HUB HARMONY

Harmonization benchmark for inland multimodal hubs
Future links for sustainability

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FINAL REPORT

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HUBHARMONY Harmonization benchmark for inland multimodal hubs: Future links for sustainability

HubHarmony aims to develop a better understanding of sustainable transportation systems through the harmonization of operational procedures and services offered at multimodal hubs. It seeks to improve seamless hub operations and obtain synergies from the global hub network.

These goals are achieved by the development of a harmonization benchmark for inland multimodal hubs and the analysis of the impact of future value added services on the local economy and the development of inland multimodal hubs.

The project work encompasses container terminals, barge terminals, city terminals, dry ports, freight villages and consolidation centres and warehouses.

The HubHarmony project makes use of a harmonization benchmark—a scoring system which enables an evaluation of the harmonization level of operational procedures and the services offered in inland multimodal hubs. Operational procedures include hub technologies, business processes, and administrative aspects and services including both current services and potential future services.

The harmonization benchmark enables logistics operators to plan the development of hubs and strengthen its corporate identity. Moreover, it enables the monitoring of progress of harmonization and collecting valuable data for future policy actions. HubHarmony gives insights into future dynamics and indicates the upcoming needs of a logistics infrastructure with a focus on interoperability and harmonization of inland multimodal hubs.

Project Consortium

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Partners:

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Dissemination Level

PU	Public	**x**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential. Only for members of the consortium (including the Commission Services)	

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Introduction

Benchmarking has been identified as a tool for identifying potential improvements in the transport sector. It aims to raise the understanding of terminal systems, to analyse the reasons for differences, and to suggest potential changes that could be implemented by decision makers. The multimodal inland terminals in Europe are currently not subject to any specific quality/benchmark assessment and control that would allow terminal operators and its customers to have a fair view of their performance. Quality criteria, indicators and standards are largely missing.

The aim of the HubHarmony project is to define and test—with a different perspective than previous initiatives and in close cooperation with practice partners—a common benchmark methodology for terminals. The benchmarks aim to document the level of harmonization of hubs according to a terminal's potential strategic focus represented in different terminal profiles. The project HubHarmony defines a 'hub' as (i) the terminal and (ii) its surrounding area in order to not restrict business processes to transhipment, but to include associated facilities, services and activities. The surrounding area of a terminal refers to businesses that use the same infrastructure as the terminal and/or are within a limited geographical area.

Terminals focus on Value Added Services (VAS)

It is an age of strong competition in the terminal sector, which was in the past often based on infrastructure investment and the steady increase of capacity. Today, some terminal operators report on having a hard time in making profit in the transhipment and seek new ways to differentiate themselves. A possibility for increasing a terminal's attractiveness is to offer additional logistics services.

Whilst typical logistics services at multimodal inland hubs are e.g. transhipment or storage, a value added service (VAS) is defined as an additional action or effort performed to satisfy a customer need (secondary service). The secondary service and the primary service add up to a market offer. For ensuring the additional customer value, VAS need to continually develop (Luo, 2010). According to this definition, current typical value added logistics services at multimodal inland hubs are e.g. shunting services or stuffing and stripping.

The HubHarmony project presents an outlook of potential future VAS at inland multimodal hubs at the interface of Physical Internet and with a particular attention to renewable energies and resource consumption. The project identifies more than 56 potential VAS. Some of these potential VAS are already offered at selected terminals within Europe without being common practice yet; some of them are today being offered by selected first-movers (pioneers) only, and some of them are potential future services and have not been seen in practice yet, but may have been noticed in a different context.

Impacts of VAS

The project gives an overview on system dynamics. It introduces the idea of causal loop diagrams for visualizing complexity and identifying impacts of VAS at hubs, and discusses potential changes with regard to the three pillars of sustainability. The causal loop diagrams indicate the impact chain and highlight the consequences, which have been induced by a given stimulus (a new value added service). The project takes a look at the sustainability of hubs and how different aspects among the three dimensions of sustainability interfere. This underlines the complexity of dynamics.

The VAS dynamic pricing is used for a detailed analysis in causal loop diagrams (qualitative feedback loops). Dynamic pricing stands for the offer of time slots for carriers to arrive at the hub at different rates. Carriers need to book their slot through an online platform (slots with high demand: higher tariff; slots with low demand: lower tariff.). The transhipment of goods is guaranteed within the booked time slot. The causal loop diagrams of the service dynamic pricing of time slots reveal the most important aspects.

In general, the implementation of this service is expected to bring several benefits at all three dimensions of sustainability for a certain period of time. However, future dynamics are not clearly defined and management needs to consider the specific framework case by case.

After a qualitative analysis, the project also includes a quantitative analysis of VAS implementation. While the qualitative terminal model describes the operational dynamics at terminals, the quantitative model evaluates changes in the performance.

The analysis of VAS was used as an input for the benchmark.

The terminal profiles

Within HubHarmony, it became evident that a “classical” separation of hubs into dry ports, inland terminals, and freight centres is not suitable for our project goal of harmonizing different terminals within Europe, as the long-term orientation and management philosophy of a terminal turns out to be of great importance. Thus, six “strategical” terminal profiles were developed. The profiles allow portraying the harmonization level of different hubs and, at the same time, the strategic diversity of terminals. The profiles represent six different focuses or emphases a terminal might have. A terminal can have more than one focus, but will usually be more advanced in some aspects than in others.

The profiles were discussed with scientists and terminal professionals during the World Café in Antwerp in June 2017. An overview of the terminal profiles is provided in Figure 1. The six profiles are briefly described as follows.

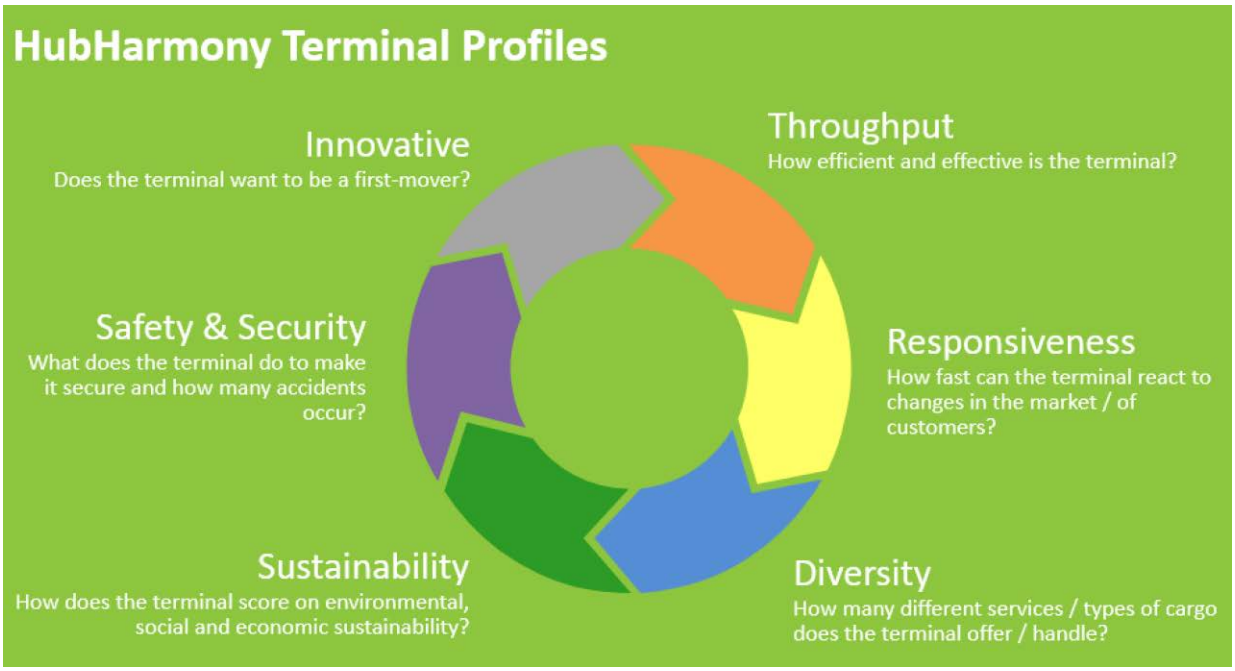

Figure 1: HubHarmony Terminal Profiles.

Sustainability

Sustainability includes the three pillars of sustainability, namely the environmental pillar, which is concerned with aspects such as nature and climate; the social pillar, which includes e.g. human rights; and the economic pillar.

Although there are various definitions of sustainability, the most common definition is found in the Report of the World Commission on Environment and Development: Our Common Future, also called the Brundtland Report. In this report, Sustainable Development is defined as "*development that meets the needs of the present without compromising the ability of future generations to meet their own needs*" (United Nations, 1987). Thus, a sustainable terminal respects environmental, social and economic needs of current as well as future generations by providing a neutral or positive impact on all three areas and mitigating, reducing or compensating any negative impacts. Sustainability transitions are long-term, multi-dimensional and fundamental transformation processes through which socio-technical systems shift to more sustainable modes, often enforced by guidance and governance (Markard et al., 2012).

Throughput

Throughput describes the amount of intermodal transport units (ITU) which are handled by a hub. Throughput can also refer to the amount of trucks, vessels or trains dealt with. In addition, the profile takes into account the time it takes for an ITU or a vehicle to be handled and to pass the terminal. A throughput oriented terminal is mostly interested in handling many ITUs and vehicles in a short amount of time.

Diversity

Diversity may refer to a number of things. It is "*the condition of having or being composed of different elements*" '(Merriam Webster Dictionary, 2017). A terminal can be diverse in many ways: the capability of handling several kinds of units or goods or even to serve various clients. In addition, it can be concerned with the diversity of the workforce. The diversity profile gives an idea about the 'horizontal policy' of a terminal and about the ability to answer the diverse needs of customers.

Responsiveness

The term "responsiveness" is defined by the Oxford dictionary (2017) as "*the quality of reacting quickly and positively.*" This kind of reaction has become more important through time. The ability of a terminal to account for the needs of their clients in a quick and satisfying way is crucial. A terminal does not only have to be responsive towards its clients but also to public regulations at regional, national and transnational levels. A responsive terminal is prepared for changes and is able to react in flexible ways.

Innovativeness

Innovation is when ideas and inventions become new products and/or services. According to Schumpeter (1934), it is an economic concept of "*doing things differently in the realm of economic life.*" Whereas invention describes the discovery of an idea, innovation is carried into practice. Thus, an innovative terminal is a terminal which encourages new ideas and actively works on their practical implementation. It questions standardized procedures, easily changes old habits and is open to a new design of business processes.

Safety and Security

Safety and security stands for the prevention of accidents (safety) and criminal activities (security). Accidents might harm people (workforce, drivers), goods (e.g. containers), or equipment (e.g. cranes). To avoid this harm, a safe terminal mitigates risks and has appropriate measures in place, e.g. rules to wear helmets, and training courses. In addition, criminal activities are a potential threat for people, goods and infrastructure. To protect the terminal from crime, a secure terminal takes adequate measures, e.g. employment of IT specialists, security software, and security guards.

The criteria catalogue

The criteria catalogue provides a sufficiently accurate picture to holistically describe a hub. Table 1 shows the final criteria set of the HubHarmony benchmark. One column lists the user groups, which may impact a criterion and/or for which a criterion is of major interest. This also allows checking if the future harmonization benchmark covers diverging interests of terminals and their users. Each criterion is assigned to at least one hub profile. The criteria were assigned to one or more of the following dimensions:

- operational procedures,
- strategic aspects,
- services offered, and
- other aspects of sustainability including economic, social, and environmental aspects.

Nr.	Criterion	Description	Terminal / Terminal surrounding	User	Hub profiles						Dimension			
					Sustainability	Throughput	Diversity	Responsiveness	Innovativeness	Safety&Security	Operational procedures	Strategic aspects	Services offered	Other aspects
1	**Hub equipment standard**	The criterion reflects the standard of the hub's equipment, e.g. environmental, safety, data, automation.	Terminal	Terminal operator, Society	X				X	X	X	X		
2	**Offers for people at the hub**	Offers for people at the hub concern terminal staff and drivers. It includes e.g. workload balance, sanitary standards and the possibility for educational training.	Terminal	Terminal operator, shipper	X			X	X	X			X	X
3	**Economic development**	The criterion describes the economic development of a hub and the strategy of allocating its revenue in a sustainable manner. R&D investment, responsible and fair pricing strategies, and transparency are some of the important aspects.	Terminal	Terminal operator, Drayage operator, Intermodal operator, Forwarder, Shipper	X							X		
4	**Communication and data standards**	The criterion describes the hub's ability to use different IT technology standards for communicating with users and its readiness to share information. It focusses on the compatibility and innovativeness of used IT standards and the ability to create standard messaging, which lead to automated actions. It also takes into regard information access and the novelity in communication channels, e.g. online interfaces.	Terminal	Terminal operator			X	X	X		X	X	X	

5	**Interconnectivity**	The criterion describes the hub's ability to use different transport modes and to interconnect to other hubs and regions. Thus, it includes the diversity of connections offered.	Terminal	Terminal operator, shipper		X	X					X	X		
6	**Punctuality and reliabilty**	The criterion describes how reliable the schedules are. It includes the absence of delays, which are quite often the result of several causes within different processes. The criterion differs between delays caused by the terminal itself and caused by stakeholders. For the latter, it includes the utilisation level of assets in order to reflect the probability of delays caused by terminal operators due to an infrastructure breakdown.	Terminal	Terminal operator, Intermodal operator, Forwarder		X						X			
7	**Throughput**	The amount of ITU a hub handles and/or can handle, the variety of different cargo types which can be handled at a terminal, and the time an ITU needs to pass the hub, including the services turnaround time and storage times.	Terminal	Terminal operator, drayage operator, forwarder, shipper		X						X			
8	**Infrastructure**	The criterion describes the capacity of fixed, tangible infrastructure at the hub, e.g. parking slots, tracks or storage spaces.	Terminal	Terminal operator, Intermodal operator	X							X			
9	**Flexibility**	Flexibility describes the hub`s commitment to proactively develop strategies and actions in order to be prepared for future changes and challenges. It is about its flexibility to cope with sudden market changes, such as new technology or legislation.	Terminal	Terminal operator, intermodal operator, society, forwarder, shipper				X	X	X		X	X		
10	**Hub security**	The hub's security describes the prevention of crime, such as cyber attacks.	Terminal	Terminal operator						X		X			X
11	**Hub safety**	The hub's safety describes its efforts to prevent accidents that cause harm of people or damage equipment, such as load damages or traffic accidents.	Terminal	Terminal operator						X		X			

12	**Environment and disturbance to local residents**	The criterion describes the impacts of the hub on the local environment and its residents, e.g. due to noise and congestion, as well as environmental impacts on a regional, national and global scale, e.g. GHG emissions.	Terminal surrounding	Society, Terminal operator	X					X		X		X
13	**Access to the hub**	The criterion describes the accessibility of the hub in terms of geography and time. This includes e.g. the congestion of access roads and the opening hours of the hub.	Terminal surrounding	Forwarder, Society, Intermodal operator, Drayage operator, Terminal operator		X						X			
14	**Micro environment for businesses**	The criterion reflects the micro environment factors that affect other businesses to settle in close proximity to the hub. It also reflects the diversity and actual number of settled businesses.	Terminal surrounding	Terminal operator, Drayage operator, Intermodal operator, Forwarder, Shipper, Society			X	X	X					X	X
15	**Future vision**	The criterion describes the hub's long-term plan for its development and its level of maturity and ambition. It includes the hub's network strategy and strategic alliances in the market.	Terminal, Terminal surrounding	Terminal operator			X		X				X	X	
16	**Diversity of core services and VAS**	The criterion describes the number of variety of services and VAS offered to the hub's customers.	Terminal, Terminal surrounding	Terminal operator, Forwarder, Shipper			X		X				X	X	
17	**Customer interaction**	The criterion describes a hub's level of customer integration, its openess to interactive innovation methods, its public relation activities and the easy access for (potential) customers.	Terminal, Terminal surrounding	Terminal operator, Society				X	X					X	X

Table 1: Criteria list

List of indicators

The list of indicators has been gathered in a review of the projects BE LOGIC, COMODAL, ISIC, COCKPIIT, TOOLQIT and AGORA in order to build on existing scientific and practical knowledge. The first set of indicators was reduced in two rounds of internal (between project partners) verification. Finally, 28 indicators were classified to benchmark the hub harmonization. The set of indicators is shown in Table 2. Each criterion can be described by a set of indicators (one or more). At the same time, one indicator may describe several criteria.

To calculate the indicators, it is necessary to gather about 40 single data entry points. The dataset is the base for calculations of indicators and comparisons of harmonization between the hubs.

Criteria	Indicators
Access to the hub	Availability of modes Operating times
Communication and data standards	Data interface types
Customer interaction	Customer relation management Homepage in English
Diversity of core services and VAS	Availability of modes Diversity of services
Economic development	Price advantage per container transshipment
Environment and disturbance to local residents	CO2 emission savings Diesel savings Electricity savings Equipment with noise reduction
Flexibility	Cut-off time savings (train) Cut-off time savings (truck) Cut-off time savings (vessel) Total transit time savings (vehicle)
Future Vision	CO2 emission savings Future infrastructrue investment Past infrastructrue investment
Hub equipment standard	CO2 emission savings Diesel savings Electricity savings Equipment with noise reduction
Hub safety	Occupational safety (lack of injuries) Occupational safety (lack of fatalities)
Hub security	AEOS status TEU not lost
Infrastructure	Availability of modes Efficient lifting policy Efficient storage utilization
Interconnectivity	Availability of modes Railway traffic directions Vessel traffic directions Total transit time savings (vehicle)
Micro environment for businesses	Proximity to industry zone
Offers for people at the hub	Trainings per employee
Punctuality and reliability	TEU not lost Total transit time savings (vehicle) Utilization rate of cranes
Throughput	Railway traffic directions Vessel traffic directions Total transit time savings (vehicle) Utilization rate of cranes

Table 2: Indicator list.

The harmonization benchmark—a case study

When using the benchmark, it is possible to compare terminals against each other or against a predefined standard of the six strategic profiles. In addition, a terminal's benchmark results show on which of the six profiles it puts its emphasis and where there might be potential for improvement. The benchmark was designed to be as easy to use as possible. This includes the availability of data points, the adaptability of the benchmark, and the readability of the results. The specific terminal data input is used to calculate the indicators, which are then visualized in the strategic terminal profiles (see Figure 2).

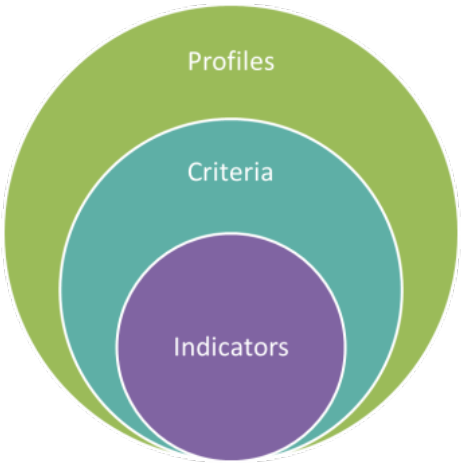

Figure 2: Link of profiles, criteria and indicators.

The benchmark is tested in a **case study for the Antwerp Main Hub** (see Figure 3). In order to assemble the data for the Antwerp Main Hub, close collaboration with the terminal manager was needed. Some of the requested data could not be provided 'off-the-shelf' but required some calculations. E.g., the occupation of the gantry cranes was not so easy to address; therefore a capacity model was needed which was developed by the assistant terminal manager of IFB/Lineas Intermodal.

In the case study, Main Hub is compared to a fictitious reference terminal. The reference terminal is a European middle-sized inland terminal. Its setting has been defined by using publicly available terminal data from e.g. storage area or number of modes (e.g., AGORA, 2018), scientific research papers (e.g. price per container (e.g., Wiegmans & Behdani, 2017)) and industry reports, data provided by partner terminals (e.g., UIRR member terminals) as well as data identified using the project members' expertise. The reference terminal is a railroad terminal which handles about 140,000 TEU (Twenty-foot Equivalent Unit) per year using two cranes, a storage area of 5,000 square meters and 27 full-time employees. It performs about 540,000 liftings during 4,000 open hours each year. It uses around three GWh of electricity and 250,000 litres of diesel per year. The reference

terminal has a website in English and has implemented customer relations management (CRM). Its cut off times for trains and trucks are three hours each.

Figure 3: Map of Port of Antwerp (Port of Antwerp, 2018).

Diversity

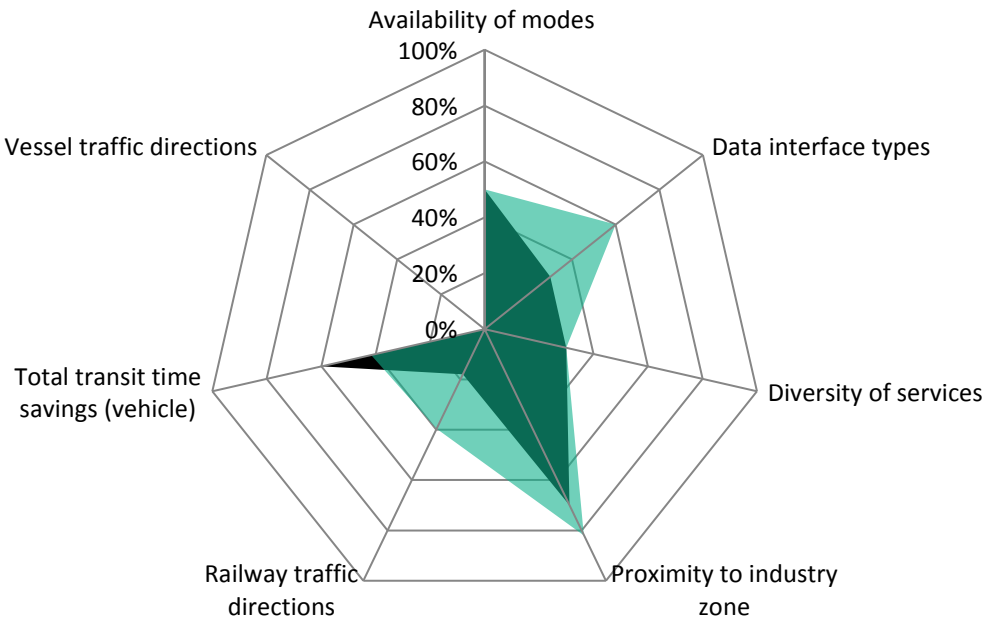

Figure 4: Diversity Profile Main Hub (turquoise) vs reference terminal (black).

Within the diversity profile, seven criteria were chosen. In comparison to the reference terminal (in dark in the figure) only 'total transit time savings' does not reach the reference value. The high rating for proximity seems obvious because the terminal is not really defined as an inland terminal but is located within the Antwerp port area, which is, by definition, an industrial zone. Within the benchmark data, mainly inland terminals that tend to lie further from industrial zones are listed.

Regarding data interface types, the usage of EDI and other messaging services is growing every year. Customer integration within their own TOS, Terminal Operating System, induces large efficiency gains and more and more terminals have begun doing it.

Some indicators relate to vessels. These indicators are shown even if the examined terminals are railroad terminals and there are no values for these indicators. In these cases, the value is represented as zero in the diagram. When comparing only railroad terminals, this indicator—as any other indicator—can be easily hidden or removed from the analysis.

Sustainability

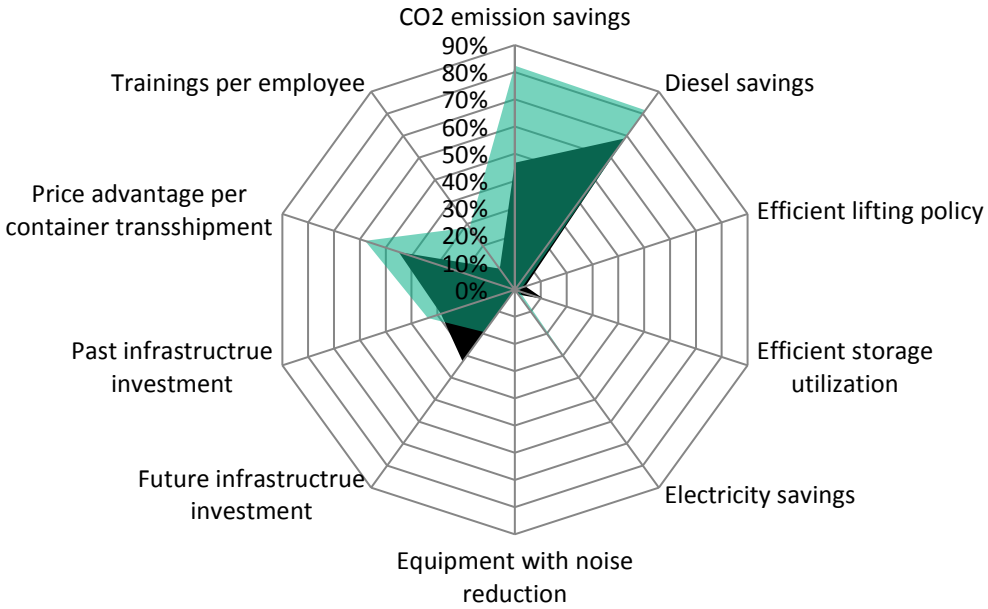

Figure 5: Sustainability Profile Main Hub (turquoise) vs reference terminal (black)

The sustainability profile is based on ten different criteria. The infrastructure at the Main Hub terminal is fairly new and the terminal infrastructure is amortized over long time periods. Furthermore, the sustainability concept gained serious ground in recent years. As a consequence, the best performance for Main Hub is found in CO_2 savings and diesel savings. The energy prices and, in particular, diesel prices push terminal managers to a less energy consuming infrastructure. Furthermore, public opinion about emissions and the harmful consequences on the health of humans puts pressure on companies in general to go green.

The contrary is true for noise pollution. In recent months, the discussion picked up the pace and the idea that noise kills all the same is growing. At the moment, the discussion is focused on rolling stock (in an urban context). Main Hub is located in a port area with no direct neighbours; therefore, noise cancelling is not high on the agenda. This criterion will definitely become more important in the coming years.

The lowest values for Main Hub can be found in future investment. Future investment seems to be a concerning value; nevertheless, the terminal was just reopened and the major investments were done prior to the closing of the terminal about ten years ago. The terminal itself still has a lot of free capacity and the gantry cranes are also still in very good shape; therefore, the budgeted future investment is rather limited.

Innovativeness

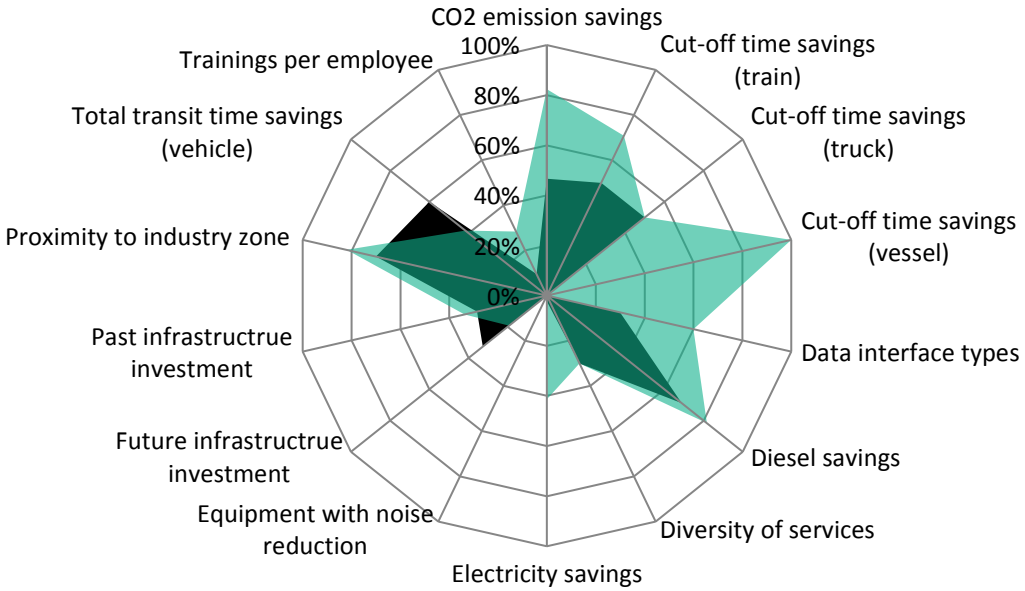

Figure 6: Innovativeness Profile Main Hub (turquoise) vs reference terminal (black).

To determine the innovativeness of a terminal, a profile of 14 criteria is used. The largest difference between the reference terminal and Main Hub is monitored for the cut-off time savings (vessel). Most terminals in the dataset are only bimodal and do not have a water connection. This is also the case for the Main Hub terminal. However, thanks to good relations and connection with the deep-sea terminal operators, the cut-off time for the deep-sea vessel is equal to the cut-off time for the rail connection. Concrete is considered at the deep-sea terminal as soon as the containers enter the Main Hub terminal.

Responsiveness

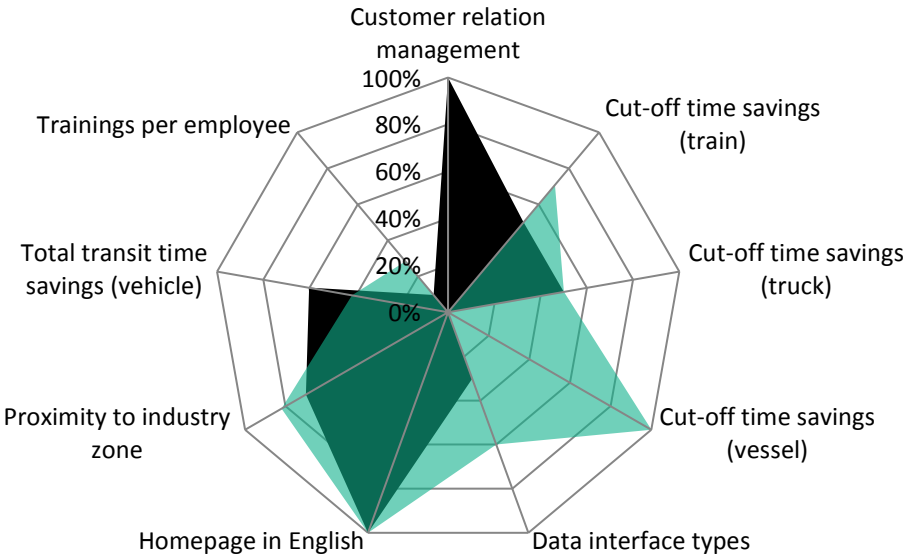

Figure 7: Responsiveness Profile Main Hub (turquoise) vs reference terminal (black)

In logistics, being responsive towards your customer's needs is key. Your ability to adapt and provide your customers with a choice can be the difference between doing business and losing turnover. In order to estimate the level of responsiveness, this profile consists of nine criteria, including all transport modes.

Again, the general picture shows a very responsive Main Hub terminal. Nevertheless, the customer relationship management system, being a direct system to keep track of every correspondence between your customer and the terminal, is still a gap in the Main Hub management system.

Safety and Security

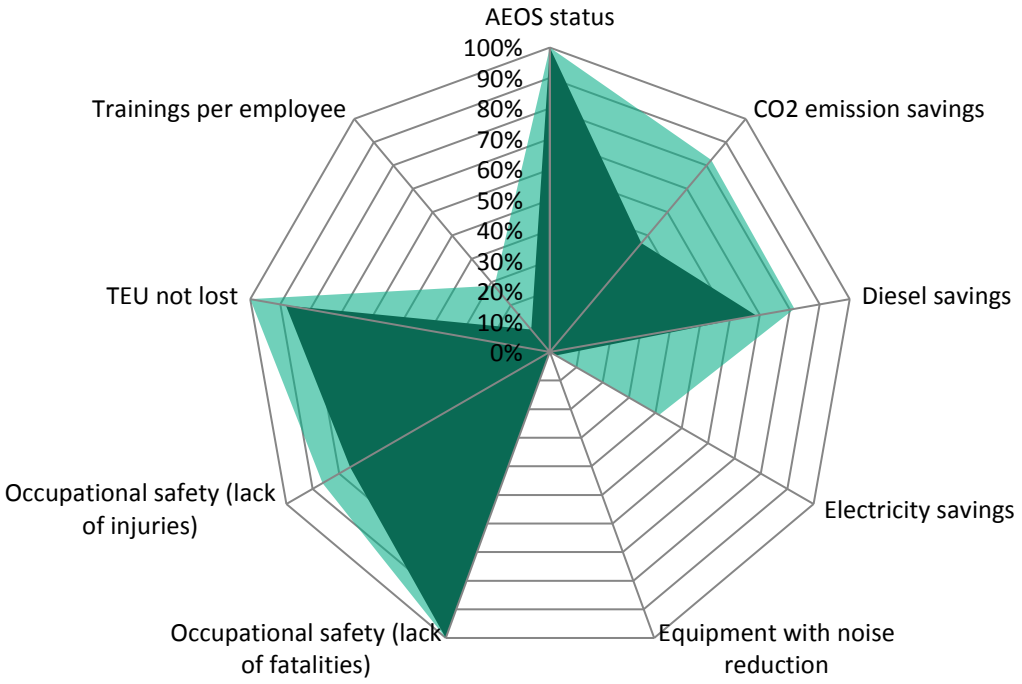

Figure 8: Safety and security Profile Main Hub (turquoise) vs reference terminal (black)

Safety and security is another upcoming value for shippers and other parties in the logistical chain. The terminal can offer operational excellence with great innovativeness and responsiveness; however, if cargo is stolen, customers will not keep working with the terminal.

The profile consists of nine criteria, including the two main concepts via various linkages. E.g., the number of injuries being a proxy for safety and the percentage of TEU not lost for security. Also, the availability of certificates such as AEO and ISPS is becoming more important every day.

The results of the profile analysis reveal that safety and security can be portrayed as one of the largest benefits of the Main Hub terminal. When compared to the reference terminal, the results of Main Hub are highly convincing.

Throughput

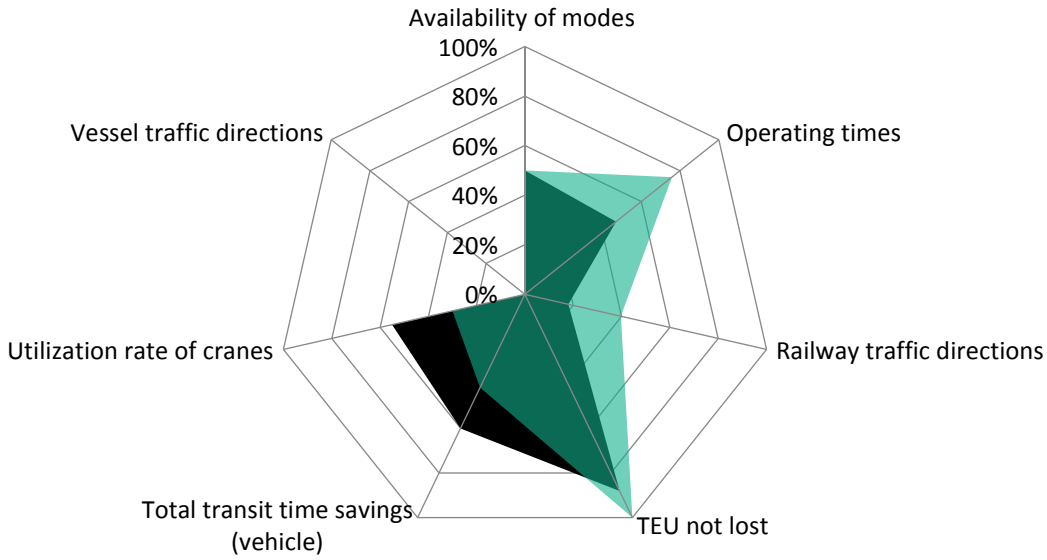

Figure 9: Throughput Profile Main Hub (turquoise) vs reference terminal (black)

Main Hub terminal was built to operate for larger volumes rather than those being transhipped today. The low utilisation rate is explained due to the large potential capacity at the Main Hub. The total transit time savings is also a result of the dimensions of the terminal. Due to the fact that the Main Hub terminal is a fairly large terminal with rather large distances to cover, the truck driver needs more time on the terminal to drop off his or her container. This is not the result of an over-utilisation of the crane. However, IFB/Lineas Intermodal tries to limit the time needed to announce and drop off the load. This is an extra service towards the customers to lower their waiting times and to increase their asset utilisation.

The main features of the Main Hub terminal in comparison to the reference terminal are the operating times. The Main Hub is in operation five days a week, two shifts from 6 AM until 10 PM, and Saturday morning, when the terminal only performs train operations and is not open for trucks. Due to the potentially high volume and the location of Antwerp in the European transport network, a lot of different services towards different hinterland connections are operated from the Main Hub terminal. Also, the shunting yard next to the intermodal terminal enables the terminal operator to set up mixed trains and attain the critical mass that makes it easier to start a train connection.

To conclude, the analysis visualizes the strong strategic focus of the Main Hub terminal towards safety, sustainability, and responsiveness. At the same time, it reveals potential steps to harmonize their operational performance and their services offered with other multimodal inland terminals in Europe.

Discussion

The results of the benchmark analysis show that a differentiation between the six profile types is not clear cut. Terminal management considers short-, mid- and long-term goals which are reflected in tactic, operative and strategic decisions. In general, strategies are not exclusively directed at one objective, but pursue multi-objective optimization, which leads to multiple criteria decision making. This is also reflected in the benchmark results.

The empirical tests proved to be a challenge within HubHarmony. On the one hand, this was because of the lack of available data and on the other hand because of the reluctance of terminal operators to share data. Periodic data collection is necessary in order for the benchmark to monitor the hub development. The harmonization benchmark can then show whether or not terminals are developing in the same direction within different profiles. It might be possible, for example, to observe that most terminals increase their sustainability profile or that innovativeness decreases over the years. The terminals can be identified as harmonized e.g. in their throughput orientation but not in their safety and security orientation.

Literature

AGORA (2018). Agora-Group project website. http://www.intermodal-terminals.eu/content/e15/index_eng.html

Luo, Z. (Ed.). (2010). *Service Science and Logistics Informatics: Innovative Perspectives: Innovative Perspectives*. IGI Global.

Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Elsevier B.V. Research Policy 41*, S. 955-967.

Merriam Webster Dictionary. (2017). *Merriam Webster Dictionary*. Diversity: https://www.merriam-webster.com/dictionary/diversity

Oxford Dictionary. (2017). *Oxford Dictionary. Responsiveness*: https://en.oxforddictionaries.com/definition/responsiveness

Port of Antwerp. (2018). Retrieved from http://www.portofantwerp.com/sites/portofantwerp/files/POA-Publiekskaart_NL.pdf

Schumpeter, J. (1934). *The theory of economic development: An inquiry into profits, capital, credit, interest and the business.* New Brunswick: Transaction Publishers, 1983 (reprint of Cambridge: Harvard University Press).

Swann, G., Prevezer, M. & Stout, D. (1998). *The dynamics of industrial clustering: International comparisons in computing and biotechnology*, Oxford University Press.

United Nations (1987). Brundtland Report for the World Commission on Environment and Development. http://www.un-documents.net/

Wiegmans, B., & Behdani, B. (2018). A review and analysis of the investment in, and cost structure of, intermodal rail terminals. *Transport Reviews*, *38*(1), 33-5