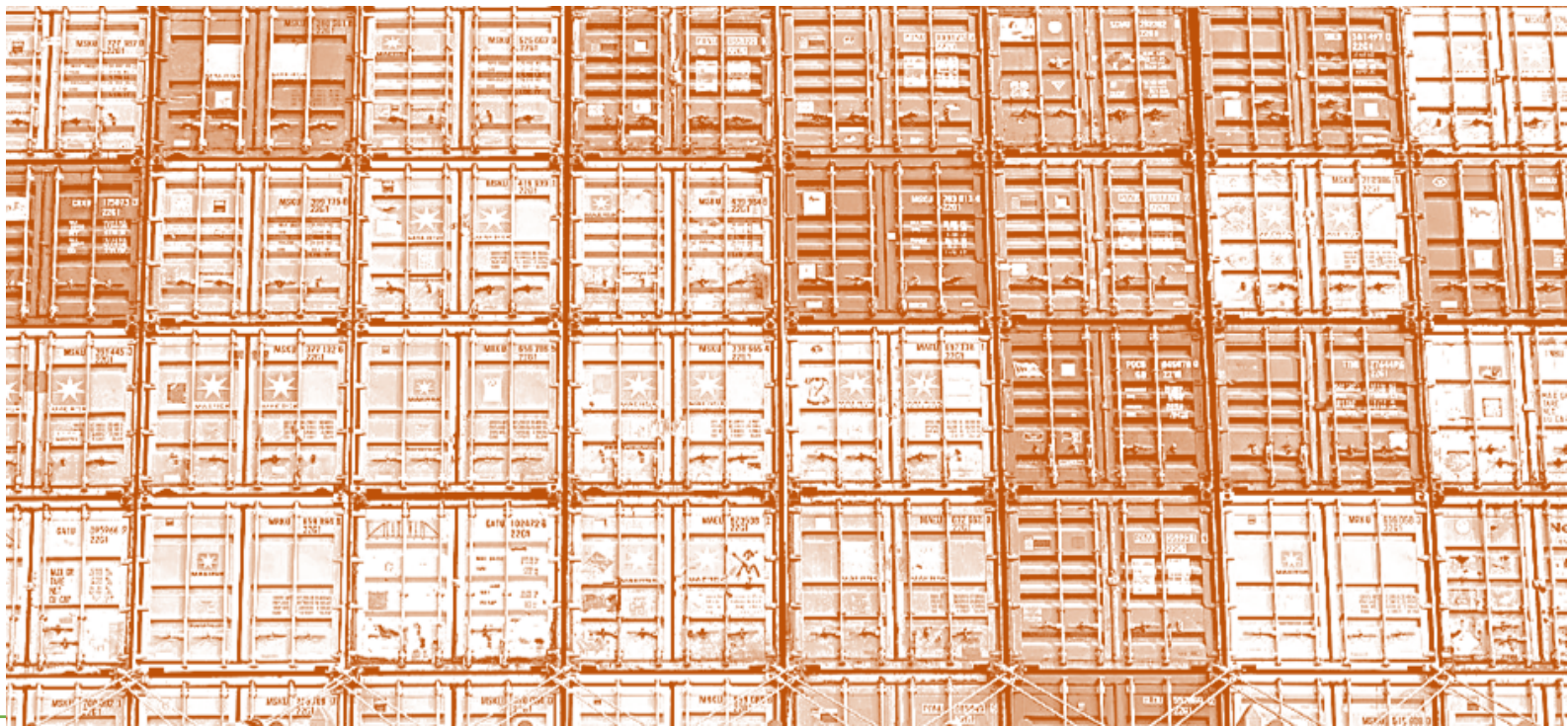
The innovation champion started with the development of the platform within its own capabilities. The software support is offered by own in-house IT support, which is active since the initiation stage. The manufacturer Trucking companies were involved during the development stage. All actors stayed aligned to implement the innovation incrementally.

Table 164: Development stages of the BCTN Portal

Level	☐ Initiation	☐ Development	☑ Implementation
Inland terminal	BCTN	BCTN	BCTN
Freight forwarders		Trucking companies	Trucking companies
Manufacturers	IT developers	IT developers	IT developers

CLUSTER 9: INNOVATION IN CAPACITY AND AREA UTILIZATION

This cluster comprises innovations that increase capacity and area usage of a terminal or a transport hub in several ways. In some cases these innovations lead to a modal shift from road haulage, which aims at social objectives.



52. Offshore Single Point Mooring

Claudio Ferrari, Alessio Tei and Maria Inès Cusano

The offshore single point mooring in the port of Genoa is an innovation that can shift port activity further away from local communities on shore by unloading tankers at sea. It is a business change, which is in its initiation phase, which will be implemented in the future[39]. The innovation is closed and privately driven. The offshore single point mooring can be considered as a radical innovation.

Table 165: Characteristics of offshore single point mooring

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

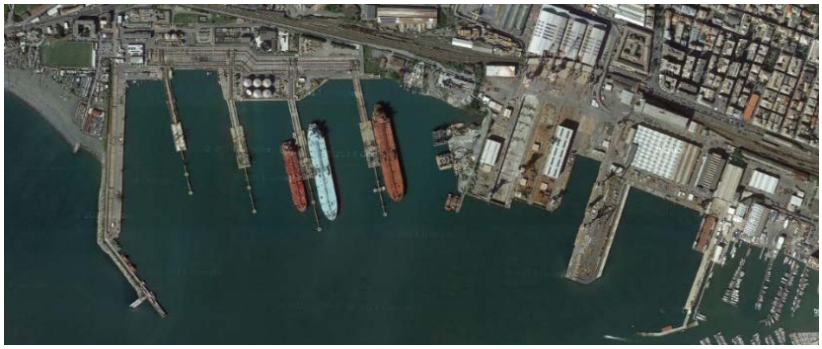
Description

Porto Petroli is the main liquid bulk terminal of the port of Genoa. With about 15 million tons of cargoes handled annually and a capacity of over 20 million tons, the terminal is currently investing in changing its own terminal structure in order to maintain the operational efficiency and improve its relationships with citizens decreasing the negative externalities due to its core business. Main handled goods are oil, gasoline and chemical products.

This innovation case is connected to the new offshore platform that will replace a part of the old terminal in order to increase the operational hours and the efficiency. The new platform diverts several pollutant activities from the city and part of the old berths will be used for the upgrade of a local shipyard with indirect positive effects on the local employment.

Porto Petroli is the biggest liquid bulk terminal in the region of Liguria. With an operational area of more than 120.000 sqm, the terminal is currently using 3 berths, whereas only one is specialized in handling a specific freight category (i.e. chemical products). Currently, the terminal is the main gateway for the Po Valley industrial facilities and one of the main energy source of the Northern Italian regions.

Figure 87: Image of the Porto Petroli di Genova terminal



Source: Porto Petroli, 2015

[39] In respect with the description, the off-shore mooring project of Porto Petroli has been suspended during the period 2015-2020, due to operational and market changing circumstances. Thus, the new Port Master Plan has sided the oil terminal expansion, linking the project to a foreseen modification of the layout of the neighbouring port areas (i.e., a possible reconfiguration of the terminals in that area).

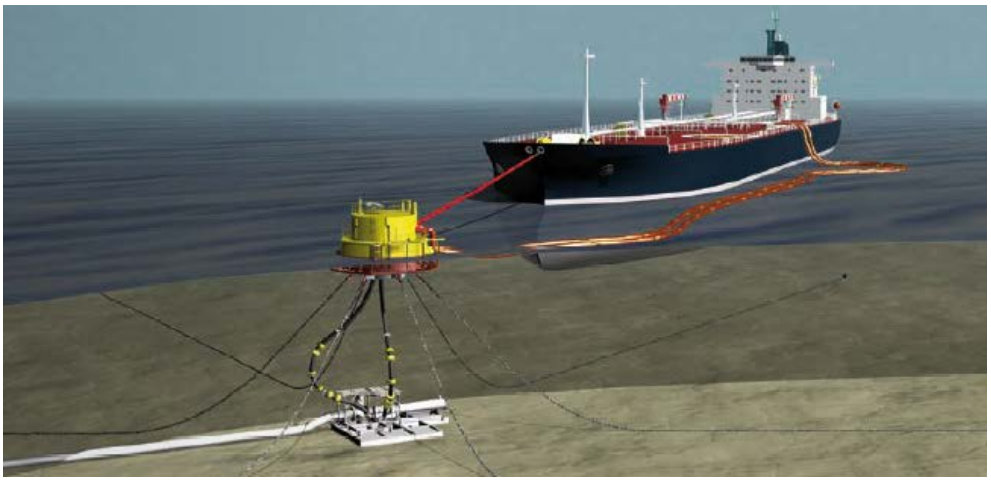
The terminal is now embedded in the urban context of the city of Genoa and the risks related to oil and chemical movements – together with the related environmental impact – pose the terminal in constant pressure.

The last 20 years, the terminal has pushed ongoing improvements in order to be accepted by the local community. The planned innovation should increase the acceptability of the terminal, contributing in investing in a high-tech facility that derives the activity risks far from the residential area. Moreover, this innovation will make the available part of the present terminal a new host for the enlargement of the current shipyard, which is managed by Fincantieri, one of the most important employers of the city.

The new offshore platform will increase the terminal productivity, which will affect the expected waiting time of the ships and the unloading period. The total investment is expected to be around EUR 50 million, of, which EUR 40 million is related to the construction costs and EUR 10 million is connected to the technical, environmental and feasibility studies.

The innovation is a radical upgrade of the current terminal that will determine a re-organization of the dedicated oil operations. The project foresees a CALM (Catenary Anchor Leg Mooring) mooring buoy, a kind of mooring buoy that is found in high seas. It is kept steady by a system of anchors and chains (usually six).

Figure 88: Rendering of a tanker moored to the new CALM



The platform hosts the head-mooring of a single ship and it has two floating hoses to connect the platform to the manifold of the ship. The platform is connected to the PLEM (Pipeline End Manifold) through two flexible hoses able to back up the movement of the platform due to the loading/unloading cargo operations.

For safety reasons related to the surface water that has to be reserved for the ship's floating, as ruled by ABS (2014a, 2014b), the platform will serve tanker ships that are no bigger than 250,000 DWT (with a maximum length of 366 meters).

The project foresees a minimum rate of cargo unloading equal to 7,500 cm/h. In this way even the largest ships, assuming a load factor equal to 85% and taking into account the time spent before and after the unloading operation and the operating limits of the platform due to safety reason (such as the prohibition to moor during the night), will be served within 48 hours.

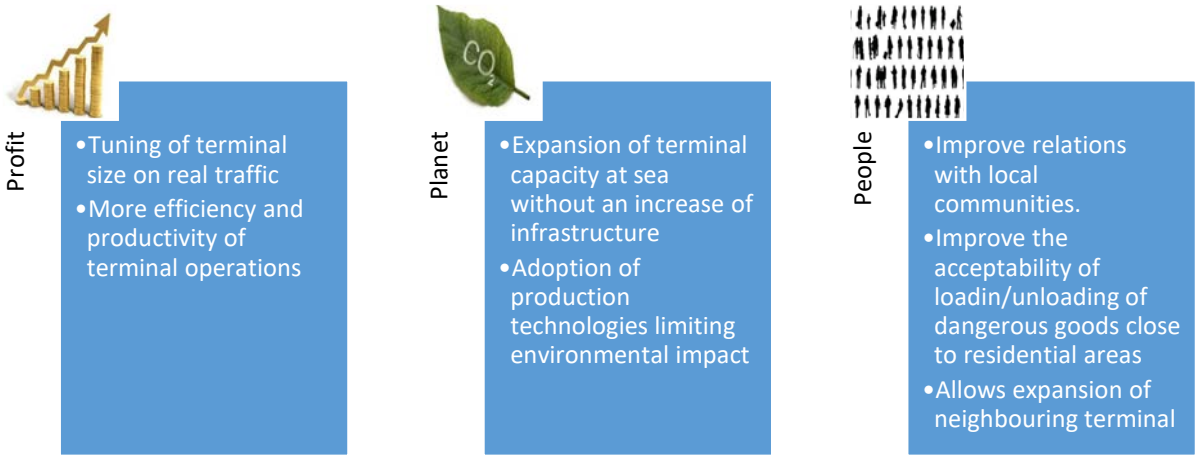
Table 166: Success and failure factors of offshore single point mooring

Success	Failure
Higher employment; radical upgrade of the current terminal; social acceptance; interesting rate of cargo unloading	Not identified

Profit, planet, people

The goals of the platform are mainly connected to an increasing social acceptance of the terminal within the local community and to the reduction of the negative externalities. The achievement of productivity and efficiency related objectives are part of the project goals but they appear as collateral.

Figure 89: Triple bottom approach of Porto Petroli di Genova



Source: own compilation based on direct interviews

Stakeholders

The new platform has been developed in order to improve the terminal performance and the level of acceptance within the local community. Moreover, the new investment will bring a new work and facility organization that should improve the terminal productivity and reduce the environmental impact.

The Offshore platform will create several kinds of connections:

- The innovation will strengthen the infrastructural endowment and the links between the terminal and all the port players within the bulk market. Even if risks related to offshore activities may contrast with the current port regulation in terms of safety levels;
- With local community through the social acceptance of the terminal, from a soft institution point of view;
- The new facility also strengthens the port competitiveness and the role of the port as national hub for liquid bulk.
- All the links appear at local level: the effects of an offshore platform will mainly impact port activity and the local community.

The offshore platform is currently under the approval of the Port Authority of Genoa and all relevant actors are aligned during the present initiation phase.

Table 167: Development stages of the Offshore Single Point Mooring

Level	☑ Initiation	☐ Development	☐ Implementation
Innovation champion (Porto Petroli di Genova)	✓		
Port authority	✓		
Shipping lines	✓		
Terminal operator	✓		
Municipal authorities	✓		
Regulators	✓		

53. DP World Antwerp Inland Terminal (Beverdonk)

Valentin Carlan, Christa Sys and Thierry Vanelslander

The inland terminal of DP World Antwerp in Beverdonk is an extended gateway, which is a relatively new concept. The term extended gateway is an extension of the traditional gateway, where goods can be left or picked up as if directly to a port. The main idea is to move the gate of a sea terminal to an inland terminal. The inland intermodal terminal is directly connected via a high capacity link to the seaport(s). The final leg of the journey is arranged by the terminal operator (Veenstra & Zuidwijk, 2016).

The innovation is considered to be in the initiation stage. The activity is open with the alignment of other developers and stakeholders. The extended gateway in Beverdonk is both privately as publicly driven and can be considered as a system innovation.

Table 168: Characteristics of the DP World Antwerp Inland Terminal in Beverdonk

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Another similar and more widespread concept is called “Dry Port”, instead of barge transport as a direct connection to the port it uses rail distribution (Roso et al., 2009). More examples of this concept yet exist due to the fact that many ports do not possess the extensive waterway network as ports within the Hamburg-Le Havre Range have.

Moving to hinterland terminals will avoid the congestion of the economic centers and even relieve it and it will create new jobs away from the city center. The inland terminals are located at places in the hinterland that still have space available for an affordable price. Furthermore, there is the opportunity for companies to cluster and for the inland terminal to provide multimodal services. Goods are bundled at a vast location to be shipped to the Port of Antwerp on regular basis, which if managed correctly increases efficiency and thus reduces costs (Rodrigue et al., 2010). Moreover, these operations provoke a modal shift and are more environmentally friendly.

Description

As off 2010, there has been a large evolution within the Beverdonk Container Terminal. In 2010, the field, which is now known as the terminal, was still just a field that was owned by NV De Scheepvaart. In December 2011, when operations started, Beverdonk was in possession of one mobile crane and one reach stacker. The container yard had a surface of 4ha and the quay was 250m long. The capacity of the terminal was 50.000 TEU.

In June 2013, the warehouses became operational so now the terminals volumes can start to grow. In the future, Beverdonk Container Terminal will have three wide spread gantry cranes and six reach stackers. The container yard will grow up to 10ha and the quay length can be expanded till 500m. Beverdonk has the possibility to increase its capacity to 300.000 TEU (DP World, 2014).

Figure 90: The evolution of the quay site in Beverdonk

Source: DP World

The case typology of the Beverdonk Container Inland Terminal can be characterized as a managerial, organizational, cultural and market change. The managerial and organizational change occurs in the sense that certain activities and tasks are relocated from the port area to the inland. These activities are: customs formalities, empty container stacking etc., but there also exists the possibility of performing stuffing and stripping activities as in the inland terminals. Additionally, there is a need for a change in business mentality between the different actors, thus a cultural and market change. Road transporters need to be prepared to cooperate more closely with barge transport by coordinating traffics with the purpose of reducing road traffic in and around the Antwerp Port area.

Currently, the innovation case is situated early within the implementation phase. The purpose is to further increase the capacity of the gate from 50.000 TEU today to 300.000 TEU when the terminal will be fully developed. This increase is necessary to successfully complete the objectives.

The project is a joint venture between the Antwerp Port Authority (APA) (20%) and DP World Antwerp (80%). Because of the financial weight/share of the APA (20%) it is not necessary for actors to be in cooperation with DP World Antwerp, hence the open nature of the innovation. The result is that everyone can access and use the Beverdonk terminal facilities, which accentuates the neutral character of the project.

The innovation case is relatively young and as a result, operational knowledge and skills can still largely improve. New measures will be implemented after the need for them is determined in real practice. The degree of innovation can thus be characterized as incremental.

Road congestion (e.g. Ring of Antwerp) and waiting times at terminals within the Port of Antwerp, higher CO_2 –emissions as a result, have become an increasingly larger issue. The impressive increase in container traffic plays an important role in this problem and raises pressure on the port distribution networks. The implementation of barge and rail shuttle services aims to relieve ports from this pressure. This way, inland terminals contribute to the maintenance of the competitive position of ports by decreasing congestion and waiting times. Another problem is caused by the small call sizes of barges that need to go from terminal to terminal in the port, which again increases inefficiencies for the deep-

sea terminals and waiting times for barge transporters. Summarized, the Beverdonk Container Terminal eliminates bottlenecks in the transport chain between deep-seaports and cargo owners by creating win-win situations for the different stakeholders involved. One of the purposes is to deliver an alternative to trucking companies. That is why from the start of the project in 2009 there was a strong cooperation with companies like DHL, Maersk and other transport organizations in Europe to ensure the win- win solutions. The project consists of 3 phases, each phase entails additional quay length, gantry cranes and reach stackers. Today, the terminal has a capacity of 50,000 TEU and currently handles 30,000 TEU. Once fully developed, the terminal will be able to handle up to 300,000 TEU.

Table 169: Success and failure factors of the DP World Antwerp Inland Terminal in Beverdonk

Success	Failure
Reduce congestion within the port area; benefit out of previous experience.	Needs to operate on large scale to be efficient; need to integrate other stakeholders.

Profit, planet, people

Objectives in this category are related to the economic aspect of the innovation, taking into account the different costs and returns that are yielded by the project. The objectives aim to give an indication of the created value by for example new partnerships, alternative use of resources and new investments. Key terms are efficiency and optimization.

The graph below contains all the objectives related to economic added value. The objectives were ranked by degree of importance by DP World Antwerp. After the ranking per importance the objectives were further ranked by degree of success. All of the objectives were high on the priority list for DP World Antwerp except for the employment objective and the encouragement of other investments. No unexpected values were booked on these two last objectives.

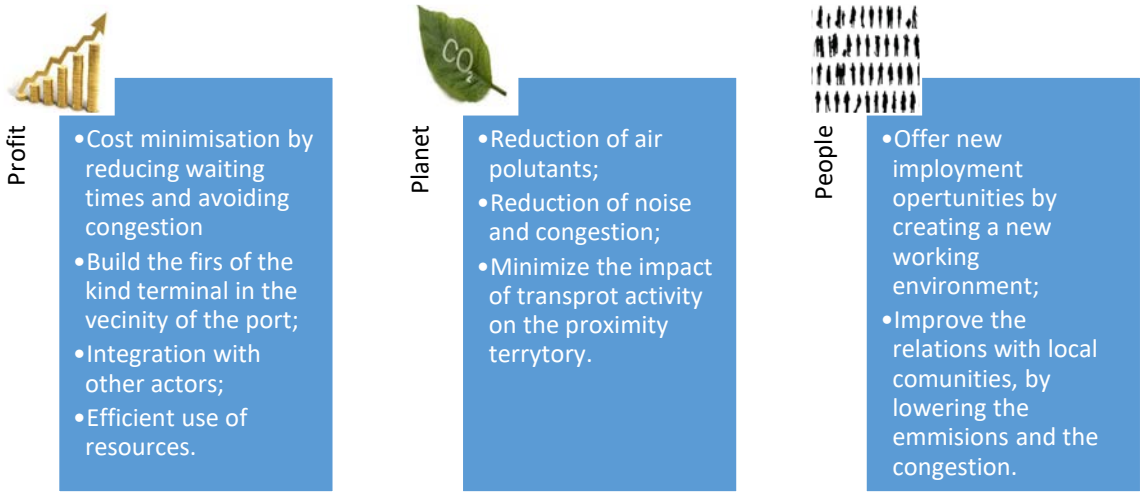
Out of the remaining objectives only positive impact on competitiveness, integration with other actors and facilitation of transferring documents achieved the success they hoped for. The positive impact on competition scored a little lower than expected and the facilitation of the transfer of documents scored slightly higher than expected. This is mainly due to good cooperation and coordination between the actors. The remaining economic added value objectives all ranked high, however, they have not yet achieved the levels of success that were hoped for. The main reason is that there are still many clients that are not yet convinced. Therefore, throughput of the inland terminal is still on the low side. Nevertheless, the project is still ongoing and a lot of effort is still being put into convincing opposing parties. Usually, these parties are to be found within the road transport business and have to be brought around by proof of an actual advantage for them.

The reduction of congestion, CO_2 and air pollutants are again objectives not yet reached because of the early stage the innovation is situated. Currently BCT only has a throughput of 30.000 TEU with a capacity of 50.000 TEU, Therefore, the anticipated levels of success have not yet been achieved. The remaining goals were achieved since they were not dependent on the actual turnover of the container terminal but on how well the innovation has been executed. The reason for the first two objectives being higher than expected is due to the measures that were taken in order to comply with certain demands of complaining neighbors in the development phase of the project.

Offering new employment opportunities was not one of the initial goals of DP World Antwerp when setting up the innovation. However, the project did create jobs. All of the other objectives in the section “people” were not held in high esteem.

Another principal objective that was not yet mentioned in the listing above is to encourage a shift in the modal split. The success rate for this goal has not yet reached anticipated levels due to the reasons mentioned above, i.e. traffic levels not yet high enough.

Figure 91: Triple bottom approach of the DP World Antwerp Inland Terminal in Beverdonk



Source: own compilation based on interview

Stakeholders

Early on, DP World Antwerp recognized the possible benefits of this concept. As a first mover, they felt like they would gain competitive advantage over other inland terminals and other terminal operators within the Port of Antwerp. They were the primary investor of the project. They believed they had the right resources and infrastructure to execute this innovation. There was not a direct demand for an inland terminal on the side of DP World Antwerp. They realized that it would improve reliability, efficiency and connectivity and most importantly decrease congestion, which is something that the market strongly demands.

The APA is the second shareholder (20%) after DP World Antwerp. The Port of Antwerp participated throughout the different stages of the project, but were mainly financially involved. They maintain a share of 20% in order to safeguard the position of other terminal operators within the Port of Antwerp. In this way they can take advantage of the innovation as well. There is no direct demand of the APA for an inland terminal, but they welcome it as an important measure to achieve the modal shift and to decrease congestion in and around the port.

The inland terminal raises the attractiveness of the port by reducing congestion and thus strengthening their competitive position in relation to neighboring ports. Furthermore, the innovation concept complies with their hinterland policy, which aims to contribute to a more efficient supply chain network. Another reason for the participation of the Port of Antwerp is to maintain a certain balance in their bargaining power in their relation with DP World Antwerp. The Port of Antwerp possess the right capacities to accommodate the innovation: IT, infrastructure, operations (e.g. BTS, AIS, AEO…). This facilitates the project throughout the three phases and especially during the implementation period.

Other Terminal Operators (e.g. PSA...) were not involved in the development of the BCT project and did not impede it either. Nevertheless, there was some demand from these actors for an inland terminal, because the need existed to overcome port congestion. This need remained the same throughout the different phases of the innovation case. In the initiation phase, Maersk was the only shipping line involved in the discussion. However, at the time they were more focused on other activities in the hinterland and were primarily committed to deep-sea traffic.

Throughout the different stages of the project, their attitude towards the extended gateway concept changed. This was especially the case at the implementation period. Therefore, the soft institution ranked neutral. The development phase attracted another shipping line, namely MSC. Currently, Maersk decided not to work with DP World Antwerp but they recognized the opportunities that could

be realized and are currently looking at different possibilities with PSA. The shipping lines involved possess the necessary capacities to participate in the innovation. Ever since the initiation phase, they recognized a potential competitive advantage. These actors participated in the discussions and did not hinder the progression of the project. However, opinions were divided.

Road transporters saw the concept as a threat to their market share and this is why that at the implementation period, many had to be convinced and yet still many have to be. Nevertheless, many road transporters are being convinced of the possible advantages, this innovation could bring to them as well (e.g. better utilization of assets, more round trips, better planning). Only a few yet understand this concept and see it as a possibility to cooperate with barge transport instead of competing with it. Barge transporters on the other hand, were optimistic from the start. They showed an improved attitude when results became more clear in the implementation period. Inland shippers cooperated well and developed a strong network with other parties. These actors possess the necessary capacities to take part in the concept and welcome it.

Grobbendonk Authority already had the required infrastructure (e.g. waterways, access roads from the hinterland, but no rail access.) and the necessary regulations to support the development of the inland terminal. There was demand on the side of Grobbendonk for this project because of the economic activity that accompanied the Beverdonk terminal.

In the beginning, there was no hinder experienced from social and political standpoint. However, after the opening of the terminal, complaints started to arise from surrounding inhabitants. BCT reacted fast by taking multiple measures to reduce noise and light pollution, Nevertheless, legal actions had to be taken to resolve this issue. Communication between both parties during the actual implementation of the innovation was not optimal. The Flanders Institute for Logistics, in brief VIL, became more involved towards the implementation of the project with the OTM award.

The European Fund for Regional Development, EFRD in short, financed 41.6% of the total project costs (EC, 2011). The EFRD is one of the funding bodies of the European Commission. The EFRD's goal is to enforce economic and social consistency by equalizing main regional differences. In other words, the fund tries to promote regional development amongst other funding of this innovative project. The amount invested has been calculated in such a way that the prices that will be set at the terminal, will attract the maximum traffic from the road.

Table 170: Development stages of the DP World Antwerp Inland Terminal of Beverdonk

Level	☐ Initiation	☐ Development	☑ Implementation
Terminal operator (innovation champion)	DP World Antwerp	DP World Antwerp	DP World Antwerp
Port authority	APA	APA	APA
Shipping line	Maersk	Maersk	Maersk
Transport operator	Barge operator	Barge operator	Barge operator
Sponsors	NV De Scheepvaart	NV De Scheepvaart	NV De Scheepvaart
Financing institutes	EFRO	EFRO	EFRO
European commission	ERDF	ERDF	ERDF

54. Container Yard of Meerhout

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Container Yard (CY) of Meerhout is a managerial, organizational and cultural change with the intention to have a future impact on the existing market. The public driven CY is currently in its initiation phase. It will be incrementally further developed and implemented in the future.

Table 171: Characteristics of the Container Yard of Meerhout

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

As container volumes and ships capacity are increasing year to year, also terminal areas have to keep up with this trend. In particular, solutions for better stacking had to be found, yard management systems had to be implemented and also appointment systems for containers approaching a port. Nevertheless, the physical area of marshalling yards and the container yards of a port cannot be increased. Therefore, new solutions had to be developed to improve the use of available transport modes around a port.

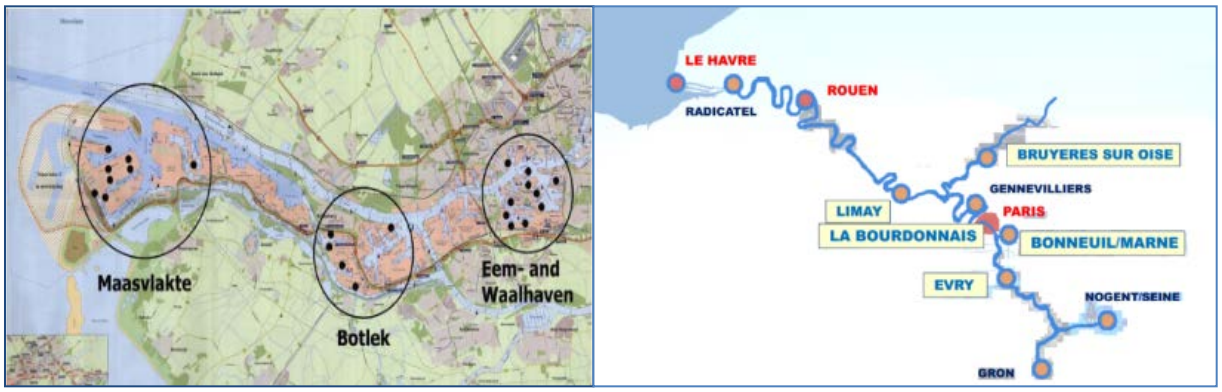
The marshalling yard representing the plot in front of the container dock for temporarily piling containers in order to speed up the loading and unloading of vessels, should be better organized and prepared before the container vessel arrives. The exported containers are piled orderly at the yard in preparation for loading, while the imported containers can be piled temporarily at the yard to speed up the unloading. This means that more capacity is needed on the quays. However, the exchange of keeping and storing of containers, is not a necessary thing to be done inside a port area.

The purpose of a container yard is to store the containers in order to perform the final door-to-door delivery or to collect and store the containers in order to be transferred to a marshalling yard. In order to reduce congestion around the ports and to mitigate environmental issues, an increased usage of complementary transport modes and their efficiency, a new concept has caught the eyes of container chain actors. The concept adopts and uses the terminals around large ports as an extended container yard. As a result hinterland accessibility becomes increasingly important for the competitiveness of a seaport.

The province of Antwerp serves as a good location for the development of this container yard principle. The Albert Canal serves in this case as a highly reliable distribution channel for the Port of Antwerp. The nearby region also disposes of a dense network of roads and highways. A similar thing can be said for the Port of Rotterdam and its Rhine Canal and for Le Havre Port and the ports at the Seine.

The Barge Hub Terminal (BHT) in the port of Rotterdam has the aim to collect/distribute containers to and from the hinterland. Barges from the hinterland call at the BHT, where containers are exchanged in order to reduce the number of calls in the port of Rotterdam. The port of Rotterdam has about 30 terminals, including empty depots. These terminals are spread over a rather large port area. Clusters of terminals are found in the area of Eem/Waalhaven, Botlek and Maasvlakte. Furthermore, Le Havre port is served by 5 main inland terminals on the Seine river and these are: Limay Terminal, Evry, Bruyeres sur Oise, Bonneuil sur Marne and La Bourdonnais.

Figure 92: Port of Rotterdam and Le Havre as examples for terminal clusters



Source: TDSL, 2013

Description

The target of the present innovation case is the distribution/collection of the last-mile container transport. Therefore, final customers in the nearby hinterland of a port are the main target. Efficiency can be evaluated by differences in utilization rate of barge transport towards or onwards the deep-seaport or the increase in rate of container transshipments that are switched to barge transport. Regarding the fact that this implementation can also have consequences at the economic level of a region and can have social benefits such as the reduction of accidents or environmental changes by modal shift from truck to barge.

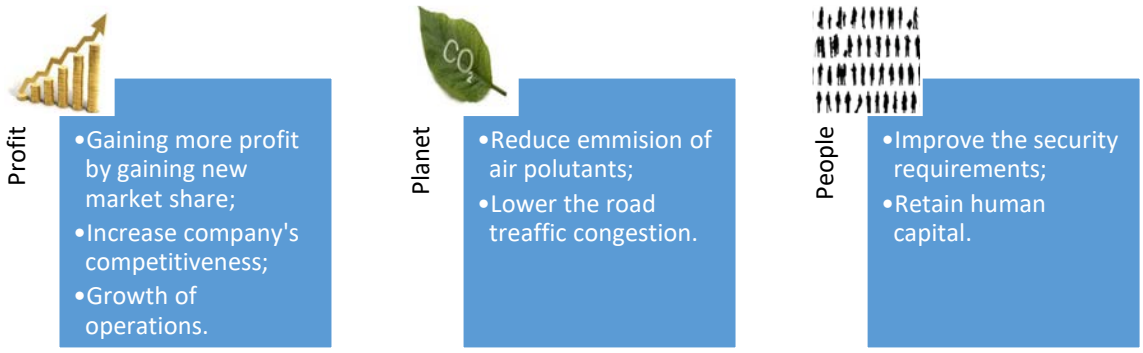
Table 172: Success and failure of the CY of Meerhout

Success	Failure
Better use of space; offer a competitive solution to trucking companies.	Needs the interest of other stakeholders

Profit, planet, people

The main objective of the establishment of a container yard is to increase market share and the impact on terminal competitiveness. By attracting new cargo the scale of operations are also expected to rise. Cost minimization is not a primary objective of this innovation case as the inland terminal aims at gaining more profit through growth. The multimodal solutions are also limited by technical capabilities. Through this innovation the developers hope they will provide a larger access to their other services such as barge transport or container storage. The container yard, by providing a multimodal solution, will also contribute to the reduction of air pollutants and congestion in the proximity of major cities. On the social side, the terminal targets the retainment of human capital and reduction of fraud attempts by offering logistics solutions in a secure area.

Figure 93: Triple bottom approach of container yard of Meerhout.



Source: own compilation based on interview

Stakeholders

Being just in the initiation stage, only few actions have been taken. The main actors, which are developing the container yard within the location of the inland terminal, are the terminal operator and the shipping lines. Due to the fact that this development needs the involvement of as many actors to be profitable and to benefit from the economies of scale, there is still the need of the involvement of other shipping lines and freight forwarders to set the framework of the container yard development. As a distinct stakeholder, other terminals are regarded as main competitors and threats for the current development.

Table 173: Development stages of the CY of Meerhout

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminal	BCTN		
Transport operators	Barge operators		

55. Transferium

Valentin Carlan, Christa Sys and Thierry Vanelslander

The innovation that is discussed in this chapter is called a transferium. The definition of a container transferium stands at the border between a seaport dock and an inland terminal. In comparison to a traditional inland terminal, a container transferium is located in the proximity of a seaport and provides a broader range of services. The main difference being its scope to spread the containers volumes serving the local customers within the area of 50-150 km by changing the mean of transport from inland waterway to truck.

This transferium is considered to be an innovation that is presently situated in the development phase. Through open collaboration the privately driven innovation follows an incremental path.

Table 174: Characteristics of the Transferium

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

Transferium terminals are a key feature to decrease the number of truck transports to the port area and offer increased sustainability advantages. When handled commodity flows are significant, regular liner services can be set up.

The main functionalities of a transferium are: expansion of the seaport; consolidation of container flow; depot for empties; enablement of a reliable transport system between the transferium and terminals in the seaport; customs bonded; and facilitation of truck-barge/ barge-barge transfer. By providing these functionalities a transferium terminal aims at: reduced congestion around the ports along with environmental problems; improve efficiency of deep sea terminals; play a buffer for peak moments; and facilitate modal split.

Table 175: Success and failure of the Transferium

Success	Failure
Reduces congestion within and around the port area.	Need trust and collaboration of other stakeholders

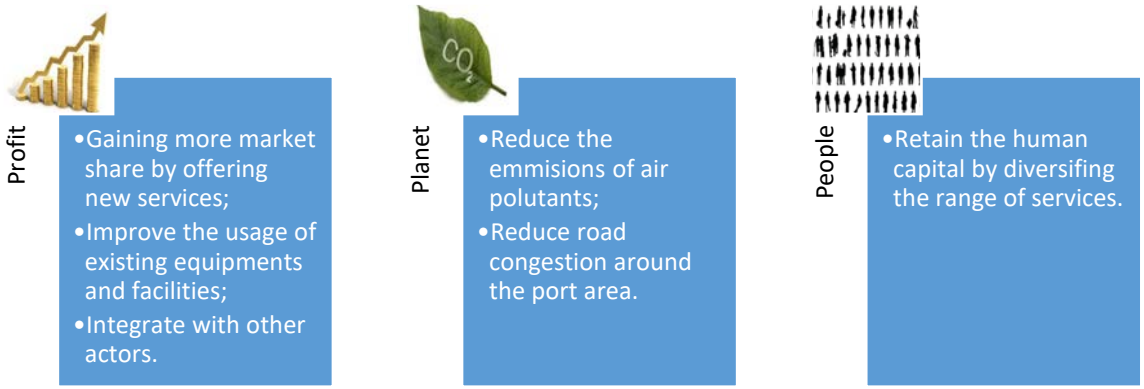
Profit, planet, people

The main scope of a transferium is based on three main pillars:
- Handling of the local cargo volumes;
- Being a truck bundling hub;
- Being a barge bundling hub.

The improvement of efficiency of deep ports was the first main objective of the present innovation. Efficiency can be measured by the improvement of port's container transshipments or by the difference in waiting time for ships to load or unload. Usually, a port expansion does not happen only one at once and these types of measurements can also include the effects of other changes. Looking further of the goals of the present innovation, the efficiency indicators of this type of innovation can be measured in a few ways. One approach can be expressed by the improvement of travel time on the

roads going towards and from the ports or the relative number of trucks on these roads before and after the implementation of this innovation. Nevertheless, the same principle can be applied to measure the improvements in environmental issues. Furthermore, the buffer role of this innovation case can be measured by the reduction of number of trucks, which are waiting in queues in peak hours at the deep-sea terminal or reduction of time clearance for containers that arrive by sea in the deep-sea terminal.

Figure 94: Triple bottom approach of the Transferium



Source: own compilation based on interview

Stakeholders

The transferium in the case of the inland terminal is seen as an facility for the trucking companies to avoid the congestion areas nearby ports or major cities. In the initiation stage there was the involvement of only the two main stakeholders: the inland terminal and the trucking companies. The two actors set the basis of the contracts and begin to operate the terminal as a transferium on a small scale. Further on in the development stage, shipping lines (barge operators) were also involved. The main issue was the less and less interest shown form the side of the terminal operator, which may lead to the failure of this initiative. The involved actors are aware of the fact that only through an increase of operation the transferium concept will be a success. Due to this aspect, special offers had to be discussed with the shipping lines in order to receive a competitive offer, which can be attractive for the trucking companies, but the margin of negotiations are still too narrow. Due to the fact that road transport is not a subject to taxes, the other transport modes, like inland navigation, can offer a competitive less expensive service.

Table 176: Development stages of the Transferium

Level	☐ Initiation	☑ Development	☐ Implementation
Inland terminal	BCTN	BCTN	
Transport operator	Trucking company	Trucking company	
Shipping lines		Barge operator	

56. Joosen Transport Hub

Valentin Carlan, Christa Sys and Thierry Vanelslander

The transport hub of Transport Joosen reflects a new managerial thinking and an organizational and cultural change because it requires the affiliation of competitor companies and collaboration among them. The transport hub is already implemented and has a closed access, but in the future it is being expected to be used as an open access logistic platform. The transport hub is a suitable solution to be setup near terminals, which are operating under a pre-notification or a time-slot-based system. This way, trucks will be able to become more flexible, they will not organize their activity too concentrated and they will be less dependable of the terminal availability. The innovation will have an impact on the way Transport Joosens conducts its businesses.

Table 177: Characteristics of Joosen Transport Hub

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The transport hub represents an extension of Transport Joosen services at a new location inside the Port of Antwerp. Through the transport hub the services offer a short term storage area of 25000 m^2 together with additional services such as container transshipment between different chassis, supply with empty containers, cleaning and/or repairing containers and attaching or removing liners. The transport hub represents an extension of services provided along with the Eurotranscon platform. The introduction of the transport hub optimizes the trips of the partner companies as they do not depend anymore on certain hours for pick-in or dropping of container inside the Port of Antwerp. The transport hub has wider benefits than specifically for the company itself.

Due to uncertainty and congestion, for trucking companies there will always be a cost optimization problem between using a transport hub over trying to approach a terminal in peak hours periods. The transport hub allows decisions to be made over one day to another and without extra planning. The more it will be used the more successful it will be, will lower average rates.

Table 178: Success and failure of the Joosen Transport Hub

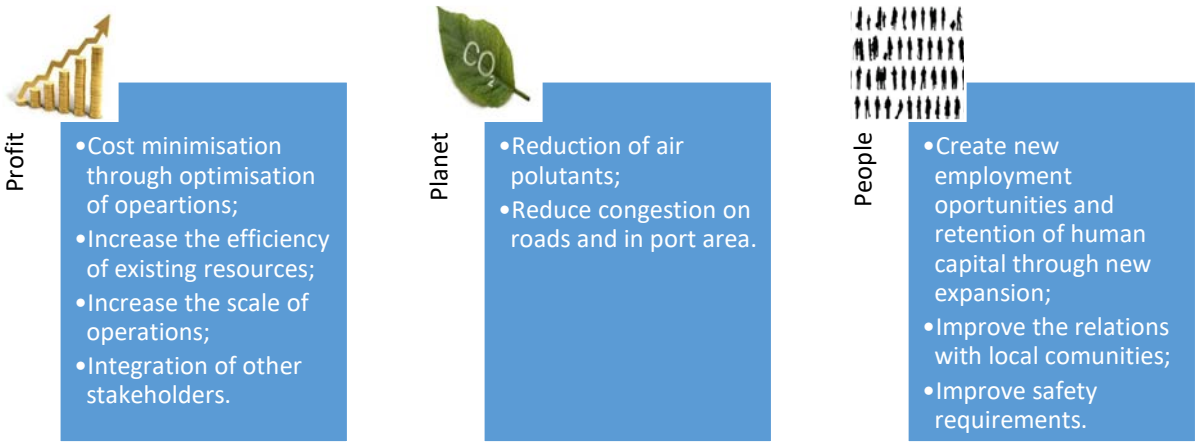
Success	Failure
It benefits out of strategic location in port, offers short container storage facility and transshipment.	N/A

Profit, planet, people

The development of a transport hub for Transport Joosen had the goal to bring all the services, offered by the company, in one site. The most important objective for the hub development was to be built a strategic location that could stimulate other developments or integrate with previous ones. From the cost perspective, the hub can be regarded as a motor to propel and integrate other logistic activities. If used at a higher scale, the operational costs for the transport hub are lower than the revenues. As indirect objectives, the benefits of having a hub are increased control of the drivers and better

organization of their schedules. More available options also make the company more flexible towards it employees.

Figure 95: Triple bottom approach of the Transport Hub



Source: own compilation based on interview

Stakeholders

The development of the transport hub was initiated to answer the need of Transport Joosen for more space. This necessity was overlapped with the idea of a strategic location, which should make the companies services more prompt and reliable. The actor, which was involved besides the trucking company, was the port authority. This actor was willing to provide a ground concession. Other trucking companies, which are performing operations in the Port of Antwerp and felt the need of a depot hub nearby, were also considered to be involved stakeholders. Even though the port authority was positively involved on the infrastructure level, the bureaucracy and slow procedures slowed down the process through all the three stages of development.

Table 179: Development stages of the Transport Hub

Level	☐ Initiation	☐ Development	☑ Implementation
Trucking company	Transport Joosen	Transport Joosen	Transport Joosen
Port authority	APA	APA	APA
Transport operators	Other trucking companies	Other trucking companies	Other trucking companies

57. Modal Shift through implementation of a local transshipment center in Beerse

Valentin Carlan, Christa Sys and Thierry Vanelslander

The targeted modal shift through the introduction of the ROC in Beerse, which is a local transshipment center, is an innovation with an open character as it can be developed within all organizations that decide to collaborate. The source of the innovation is entirely private and the change that had to be done was radical.

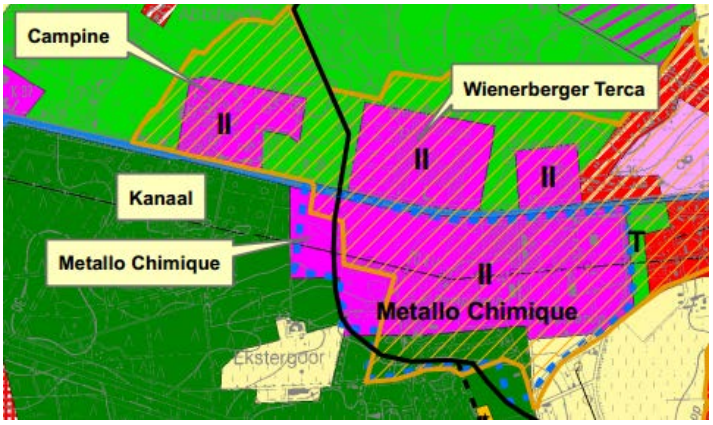
Table 180: Characteristics of Modal Shift ROC - Beerse

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The local transshipment center in Beerse was one the options that the municipality of Beerse envisaged to mitigate the road traffic problems around the city. Among the proposed solutions there was also the potential usage of the extra capacity offered by canals resulting in a shift of the freight flows from road to inland navigation. For this reason, companies such as Wienerberger, Campine, Metallo and at one point Leysen, had to join together and consolidate their flows in order to make the development of a new local transshipment center viable.

Figure 96: Location of each involved partner

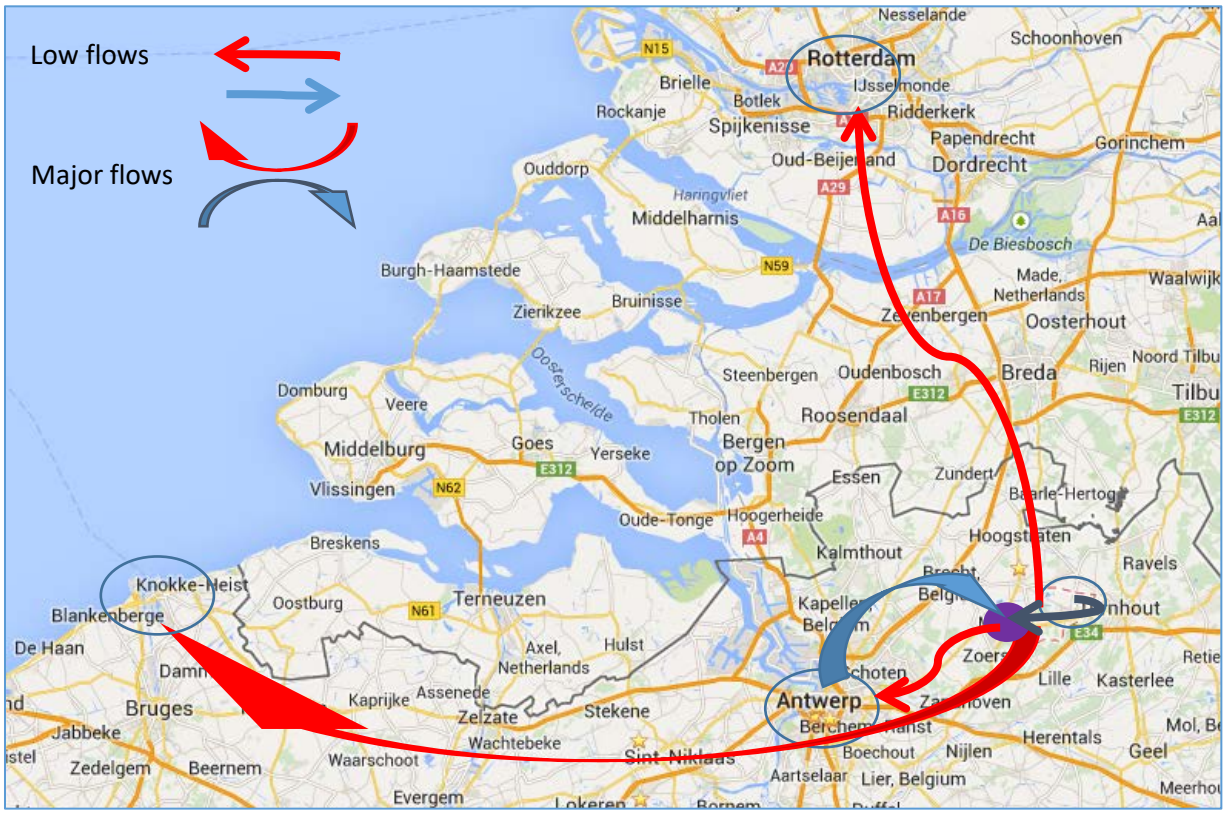


Source: ARCADIS, 2008

Each involved partner was located in the proximity of Beerse and had their interest for consolidating their flows together with the other partners. The four partners had different flows as follows: Metallo exports its flow via Antwerpen, Weinerbergen through Zebrouge to UK, Campine to Antwerp or Rotterdam and Leysen was supposed to collect the waste flow from Beerse towards its own drying ovens. The imbalance problem would have been compensated by the two biggest partners, Metallo, which plays the role of the importer, and Weinerbergen, which exports freight from Beerse.

At the beginning the discussion was focused on the access to the transshipment center, which was a bridge or a road that should be built. In the end the building of a new bridge over the canal was preferred as a critical infrastructure factor to ensure the connection between the partners.

Figure 97: Envisaged freight flow for the Transshipment Center in Beerse



Source: own composition based on interview

The eventual drawback was the decision to build a new access infrastructure rather than the development of the new center itself or the agreement between partners. For this reason four alternatives, two for the access in the northern area and two for the access in the southern area, are described in the Beerse action plan 2008-2012 '*Samen werken aan een gezonder leefmilieu en samenleving in de kanaalzone West te Beerse*'. The same document also described the subject of the meetings, which had taken place in the development stage of the project and revealed the action plan and, which should have been undertaken by each involved partner (Beerse, 2014). Unfortunately, the postponing of the decision to construct new infrastructure brought further development of the project to a halt.[40]

Table 181: Success and failure factors of the Modal Shift ROC - Beerse

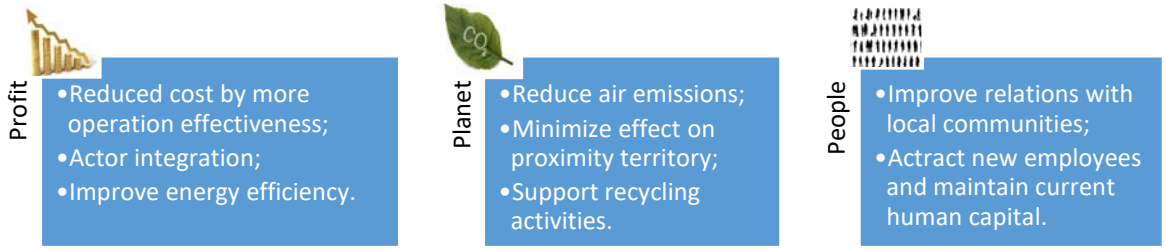
Success	Failure
Benefit out from the commitment of several stakeholders had the support of local community.	The construction of the access infrastructure was delayed.

Profit, planet, people

Metallo's objectives for the implementation of a transshipment terminal were not only economical. The local community was an important factor and Therefore, both projects aimed at improvement relation by promoting environmental objectives and bringing in front social objectives. Reducing congestion not only that was an important objective, but the goal was to entirely dismiss it by moving all the freight flows form road transport to inland navigation.

[40] Weinerbergen experienced a decrease in flow volumes and could no longer guarantee their volumes, Leysen was taken over by Van Gansenwinkel and they were no longer interested in the extra investment, Metallo merged into Metallum Holding group, which showed less interested in this type of projects regarding the terms of payback.

Figure 98: Triple bottom approach of modal shift terminal in Beerse



Source: own compilation based on interview

Stakeholders

The development of the transshipment center in Beerse involved the implication of different types of actors from local communities, industrial partners, research institutes and government. The modification that sets the typology of this innovation is the market change. Involved actors needed to take decision at managerial level and also by merging together, partners had to change their organization scheme in order to comply with new flows consolidation.

The innovation champion for the transshipment center in Beerse was the consortium of the involved companies, which pushed the collaboration further. An important role was also played by the local communities, which were clearly stating their conditions regarding their benefits and environmental protection.

During both the initiation and development periods, although the discussion was also set on future use of inland navigation, shipping lines were never part of the created network, which created a disadvantage for the project.

The initiation process started during the first half of 2006. In the second half of 2006 the development stage begun. During the development period several meetings with local communities were organized, which resulted in actions plans that divided the tasks between the involved partners.

The concerns of the community where linked with the developments and if the innovation would harm the livability of their neighborhood despite the additional employment opportunities. As a response for their concerns, a transparent environmental impact assessment was conducted to guide the decision making process, which brought the community closer to the network. The development period officially lasted until the end of 2013 when the four partners announced their dismissal, even though the business case was never set under discussion since 2008.

VIL initiated a study for, which they contacted barge operators and terminal operators along the canal, but they did not involve shipping companies, which could have been interested in the new transshipment terminal.

The main reasons why the project did not continue, were disagreements concerning the construction of the new infrastructure (new bridge and access road, which gave fears of attracting new traffic) and the market change, which influenced the position of the key actors (see above).

Table 182: Development stages of the Modal Shift ROC in Beerse

Level	☐ Initiation	☑ Development	☐ Implementation
Consortium of partners	Metallo, Weinerbergen, Campine, Leysen	Metallo, Weinerbergen, Campine, Leysen	
Transport operators	Barge operators	Barge operators	
Municipality	Beerse municipality	Beerse municipality	
Research institute	VIL	VIL	

58. Modal Shift through implementation of a local transshipment center in Beverdonk

Valentin Carlan, Christa Sys and Thierry Vanelslander

The use of the Beverdonk terminal as a modal shift terminal for its freight flows, was the second option of Metallo after Beerse (as discussed in the previous case). The concept of using Beverdonk as transshipment center is now already implemented. Metallo Chimique decided to use transfer their container via short-sea shipping from Antwerp or Rotterdam to Beverdonk and then using road transport from Beverdonk to Beerse. The innovation is now implemented and is still privately driven. The development was open for collaboration and the targeted market change was managerial, organizational, cultural and radical.

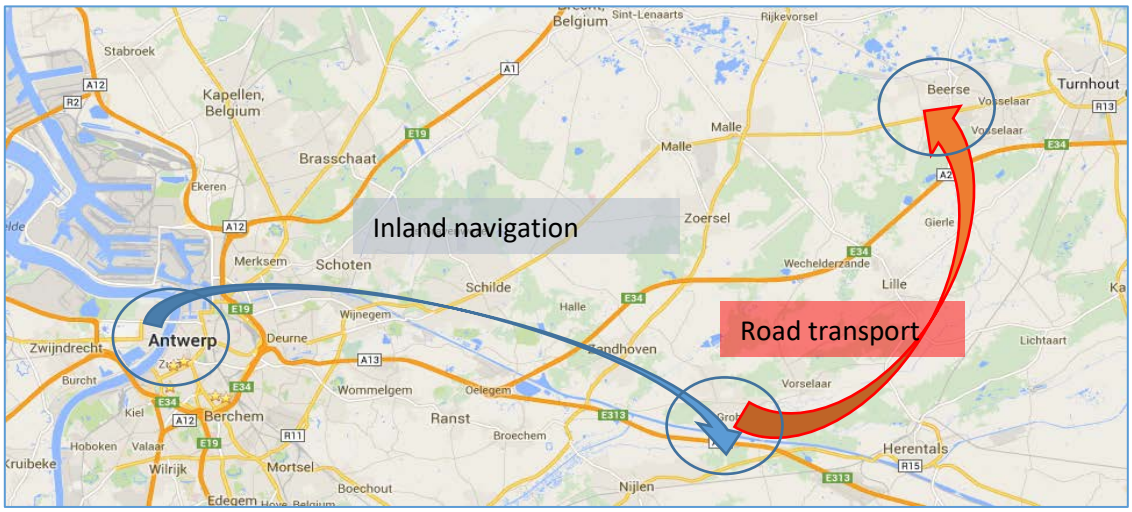
Table 183: Characteristics of the local transshipment center in Beverdonk

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The transshipment center in Beverdonk was used by Metallo in 2013 and represent the continuation of the implementation of a transshipment center. The idea was to assure freight flows towards their plant in Beerse while keeping a good relation with the local community. Using containers to facilitate the transshipment actions, Metallo also uses short-sea shipping from the seaports of Antwerp or Rotterdam to Beverdonk and road transport for the last miles to the final destination in Beerse. The collaboration for the new scheme involved only the partnership of Manuport Logistic for the inland navigation segment and Transport Joosen for the linkage between the transshipment center and their plant.

Figure 99 Transport means used by the transshipment center of Beverdonk



Source: own composition based on interview

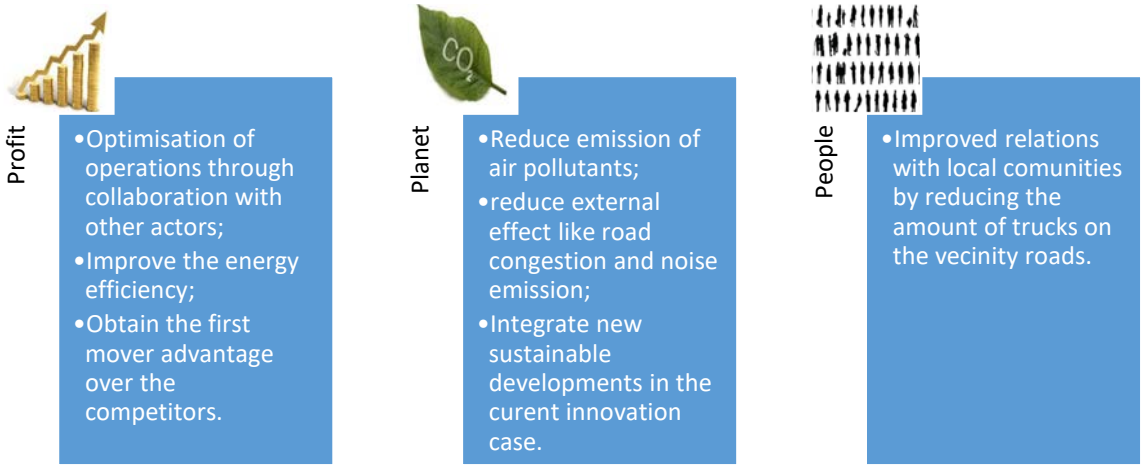
Table 184: Success and failure factors of the local transshipment center in Beverdonk

Success	Failure
Benefit out of previous experience. Incorporates multimodal solution.	N/A

Profit, planet, people

The collaboration with the Beverdonk terminal was an opportunity for both stakeholders, the terminal operator and the freight forwarder. The main objectives were to reduce the transport cost of raw materials and to optimize the operations. The use of the Beverdonk terminal as a transshipment point from barge to road, offers a transport option that increases the scale of operations and energy efficiency. Moreover, the environmental impact, noise and congestion around the deep-seaport are both diminished. By shifting the cargo transport from road to barge and diminishing the amount of trucks on the road, the freight forwarder also improved relations with the local communities.

Figure 100: Triple bottom approach of the local transshipment center in Beverdonk



Source: own compilation based on interview

Stakeholders

The collaboration with the Beverdonk terminal did not needed changes on the infrastructural level. The market change is considered to be a key factor that had to be revised for the integration of two transport modes: inland navigation and road transport. The innovation has an open character as it can be developed within any organization that decides to collaborate.

The success factors for the stakeholder collaboration were: the openness of partners to share their insights and their cost structures in order to find an equitable form of relationship; implication of an open partner, which sustained intermodal transport; implication of a shipper that brought extra experience to the created network; the fact that no investments were needed to be immediately done, which was an opportunity to test the viability of the proposal without immediate financial risks.

The innovation champion for the development of the transshipment terminal in Beverdonk was Metallo, by being the main driver behind the process. There was no involvement of any infrastructure development, nor the collaboration with other agents to consolidate the freight flows. The only level where actors where collaborating, was soft institutional for all three periods. During the initiation period, Metallo went into a lock-in effect with their current freight forwarder, due to their reluctance to collaborate in a multimodal scheme. This situation changed when a new partner (Manuport) was willing to collaborate and to replace the old freight forwarder. The initiation process started during the fourth trimester of 2013, the development stage took place in the first half of 2013 and since May 2013, Metallo is collaborating with the Beverdonk terminal as uses it as its transshipment center.

Table 185: Development stages of the local transshipment center in Beverdonk

Level	☐ Initiation	☐ Development	☑ Implementation
Freight forwarder	Metallo	Metallo	Metallo
Inland terminal	Beverdonk	Beverdonk	Beverdonk
Transport operator	Barge operator, Transport Joosen	Barge operator, Transport Joosen	Barge operator, Transport Joosen
Shippers	Manuport	Manuport	Manuport

CLUSTER 10: INNOVATION IN INLAND NAVIGATION WITHIN AN URBAN CONTEXT

This cluster discusses two innovation that introduce inland navigation concepts of urban distribution of goods and even cars. Both innovations were lead by the French CFT and had to deal with several factors that could lead to failure or success. The alignment and the interest of the city of Paris was relevant for the success of the innovations.

59. Urban Distribution of goods with inland navigation

Valentin Carlan, Christa Sys and Thierry Vanelslander

This urban freight distribution project "Distri-Seine" aims at the potential of urban waterways and channels. The innovative concept wants to use urban waterways to shift cargo from congested urban roads and reduce pollution. The innovation is considered to be a managerial, organizational and cultural market change that is being initiated. The innovation is closed and privately driven.

Table 186: Characteristics of Distri-Seine

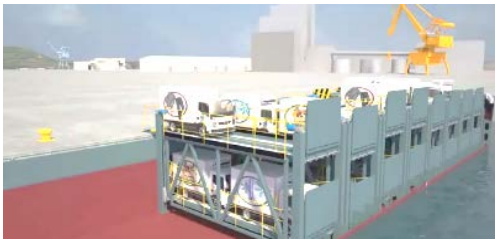
Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The innovation introduces the usage of electric driven barges to bring trucks and swap bodies from the peri-urban warehouses to the urban city centers while avoiding the congested roads. Currently, delivering goods by trucks directly to city centers, is an important source of air pollution, congestion and noise. The waterways represent historical transport corridors, which usually go right through the hearts of cities. The freight will only be transported by road during the last distance, which is only a few kilometers until destination while avoiding the highly congested roads towards city centers. The project proposes the introduction of 100% electric river transport barges and 100% electric driven trucks, which will be noise and particle emission free.

Distri-Seine proposes a logistic solution that has the aim to optimize and make use of the scale effect for better freight distribution. The concept does not need special quay construction or special handling equipment for loading and unloading the truck and the swap bodies on board of the barges. The flexibility of the system offers the possibility to reach a wide variety of quays, which means that the same vessel can be used for different loading/unloading points. After the process is finished and the vessel leaves the quay, other activities can take place with no other arrangements. A special feature of the Distri-Seine concept is that it can provide energy for electrical vehicles on board while traveling.





Source: CFT, 2014

Distri-Seine projects has its aim in making a change in the current freight logistic chain distribution by switching from road distribution to small navigation channels in urban areas. The main idea is to reduce congestion on urban roads and use the extra capacity offered by the waterways, which goes all the way in city centers.

The innovation is business orientated and tackles aspects from technological, managerial, organizational and cultural levels. From a technological point of view, the innovation includes adaptations of barges in such a way that they could load and unload trucks sideways. The side of the loading/unloading is crucial to the limited wideness of inland channels and flexibility advantage of release for each truck at a time. The project itself, for better usage of barge capacity, includes also a double level of truck storage, which requires lift and ramps for both the down and upper level. Another technological feature of the Distri-Seine project, is that it does not requires changes in quay infrastructure, which means that the barges should allow loading/unloading to any type and height of quays. The adaptation to the specific characteristics of the quaysides, should be realized by the usage of elevators and individual ramps. The managerial and organizational switch is related to the rethinking of the whole supply chain, which will include a new transport mode in the process. The extra capacity, which is available on barges to carry on their board freight trucks, refers to the service that will not be chartered to only one customer or company. For this reason, many stores form different suppliers, which have their activity inside the city center, can use the Distri-Seine. However, a new supply chain management and organizational scheme has to be rethought. The shift from a conventional road freight distribution towards inland waterways, represents also a cultural change whereby people and companies have to adapt to the new process.

Distri-Seine project is currently in the initiation stage and the whole framework has to be set up for the next stage by finding clients who are willing to use the new urban freight distribution concept and their location. The project represents a private initiative from CFT, which has a closed character and, which has the aim of being incrementally developed. The incremental degree of innovation is set by the fact that already used technology will have a new destination that includes changes in the management process and cultural view as well.

The success factors of Distri-Seine project are: the company's history and experience regarding the inland waterway navigation and freight distribution; the use of already existing equipment such as barges and push boats; the industrial dimension of the company, which is not easily sensitive to minor fluctuations on freight traffic flow or employment related deficits; the fact that is not an exclusive project and that it is open to be used by any customer, offers a type of service that is not yet on the market; the possibility to be easily adapted to changes in demand or of location. A failure factor for the urban freight distribution is the accessibility to the quayside from legal point of view. The accessibility to the quayside is a strategic feature for the project. The location needs to be as close as possible to freight destination. Another failure facture for the project is the risk of sudden withdrawal of stakeholders.

Table 187: Success and failure factors of the Distri-Seine

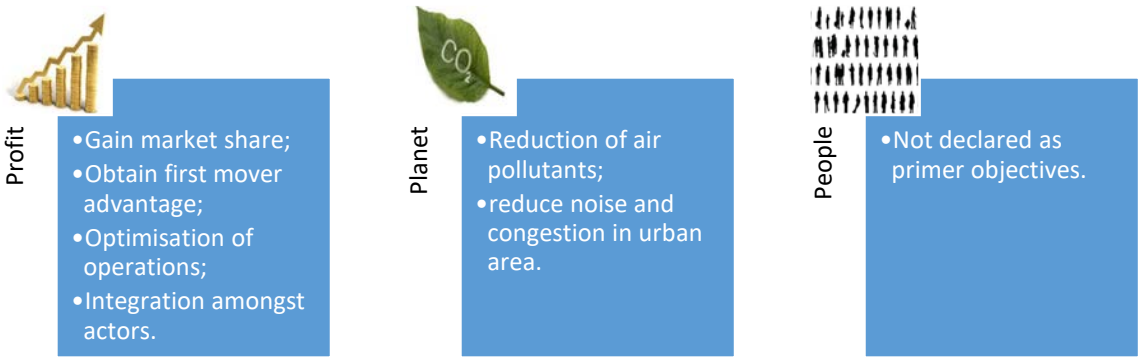
Success	Failure
Benefit out of support from the municipality; regulation that are hindering other modes of transport; it reallocates unused equipment.	Legal accessibility to the quayside; Proximity of quayside to final destination; Stakeholder involvement

Profit, planet, people

Urban freight distribution from the point of CFT, represents an extension of the current activity, by using current existing infrastructure such as the quayside and inland navigation channels for urban freight transport. The main reasons behind the innovation are economic and do not have the aim to reduce existing costs, but to make use of alternative existing capacity such as barges and quays. Also from an economic perspective, through the implementation of urban freight distribution by barge, CFT will have the benefit of gaining market share, be the first specialized company for this type of service with differentiation from their competitors and have better integration with other actors (warehouses and final markets inside urban areas). Urban freight distribution of CFT also aims at achieving environmental objectives such as the reduction of CO_2, air pollutants, noise (using electric engines for equipment from tugs to electric trucks). Another important objective is the reduction of road

congestion by contributing to the reduction of trucks in urban areas. Moreover, the use of electric engines has the aim of encouraging other investments in this area and to comply with environmental regulation. The social benefits gained by the urban freight distribution have less importance than in previous cases. The business model does not aim directly at social objectives, although they are acknowledged as secondary effects.

Figure 102: Triple bottom approach of Distri-Seine



Source: own compilation based on interview

Stakeholders

The Urban freight distribution project from CFT is situated in its initiation period and receives the contribution of four actors: the innovation champion, the port authority, the freight forwarders and the municipality. Looking from different perspectives, the overall implication of the actors is positive in this initiation stage of the project. The CFT as innovation champion has its interest in building the infrastructure, more specifically to adapt the existing barges accordingly to the specific operational needs, to involve the contributors and convince society for the benefits of the project, create a strong network around the interests of the project and to increase market demand for the new urban freight concept.

The port authority DRIEA Ile-de-France (former Service de la Navigation de Seine) has its interest to control and approve legal aspects for the safe use of new infrastructure. The freight forwarders are part of the network around the new project, because of their role of beneficiary of the new project. Freight forwarders have the task to put forward the demand's characteristics such as location, amounts, hours of service and frequency. An interesting aspect is the double position of freight forwarders in the network, although they are the main drivers behind the market demand in the same time (during the initiation period), they are using competitive services for their current activity. The role of the municipal authority is represented regarding the additional usage of the quayside and the urban waterway canals. From a legal point of view, the decision of the municipal authority to limit the access of freight distribution trucks inside the perimeter of the city, stimulates projects, such as urban freight distribution by barge, to be developed.

Table 188: Development stages of Distri-Seine

Level	☑ Initiation	☐ Development	☐ Implementation
Inland transport operator	CFT		
Authority	DRIEA Ile-de-France		
Freight forwarders	Final distributors		
Municipality	Paris Municipality		

60. Urban Distribution of cars with inland navigation

Valentin Carlan, Christa Sys and Thierry Vanelslander

The Urban Distribution of Cars with the possibility to charge Electrical Vehicles, is an innovation that is being initiated in the city of Paris. It is a closed innovation that is driven by a private actor while following an incremental path of development. The innovation uses existing technologies to introduce a managerial, organizational and cultural market change.

Table 189: Characteristics of the Urban Distribution of cars

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The urban car distribution aims at reusing urban inland waterways as an alternative to road haulage to transport vehicles to car showrooms, which are situated in the center of the city. The innovation combines technology of dedicated barges for vehicle transportation and the necessity of delivering the vehicles to hard accessible locations. The CFT group designed an alternative for vehicle delivery in Paris that implied only a few adaptations to current barges and without modifications on the quayside. The vehicles are envisaged to be brought to the center of the city by a dedicated car carrier and pusher. Loading and unloading is done by a specialized ramp. The innovation was officially presented in July 2011 and CFT, together with Paris city hall and Paris Ports, made the first test in Quay de Bercy, Paris XII. The test was considered to be a success.

This innovative solution can deliver up to 120 vehicles at once from a storage location outside the Paris city center (such as Limay, Flins. Poissy, Gennevilliers and even further) and deliver them in or from Paris. The solution itself can be used both for new or used cars, which can be transported outside the city.

Figure 103: Urban car distribution using inland navigation ways

Source: CFT, 2014

The transport of vehicles by barge is a viable alternative that has better benefits in comparison with conventional double-decker trucks. Moreover, the city of Paris declared to limit the access of the distribution of trucks inside the city center. This decision forces the car showrooms to search for other supply alternatives.

The concept of urban car distribution does not need new technological changes, due to this fact the changes, which have to be made, are only managerial, organizational and cultural. These changes aim at market change. Current car showrooms, inside the city centers, have to reorganize their supply chain and customers will need to pick up their vehicle from the barge unloading point on the quay. The project represents a private initiative from CFT, which has a closed character and, which represents an incremental development. The incremental degree of innovation is set by the fact that already existing technology is adapted to new purposes.

The success factors for the urban car distribution are: the easy quay access without any further technical changes for the barge, nor for the quay. Another success factor is the change in legislation regarding the access inside city areas of distribution trucks. Furthermore, another success factor of the project is the reduction of external cost with the reduction of road traffic: reduction of air pollutants, reduction in number of accidents, reduction in noise… etc. A failure factor for urban car distribution are the navigation limits for the Seine river and the small adjacent channels.

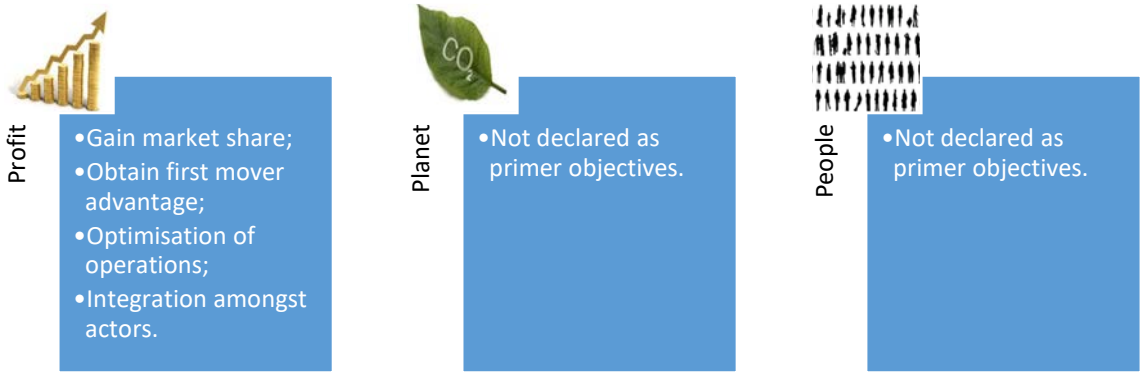
Table 190: Success and failure of Urban distribution of cars

Success	Failure
Benefit of support from the municipality; Regulations that hinder other modes of transport; Reallocation of unused equipment.	Navigation limits

Profit, planet, people

The Urban car distribution by barge innovation case is driven by the same ideas and follows the same concept as the urban freight distribution. The difference is being set by the different market that is addressed and the less technological changes, which have to take place. The main goals of the urban car distribution project of CFT, aims at gaining a new market share, it desires to integrate with new actors and diversifying their activity together with obtained side benefits like reduction of congestions and novice air emissions. The main argument for developing the project is clearly set by the economic objective, followed by environmental aspects and social benefits.

Figure 104: Triple bottom approach of Urban car distribution



Source: own compilation based

Stakeholders

The Urban car distribution project from CFT is in its initiation period and it benefits from the contribution of five actors: the innovation champion, the port authority, the concessionaire the freight forwarders and the municipality. Looking from different perspectives, the overall implication of the actors is positive in the initiation stage of the project. The CFT as innovation champion has its interest

in building the infrastructure, more specifically to adapt the existing barges accordingly to the specific operational needs, to involve the contributors and convince society for the benefits of the project, create a strong network around the interests of the project and create the market demand for the new urban freight concept.

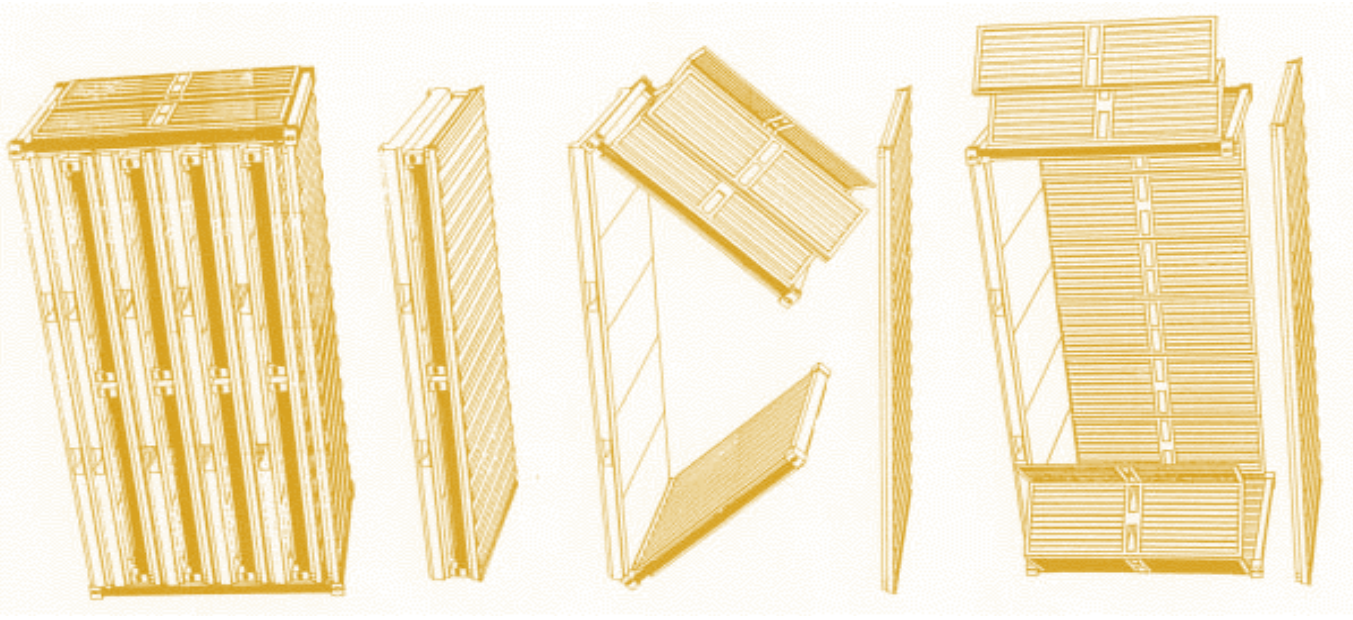
The authority, DRIEA Ile-de-France (former Service de la Navigation de Seine) has its interests to control and approve the legal aspects for the safety of new infrastructure usage. The concessionaire as well as the freight forwarders are part of the network created around the new project because of their role of beneficiary of the new project. The network created around the urban car distribution project, contains a sub-network formed by the concessionaire and the municipality, which supports the new project. The main actors, which are raising the market demand for the new project are: the innovation champion, the concessionaire and the freight forwarders.

Table 191: Development stages of the Urban distribution of cars

Level	☑ Initiation	☐ Development	☐ Implementation
Inland transport operator	CFT		
Authority	DRIEA Ile-de-France		
Terminal operator	Quay concessionaire		
Freight forwarders	Final distributors		
Municipality	Paris Municipality		

CLUSTER 11: CONTAINER INNOVATION

A radical innovation was the introduction of the container in the sixties. From a supply chain perspective, a new revolution of the transport system might be the foldable container. The issue with respect to the excessive costs due to storage and empty repositioning of existing or conventional containers lies at the base. The implementation of this concept might result in a competitive advantage. Next, two other innovation cases, viz. SEA45 and 10’6”ft container focuses on optimizing logistic connections.



61. 4FOLD

Valentin Carlan, Christa Sys and Thierry Vanelslander

4FOLD is an acronym for a foldable container. Already in 1972, Blanchard Russell T. patented a foldable or collapsible shipping container. In the abstract of the patent, a foldable container is defined as "*A collapsible container having high stacking strength and having means on the ends thereof cooperating with means on the sides, top and bottom to maintain the container in an operative condition without the use of fasteners*." According to Blanchard (1972), foldable containers were the solution to empty repositioning of perishable shipping container that sterilized prior to transport perishables, sea food, etc. again.

Table 192: Characteristics of the 4FOLD container

Characteristics of the innovation				
Type	Technology – unit change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

In the last decade, research regarding foldable containers focused more on cutting operating costs (Konings & Thijs, 2001; Konings, 2005; Shintani et al., 2010; Moon et al., 2013). This innovation is now rather driven by the fact that liner carriers struggle with the problem of repositioning empty freight containers due to trade imbalances, the phenomenon of seasonal flows or different types of goods, which requires certain types of equipment. Up to 40% of transported containers are transported empty. Empty containers cost the worldwide shipping industry around €20 billion a year.

Some initiatives for foldable containers failed. Konings & Thijs (2001) found that these containers have not been introduced successfully due to skepticism about technical performance, the complexity of the folding and unfolding process in particular, as well as logistical and organizational problems with using foldable containers.

Konings & Thijs (2001) discusses two types of foldable container that have achieved the phase of pilot and market introduction, viz. the Six-In-One container and the Fallpac container. Table 193 compares the characteristics of three concepts of foldable containers.

Konings & Thijs (2001) concludes that technological innovations form the basic condition to enhance the economic viability of these boxes. 4FOLD just aims to meet the technical challenges. Konings (2005) and Shintani et al. (2010) show that the use of foldable containers can lead to substantial net benefits in the total chain of container transport.

4FOLD is a new foldable container design owned and promoted by Holland Containers Innovation B.V. (HCI). HCI was established early 2008 as a spinoff from the Delft University of Technology (TUD), which has the aim of promoting the use of the foldable container. The first fully-size prototype container was developed in March 2009.

Table 193: Comparison of the Six-In-One container, the Fallpac container and the 4FOLD container.

		Six-in-One container	Fallpac container	4FOLD
Dimensions		20 ft	20 ft	40 ft
Weight (tare)		2900 kg	4000 kg	5900 kg
Stacking height		Five over one		
Folded dimensions		six in one	five in one	four in one
Folding procedure	Equipment needed	Forklift	Forklift	Forklift
	Employers	3	2	2
	Timing	15 min	10 min	4 min
Claimed faults		Cost of folding/unfolding;	Leakage through the side doors;	High price (6x price of standard container).
		Vulnerability to damage;	High tare weight;	
		Theft of container parts;	Limited application due to little marketing and insufficient promoting.	
		High price (3.5 times more expensive than a standard container);		
		Requires more time and space for handling.		

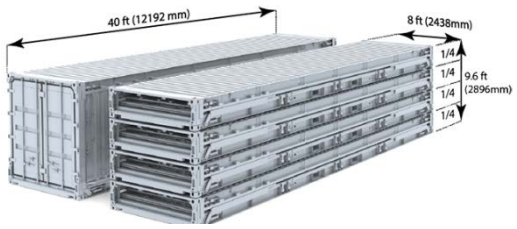
Source: own compilation based on Konings (2005) and CARU Container (2014)

Two years later, HCI received for this prototype a Container Safety Convention (CSC) certification. In March 2013, the foldable container is fully ISO certificate. The production of the first series of the foldable container could start.[41]

The innovative element of the HCI Foldable Container or 4FOLD is the fact that it is a fully compatible 40 ft. high cube ISO and CSC certified container easy and fast folding with standard equipment. With respect to the degree of innovation, it can be indicated as an incremental innovation. However, the new design of this technological development, which is completely different from previous attempts and its impact on the supply chain, it is rather categorized as a system innovation.

This concept can be folded to 25% of the original volume, allowing 4 folded containers to be stacked and connected to form exactly one standard container again. These can then be stored, transported and handled as one package (see Figure 106: 4FOLD folding process). The global world trade will benefit of extra capacity, ships and depots can be used in a more efficient way. This innovation allows for a cost saving of up 25% on operational costs for shipping lines and lower CO_2 emissions due to the reduced number of transport movements.

Figure 105: 4FOLD



Source: http://www.hcinnovations.nl/products.html

Regarding technological change, this innovation meets the requirements of waterproof, solid or lightweight in contrast to previous similar concepts that failed. As to managerial as well as

[41] http://www.hcinnovations.nl/company.html

organizational change, using foldable containers means rethinking the shipping activity by integrating the new operations of folding and unfolding. Besides the need of equipment, there is also the need of two persons to perform the folding/unfolding operation. With respect to cultural change, this innovation case also needs to change people's perception.

The previous failures of foldable containers designs left a bad label for this type of equipment in shipping industry. Shippers and 3PL have to gain trust in the new equipment and use it.

Figure 106: 4FOLD folding process

Source: CARU Container

The HCI and CARU Container B.V. already ordered a significant amount of foldable containers and the first testing trip between Hong Kong and Rotterdam, where they were unloaded from Cosco's Prince Rupert vessel was already done. The boxes are now being tested out on a route between Venlo, in the Netherlands and Spain so the current innovation can be considered already as functional and implemented. (Todd, 2014)

The 4FOLD will be used based on a leasing fee, which should be high enough to cover the purchasing cost of foldable containers but still is attractive to overcome the use of standard containers. The HCI's long-term goal is to achieve mass deployment through strategic licensing agreements with global shipping lines and container leasing companies.

Furthermore, according to Konings (2005, p. 342), the success of foldable containers is related to three aspects: the costs and quality of the product, the used the logistic concept and the marketing of the product. Table 194 summarizes the 4FOLD characteristics in accordance with the aspects proposed by Konings (2005).

Table 194: 4FOLD product characteristics

4FOLD	
Product characteristics	
Costs for folding and unfolding the containers	The cost for (un-)folding the container is relatively low. The procedure requires the assistance of a forklift (same with competitive models), but the folding can be done by only one worker. Furthermore, the producers guarantee that the operation is doable in approximately 4 minutes.
Manufacturing costs	The manufacturing costs of one 4FOLD unit is relatively high. The cost for producing the 4FOLD container raises at around 6 times more expensive than a standard container.
Compatibility with existing equipment for intermodal transport	The 4FOLD container is designed to be compatible with all existing handling equipment that is being used in the intermodal transport, like a standard container (Table 193).
Specific technical features	The specific technical features of the 4FOLD foldable container are patented by HCI B.V.
Logistic concept	According to CARU containers, the most promising market opportunities for foldable containers are in the intermodal logistic chains of major 3PL, 4PL players.
Product marketing	From the CARU Container perspective, the 4FOLD is an innovative product that can become a commercial and marketing tool to increase their level of service. The company is constantly looking to complete their container portfolio. This new solution can be addressed to their global customer network with specific needs and a higher savings potential, specially orientated to customers with considerable imbalanced flows.

Source: own compilation based on Konings (2005) and CARU Container (2014)

Table 195: Success and failure factors of the 4FOLD container

Success	Failure
Reduce the need of staking area for empty containers; Waterproof; Quick foldable time.	More expensive; Staff costs; Need to use forklift to fold it; Competition of a 45ft foldable container.

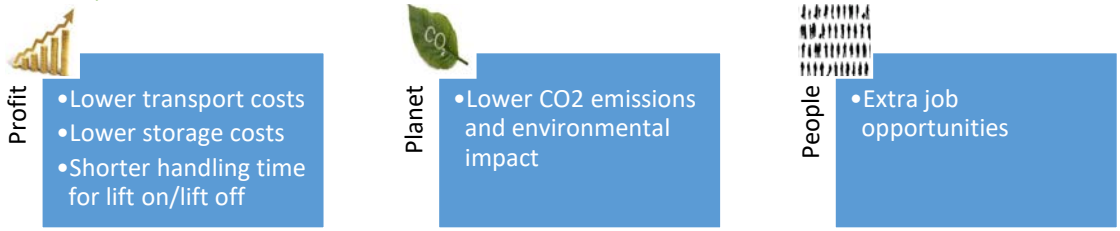
Profit, planet, people

The objectives of the 4FOLD are mainly economic and not immediately related to cost minimization because of the higher acquisition cost. CARU Containers, by using the 4Fold, aimed at economic gains, which are offered to the first one on the market who uses this equipment. This first mover advantage allows CARU Containers to differentiate itself between its competitors. The use of 4FOLD also has the aim of increasing the agency's scale of operations with a positive impact on their competitiveness and targets around 100.000 units in use over their entire network. Reaching this level will guarantee the economic success of the current innovation case.

Next to the economic reasoning, this innovation case is also driven by environmental objectives. More effective transport of empty containers also has a positive impact on the environment. The amount of container slots, moves or routes used for empty container reposition, can now be reduced by a 75%, by moving 4 empty containers, which are using the same volume as 1. The most important objectives from the environmental point of view, are the reduction of CO_2 and emitted air pollutants as well as the reduction of congestion inside transport terminals. By coupling together 4 empty containers, the storage place is significant diminished. On the contrary, due to extra need of ground clearance to perform the folding/unfolding operation, the impact on proximity landscape was not a main objective.

Regarding the social impact of the use of foldable containers, none of these objectives were important. The starting of the 4FOLD development did not take into consideration the social benefits. Although after development stage, the need of extra human labor to perform the folding/unfolding operation can be regarded as a new employment opportunity if the foldable container is being used at a larger scale.

Figure 107: Triple bottom line – 4FOLD



Source: own compilation based on interview

Stakeholders

HCI, based in the YESDelft incubator, has been working on its 4FOLD innovative container since 2008. In November 2013, CARU Containers joined the existing shareholders of HCI B.V., which took over 5% of the shares via their investment company P.O.R.T. Holdings B.V. The current mix of involved companies is meant to push the foldable container concept further on the market. The role of CARU Container is focused on leasing products, while the HCI focuses on capital and further technology development.[42] From the point of view of CARU Container, the cooperation with HCI B.V. is a value proposition, both for them and for their customers. Having the advantage of already knowing the trade imbalances and cost of storage and repositioning for empty containers, it will be an additional advantage to know the specific routes that can use foldable containers instead of standard ones.

The specificity of the development path of the 4FOLD container is that it did not included from the beginning the actual contractor, which has the role of commercializing and leasing the final product on the market. CARU Container, from its position of shareholder in HCI, has the role of spreading the 4FOLD container on the market. According to Konings (2012), container lessors or broker agencies can play an important role in initiating foldable containers. Konings states that the special relationship between shipping lines and container lessors, appears to be of particular importance and is a key to pave the way for using foldable containers (2012). CARU Container (2014) thinks that the decision of developing a 40" foldable container instead of opting for a 45" foldable container might hinder market introduction. During the initiation period, TU Delft took the initiative to develop a foldable container, which had the dimensions and characteristics of a standard 40" container. Despite of previous failed attempts, TU Delft proposed a new product design that would overcome the previous failure issues.

On the infrastructure level, it was the positive involvement of TU Delft, HCI as innovation sponsors and the research institute, YESDELFT, which pushed the innovation case further. It were these stakeholders who believed in a better technical solution, which could overcome issues like waterproofness or strength. From the same point of view, the position of the shipping lines, CMA CGM, was not favorable. This position was mostly motivated because of previous failure attempts.

From the level of hard institutions, positive feedback was given by TU Delft, HCI and the Belgian manufacturing company. The manufacturer has built the product according to the design and being assisted by HCI it obtained the CSC certification.[43]

A weak network, during the initiation period, was mentioned between the HCI and the CARU Container agency. The effect of this weak network lead to the development of only 40" dimensions boxes. It is considered that the involvement of the leasing company in an early development stage would have

[42] http://www.hcinnovations.nl/news11.html
[43] http://www.greenport.com/news101/products-and-services/improving-efficiency-in-container-shipping

influenced the development of different type of products. The container broker agency wishes to have also a foldable container with the dimensions of 20" box, which would be "more flexible and open to users like rail companies or inland distributors" (CARU containers, 2014).

Competition from other innovations was present. Other companies developed similar innovations within their networks in order to optimize the reposition of empty equipment as well as finding ways to return a container to the departure point in more productive ways. The development period benefits from the involvement of more actors in comparison with the initiation stage. Standardization bodies, leasing company and another manufactures joined the development of the 4FOLD container.

From the infrastructure point of view, the design received positive feedback and during this period, the CSC certification for series production was obtained. This achievement had been realized in strong collaboration of the HCI as the innovation sponsor, the new Chinese manufacture company and the standardization bodies. Although it received good reactions from the Shipping lines, the involvement of the shipping line was not strong; CMA CGM were still reserved regarding the high scale usage and the market reaction regarding the use of the foldable container. Another important step was achieved in June 2011 and later in 2013 when HCI received the ISO certification for the 4FOLD. After that, HCI, sets up the production of the first series of foldable containers, which were followed by a number of pilot projects together with various shipping lines to introduce the 4FOLD container on the market.

The missing actors during the development period were the 3PL companies and rail operators, which could have orientate the development of foldable container towards their needs. Rail operators being more interested in using 45" containers and inland distributor in 20" boxes cannot shift to other box dimensions. The same reason is also cited for the lock-in effect, which is created by the developers. It is expected that rail operators and the leasing shareholder, CARU Container, will develop new products, which will overcome this issue in the coming period.

The Implementation period, like the other two stages, included again changes in the actor's involvement regarding the 4FOLD project. TU Delft, which in the initiation stage was identified as the innovation champion, was not involved anymore in the further implementation process.

The other relations still exist: HCI, CARU Containers and the Chinese manufacturer are in strong cooperation. Shipping lines, although they remained interested in the evolution process, they are reluctant regarding the usage of the foldable container. The main reason for this, is the needed extra labor to fold/unfold the equipment. Week networks are still existing between shareholders, 3PL service providers and rail operators. The initial developers who created the foldable container design, compatible with the dimensions of a standard 40" container, created this difficulty. This problem is still regarded as a major lock-in effect, created by the innovation initiators.

Table 196: Development stages of the 4FOLD Container

Level	☐ Initiation	☐ Development	☑ Implementation
Innovation sponsor	HCI	HCI	HCI
Research institute (innovation champion)	TUD - YESDelft		
Manufacturing company prototype	Belgium builder		
Asian manufacturing company		Chinese builder	Chinese builder
Container broker agency		CARU Container	CARU Container

62. SEA45

Valentin Carlan, Christa Sys and Thierry Vanelslander

The second innovation case in this cluster, SEA45, is an alternative solution to the decreasing number of trucks transiting central European countries[44]. The acronym SEA45 refers to a NVOCC (Non Vessel Operating Common Carrier)[45] short sea service in the logistic connections between North-Western Europe and Greece/Turkey using 45' containers. This open innovation case is the result of a collaboration between Contrade Shipping (Greece) and ACB Group (Belgium), which started in 2011. Since its beginning, the service is a door-to-door connection, providing two departures per week with a transit time of 7-8 days. The innovative element is the combination of the economic and ecological advantages of Shortsea Shipping with the loading capacity of a standard trailer[46]. It has been privately driven and is implemented.

Table 197: Characteristics of the SEA45

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The ACB group was the first company, which introduced the 45 ft. pallet high cube container into the Shortsea Shipping market, more specifically the Greece and Turkey market[47]. Previously, 20 ft. or 40 ft. standard containers were used in these markets. The alternative was the combination of road transport using standard trailers via the former Yugoslavia and ferry or the combination of rail to Bari, as part of an intermodal transport and then followed by ferry to Patras in Greece.

An important hurdle was the acceptance of 45 ft. high cubes on board by the shipping operator. He had to accept on their board and change their equipment. Due to the unusual dimension, the capacity on vessels is limited, Therefore, more conditions have to be taken in account in the stowage plan of the vessels. A good option to stow the 45 ft. high cubes containers on board of whips is through dedicated slots for reefer container or on top of 40 ft. container. The offer that ACB group was a fair trade-off between the number of containers and the number of trips per week, in order to have a competitive advantage over the parallel transport options.

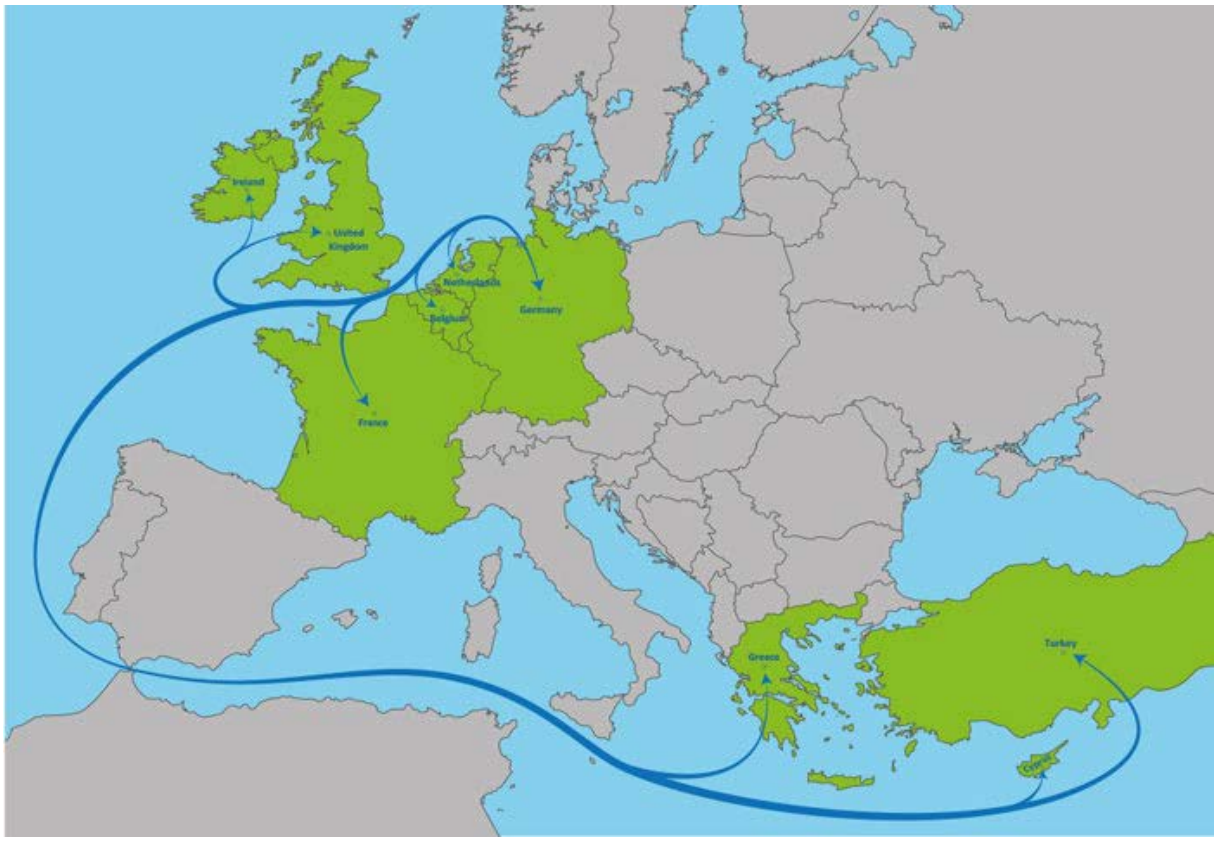
[44] More info: http://www.sea45.eu

[45] NVOCC service usually consolidates small shipments of LCL (less container load) issues HBL (House Bill of Lading) and undertakes the services provided by freight forwarders.

[46] 33 europallets or 26 UK pallets on the ground.

[47] A parallel service of another operator of 45 ft. container stopped in 2011.

Figure 108: Sailing map of SEA45 service



Source: http://www.SEA45.eu/schedule/

Agreements were made between three shipping lines, which offer services form Antwerp, Rotterdam and Hamburg. Their departure days are spread over an entire week. The departures from North-west Europe through the Mediterranean sea are organized on two routes: one northbound and one south bound. The northbound contains the following sequence of port visits: Piraeus, Istanbul, Izmir, Egypt, Algeria, Valencia and then Northwest Europe. The southbound contains the following sequence: Algeria, Egypt, Izmir, Istanbul, Greece and then Northwest Europe. For Greece, the frequency of the departures is now 2 departures northbound and 3 departures southbound, and for Turkey there are 3-4 departures per week scheduled on the northbound and 2 departures per week on the southbound.

The new service is not orientated to take over flows from other existing short sea 45' shipping operators. It is orientated to bring the short sea shipping 45 ft. containers, which were transported by road or rail.

A success factor of the SEA45 service is that the capacity offered by the 45 ft. pallet-wide high cube containers is the same as regular 13.6 m road trailers. Therefore, there are no significant changes in the logistic chain required. Another success factor for the SEA45 is the combination of existing deficit area with short sea. While failure factors threaten the innovation as customers can prefere 40 ft. containers, due to lower rates. The dimension of the SEA45 container are presented in Table 198.

Table 198: Dimensions of SEA45 container

EXTERNAL DIMENSIONS:	INTERNAL DIMENSIONS:
Length: 13.716 mm	Length: 13.556 mm
Width: 2.500 mm	Width: 2.444 mm
Height: 2.896 mm	Height: 2.695 mm

Source: SEA45.eu, 2014

The capacity offered by the use of SEA45 container is:
- loading capacity 89 CBM
- payload 25.5 tons
- 33 euro pallets / 26 UK pallets ground surface

Using the 45 ft. container brings an increase in number of pallets that can be transported in one shipping. Setting the comparison line to 40 ft. containers a total increase of the number of used 45 ft. containers is expected. Table 199 presents the comparison between the number of pallets, which can be fitted inside a 40 ft. and a 45 ft. container.

Table 199: Number of pallets that can be accommodate by standard and pallet-wide containers

Type of container / Type of pallets	Standard			Pallet-wide		
	40 ft.	45 ft.	Capacity increase (%)	40 ft.	45 ft.	Capacity increase (%)
Number of standard pallets (1,2x0,8)	25	27	8%	30	33	10%
Number of British pallets (1,2x1,0)	21	24	14%	24	26	8,3%

Source: own composition based on container dimensions.

In order for the multimodal service to work, the ports of Antwerp or Rotterdam are used as hubs serving regions from United Kingdom, Ireland, Germany and north of France.[48] The service offered by ACB group represents an alternative solution, which has the aim to diminish the number of trucks by using Short sea shipping. The ABC group can offer an only 2 days slower service, but for a lower cost and with fewer external emissions, being in line with the requirements of modern shippers.[49]

The new short sea service offers swift ship loading/discharging times and punctual delivery to customers. The carriers accept a payload of 26 tonnes and ADR/IMO cargo, and they offer temporary storage of full containers at a port or depot between arrival and final delivery, as well as delivery one day after discharging the cargo. Containers are locked with high-security seals, there are no intermediate stops during transport and agents are familiar with local customs procedures.[50]

The current innovation case is already in the implementation phase. After the success of initiating the first connection with Greece, the service was extended to Turkey and Cyprus representing a present to future advance. The source of the innovation was a private initiative between the collaborative parties. It has a closed statute and it can be considered to be an incremental change due to the existing technologies that were put together to offer the a new service.

Table 200: Success and failure factors of the SEA45

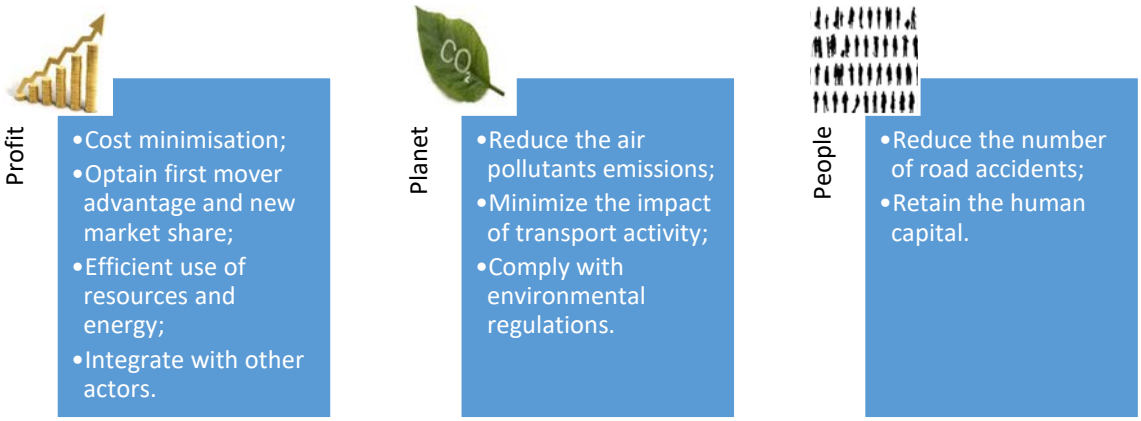
Success	Failure
Close relations with clients and partners.	Treat form other modes of transport; Legislation of different over the countries.

Profit, planet, people

The main objectives of SEA45 are to offer a reliable service, designed to link together Benelux area with Greece and Turkey. Even though the service does not have a competitive advantage through time performances the reliability and frequency are the two main characteristics, which make this service attractive. The importance and success rates of the objective referring to SEA45 service are equally distributed through all three sets of objective economic, environmental and social.

[48] http://www.shortsea.be/html_nl/nieuws/nieuws_archief_artikel.php?id=1137&zoekstring=acb
[49] http://www.shortsea.be/html_nl/nieuws/nieuws_archief_artikel.php?id=1257&zoekstring=acb
[50] http://www.sea45.eu/website/sea45_eu/assets/files/articel_itj_10_2012.pdf

Figure 109: Triple bottom line – SEA45



Source: own compilation based on interview

From an economic perspective, the success of the objectives is given by avoiding empty trips between the ports along the transport route. This logistic goal was led by the desire to minimize the cost, optimize the operations and to avoid the depletion of current use of resources.

A draw back of the current service is that it does not enhance the flow of documents. Due to the fact that the vessels are calling on ports, which are outside European Union, special transit documents are needed to be created, like declaration of the origin of the cargo etc. Another lack of the SEA45 service is that due to the limited amount of number of 45 ft. containers, which is 25 containers per sail and, which can be taken on board of short sea vessels, it also limits the scale and access to the service itself.

From the perspective of the environmental impact SEA45 service also have high objectives and their success is guaranteed by the use of short sea vessels instead of terrestrial transport modes. Compliance with environmental regulation is highly important due to new possible restrictions, which might constrain the competitive modes of transport, for example if new regulation will force the shippers to limit their generated emissions, SEA45 will always be under the limits.

From social point of view, SEA45 managed to retain human capital due to the increase of scale of operation, also by shifting cargo flow from road to short sea shipping, in the past the same amount of cargo had to be transported over 3000 km by truck, now it is necessary only 200 km on the road. The SEA45 service had the objective to meet security requirements, like thefts and illegal immigrants.

Stakeholders

In the initiation period from the perspective of infrastructure level a high involvement was sensed form the perspective of Innovation Champion who had also a high marked demand. Terminal operators and shippers had to be talked into the process but they had a rather low implication because they were supposed to handle equipment, which they were not using at that moment.

Regarding the soft institution aspect, guideline of EU and regulation for maximum weights allowed to be transported in the countries played an important role on setting the limits for container loading. For example, the maximum admitted container weight in Netherland is 50 tonnes, in Belgium this is 44 tonnes while in Greece it is 42 tonnes.

The initiation process started with the initiative of the innovation champion, which had the challenge to convince other partners to join and find common goals and opportunities to achieve them. The common objective was to cope with late arrivals, diminish the damages to transported cargo and better use of actual transport facilities. The terminals and shippers operators at the begging where reluctant and they did not want to take any chances with damages that might occur during the handling process. In the end, other practical experiences regarding the use of 45 ft. containers, convinced them to step into the process.

Once the actors agreed on the use of 45 ft. container the departure schedule had to be decided and the shipping process started. The development and implementation stages of the innovation, therefore, did not differ and a differentiation between them is not needed to be made.

The implication of the involved actors in the development period remained almost the same. Terminal operator and shippers changed their attitude regarding the 45 ft. containers and once they had seen that special procedures were not required, they became more positive about the project. During the two stages there was a market demand from shippers of 45 ft. containers, which was an incentive to proceed collaborating and to use the SEA45 service.

Table 201: Development stages of the SEA45

Level	☐ Initiation	☐ Development	☑ Implementation
Container broker agency	✓	✓	✓
Container operator	✓	✓	✓
Terminal Operator	✓	✓	✓
Shipping lines	✓	✓	✓
Shippers	✓	✓	✓

63. 10’6” ft. container

Valentin Carlan, Christa Sys and Thierry Vanelslander

The innovation case, a specially designed 45’/10’6” (99 cbm) container, refers to an intra-European alternative for high cube loads of Bosch-Siemens Household Appliances (BSH). The managerial and organizational elements relate to the optimization of capacity, viz. the transportation of three layers of washing machines instead of two layers. A pallet wide concept with a height of 10’6” increased the capacity to 99 cbm (internal height 3m). With these dimensions, the equivalent of a mega trailer can be loaded. This innovative idea results in the organization of a completely new supply chain, which also entailed a cultural change.

Table 202: Characteristics of the 10'6" ft. container

Characteristics of the innovation				
Type	Technological, Managerial, Organizational, Cultural – Business Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open	Closed		
Source	Public	Private		
Degree	Radical	Incremental	Modular	System

Description

The use of mega trailers (100 cbm) was integrated in the BSH production process (South Germany). BSH wanted to shift its transport towards Shortsea Shipping without changes in its production process. Due to the physical characteristics, dimension and weight, the standard container[51] was not a solution given that it was not used at its full capacity. BSH wanted the ability to combine the advantages of Shortsea Shipping with the extra space that provides a mega trailer. Two other problems to overcome were the restrictions on the road end and the linkage of the various transport modes. Therefore, a 10’6” container was designed for the transport of washing machines from five South Germany factories to the main DC in the United Kingdom.

In collaboration with a German partner, Robert Kukla GmbH, a 45ft pallet wide containers with an external height of 3.20m and 3.00m of internal was designed.

Figure 110: 45’/10’6” container

Source: ACB Agency, 2014

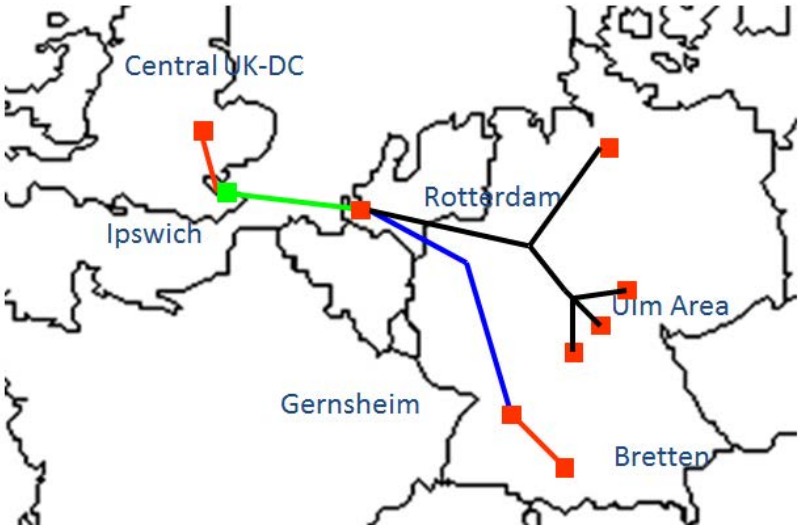
[51] A standardized container has a limited height was 2.38 or 2.68m, both 40 and in 45ft pallet wide containers. This height allows a maximum of 2 layers to cargo in the container and go three in a mega-trailer.

In terms of technological changes, new boxes have the following dimensions:

- Internal length 13.60m
- Internal width 244 cm
- Internal height 300 cm
- Cubic capacity 99 m³
- Max. payload 29.300 kg
- 5 high stackable

These technological changes also have an impact on the mode of transport. The goods follow now a multimodal transport trajectory (Figure 111), viz. the containers are transported with a modified chassis from the factory to the inland terminal (red), then by barge to Rotterdam (blue). The last part of the trajectory is carried out with a shortsea service to the UK (green). The target was to transport in period of 3 year time 336 million tkm from road to waterway/sea.

Figure 111: Multimodal transport trajectory



Source: ACB Agency, 2014
Black line: railways; Blue line: waterways; Red line: roads

A problem emerged in transporting 10'6" containers from the logistic plant, located in Bretten (near Karlsruhe) to Gernsheim, viz. a distance of approximately 70 km was to be carried out by the modified oversized chassis. For this special designed deeploader, an exception has to be requested at the local authority to comply with road regulation imposed by the regional government of South Germany. In 2014, the figures show and average of 17 containers per week, which are being transferred from this plant (ACB, 2014).

The other two plants, respectively located in the Ulm area and in the area of Nauen, have no access to inland waterway connections. Here, the rail connection was first chosen (black lines in Figure 111). The 10'6" containers were loaded on platform wagons. However, this idea failed because of the extra height. Given the electric wiring, this type of container could not be used. Hence, the goods were transported via conventional wagons to Rotterdam where they were then loaded in 10'6" containers. For this operation, a special covered platform had to be build. The transfer was done directly from wagons to 10'6" containers by a forklift. At the beginning of the implementation period, this kind of operation was successful. However, the organized activity in this manner was stopped because of increasing competition from road transport, which lowered their transport pricing and poor packaging and, which lead to an increase of damage. In the meantime, this transport activity restarted and now uses normal 8' high containers for, which the extra loading/unloading activity is not needed.

The innovation, viz. the design of the chassis and the containers was in 2004 awarded with a Marco Polo subsidy from the European Commission. The project started in 2005 and 2006 for the first phase

and in 2007 for the second phase (with the use of reloading in Rotterdam to 10'6" containers). The first phase of the chain was designed for 10 deliveries per week and the second phase was designed for 45 deliveries per week, using a total number of 72 containers. Ten years later, the evaluation of the project shows that the modal shift was successful. Other additional benefits are the fact that multimodal transportation is more effective than mega trailers and there are no longer waiting times in the UK. Partially, the project still continues. The evolution of the fuel price is the major determinant in considering trimodal transport in comparison to pure trailer transport.

Table 203: Success and failure factors of the 10'6" ft. container

Success	Failure
Close relations with clients and partners; Accumulated knowledge by all partners involved; The support received from the Marco Polo project; The willingness/cooperation of the shipping line; The willingness of ACB agency as a response to changing client requirements.	Treat form other modes of transport; Legislation of different over the countries. Fuel price

Profit, planet, people

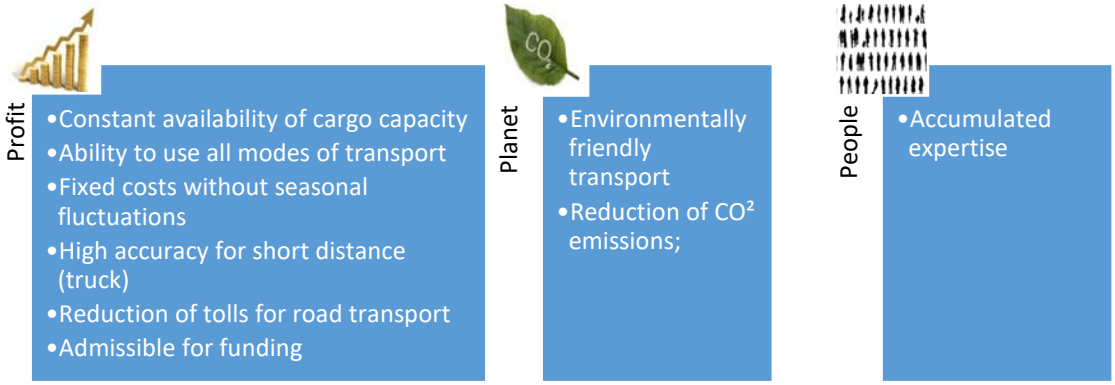
The objectives of developing the 10'6" containers are mainly economic, raised from the benefit of better capacity usage and environmental objectives. From an economic point of view, the innovation has a high importance. Taking apart the objectives of "Facilitate transfer of official document", which is not applicable for this case and "improve energy efficiency", which was not a direct economic goal, the other objectives scored high marks on the importance scale. What is interesting to observe is that for some untargeted aims the innovation was successful after implementation for example "optimization of operation", "Increase scale of operation" and "integration with other actors".

At the same level, some highly rated initial objectives were not that successful after the implementation. For example in the case of "encourage other investments", for, which practice showed that because of constant level demand the increased capacity offered by the new development was unnecessary. An example of the overrated objective is the "positive impact on competitiveness", which in this case was not that successful because better economic advantages of competition, which thanks to their economic power was able to sell their services below at a price below production costs.

The second set of objectives rated by the ACB was the one regarding the environmental impact. As it can be seen from the figure below, the environmental objectives were rated as very important, for, which reason the project also was awarded with Marco Polo finance. As it can be seen form the figure below, all the objectives, which were rated as important, were also successfully accomplished. ACB always had the target of accomplishing each level of European emission standards. "Reduce water and soil pollution was not a main objective, although it was accomplished by better use of transport capacities.

The third set of objectives rated by the ACB refers to the social impact. As it can be seen from the figure below the social objectives were not rated as important, but Nevertheless, they had a high successful rate. For example the retention of human capital was achieved because it brought new operations in a crisis period, and the personnel was more motivated to work for the company; as well as the relations with local communities, which were improved because the project brought extra activity for the barge operators. Number of accidents was also reduced and it was a successful objective obtained through the 10 times reduction of the number of kilometers for, which the cargo is traveling on the road in trucks. Another successful objective was the security of the cargo, knowing the fact that containers are better theft proof than regular trailers. Social and labor as well as safety regulation always had been a concern and they were also successful in the case of this project.

Figure 112: Triple bottom line – 10'6"ft. container



Stakeholders

This innovation case is the result of cooperation between Bosch Siemens Household, Robert Kukla GmbH and ACB agency. During the initiation period, a high involvement of the Innovation Champion was noticeable who also had a relatively high marked demand. The shipper who aimed for better utilization of transport resources and also the terminal operator and freight forwarders, put together a similar effort at the start of this project. During the implementation, shipping lines were less involved than the other direct participating actors. As a hard institution, the regional government of Baden-Wurttemberg in Germany needed extra time to give the green light for the development of the project. Also the same barrier had to be crossed in the beginning for the access of Marco Polo funding. During the initiation stage, there was competition but it did not react to the actions of the innovation itself.

The implication of the involved actors in the development period remained almost the same, with the exception of the shipper, whose decision process for the second phase was taken in that long period that influenced the prices of the container and the commitments towards the clients, the terminals and other partners. Also the involvement of the Marco Polo raised in the development period because of the sustainable solution for the modal shift from truck to barge, which the present project was offering. An extra actor that was enrolled in the development stage was the rail company, which was involved in the development of the transshipment activity of cargo form conventional wagons to 10'6" containers. Also in the development stage there was a strong response from competitors that took acknowledgement of the development and reacted by lowering their prices below their production costs just not to lose their clients in favor of the ACB's new service offer.

The implication of the involved actors in the implementation period remained nearly the same. While the activity was up and running the interest of actors also became higher. And the involvement of the regional government of Baden-Wurttemberg, Germany and the European Commission through the Marco Polo program was no longer necessary. After the implementation of the project the competition reacted even harder and they also have to optimize their activity in other to counterbalance the actions of ACB.

Table 204: Development stages of the 10'6"ft. container

Level	☐ Initiation	☐ Development	☑ Implementation
Shipyard (innovation champion)	✓	✓	✓
Robert Kukla GmbH	✓	✓	
Forwarding agency	✓	✓	✓
Terminal operator	✓	✓	✓
Municipal authority (D)	✓	✓	✓
Rail operator		✓	✓
Shipping lines	✓	✓	✓

64. Empty Equipment Management

Valentin Carlan, Christa Sys and Thierry Vanelslander

The present innovation case, generically called *Empty Equipment management* from BCTN, is at the moment of this research in its initiation period. Currently, the service is being operated individually by each terminal in relation with the shipping company, which owns these containers. The target is more collaboration between terminals, which requires a managerial, organizational and cultural change in dealing with empty containers. The innovation is closed and considered to be systematic.

Table 205: Characteristics of Empty Equipment management

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The imbalance between empty container supply and demand causes extra costs for transport operators. Moreover, unavailability of empty containers also creates significant delays within the supply chain network. To respond to the incoming demand and to even up the container stock, empty containers have to be moved between terminals within regions and even adjacent regions. In regions where containerized goods are imported, but few containerized goods are exported (or in some cases vice-versa), empty containers have to be transported within the port area. The repositioning of empty containers thereby causes negative effects, such as additional costs, environmental and socio-economic impacts, and ties up transport and storage capacities (Choong at al., 2002; Shintani et al., 2007; Di Francesco et al., 2009; Song & Dong, 2011; Braekers, 2013). In 2010, worldwide costs for empty container repositioning have been estimated to 34.8 bn USD.[52]

Mitigation measures against empty containers moves are often difficult to implement. Conflicts of interests arise between companies along the container transport chain such as shipping lines, terminal operators or forwarders, but also between other stakeholders such as regional authorities and residents, there can be collision. The most cited reason for this disagreement is the lack of transparency and knowledge about processes and actors interests.

Empty containers are only transported upon request by shippers or by shipping lines. The place of container unloading is typically the starting point of the empty container transport chain. If there is no export cargo at that certain location or in its proximity, empty containers are transported to empty depots. The transport chain can be organized either by forwarders or by shipping lines in the name of other stakeholders who are the owners of containers themselves. A study of DTSC (2009) mentions the following methods of empty container management practices:[53]

- Reclaiming the container's scrap value onsite;
- Sending the container to a person who reclaims the container's scrap value;
- Reconditioning or remanufacturing the container onsite;
- Shipping the container to a person who reconditions or remanufactures the container.

[52] http://www.transbaltic.eu/wp-content/uploads/2012/09/Brochure-task-5.2-Empty-container-management.pdf
[53] http://ehs.ucr.edu/waste/DTSC_Empty%20Containers%20Fact%20Sheet.pdf

The positioning of empty containers is thus one of the most complex problems concerning global freight distribution, an issue being underlined by the fact that about 2.5 million TEU of containers are being stored empty, waiting to be used. Empties thus account for about 10% of existing container assets and 20.5% of global port handling. The major causes of this problem are presented in Table 206[54]:

Table 206: Reasons for high imbalances in container demand and supply

Trade imbalances	A region that imports more than it exports will face the systematic accumulation of empty containers, while a region that exports more than it imports will face a shortage of containers.
Repositioning costs	They include a combination of inland transport and international transport costs.
Revenue generation	Ship-owners (container owners) reposition their containers to maximize their revenue, not necessarily the economic opportunities of their customers.
Manufacturing and leasing costs	If the costs of manufacturing new containers, or leasing existing units, are cheaper than repositioning them, which can be possible over long distances.
Usage preference	A large number of shipping lines uses containers as a way of branding the company name and to offer readily available capacity to their customers.
Slow steaming	Excess capacity and rising bunker fuel prices have incited maritime shipping companies to reduce the operational speed of their containerships from 21 knots to 19 knots, this practice is known as slow steaming.

Source: Rodrigue, 2013

BCTN BV owns 5 terminals in the Benelux region and collaborates with both shipping and trucking companies. At the level of their terminals, BCTN B.V. desires to create a smart network for empty container distribution and fast usage. A smarter network means that the terminals, which have extra empty equipment and, which are closer to a the loading point of an export cargo, should be the ones to send the empty equipment and to find a solution among the terminal network to redistribute the empty container. The main reason for this new operational scheme is to improve the service provided to their clients. Providing an empty container within a just-in-time framework at a certain location is often a difficult task due to import-export imbalances and because the empty equipment sharing is not always agreed by the owners.

The new proposal of empty container manager requires changes under the entire managerial scheme of BCTN BV. The empty containers will be shared used from the company level and not from each terminal side. This project requires exchange of information regarding the demands of each terminal and also the empty containers stocks. Another boundary, which is encountered by the current proposal, is the international environment. Cultural differences might have to be overcame for the implementation of this initiative.

Moving a container efficiently and practically is a goal of all parties involved in the container business. The idea of reusing empty containers is an effort to minimize the number and cost of truck trips. The cost of moving an empty container is almost the same as it is for moving a full container. As for this innovation to be considered efficient or not, an assessment of after and before costs must be performed. However, a problem will still remain crucial in this comparison, which is the scale of region in-between in, which this assessment is done. The case of local empty or intercontinental container flows, for example, might show differences between management systems. In the first case the effort of an empty container management system might not be efficient, but when the discussion moves to a larger scale, the costs of having an empty container management system can be covered by the savings.

The main concern of this innovation case is the empty equipment transfer between the terminals of the same terminal operator. More specifically, BCTN terminals Nijmegen and Meerhout have a surplus

[54] https://people.hofstra.edu/geotrans/eng/ch5en/appl5en/ch5a3en.html

of container operations by receiving or sending containers from or to the ports of Rotterdam and from or to Antwerp. For this reason, each terminal has their own "relation" with each seaport (Figure 113).These links are used for transporting both full and empty containers.

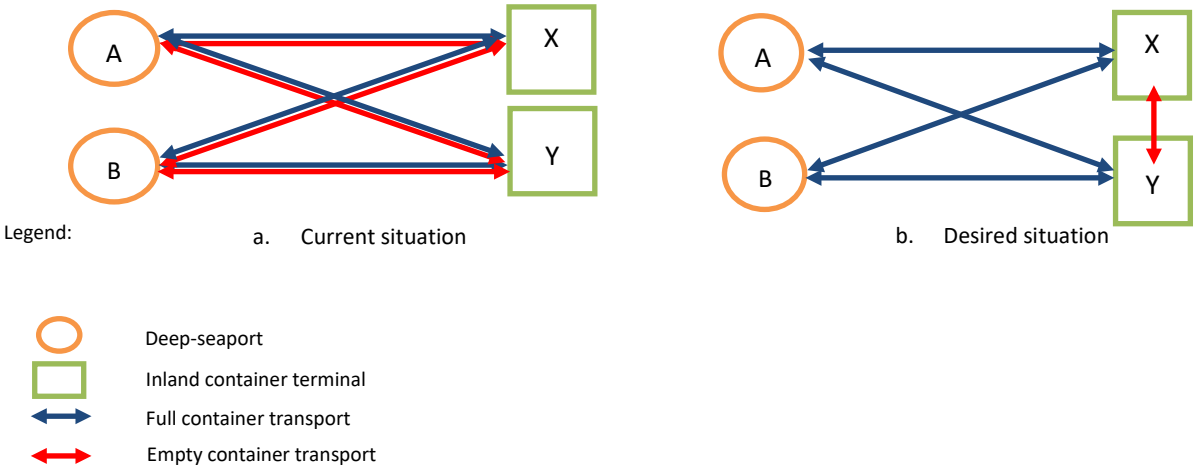
Figure 113: BCTN network of inland container terminals

Source: BCTN, 2014

This situation results in the utilization of a long connection link also for the unproductive tasks (free of charge) of repositioning of empty containers (see Figure 114, red links). An optimal economic situation would exist if the long distance connections would be used for productive tasks, transport of full containers, and the short distance connections would be used for the transfer of empty boxes. This situation would only be possible in the case that the trade balance (import and export) would be equal towards and from the studied geographical area.

The extra link, which is proposed to replace the transport of empty containers between the container terminal and the deep-seaport in this specific case, can be done over the Albert Canal and through the river Meuse. In reality, this scenario is hard to achieve. The initial envisaged goal of the current proposal is to reduce the costs of empty equipment transfer on the long distances by asking the clients to use empty containers, which are in the nearby depot and later on to decide, which other containers could "replace" the initial one. In this way, clients will have immediate access to an empty container. Another benefit is that the terminal operator will manage in a more optimal economic way the stocks and the locations of empty containers.

Figure 114: Reduction of empty container reposition movements.



The most important barrier comes from the containers owners side. In the shipping industry every re-use of containers is charged and a consensus regarding this matter have not been agreed yet. Special requests of specific containers that should be of use for a specific cargo still exists from the shipping companies side. The cost of empty container loading and unloading operations is another important issue, which has to be decided. This costs are significantly lower when higher volumes of containers are manipulated. Looking at the fact that the amount of containers, which are going to be transferred between individual inland terminal is low, this cost is considered an extra burden. Moreover, the

available empty containers stocks needs the implementation of a special monitoring software. Therefore, the situation under, which this innovation case would bring economic benefits still has to be formulated.

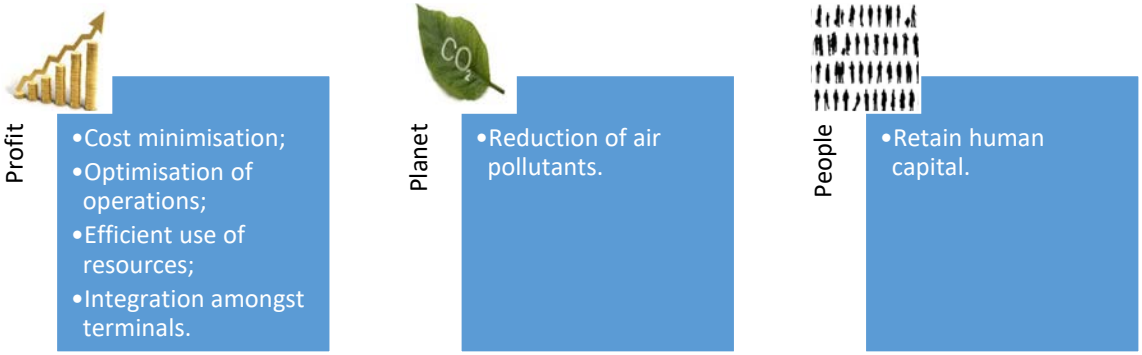
Table 207: Success and failure factors of Empty container

Success	Failure
Optimization of empty container flows; Less extra operations that need to be performed.	Reluctance from container owners; need to develop a container tracking procedure.

Profit, planet, people

Improved empty container management reduces costs and optimizes operations. The terminals of the same terminal operator located in different areas can improve this management by better informing each other regarding the stock of available containers. This feature targets also at the improvement of the competitiveness level by offering more attractive services to the containers owners. Moreover, the ships, which are used for relocation of empty equipment will be redirected to other more productive operations. By better use of resources the activity of the company will have a lower impact on the environment, reduce air pollutant emissions and CO_2. From a social point of view, the human capital will be better retained in the company by developing a more flexible working environment.

Figure 115: Triple bottom line – Empty equipment management



Stakeholders

The initiative to improve empty equipment management, has been taken by the inland terminal. However, the support of the shipping lines (or current owner of containers) is necessary. The management of empty equipment refers in this case to the substitution of containers with each other, even though they are in a different location. It brings benefits to both shipping lines and the inland terminal. The inland terminal will secure the relations with its clients and will improve their service. The shipping lines will have shorter waiting times for a container to be available. The main driver, which is pushing forward for the completion of this innovation initiative, is the terminal operator who has to build his entire infrastructure to monitor the position and availability of the empty equipment for his clients.

Table 208: Development stages of the Empty equipment management

Level	☑ Initiation	☐ Development	☐ Implementation
Inland terminals (innovation champion)	✓		
Shipping lines (container owners)	✓		

CLUSTER 12: INNOVATION IN RELATION TO SUSTAINABLE PORTS AND VESSELS

The last cluster groups innovation cases, which relate environmental issues such as the reduction of air pollutants or the carbon footprint of activities. This specific collection of cases gives insight to the process and the effect of innovative management actions such as port assessments of the carbon footprint or the installation of a exhaust gas cleaning scrubber on board of a vessel.

65. The Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber on an APL Containership

Genevieve Giuliano and Geraldine Knatz

On-board scrubbers are a key emerging technology to reduce emissions of SOx, volatile organic compounds (VOCs) and particulate matter. The Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber on the APL containership is in its implementation phase as a present innovation. During the development of this private innovation, the activity was open for collaboration with partners outside the firm, which is the innovation champion. The innovation can be considered as a radical, managerial, organizational and cultural market change.

Table 209: Characteristics of the Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber

Characteristics of the innovation				
Type	Managerial, Organization, Cultural - Market Change			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Radical	Incremental	Modular	System

Description

The maritime sector is engaged in a multitude of actions to reduce emissions of sulfur dioxide, particulate matter and nitrogen oxides to meet the increasingly stringent standards of European and North American regulators. Emissions have primarily been reduced through switching to lower sulfur diesel in proximity to the coast. Yet it is unclear whether these standards alone will be sufficient to meet the new targets. Furthermore, while carriers are deploying new ships that have improved environmental performance, containerships can have a service life of over 30 years. Thus, retrofit technologies are needed to improve the environmental performance of existing ships.

The reduction of particulate matter has taken on new relevance in recent years with the recognition that black carbon has a substantial impact on climate change. Especially in instances where marine engines operate in the earth's higher latitude. Particulate matter that settles on the ice increases heat absorption and can speed up the melting of polar ice.[55] For this reason, the production of particulate matter from low quality bunker fuel can no longer be regarded as only a problem for populated areas. Onboard scrubber technologies provide a clear approach to accomplish the goal of reduction of these emissions.

Despite the growing use of low sulfur fuels, emissions of SO_x, PM and VOCs remain a persistent problem in the San Pedro Region. Emissions from the Ports of Los Angeles and Long Beach have the most direct impact on the immediate port area, including the cities of Long Beach Wilmington and San Pedro. Fallout from port emissions, however, is not limited to this region and also impacts the greater Los Angeles area.

One analyst recently estimated that the annual cost to the container industry from a full switch to low sulfur fuel would be $100 billion.[56] While a switch to LNG fuel could meet the standards without emissions after-treatments. The penetration of LNG vessels is, however, still speculative and

[55] http://e360.yale.edu/feature/carl_zimmer_black_carbon_and_global_warming_worse_than_thought/2611/

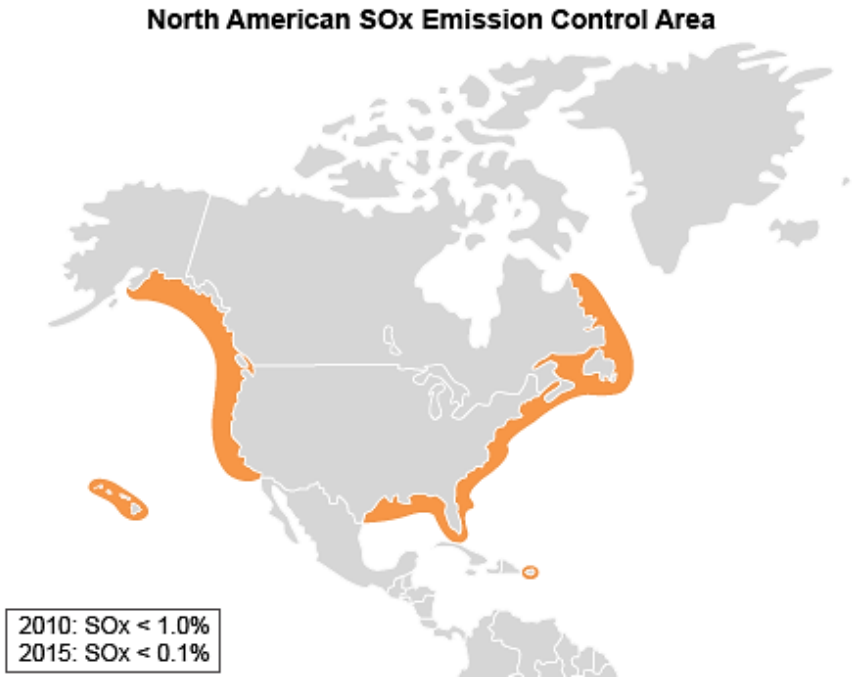
[56] "Shipowners Hope Low-Sulfur Fuel Deadline Gets Extended" March 28, 2014
Journal of Commerce Online

constitutes only a tiny percent of the total fleet. Thus, a technological solution that could reduce the need for a complete fuel switch could potentially have significant ramifications for the viability of the container shipping industry.

In order to offset costs associated with the new more stringent requirements, the Transpacific Stabilization agreement has established a new set of surcharges on containerized cargo as reported by the Journal of Commerce:

"Trans-Pacific cargo heading to ports on the West Coast of North America face a $53 per 40-foot container charge, while containers transported to the East Coast will be charged an extra $67 per FEU charge The rates reflect new environmental regulations, which stipulate that ships must switch to low sulfur fuel in ECAs, which run 200 nautical miles off of the North American coasts. TSA members currently charge $16 to the West Coast of North America, and $17 to the East Coast."[57]

Figure 116: North American SO_x Emission Control Area



Source: IMO

The impacts of the new restrictions were recently assessed by the Journal of Commerce: *"Under MARPOL Annex VI, sulfur oxide, or SO_x, content in marine fuel was reduced globally from 4.5 percent to 3.5 percent in 2012 and as of 2020, SO_x content in marine fuels will be further cut to 0.5 percent subject to a feasibility review to be completed no later than 2018. Limits inside designated emission control areas, or ECAs in North America and Europe, were reduced to 1.0 percent in 2010, from 1.5 percent, and will be reduced again to 0.1 percent in 2015."* [58]

On-board scrubbers are a key emerging technology to reduce emissions from maritime vessels in line with new restrictions in emission control areas (ECAs). In 2012, the Ports of Los Angeles and Long Beach, along with other project participants funded a demonstration project to evaluate the efficacy of a sea water scrubbing system developed by Wärtsilä in removing SO_2 and PM from a container ship under real world conditions. The scrubber was installed on multiple auxiliary engines onboard of the APL container ship. Testing was conducted in 2011 and 2012, on-board of the APL vessel "England" of

[57] http://www.joc.com/maritime-news/trade-lanes/trans-pacific/trans-pacific-shippers-face-low-sulfur-fuel-surcharges_20141021.html
[58] "Shipowners Hope Low-Sulfur Fuel Deadline Gets Extended", 28 March 2014, Journal of Commerce Online

two auxiliary engines during four port calls on Los Angeles averaging 72 hours each. The scrubber was activated during sailing 25 nautical miles offshore from the Los Angeles port and remained operational until the vessel exited California state waters. Additional testing was conducted during maneuvering in the Port of Kaohsiung, Taiwan and while in transit to Chiwan, China.

The following paragraph is a summary of the results of the APL England test from the consultant's final report:

The project demonstrated that a single low maintenance seawater scrubbing device installed on three auxiliary engines successfully treated the emissions from high-sulfur and low-sulfur marine diesel fuels, reduced the targeted contaminants in the exhaust stream, removed the waste from the washwater prior to discharge overboard and maintained the pH of the discharged water within the IMO guidelines. This same device can be scaled up to be used on main engines achieving the same technical results."

The implications of this conclusion is that the installation of the scrubber could allow a participating vessel to continue to use less costly fuel with higher sulfur content. According to the summary of technical equipment from the consultant's report, the lifespan of the scrubber on the 5,510 TEU container ship owned and operated by American President Lines Bermuda Ltd. ("APL"), is 25 years. Furthermore, the availability of onboard scrubbing technology holds promise for ensuring that vessels can always meet the requirements of host ports regardless of the quality of available fuel.

The purpose of this innovation demonstration project was to reduce air emissions from a commercial containership in transit using an exhaust gas cleaning device. The motivation behind the project was to find an alternative way to satisfy IMO fuel sulfur limits in designated emission control areas (ECAS).

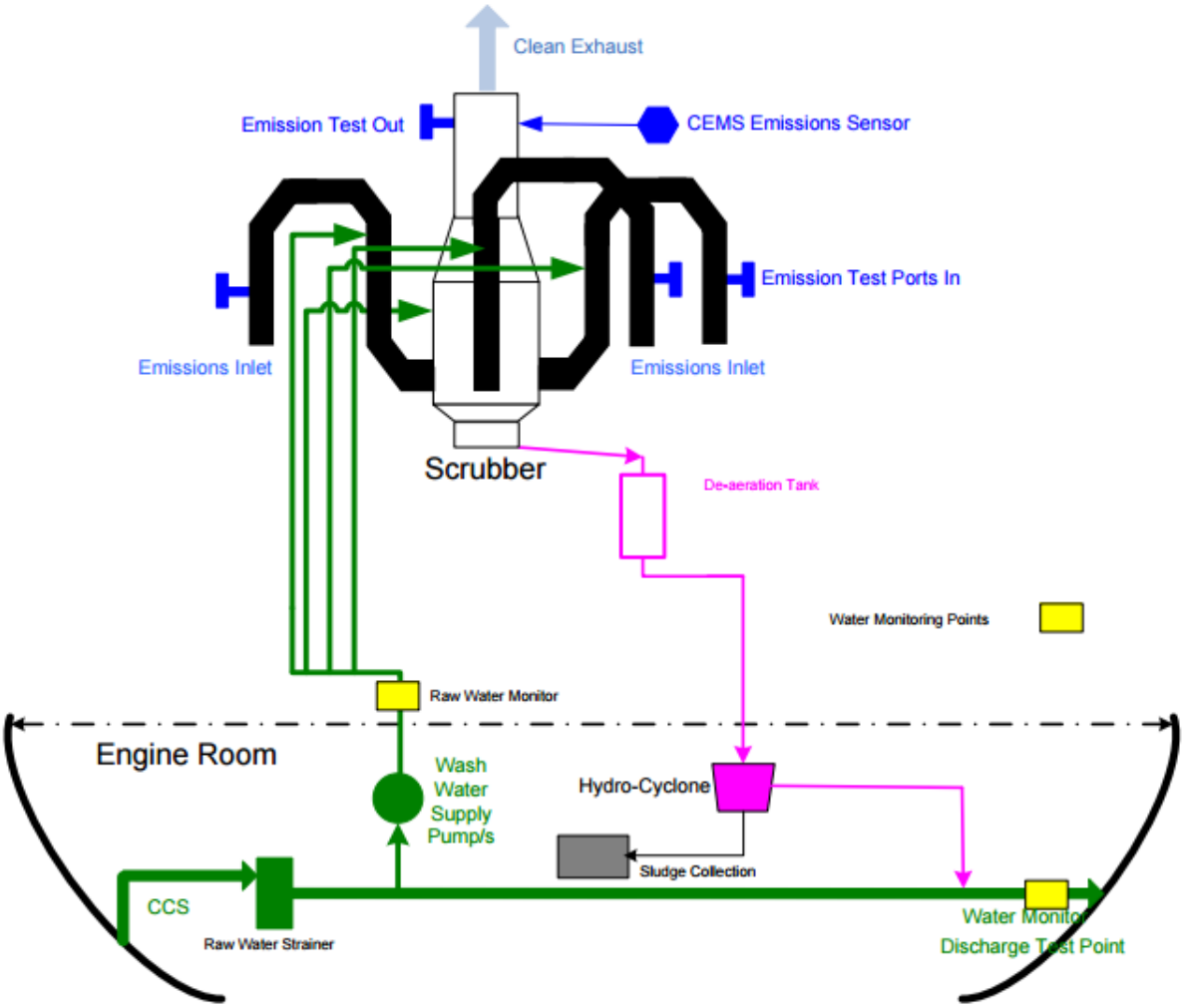
Figure 117: APL England with operating scrubber to the right of the funnel.

Source: Bluefield Holdings, Inc, 2013.

The exhaust cleaning system is a device that relies on the natural buffering effects of the alkalinity of seawater to remove the sulfur dioxide. The unburned hydrocarbons and particulate matter bind to minute air bubbles that are removed in a multistage washing treatment. The recovered solids are disposed onshore as a hazardous waste and the treated wash water is disposed at sea. The results of

the demonstration are available in the report "Evaluation of the Emission Reduction Performance of a Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber."[59]

Figure 118: Scrubber layout and monitoring locations



Source: Bluefield Holdings Inc., 2013

The test fuel was Heavy Fuel Oil (IFO 580) and Marine Gas Oil. Three tests were done at various load settings for each fuel type without the scrubber to establish a baseline of pollutant emissions in the exhaust. Effective January 1, 2012, the IMO limited the sulfur content for Heavy Fuel Oil to 3.5%. By August 1, 2012, all vessels operating in the North American Emission Control Area had to burn fuel less than 1% sulfur. The California Air Resources Board issued a research exemption to allow the APL England to burn non-compliant fuels in California if necessary during the testing.

One of the potential success factors for the scrubber to experience market uptake, is the emergence of the ECAs of IMO and the worldwide demand for cleaner ships, especially in Europe and North America. Table 210 gives an overview of the success and the failure factors. The latter ones are challenges for the innovation, which could prevent market uptake or slow it down.

[59] Bluefield Holdings Inc., 2013, which is available on the Port of Los Angeles Clean Air Action Plan website available at https://cleanairactionplan.org/documents/evaluation-emission-reduction-performance-hamworthykrystallon-exhaust-gas-cleaning-scrubber.pdf/

Table 210: Success and failure factors of the Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber

Success	Failure
Reduced air emissions from ocean going vessel operations. Provides an alternative way to comply with IMO ECAs while reducing operating costs. Various improvements made on input from demonstration project to reduce maintenance and increase operator oversight. Technology adopted for cruise ships, ferries and RO-Pax vessels.	Creates a solid and liquid waste that must be disposed of properly and at additional expense. Wastewater showed high levels of suspended solids in some samples.

Profit, planet, people

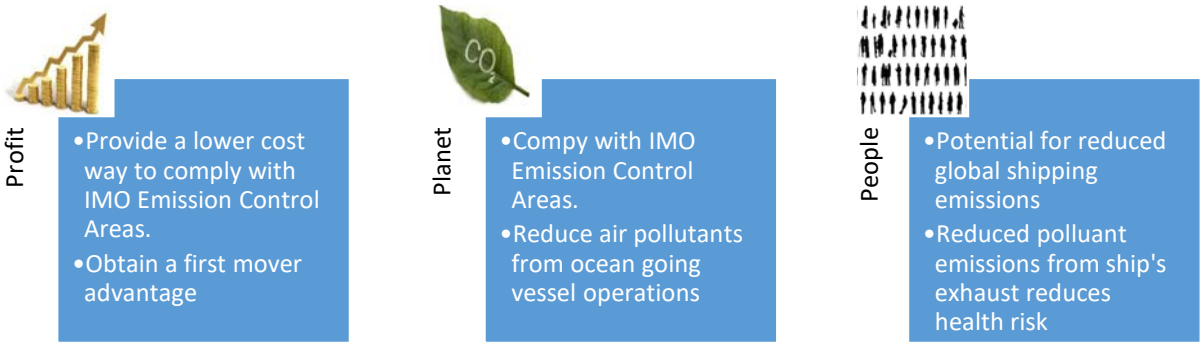
The use of the scrubber reduces emissions of SO_x by up to 99% and up to 70% of particulate matter when using heavy fuel oil. When using marine gas oil as a fuel, emission reductions for SO_x and PM were reduced by 97% and 78%, respectively. NO_x emissions were reduced from between 2 to 5% using heavy fuel oil and between 2 and 8% using marine gas oil. Use of the emission scrubber does generate a solid and liquid waste that must be treated and properly disposed of.

The International Maritime Organization (IMO) and the US Environmental Protection Agency both regulate and provide guidance for wastewater from exhaust gas scrubbers, particularly for temperature, salinity and total suspended solids. Some samples indicated elevated levels of total suspended solids and follow-up samples were taken and tested for heavy metals zinc and copper but no exceedances of water quality were found. Unfortunately, the Chinese customs officials refused to allow offloading of the wastewater samples collected while the ship was underway between Taiwan and mainland China and the samples could not be transported in time to meet the criteria of the testing methodology and were Therefore, discarded.

The business case for the use of scrubber technology depends on the cost differential between fuels that meet the emission control area standards and non-compliant fuels. At the time of the demonstration in 2013, the cost differential between heavy fuel oil with 3.5% Sulfur or less and fuels containing less than 0.1% (required in 2015 in ECAs) ranged between $240 to $350 US. With this differential and using the scrubber, the owner of an 8000 TEU container vessel in transpacific service could save as much as 20 million US $ per year. The cost to retrofit a transpacific container vessel was estimated in 2013 as approximately $5.26 million US with an approximate additional cost of approximately 3.1 million US for engineering and design, installation, commissioning and training, the total less than one year's estimated savings. Annual maintenance and repair estimates were estimated to be $200,000 US.

Wärtsilä filed a patent application for its scrubber technology in 2010 and received its first commercial order for a scrubber in 2011 from Containerships Ltd., which was owned by the Icelandic shipping company Hlutafelagid Eimskipafelag Islands hf. Early 2012, Algoma Central Corp signed a contract to retrofit six ships for service on the Great Lakes. In 2013, the technology was adopted by cruise ships, ferries, and Ro-Pax ships (combined passenger and wheeled cargo).

Figure 119: Triple bottom approach of Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber



Source: own compilation based on project report and interviews.

Stakeholders

The Port of Los Angeles and the Port of Long Beach provided financial support for this demonstration project through their joint Technology Advancement Program. Wärtsilä led the development of the scrubber that was used in this study. APL provided the ocean going containership used in this demonstration with the ship captain and the crew overseeing the installation work. InfoWedge did the emissions testing and EarthCon did the wastewater testing. Bluefield Holding Inc. analyzed the data and prepared the final report. All of these actors played a role in at least on the development stages as described by Table 211.

During the initiation phase, Wärtsilä's scrubber development, which was initiated in 2006, was significant for the emergence of this technology. In 2007, the industry press first reported that Wärtsilä was pursuing marine diesel scrubber technology. In 2008, the IMO agreed to implement tighter emissions standards for ECAs. Wärtsilä noted that the regulatory push to require low sulfur marine diesel was a key impetus for the development of the technology – and that it would be viable both for new builds and retrofits. At the time that the technology began development, the cost differential in regular bunker fuel and low sulfur fuel was $500/ton.

During the development stage, the scrubber manufacturer filed a patent application for the technology.[60] It subsequently began active trials of onboard scrubbers. The implementation of the scrubber on the APL England represents such a trial.

In the final stage of implementation, Wärtsilä received its first commercial order as mentioned above (Hlutafelagid Eimskipafelag Islands hf). The APL England was tested on April 25-26, 2012 under high load conditions and at berth in the Port of Los Angeles on May 23, 2012. The scrubber was brought on line approximately 25 nautical miles offshore from the Port of Los Angeles.

Table 211: Development stages of the Hamworthy/Krystallon Exhaust Gas Cleaning Scrubber

Level	☐ Initiation	☐ Development	☑ Implementation
Port authority	✓	✓	✓
APL Singapore	✓	✓	✓
Wärtsilä	✓	✓	✓
Ship Captain and crew		✓	✓
Bluefield Holdings		✓	✓
InfoWedge			✓
EarthCon			✓

[60] "Wärtsilä Finland Oy Files Patent Application for Machinery Arrangement of a Marine Vessel" August 21, 2010 Indian Patent News

66. Carbon Footprint Assessment of the Port of Piraeus

Athena Roumboutsos and George Sakkas

A carbon footprint is historically defined as "the total sets of greenhouse gas emissions caused by an organization, event, product or person." While the definition focuses on emissions, their source concerns energy generation and use and the level of its efficiency. An organization's carbon footprint can be measured by undertaking a GHG emissions assessment or other calculative activities denoted as carbon accounting. Once the size of a carbon footprint is known, a strategy can be devised to reduce it, e.g. by technological developments, better process and product management, carbon capture, consumption strategies, carbon offsetting and others. It is an innovative policy or a "new" way to assess environmental issues within a port. This assessment demanded a managerial, organizational and cultural change from all stakeholders as policy and regulation become more stringent towards polluters. It is an open public driven innovation, which followed an incremental path towards market change in the past.

Table 212: Characteristics of the Carbon Footprint Assessment of the Port of Piraeus

Characteristics of the innovation				
Type	Policy Initiatives (Managerial, Organization, Cultural – Market Change)			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Incremental	Modular	System	Radical

Description

Piraeus, the largest port in Greece and one of the largest ports in the Mediterranean, plays a crucial role in the development of international trade as well as the local and national economy. With a history dating from 1924 when major civil works started taking place, Piraeus Port today has a range of activities concerning the Commercial and Central Ports, ship services and real estate development.

Nowadays (2014), the Piraeus Port Authority S.A. (P.P.A. S.A.) employs more than 1.300 people and annually provides services to more than 24.000 ships. P.P.A. is developing into a modern and dynamic company that provides high quality services, keeps investors satisfied, ensures long-term employment and serves commercial transactions in Greece in favor of the national economy and the consumers in the most efficient way and within the context of the global port industry. The Port Authority Charter places emphasis on environmental protection, which from an administration aspect includes:

- Environmental Management System (Environmental Policy Statement and Certificate PERS)
- Environmental Quality (Marine Environment Quality, Quality of noise environment, Quality of atmospheric environment, Landscape Shaping land area, Energy management, Waste Management)
- Ship Waste Management Plan (must be a link with the procedures, forms and fees and charges that apply
- Tackling Marine Pollution Emergency
- Legislation

As other ports invest in compliance to international and national regulation regarding emissions and GHGs, Piraeus has to follow suit. Therefore, although publicly induced, there is a competition of compliance between ports and to obtain the image of a more sustainable port. Next to regulation, the assessment provides an incentive to improve the sustainability of the port by decreasing the carbon footprint. Although the assessment tool has a number of success factors that could lead to a more

general market uptake of such tools, there are still some challenges ahead that could lead to failure if not dealt with properly. Energy and GHG monitoring in the port are a challenge and also there is a need of stakeholders and companies to get aligned.

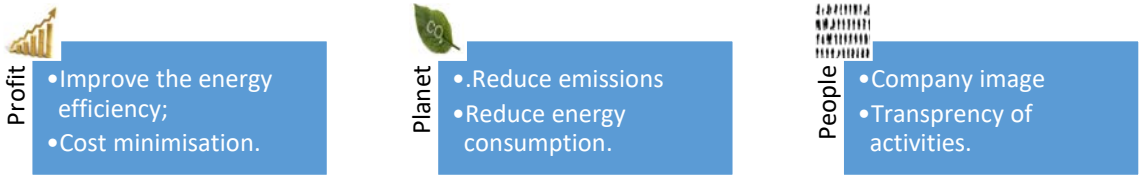
Table 213: Success and failure factors of the Carbon Footprint Assessment of the Port of Piraeus

Success	Failure
The need to be competitive Compliance with regulation Innovation provider	Absence of energy & GHG monitoring Fragmented nature of activities with respect to energy use Weak networks with the company

Profit, planet, people

Addressing the carbon footprint of an organization is the first step in assessing the needs and to process how to improve the efficiency. While, environmental protection is within the P.P.A. strategic agenda, rational use of energy and the introduction of alternative forms have only recently been considered.

Figure 120: Triple bottom approach of Carbon Footprint Assessment of the Port of Piraeus



Source: own compilation based on interview

Stakeholders

Government Policy with respect to the future strategic development of the Port of Piraeus had a strong influence on pushing things forward. Setting clear objectives by the CEO also improves the situation with respect to the internal organization. However, as the major "push" (Champion) is external to the organization, the future of the innovation is not secured.

Furthermore, as there is no obligation (at present) to undertake a carbon footprint assessment or endorse such a procedure there was no organizational /managerial processes in place to undertake a carbon footprint assessment and they had to be developed gradually through soft institutions. The lack of strong networks within PPA did not assist the effort.

However, competition from other Ports is considered important as carbon foot printing improves the competitiveness of the port and its overall image vis-à-vis competing ports and its shareholders.

Table 214: Development stages of the Carbon Footprint Assessment of the Port of Piraeus

Level	☐ Initiation	☑ Development	☐ Implementation
Innovation provider	Carbon Positive	Carbon Positive	
Piraeus Port Authority (PPA)	CEO	CEO	
Government		Greek government	
Leader from process application	PPA	PPA	

67. Carbon Footprint Assessment of Star Bulk

Athena Roumboutsos and George Sakkas

A carbon footprint is historically defined as "the total sets of greenhouse gas emissions caused by an organization, event, product or person." While the definition focuses on emissions, their source concerns energy generation and use and the level of its efficiency. An organization's carbon footprint can be measured by undertaking a GHG emissions assessment or other calculative activities denoted as carbon accounting. Once the size of a carbon footprint is known, a strategy can be devised to reduce it, e.g. by technological developments, better process and product management, carbon capture, consumption strategies, carbon offsetting and others. This assessment aims at a managerial, organizational and cultural change from all relevant stakeholders as policy and regulation become more stringent towards polluters. In this case, it is an open, present, public driven innovation, which followed an incremental path towards market change. Pushed by public actors, it has also been developed by Star Bulk for its own fleet.

Table 215: Characteristics of the Carbon Footprint Assessment of Star Bulk

Characteristics of the innovation				
Type	Policy Initiatives (Managerial, Organization, Cultural – Market Change)			
Level	Initiation	Development	Implementation	
Timing	Past	Present	Future	
Activity	Open		Closed	
Source	Public		Private	
Degree	Incremental	Modular	System	Radical

Description

Star Bulk is a global shipping company providing worldwide seaborne transportation solutions in the dry bulk sector. Star Bulk's vessels transport major bulks, which include iron ore, coal and grain and minor bulks, which include bauxite, fertilizers and steel products. Star Bulk was incorporated in the Marshall Islands on December 13, 2006 and maintains executive offices in Athens, Greece.

On a fully delivered basis, Star Bulk has a fleet of 69 vessels (2014), with an aggregate capacity of 8.7 million dwt, consisting primarily of Capesize as well as Kamsarmax, Ultramax and Supramax vessels with carrying capacities between 52,000 dwt and 209,000 dwt. Star Bulk's fleet includes 32 operating vessels and 37 vessels currently under construction at shipyards in Japan and China (at the timing of this research). All of the newbuilding vessels are expected to be delivered during 2014, 2015 and early 2016. Star Bulk's common stock is listed for trading on the NASDAQ Global Select Market under the symbol "SBLK." On July 11, 2014 announced transactions in view of the merger with Oceanbulk Shipping LLC and Oceanbulk Carriers LLC. Measuring the carbon footprint of an organization is the first step in assessing the needs and processes by, which to improve. While this may be considered a standard process in environmental and energy consumption monitoring, few shipping companies have endorsed the process.

Table 216: Success and failure factors of the Carbon Footprint Assessment of Star Bulk

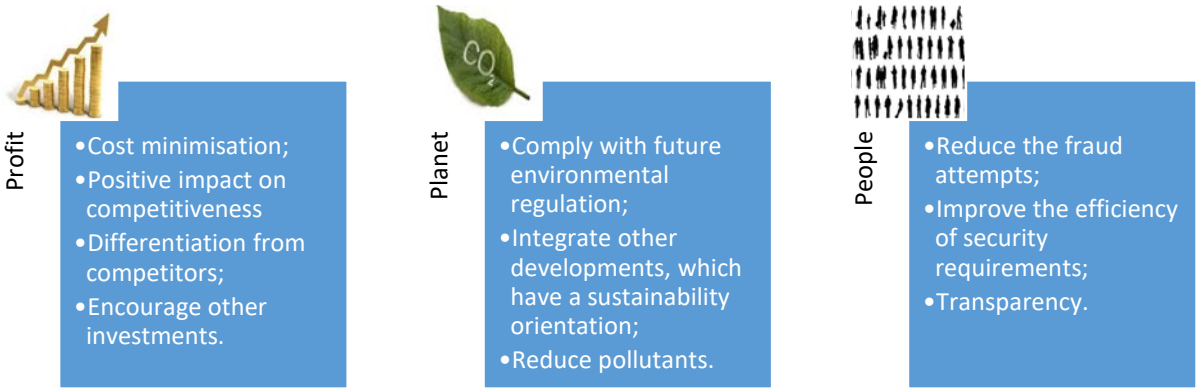
Success	Failure
CEO & BOD support; Star Bulk's common stock is listed for trading on the NASDAQ Global Select Market; Strong networks with the company; Innovation provider	N.A.

Profit, planet, people

When the company received its "First Carbon Emissions Measurement Certificate" the following announcement was made:

"… Star Bulk is one of the first shipping companies to proactively manage its carbon output and risk, and prepare for future regulation by embarking on an independent, phased approach to understanding the carbon footprint of its fleet. The intelligence generated provides the foundation for identifying opportunities for improvements that can generate cost benefits and commercial advantage. Star Bulk conducted two full onboard energy audits to assess each vessel's operational pattern and identify potential energy saving opportunities. Throughout the program process, a combination of technical and operational measures to deliver optimum emissions reduction was also implemented. This included installing PBCF (Propeller Boss Cap Fins) and upgrading all the m/e by installing fuel valves and alpha lubricators. Using an intelligent weather routing system, Star bulk is aiming not only for a shorter and safer route but also most energy efficient. A monitoring system has also been installed to demonstrate net energy delivered on the propeller. Star Bulk is now in the second 'Reduction' phase of the CPPS, monitoring the effectiveness of these measures to eventually receive the Carbon Positive phase two 'Reduction' certificate. This phase is effectively building on SEEMP to create a 'SEEMP Plus' that puts this regulation into practice..."

Figure 121: Triple bottom approach of Carbon Footprint of Star Bulk



Source: own compilation based on interviews

Stakeholders

In its annual reports, the company identifies a number of key business risks, which may undermine its aggressive development plans. Amongst these concerns are the potential inability to meet environmental regulations that may become stricter restricting the potential to serve all locations and effecting both the value and ability to operate of the fleet. In addition, new regulations incur additional costs:

"These costs could have a material adverse effect on our business, results of operations, cash flows and financial condition. A failure to comply with applicable laws and regulations may result in administrative and civil penalties, criminal sanctions or the suspension or termination of our operations. Environmental laws often impose strict liability for remediation of spills and releases of oil and hazardous substances, which could subject us to liability without regard to whether we were negligent or at fault."

Furthermore, the company was concerned with the adequacy of internal controls over financial reporting. When the company received its first Certificate (which coincides with the conclusion of the development phase of the innovation), the announcement supported the increase in stock prices and new charters.

Table 217: Development stages of the Carbon Footprint Assessment of Star Bulk

Level	☐ Initiation	☑ Development	☐ Implementation
Shipping company	Starbulk	Starbulk	
CEO	√	√	
BOD	√	√	
Crew members	√	√	
Head of Chartering		√	
Innovation provider	Carbon Positive	Carbon Positive	
External audit	Ernst & Young	Ernst & Young	

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ANNEX 1: INVOLVED UNIVERSITIES

University of Antwerp

University of the Aegean

University of Genova

Kühne Logistics University

Technical University of Lisbon

Nanyang Technology University

University of South-California

ANNEX 2: INVOLVED INDUSTRY

Industry	Name
Shipyard	IHC (NL)
Carriers	MSC Belgium (BE), NOL (SN), Star bulk (GR), Eltsons (GR), APL (USA)
Port Authorities	Porto petroli di Genova (IT) and Ports of Sines (PT), Lisboa and Leixões (PT), Piraeus Port Authority (GR), Port of Antwerp (BE)
Terminals operators	DP World Antwerp (BE), APMT (IT), AET (BE),Terminal Bruzzone (IT), Jurong Port (SN), PSA (SN)
Stevedoring	Wijngaardnatie (BE), Zuidnatie (BE), Waterland (NL), Gruppo Nogar (ES), Port of Kokkola (FI)
Barge operator	CTF (FR), Blue line logistics (BE), UA research: small barges (BE)
Inland terminal	BCTN (BE)
Road operator	Transport Joosen (BE), Calcartage(USA)
Other	Caru container (NL), Chartwold Shipping Corporation (GR) Software developer consultant (PT)
Logistics	Arcelor Mittal Logistics (BE)
Rail operator	Metrocargo (IT)
Forwarding agent	ACB agency (BE)
Shippers	Metallo (BE), Nike (BE - validation)…
Customs	Ports of Sines (PT), Lisboa and Leixões (PT)
Container broker agency	Caru container (NL)
Research	University of Antwerp (BE)
Software	Software developer consultant (PT), Software houses (BE)
Shipping corporation	Chartwold Shipping Corporation (GR)
Waterway manager	De Vlaamse Waterweg (former W&Z NV, DS nv)