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DRY PORT NETWORK MODEL: BEST PRACTICES IN THE EU WITH NOTES FROM THE USA

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ABSTRACT

The modern distribution of goods is highly complex, as it supports a closely linked globalized world. In the development of port terminals, competition is no longer only at the level of services. The increase in maritime transport and demand/supply in the hinterlands, with ensuing problems of capacity, distribution and movement, have called for renewed attention on adequate structures and infrastructures. This evolution, enabled by technology, commercial interests and public policies, can be considered as a stage in the ongoing development of containerization and intermodal transport. At this stage, it is important to consider port terminals and maritime navigation networks as a system, together with terrestrial goods transport. Increasingly, regions are developing so-called dry or inland ports, to better serve the demand. We set out to define a sustainable model for dry ports, beginning with a review of relevant literature focused on Italian, Dutch and selected USA examples. We first define dry port, in the context of intermodal transport, ports in general and inland ports. Our investigation led to the identification of management tools and best practices. We report on visits and interviews to selected inland ports and identify key dry port activities, applications of innovative technologies and implications for different modes of transport. For the three countries studied, we identify strengths and weaknesses related to infrastructure, structures, internal organization of yard, types of imported and exported goods, transport methods and related travel times and costs. In regards to resilience and sustainability, vulnerabilities such as congestion, climate issues and cyber-attacks are considered. Finally, a maturity model for assessing dry ports is proposed.
Keywords: container traffic, dry ports, Europe, freight village, inland container terminal, Italy, maritime hinterland, The Netherlands.

1 INTRODUCTION

Although the internal distribution of goods developed following the industrial revolution, only in the 1970s developments in intermodal transport favoured the creation of internal terminals synchronized with global supply chains [1,2]. The modern distribution of goods is highly complex because it is closely linked to a globalized world. For the development of port terminals, competition is no longer only at the level of services. Furthermore, the increase in maritime transport with the related problems of capacity, distribution and movement, have focused renewed attention on logistics to the hinterland, in order to be able to respond to new needs with adequate structures and infrastructures.

This evolution, enabled or affected by technology, commercial interests and public policies, can be seen as a cycle in the ongoing development of containerization and intermodal transport. This has led to the integration of port terminals and maritime navigation networks, with systems of internal terrestrial goods transport and its emerging component, the inland port [3]. Positive aspects include: reduced congestion, energy conservation, improved utilization

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of formerly empty containers, concentration of goods at a limited number of ports of call, and more frequent and reliable connections to the hinterland.

Notteboom and Winkelmans [4] argue that geographical conditions, despite providing advantages with regard to quality, availability and functionality of logistics services, are not the only considerations. Fundamental factors include connections to the hinterland, terminal productivity and the reputation of a port, which affect competition not only between individual companies, but between entire supply chains [5]. Containerization derived from a rapidly expanding volume of global trade and from significant efficiencies in operations (concentration) and supply chain horizontal integration. This comprised an important evolution of supply chains [6,19–22] and led to significant increases in the average size of ships [7] and ensuant *considerable* savings at sea. An inland port, well integrated with a seaport provides efficient connections to inland markets for imported and exported goods. Related to this, various logistics activities, such as distribution centres, container and chassis depots, warehouses and logistics service suppliers are delivered.

Transport into the hinterland via inland ports is planned and regulated by commercial operators and economic development authorities. For these there is no universally accepted terminology. Different terms, such as dry ports, land terminals, inland ports, internal hubs, internal logistics centres, freight villages and inland transport villages are sometimes used. The terminology varies geographically, and according to different providers within the supply chain as well as according to services present. Although the meaning of the term is debated, 'dry port' is often used to refer to a terminal where various cargo handling and value-added activities typically found at a seaport where rail or barge services are provided [8,9]. The word 'dry' seems to exclude waterways, thus, the concept of inland terminal is polymorphic. It could have different meanings based on location, accessibility, connections, relationship with other port terminals and seaports, roles, functions and marketing objectives. In any case, three characteristics are fundamental: massification, direct connection by rail, barge or truck to one or more port, and containerization [8,20,21].

The functional specialization of inland terminals is necessitated by clusters of logistics activities and the necessity of large ships. In addition, scheduled services and transshipment operations due to the increase availability of goods and the investment in development of container terminals comports increased productivity, price reduction, reduced dwell time of ships in ports and improved times for deliveries, manoeuvres, anchorage operations, access and cargo handling and unloading. Customers evaluate the total logistic cost of transporting containerized goods, developing the global supply chains with an intensification in pressure on the maritime system, on port operations and on the distribution of goods in inland waters. Accessibility is fundamental to the competitiveness of the port and it is important to the management of supply chains, transport functions and the various actors at inland terminals. Thus, seaports and inland ports perform similar tasks, and while a seaport is a required node for the maritime/terrestrial interface, an inland terminal is an option available when conditions are not favourable for direct seaport access. Moreover, a dry port can be economically strategic, as it can induce value-added activities and services closer to customers. It can create competition for and improve the logistics of containerized goods.

The inland terminal can generally be more readily expanded to serve as a container depot, warehousing facility, area for delivering containers and even customs operations. Together, these can present significant advantages for shippers.

It is clear that a port and an inland port, adequately connected, can increase the economy of a region or country. Careful and continual control is necessary, with facilitation strategies and

innovations provided to the various actors, who manage different aspects. We can see that in developed countries, particularly in North America and Europe, which tend to be at the end of many containerized supply chains, numerous inland ports and rail terminals have and are being developed. In these countries, particular attention is given to incoming logistics which are capable of serving a wider market. Small at first, they have moved from regional/local systems to become central gateway centres [3].

In North American and European countries, such as The Netherlands, the presence of service by barge allows the development of internal trimodal ports and massification even in the absence of a railway. At the same time, the organization of supply chains and the strategy of Asian export-oriented countries have shaped the distribution of goods, by incorporating internal terminals in their logistic zones. Due to the fact that there are very different dry ports in the world, or even on the same continent, there is no dry port model to refer to. At the same time, there are numerous scientific articles and studies relating to the topic, also in this case, the concept is often associated with different ideas. Thus, the goal of this paper is provide a guideline for best practices, relating to a sustainable and efficient dry port model, based on analysis of pre-existing articles and on interviews with experts as well as site visits. This document may therefore offer ideas to those who intend to carry out the execution of a new dry port.

2 METHODOLOGY AND INTERVIEW

Following the analysis on the concept of dry port and current strategies, attention is focused on Italian, Dutch and selected USA environments.

The approach taken is similar to that of Baxter and Jack [10] who suggest the use of various data resources and some qualitative case studies, as the boundaries between phenomena and context are not clearly evident [11].

The results of the survey, carried out for Dutch and Italian terminals, are used in the paper in order to describe different conditions in the two countries. Literature is used to describe selected ports in the USA. Strengths and weaknesses as well as ideas for implementation and innovation are identified. The purpose is to describe a series of considerations useful for developing a handbook to report best practices applicable to dry ports, taking into account the uniqueness that characterizes each.

The aim of the informal interview was to overview topics and create a support tool for terminal managers and operators. As there are no two identical ports, it is not easy to find a solution that fits all.

In order to complete the study, directors and managers of ports in the EU countries were interviewed during visits to some of these terminals. The visits started with a brief presentation about the terminal, performed by the authority, followed by a discussion based on a detailed questionnaire.

Face-to-face interviews seemed to be the most suitable for the research and to understand the dry port phenomenon in a real-life context, as they allowed us to investigate on several fronts and to be able to talk about the various aspects of the different terminals. Remote interviews using standard questionnaires would not have allowed such a complete study of all the factors. In this way, it was also easier to compare the terminal in question with the others as well as to have an immediate response from the respective managers. These interviews in fact allowed us to understand not only which factors were missing from the various terminals, but also which ones were more important than others, and more important for the drafting of a handbook/reference model.

Through these meetings and with reference to the literature, a questionnaire was designed containing about a hundred questions divided into the following macro-areas: operating companies, geographical location, urban instruments, governance, structure, infrastructures and logistic services. We also asked the administrators to comment on the most important characteristics that a terminal must have to be considered a dry port. The answer are reported in an aggregated form inside the model.

The questionnaire was then used to interview three Dutch terminals and two Italian terminals. Starting with the simple questions of the questionnaire, the interviews expanded to capture the extensive knowledge of port personnel on the subject.

The interviews provided details for more than just the five ports as the subjects were managers of additional terminals for which they described the principal characteristics. They therefore provided a general picture of Dry Ports In The Netherlands Northern Italy. The question used to interview the directors and the managers is are attached in Annex A.

2.1 The questionnaire

The questionnaire, used for the interview, was developed after previous meetings with dry ports and inland terminals professionals and academics. It is divided by topics and involves different important aspects found in a dry port. In the following are presented the macro areas and the topics treated during the interview:

- Operating companies, geographical location, urban instrument and governance: The discussion treated argument about incentives and investment from port authorities and economic development agencies, policies for custom procedures, safety and security, type of governance, services and strategies, cooperation and competitiveness with other terminal, management of the terminals, accessibility, custom clearance and others.
- Structures, infrastructure and logistic services: This macro area focused on accessibility and connection, in particular on the present type of infrastructures and on the intermodal services, then also structures and services, like warehousing and empty depots, were discussed.
- Characteristics of a dry port: The interview ended with a series of questions related to the idea of dry port that managers, directors and academics have. The intent therefore of this particular section of the interview was to identify those aspects generally considered fundamental, with the aim of structuring a model that presents man of the best practices.

3 ANALYSIS RESULTS AND COMPARISONS

After the interviews, the data concerning the studied terminals and the port infrastructures of the two Italian and Dutch situations are analysed in order to determine the strengths, the weaknesses, the opportunities and the threats and to effectively understand the potential of the infrastructures interviewed in these terms. A review of select SE USA dry ports was also conducted.

The main aspects/criteria that involve both EU port regions are accessibility, dependence on companies with port activities and on the type of activity, dimensions of the hinterland and markets, time and costs, capacity, innovations and opportunities.

The comparison between the ports of Northern Italy and the Northern Range ports is interesting, as the two systems are characterized by marked differences not only in terms of size

(the port of Rotterdam, alone, moves volumes of container traffic higher than those of the entire Italian port system), but also with reference to the organizational structure and governance.

The size of the reference market contributes to the significant differences. In fact, the ports of Northern Europe, serve one of the largest markets in the world, while Italian ports are much more limited [18]. Considering the movement of loads with origin/destination in Italy to the Northern Range, Rotterdam could be considered as the 'eighth Italian port'.

The Dutch port logistics system is characterized both by a very high volume of freight traffic, and by its degree of attraction greater than the Italian one. The preference of many international operators for the port system in Northern Europe is attributable to the greater 'reliability' of this system and to a series of economic and strategic elements, as well as quality logistics services.

These represent decisive variables for the choice of the operators and indicates that an efficient system does not imply higher handling costs. Actually, infrastructures in both countries need to be enhanced.

The Netherlands, with the expectation of managing ever-increasing volumes, will need new railway systems that allow it to continue to respond efficiently to the demands of the large market it currently serves. The interventions underway in Italy, in support of the port facility will prepare the territory for developments by acting on the network bottlenecks and on the efficiency of the ports.

In the US, seaports on the west coast traditionally carried higher volumes of containers from Asia. Port of Los Angeles is still the nation's top port by value in 2021, but the volumes of containers start to increase in the east coast seaports after the Panama Canal expansion in 2016 [23]. Also, due to the trading war between China and the US in 2019 and the COVID pandemic in 2020, Port Laredo in Texas became the largest inland port on the US–Mexico Border and rank No. 4 in the nation, with more than $205.88 billion trading in 2020 [24,25].

The increasing volume in east coast seaports like Virginia and Georgia lead to new development of inland dry ports like the Virginia Inland Port (VIP) in Virginia, and the Appalachian Regional Port in Georgia, which are located a few hundred miles away from the perspective seaports (Virginia International Gateway and Port of Savannah in Georgia) [26,27]. These dry ports are closer to inland markets and serviced by Class I railroads and Interstate highways.

On one side, these dry ports play a key part of the ship-to-rail-to-truck supply line between Europe/China/other foreign manufacturers to the US, on another side, these dry ports consolidate and containerize local cargo for export to other countries. Other benefits of these dry ports include reducing highway congestion and air pollution at the regional area from shift intermodal containers from truck to rail.

SWOT Analysis confirm that geographic positioning is the defining element the Italian port logistics offer. Regarding terrestrial interconnection infrastructure, infrastructure endowment, efficiency and reliability of the ports, the Italian port system is penalized. Its railway connections and roads are considered a fundamental disadvantage by operators (Tables 1 and 2).

The situation in the USA relates to the issue of West Coast ports with their direct access to huge rail terminals and the SE USA ports, where dry ports are emerging (Table 3). The dry ports in America are in their nascency, so can likely benefit from the experiences of the more established European ports.

Table 1: The Netherlands – SWOT analysis.

Strengths	Opportunities
- Reliability and efficiency of three updated modes of transport - Diversity in port activities and companies - Geographical advantages and good accessibility (government support) - Large throughput volumes, market and operational time	- Sustainable, innovative and recycling activities (automatism, 3D painting, fumigations) - Synchro modality - More infrastructure to increase capacity, velocity - Supply chains and growth nodes to increase intermodal capability
Weaknesses	**Threats**
- Bottlenecks and bad connection due to increased volumes - Land constraints and little free area in the terminal - Custom clearance not always available - pollution problems, new barges, eco-sustainable are needed	- More intermediary warehousing through the supply chain - Deeper hinterland capability requiring more logistics pro assets - The maximal capacity may be reached due to limited potential are for new port activities and the use of advanced equipment - Management of synchro modality

Table 2: Italy – SWOT analysis.

Strengths	Opportunities
- Strategic geographical position - Diversity and excellence in port activities and large number of seaports and companies - High number of goods moved through railway (2° place in EU) - Ecological shuttle trains - The Motorways of the Sea network permits international relations	- Improve the position of the freight terminals (on a certain corridor) - Improve the infrastructures system: integrate ports, freight terminals, railways and customs with more efficient intermodal transport - Institution of One Belt One Route - Insert spaces in the terminals for research
Weaknesses	**Threats**
- Structural and infrastructural shortcomings - Unfair competition from foreign operators for Italian ones - Difficulties in using intermodality - Bottlenecks on port and connections, problems on customs procedures and bureaucratic constraints - Few incentives for cleaner vehicles	- Infrastructure system not yet adequate for larger container volumes - Difficulties in consider the system as logistic interconnected - Difficulties in reforming the port governances - Possibility that despite new incentives to use green vehicles private cars are used

Table 3: SE USA – SWOT analysis.

Strengths	Opportunities
- Strategic geographical positions - Environmentally friendly electric rubber-tired gantry cranes - Not hampered by air trade reductions - Direct rail routes, moving shipments 200–400 miles (300–500 km) closer to O/D in the industrial and highly populated regions - Benefits from 25 year old (and new) free trade deal with Mexico - Laredo port: not hampered by new fuel regulations; partnership with Ryder; air, truck and rail services	- Under-capacity (e.g., Laredo only 40% of capacity (35,000 trucks per day) being used - Economic development magnet, drawing business and industry to the Southeast U.S. - Post-Panamax expansion - Luring businesses and users
Weaknesses	**Threats**
- Some are very small, e.g., Georgia at 42 acres (169.968 m^2) - Laredo – 98% of trade is with Mexico (not diverse) - Additional land not available for warehouses (Virginia)	- Long term limits on expansion at some ports (e.g.,. Virginia only 161 acres 651.544 m^2 (could use 1000)

Following are some observations and opportunities for the Italian and Dutch port systems:

a) Considering container traffic in Europe and the growing importance of the Europe-Far East route, there is a portion of the market that can be contested by the two port systems (near the Alpine arc);
b) The greater accessibility rate when compared to Central Europe, also in the South-North direction, with the strengthening of the major European axes can be an opportunity;
c) The presence of the 21st Century Marittime Silk Road that will connect China's ports to Europe, through the South China Sea, the Indian Ocean and the South Pacific.
d) The two countries have committed to work on areas of mutual interest such as roads, railways, bridges, civil aviation, ports (Genoa and Trieste), logistics, renewable energy and telecommunications with an improvement in transport, so that they are effective, efficient, safe and sustainable.

4 THE MODEL

Considering new infrastructure, a proposal must be accompanied not only by the aspects inherent to a design in the start-up phase, but also by a precise study of traffic, goods, logistics services, innovative equipment, infrastructure, capacity and specialization of the site. In order to evaluate costs and competitiveness other aspects must also be taken in consideration, as environmental aspects (even in the case of political decisions), economic assessments, sustainability (which also implies global sustainability of maritime traffic) and sharing of

design choices with the interested companies (railways, roads, barges). In setting up a Dry port, it is important to identify available funding, whether for new construction or adjustments. Design and actual layout of a dry port, are specific for each, based on the different characteristics and conditions [28]. In the absence of a definitive design, an actual layout can be considered, characterized by the best practices that reduce to a minimum or even eliminate the time required for freight vehicles to operate within the stacking and loading area. For the dimensional evaluations of the plant, the reference area of the industrial production and consumption demand of the hinterland will be considered, analysing some existing physical realities, such as the terminals of Madrid, Lyon, Sao Paulo and Santo Andre ranging from 92,000 to 1,840,000 m^2, an average safety value of 120,000 m^2 can be taken which will then be incorporated in the modelling to test the impacts. Any case, although the dimensions are a very important factor, they are not essential, in fact we have seen from the Dutch examples that a platform can work efficiently and safely, even in modest spaces, if well organized. When determining the dimensions of a dry port, it is necessary to take into account the potential areas of development in railway infrastructures with railway connections to the exchange yards, areas for road vehicles handling, areas dedicated to the storage and warehousing, as well as administrative and customs offices, finance guard and services for operators. The container area and the requirements of its flooring must also be considered, normally an average value of 40 square meters per container is required.

With regard to the dimensions and infrastructure requirements of intermodal transport, these should be assessed based on the estimated demand for freight transport expressed in containerized rail freight/barge volumes in transit in the area. Moreover, it would be advisable to locate the dry port far from residential areas, with the aim to make the structure less impacting, as the operations take place also during the night, seven days.

Finally, to ensure efficiency and safety, the layout must consider the spaces dedicated to the handling of containers and other loads that can be carried out by dedicated vehicles such as portals, forklifts, mobile and gantry cranes.

Dry ports should be governed by terminal operators under the supervision of the transport minister and require the same safety and security measures as a seaport. Dry ports can be either public or private, although in the two EU countries, public ones seem to be preferred. Goods handling and distribution companies, port authorities, local/regional authorities/governments may be involved in the management of a dry port. The role of the operator is crucial in marketing, to ensure that the site is promoted to the largest possible number of customers. We suggest that an expert operator be identified in order to ensure effective cooperation between the various intermodal actors, provide effective customer-tailored services, and guaranteeing security, protection and reliability.

According to the study, aspects to consider in a dry port model to realize an optimized plan which minimizes logistics costs, five macro areas are key:

1 – Localization and accessibility, both for existent and new sites. In particular the best solution for the evaluation of a new site could be using GIS software, based on the AHP Method, which use a list of multicriteria that have different values for different countries. Criteria as connections, inland market, congestion, demand and environmental, structural and other constraints [12]. The points extracted permit to evaluate and analyse the potentials, the costs and environmental effects in order to minimize the total transportation and operational cost for each location and the pollution. It should also be studied the accessibility, the daily traffic, the level of service and the distance/connection with another logistic platform.

2 – Services and operations (same of a seaport): consolidation of maritime goods in intermodal short and long distance; container packing/unpacking; warehousing and storage capacity; fast operations of custom clearance; movement of containers considering the dimension of the area; fumigations; empty depots; facility for labour and customer.
3 – Logistic facilities with proactive and active actions in order to avoid congestion, bottle neck, that force to send goods directly from seaport to customers by road using a modelling dry-port-based freight distribution planning (Crainic, Dell'Olmo, Ricciardi, Sgalambro) [13] that defines the optimal routes and schedules for the fleet of vehicles providing transportation services between the terminals of a dry-port-based intermodal system, thanks to mathematical programs. The inputs are described by the time, the set of candidate dry ports and the window for the delivery (or the pick-up) of the cargo and the size of it. They may include the size of the available fleet, the capacity of each shuttle and the classes of costs.
4 – Governance, policy and regulations must guarantee transparency and equal treatment with regard to customers and fair infrastructure pricing, related to land, environmental, investment, port, logistic, transport and trade facilitation, infrastructure and safety and security. The aim is to reach a cooperation between different actors with a horizontal informational exchange (at different nodes of the chain) and vertical (between transport providers and transport users).
5 – Technological innovation, such as 3D printing, automated vehicles, electric propulsion vehicles, automated services and sustainable services, as recycled resources, alternative fuels and solutions is important, as collaboration with institutes, universities and schools with related exchange of information, knowledge, resources and operators.

In accordance with what we have observed and discussed with some academics and managers of Italian and Dutch freight villages, a maturity matrix is proposed for dry ports. Five levels are identified (Table 4). The matrix shows various categories of aspects of a dry port, based on efficiency achieved, and determined on the basis of the presence or absence of the parameters identified in the previous section. The first level presents the basic characteristics, as the direct connection of the goods and the displacement of some harbour functions and services in the hinterland. The second level adds a modal shift of the load from road to rail or barge. In the third level, the custom clearance and the storing and sorting options are ensured, in order to speed up times and consequently decrease costs, improving the logistic chain. The fourth level adds the management of container flows arriving from different ports and quality services which implement the logistics chain. The fifth level present an excellent dry port, which promotes technological and sustainable innovation as circular economy, sustainable transport, alternative fuels, energy transition to sustainable and recycled resources, fumigations, digitalization of logistics, cyber security, 3D printing, synchro-modality and new technologies.

Dry ports must identify specific areas for connections and accessibility and adjacent areas for sorting. They must also have room for empty space, technical offices, warehouses, heavy vehicle operation, offices for the verification of customs operations, the use of innovative technologies. Eco-sustainable resources should be encouraged, and space for school and university research/technology transfer could be considered. Two examples of innovative technologies that can increase the efficiency of a dry port are the use of 3D printing at the terminal, which allows to produce necessary components avoiding unnecessary transportation. Another idea is the use of special containers that fold up on themselves, in order to optimize empty spaces, this technique can reduce transport costs by 50% and emissions by 20%.

Table 4: Maturity matrix.

Maturity Level 5 → Excellent	Functions of Maturity Level 4 Empty depots; Fumigations; Innovation and new technology, environmentally friendly and sustainable
Maturity Level 4 → Good	Functions of Maturity level 3 Management of container flows to different points. High quality terminal while improving the efficiency and effectiveness of logistic chain
Maturity Level 3 → Standard	Functions of Maturity Level 2 Custom clearance, Sorting, Storing
Maturity Level 2 → Basic	Hinterland space for the port/ports and terminal, to outsource port's functions; Reduced seaport congestion and emissions, improve seaport throughput, due to the movement of containers from road to rail/barge
Maturity Level 1 → Poor	Hinterland space for the port(s) and terminal, to outsource port's functions; presence of traditional port services; movement of containers through direct road connections.

Finally, we can say that the Dutch ports have good characteristics, although the spaces are often limited, obliging terminals to divide spaces into two distinct terminals, connected separately via barge and by train. An example is Veghel and how it will happen in Oss with its new railway service. Deposits for empty spaces and supplementary services are almost always present, relating for example to renewable resources. In general, Dutch dry ports are between the good level and the standard level, except for sporadic cases of a lower level. As far as Italy is concerned, there are still many ports with difficulties, especially due to difficulty in scheduling logistics chains, and relate to structural inefficiencies. Although the level is on average, basic/standard, there are many planned interventions. Therefore an increase in function is expected in the next years through more efficient services and infrastructures.

5 CONCLUSIONS

This study is intended as a contribution to existing research. It offers advice and potential solutions for the future of dry port planning and design, with respect to capacity, location, functions, governance, policies and sustainability, in order to maintain efficient freight chains and containerized trade. The research has limitations mainly due to the uniqueness of each port site and there is difficulty in finding a single model that can be valid for all. However, the results show that it is possible to identify the main parameters, characteristics and best practices for dry ports and define efficiency based on the presence or absence of certain services.

It should be emphasized that the members who participated in the interviews are from ports that are characterized by different management, costs, connections, volumes and transport methods. Meetings of academic and meetings with managers, top management, administrations and organizational structures indicated early problems for comparison. The study had the objective to build a dry port model based on Dutch and Italian situations – in order to understand the classification of dry ports – highlighting strengths and weaknesses as well as possible initiatives that could apply.

Dutch ports often have connections via barge, so their characterization as dry ports would therefore seem not to include those terminals that are actually connected to the navigable

lines. However, the present research work follows the definition of Woxenius and Roso [14] for which a dry port requires a direct connection to a seaport. The results actually underline that the Dutch case studies taken into consideration reflect the needs of dry ports, and thus confirm the initial hypotheses that they should be analysed as such.

Moreover, by analysing specifically the Italian and Dutch cases, we can see how both are trying to invest in structural and infrastructural expansion, with a shift towards rail transport. It should be pointed out that the model is not completely compatible with any case study, as every dry ports may have different needs and characteristics, based on local/regional economic, geographical and regulatory context. And while it is necessary to consider the uniqueness of each site, the model can be useful to port operators wishing to invest in a Dry Port, focusing on the main challenges that can affect the success of the investment.

From a management point of view, good communication and sharing of information are required, in particular referring to the transfer between different modes of transport and to additional costs incurred. It should also be emphasized that dry ports seem to adapt and expand better when terminals are already operational, since the connected seaport has congruent goals. Moreover, the planning process can be lengthy and complex, and it may take much time to get approvals.

Lastly, container traffic should be checked both at the dry port and at the seaport, to identify any changes and the labelling of a unit containing dangerous material should be the same both on rail/road/barge, and on a ship [15,16]. In addition, equipment must be properly designed, and the dry port capacity must be sufficient to meet the demand for the ports it serves. We intend this research to be an encouragement for the economic bridge that unites Italy and the Netherlands in relation to ports, infrastructures, logistic, sustainable innovation, marine pollution, defense of coasts and shipbuilding. As seen, although the port system of the Northern Tyrrhenian Sea and Livorno are one of the most promising strategic junctions of the southern European logistics network [17,19], they lack the most modern infrastructures even as projects are in progress. It is said that, 'Holland was made by the Dutch, stealing it from the sea' and so is a school with a thousand potentialities and ideas that they share in order to cooperate and improve.

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ANNEX A: INTERVIEW LIST

Operating companies, geographical location, urban instruments and governance:

- Incentives from port authorities and economic development agencies,
- Policies related to foreign trade areas and customs procedures,
- Policies related to cargo safety and security procedures,
- Competitiveness with other terminals,
- Private investor(s) and/or developer(s) of real estate,
- Governance structures with respect to port-hinterland relations,
- Governance model(s),
- Information systems and opportunities for exchange between companies,
- Networking strategies adopted,
- Policies of regional authorities and market parties in order to optimize container flows and reduce empty haulage,
- Vertical integration,
- Management of the terminal(s) and of the services,
- Docks control and management,
- Concessions for companies,
- Urban planning tools (land costs and availability),
- Modal availability and accessibility,
- Supply chains related to the terminal(s),
- Structural and infrastructural issues,
- Economic density,
- Foreign trade area with trade facilitation,
- Geographic model for logistics,
- Connections with other platforms,
- Environmental constraints,
- Railway capacity,
- Economic development strategies,
- Land use policy.

Structure, Infrastructures and Logistic Services:

- Infrastructure: railway, junction, roads, inland waterways; airports; pipeline,
- Direct national and international connections,
- Infrastructure accessibility, average transport costs and times,
- Incentives for use the use of certain infrastructures, incentives for railway infrastructures,
- Financial incentives for the development of terminal and internal corridors,
- Special packages to use the infrastructure for tourism/passengers,
- Incentives to invest for direct and indirect recovery of investment costs,
- Incentives to participate in public-private partnership with other parties,
- Synergies with other transport nodes and other network actors,
- Internal services (custom clearance, container storage, consolidation and/or deconsolidation),
- Number of container terminals,
- Strategies for repositioning and rotating cargo,
- Empty container management,

- Storage and handling capacity,
- Import/export report,
- Quality of services offered,
- Delays related to custom inspections on cargo (port fees, mooring, pilotage, etc.),
- Prices associated to the container terminal (by rail, by barge and by truck),
- Efficiency and price of final transport by truck,
- Distribution of costs and benefits between players and network nodes,
- Distribution of logistic companies,
- Regional network of loading centres (that guarantees freight connections in and between logistics areas),
- Intermodal services (with short distances and lower costs) between places dominated by import inland and places dominated by exports,
- Logistics activities connected to the port as:
  - Activities for the management of large volumes of bulk, suitable for navigation and railways,
  - Activities related to the company that have sites in the port area,
  - Activities destined to loads subject to fluctuations (due to season or to irregular supply),
  - Activities highly dependent on short sea shipping radius.