INNOVATIVE IDEAS AND DESIGN OF AN INTEGRATED DRY PORT AND SEAPORT SYSTEM

Andrea Rosa* and Riccardo Roscelli*

ABSTRACT

The paper discusses an integrated seaport and dry port system for the expansion of the Genoa Voltri container port in Italy. The basic idea is to relocate the land-side port operations to north of the mountains close to the seaport, so as to obviate the lack of space in the seaport and the congestion of the transport connections close to it. The proposal entails both organizational and technological changes. The study also examines the viability of the project idea and the feasibility of a project financing operation to implement it.

Keywords: Integrated system, seaport, dry port

INTRODUCTION

With the constant and very remarkable growth of container traffic experienced so far, and foreseen for the future—although perhaps at a different rate or in different times given the current global economic situation—several ports are getting equipped to accommodate more maritime traffic, ever larger containerships, and therefore larger inland container traffic. Such developments require, among other elements, space for the terminals and efficient inland transport connections with spare capacity. It is not always possible to find available space for development within the port area. This is the case of the port of Genoa (Italy) which, as described in this paper, is enclosed by the city of Genoa and by the mountains that line the coast. The solution for its development, as well as for other ports that have the same space constraints, is to relocate some of the port operations by providing extended gates inland, thus having inland freight terminals where container can be left or picked up as if at the seaport. This kind of development is attracting much attention from researchers (see, for example, the works of Leveque and Roso, 2002 and Roso, Woxenius and Lumsden, 2009) and finding applications in several places in the world (see the examples in the papers just referred to, and -as a further instance- the work being carried out

* SiTI - Higher Institute on Territorial Systems for Innovation Via P.C. Boggio 61, 10138, Torino, Italy.

within the Dryport Interreg project: www.dryport.org). Each application has its own particular features to deal with the distinctive characteristics of the port and territory served. Expanding the port and relocating some of its operations to a dry port also allows for the rationalization of a part of the transport flows in and out of the seaports and an improvement in its connections to the inland transport networks.

This paper outlines some of the main points related to the development of a dry port for the container terminal at Voltri, Genoa, relating some current results along with an outline of the work remaining to be done. The work referred to in this paper was started in 2005 by the Higher Institute on Territorial Systems for Innovation (SiTI), with which both authors of this paper are affiliated, and a group of maritime operators based in Genoa. As recalled by Roscelli (2007) when describing the origin of the study, the idea of directly connecting the Voltri port with inland terminals via a tunnel through the mountains at the back of the port had been put forward in the 1960s by *Istituto Ligure di Ricerca Economica e Sociale*/Ligurian Research Institute for Economic and Social Research (ILRES) when the Voltri terminal had yet to be built. However, at the time, that insight was not followed by operational studies.

The paper aims to give a general idea of the project, as the work carried out would be too broad to be related in a single paper, while also touching upon some of the technical issues and some of the options explored to study them.

I. THE CONTAINER PORT OF GENOA AND THE MOTIVATION FOR THE PROJECT

The port of Genoa is located in the north-west of Italy and is the main container gateway port in Italy. It has several container terminals of different dimension, the largest of which is the Voltri one, located at some distance west of the most urban part of the seaport where the other container terminals are. The Genoa port handled some 1.8 million TEUs in 2007, about 1 million of which in the Voltri terminal. The whole port is enclosed in the urban area of the city of Genoa (approximately 611,000 inhabitants) and both are encircled by the Apennine Mountains which line the coast and limit available space for developments. Road and motorway connections that serve both the port and the city are congested much of the time and the rail network of Genoa, used by some 17 per cent only of containerized goods in 2006, has limited spare capacity.

The immediate hinterland of the port of Genoa, and currently also its main market area, is the Po plain of northern Italy, just north and north-east of the Apennines Mountains that surround the port and the city. Over 24 million people live in the regions of the Po plain, which includes the city of Milan, and almost 50 per cent of the Italian gross domestic product (GDP) relates to them (ISTAT, 2007). Such hinterland is currently contested between Genoa and the Northern European ports: the latter ones are successfully connected to the freight centres of northern Italy by many rail shuttles per week.

Existing plans for Genoa aim at reaching a total container throughput of up to 3.2 million TEUs a year. Yet, lack of space to expand the port along with the lack of spare capacity on the transport connections to the hinterland as well as the current successful penetration from the north into markets very close to Genoa, limit the chances of a further effective expansion, possibly confining the Genoa container port to a minor role in the area.

However, Genoa enjoys an attractive geographical position, both in terms of potential hinterland and of maritime routes. Many of the high-income areas of Italy and South and Central Europe are closer to Genoa than they are to the Northern Range ports (and the Alpine crossings are being further developed). Besides, the maritime journey to Genoa from the Far East via the Suez Canal is approximately four to five days shorter than the journey to the Northern Range ports. Moreover, the Genoa Voltri port may allow, with some dredging, water depths of up to 20 m (65 ft).

The project idea outlined in this paper aims at reaping the potential of such positive features by implementing infrastructural and organizational changes, so as to make the Voltri container terminal, once expanded with a dry port, able to deal with a throughput of up to 10 million TEUs a year.

What the project idea envisages is a port providing a real option also for mega-containerships, thus becoming a true reference point for containerized freight to and from northern Italy, and a Southern European container gateway. In such a scenario, Genoa would be able to capture part of the foreseen general growth in container traffic, the part for which it is geographically competitive, which would otherwise be adsorbed mostly by Belgian, Dutch and German ports therefore loading further, and possibly straining, the railways and motorways crossing Europe in the north-to-south direction. This scenario would entail a sort of competition/cooperation among Mediterranean and Northern Range ports resulting in a rational use of cross European transport infrastructure, particularly of some of the main corridors being upgraded or developed, such as the Genoa-Rotterdam one.

II. THE SEAPORT/DRY PORT CONCEPT AND ITS APPLICATION TO GENOA VOLTRI

The key idea of the redevelopment of the Voltri container terminal is the full implementation of the dry port concept. Only port operations that need to be on the quays remain there (loading and discharging containers onto/from ships), the others are moved to a dry port located where space for the required facilities is available and where such facilities can be efficiently linked to the transport networks, especially the rail network. The dry port becomes the actual land access to the container port, also in terms of customs. In the case of Genoa the location of the dry port would be in the plains north of the Apennine Mountains thus avoiding linking the dry port to the rail and road network of the Genoa area and obviating the space limits due to the urban and mountainous environment along the coast. The dry port for the Voltri terminal could be placed at a distance from the seaport of about 30-40 km, although at present an actual possible location, or set of locations to choose from, has yet to be characterized.

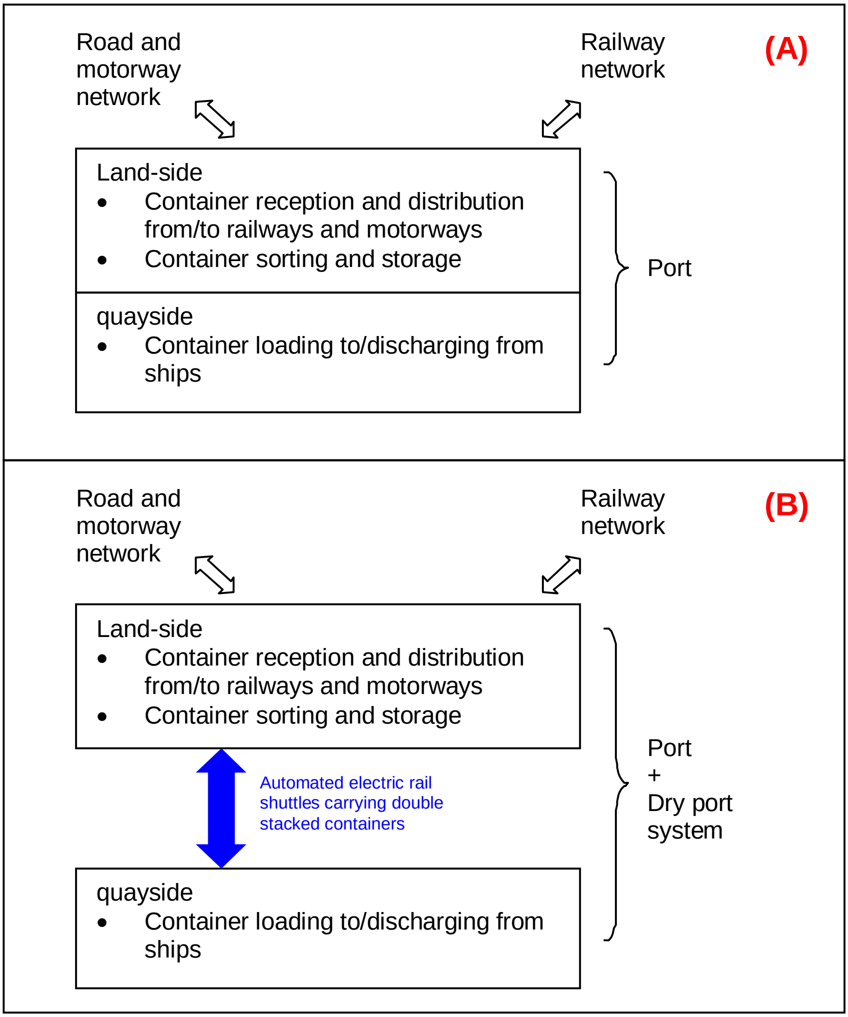
The concept of the transformation being put forward is shown in figure 1. While the working of the present seaport could be sketched as in the top part of the picture, the future dry port plus seaport system would be as shown in the bottom part of figure 1.

The connection between seaport and dry port is a crucial element and its role is to make the two sections of the port work as a single system, as if they were close to each other. In the Genoa Voltri case the connection would be provided by automated electric rail shuttles taking the containers directly from the foot of the ship to shore cranes to the yards in the dry port, or the other way. The shuttles are not intended for general railway circulation but only for use between the seaport and the dry port and would run on a dedicated line, part of which in a tunnel through the Apennines.

III. FROM IDEA TO IMPLEMENTATION: THE INITIAL STEPS

The work towards the development of the seaport/dry port system idea for the port of Genoa is now at the end of its second phase. The first part of the work ran from early 2005 to mid-2006 and, after a series of presentations to stakeholders, the results have been reported in a book edited by Lami (2007). The aim of that part of the work was to delineate the idea (Roscelli et al., 2007) and start investigating some of the issues that would determine its viability. Among the subjects included in that discussion and investigated were the redesign of the Voltri terminal layout (Belforte and Musso, 2007), elements towards the design of the container loading/unloading system directly between ships and shuttles, the rail shuttles and the layout for their tracks in the port (Belforte et al., 2007), as well as the geology of the area that would be crossed by the tunnel for the shuttles (Barla and Amici, 2007) and the methodology to carry out an environmental evaluation of such a large and complex system (Bottero et al., 2007). The initial study also included a discussion of the Italian port system (Musso, 2007) and a first investigation of the financial feasibility of the project (Lami, 2007): from the very beginning, the intention has been to put forward an infrastructure and a system which would pay for itself and could be developed within a project financing operation.

Figure 1. The port system (A) and the seaport plus dry port system (B)



Source: SiTI and collaborators (2009).

While only delineating some of the elements of the proposed port system, the results of the first work stage have allowed the working group to take the project into the realm of public debate and to present the idea to different levels of government and to the press.

It should be mentioned that the groups that have worked on the development of the idea, both in the first and second stages of the study, have been made up of professionals and researchers from several disciplines, as well as maritime transport operators.

The second stage of work, which started in mid-2007 and was being finalized as of mid-2009, involves the further development of many of the points already considered as well as work on several new points concerning the general viability of the project. The results of this latter stage of work are being collated, as this paper is being written in SiTI et al. (2009), a detailed internal report which describes the points outlined in the remainder of this paper and explores further ones.

It should be remarked that, although the results obtained during the second stage of work add a further set of building blocks towards the feasibility assessment of the Voltri seaport/dry port system idea, further work would be required to complete a comprehensive feasibility study. This is not simply a matter of resources and time to take the study forward. More importantly, it is a matter of proper and timely involvement of the public administration and, in general, of the stakeholders at local, regional and national level, in the actual development of the idea. The promoters of the Voltri transformation study have so far been private: for instance the second stage of work has been financed mainly by SiTI (the research institute leading and coordinating the project), with the contribution of several maritime transport operators based in Genoa. However, the social and economical effects of the project are so wide that the public decision makers need be involved to steer the project as soon as it goes beyond an initial study. Their involvement will also be warranted during the operative stage of the new port system, when infrastructure and services will need fair regulation and control. Also the public acceptance of the project requires the involvement of public decision makers and stakeholders in the steering and development of the idea.

In fact, the dissemination of the results of the first stage of the project has attracted the attention of the local administrations that encouraged its development in an agreement signed at the beginning of 2008 between the Liguria Region, where the port is, and the adjacent Piedmont Region, where the dry port will be. More recently, at the end of October 2008, a further document signed by the Liguria and Piedmont regions, and by the neighbouring Lombardy Region, fostered the establishment of a promotion agency for the project. The role of the promotion agency should be to take the idea discussed thus far and refine it so as to reach the preliminary design stage required to start a project financing operation.

IV. THE ENVISAGED SEAPORT/DRY PORT SYSTEM

The proposed redevelopment of Voltri into a seaport plus dry port system is innovative in several ways: for instance, it involves a step change in the container throughput of Genoa, in the role of the port and of its hinterland, in the opportunities for the dry port area; it also involves the development of methods and means to transfer efficiently containers directly between ships and rail shuttles, it will require a rail shuttle system able to deal efficiently and fairly with a very large number of containers per day as well as a new organization of port operations.

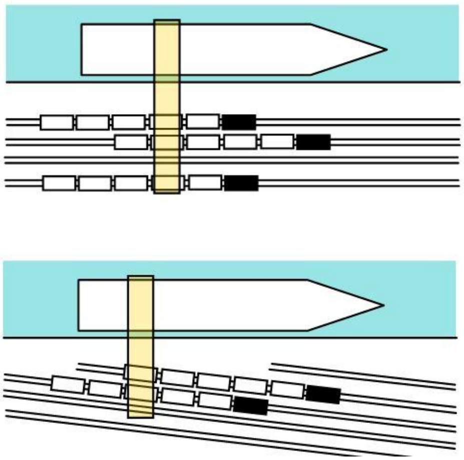
A. The seaport and its operation

As mentioned earlier, central to the redevelopment is the idea of keeping on the quays only the port operations that need to be there (loading and discharging containers onto/from ships), while the remaining operations (including storage, sorting, reception, and distribution via rail and road links) are relocated inland in the dry port. The latter becomes the actual land access to the container port, even in terms of customs. Therefore, the dry port being planned fits into the dry port framework developed by Leveque and Roso (2002) whereby “a dry port is an inland intermodal terminal directly connected to seaport(s) with high capacity transport means, where customers can leave/pick up their standardized units as if directly to a seaport”. However, an important element that characterizes the dry port considered in this work is that it is intended as an integral part of the port rather than as an intermodal freight centre linked to the port but independent from it.

Much of the work both in the first and second stage of the study has been devoted to the development of the layout of the seaport and of the shuttle tracks within it, and to the study of ways to transfer as directly as possible the containers between ships and rail shuttles. All those issues are strongly connected and condition one another.

According to the initial proposal (Musso and Belforte, 2007) the rail shuttles would automatically move along their tracks on the quays so as to place a wagon with an available container slot under the trolley of the relevant STS crane, which was to transfer the containers directly from the ship to the shuttles in the order they were discharged. Once fully loaded, each shuttle would go to the dry port where the containers would be sorted. When containers were to be loaded onto the vessels, they would be ordered on the shuttles so as to reach the foot of the STS cranes according to the ships’ loading plan. The layout of the shuttle tracks on the quays is very important to make all of the above possible, both the shuttle movements alongside a ship and the traffic of shuttles in and out of the seaport. The possibility of having tracks parallel to the quays or, alternatively, approaching the quay at small angle have been studied (see the sketches in figure 2). To ensure free movements of the shuttles under the STS cranes, the layout entailing loading/unloading tracks approaching the quay at a small angle and main line tracks parallel to the quays (for shuttles moving in and out of the seaport) was chosen (Musso and Belforte, 2007).

Figure 2. Illustration of container movement between vessels and shuttles

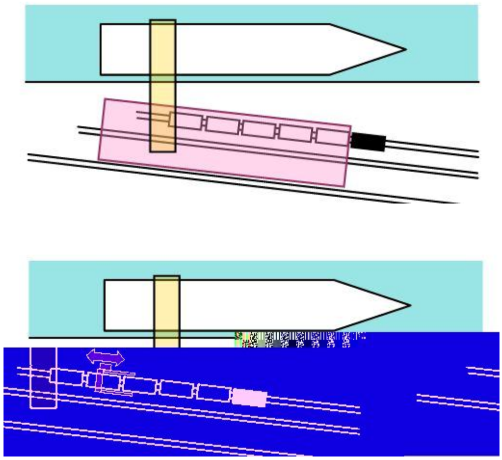


Source: SiTI and collaborators (2009).

Note: Sketches showing the arrangements initially examined to transfer containers directly between vessels and shuttles. The band across vessel and tracks exemplifies the action range of a STS crane. Main line tracks are not shown.

The general idea of port shuttle loading/unloading system described above has been re-discussed in the current part of the study. The plan to have shuttles leaving the seaport and moving to the dry port as soon as they are loaded, carrying containers yet to be sorted, as well as the idea of having shuttles arriving into the seaport with containers prepared according to the loading plan of the container vessels have been kept unchanged since they are part of the leading idea of relocating most "dry" operations to the dry port. However, the loading/unloading system for the shuttles in the seaport has been redesigned so as to have stationary rail shuttles at the foot of the STS cranes and containers taken between cranes and shuttles by either small automated gantry cranes—each one spanning two tracks and a buffer space—or, alternatively, automated straddle carriers (see the sketches in figure 3). The two options are currently compared with each other. Moving the rail shuttles at the foot of the STS cranes to facilitate loading/unloading operations has been shelved due to energy efficiency reasons (with the latest concept, a single container is moved each time rather than the whole shuttle) as well as for safety and simplicity of operations (obtained especially with automated gantry cranes). Moreover, introducing a further transfer step means having some flexibility and being able to allow for buffer space and operations e.g. by providing buffer space along the tracks where containers being shifted, reloaded, or deserving immediate attention can be placed temporarily.

Figure 3. Illustration of container movement between vessels and shuttles



Source: SiTI and collaborators (2009).
Note: Sketches showing the arrangements examined to transfer containers between vessels and shuttles in the current stage of the study. The band across vessel and tracks exemplifies the action range of a STS crane. On the left, the arrangement entailing a gantry crane across two tracks and a buffer lane (the rectangle over the tracks represents the working area of the gantry crane). On the right, the arrangement with automated straddle carriers loading/unloading the shuttle. Main line tracks are not shown.

Although the organization of container transfers and shuttle operations on the quays has been changed, the idea of having loading/unloading shuttle tracks approaching the quay at an angle—set at 7° with respect to the quay to refer to commercial railway track equipment—has been retained since it allows relative independence of movements among shuttles. Moreover, when automated straddle carriers are assumed to move over the shuttles to load/unload them, that track layout limits track crossings required to straddle carries.

The loading/unloading tracks located on the quays are then connected to the shuttle main lines which lead to a yard within the seaport where shuttles can queue, overtake one another and be stored (e.g. when ready for use) or kept aside (e.g. for maintenance), and manual operations can be carried out in a cordoned area (for instance, the connection and disconnection of reefers from electric power). The main line connections within the seaport, at present envisaged with two tracks per direction, include also buffer spaces and further allow for shuttle overtaking.

A simulation analysis is planned for the continuation of the study which will clarify the functionality and the efficiency of the track layout being put forward. The simulation will investigate the effects of the intense shuttle traffic foreseen within the seaport system, support the development of possible amendments to the layout and validate the final layout proposal.

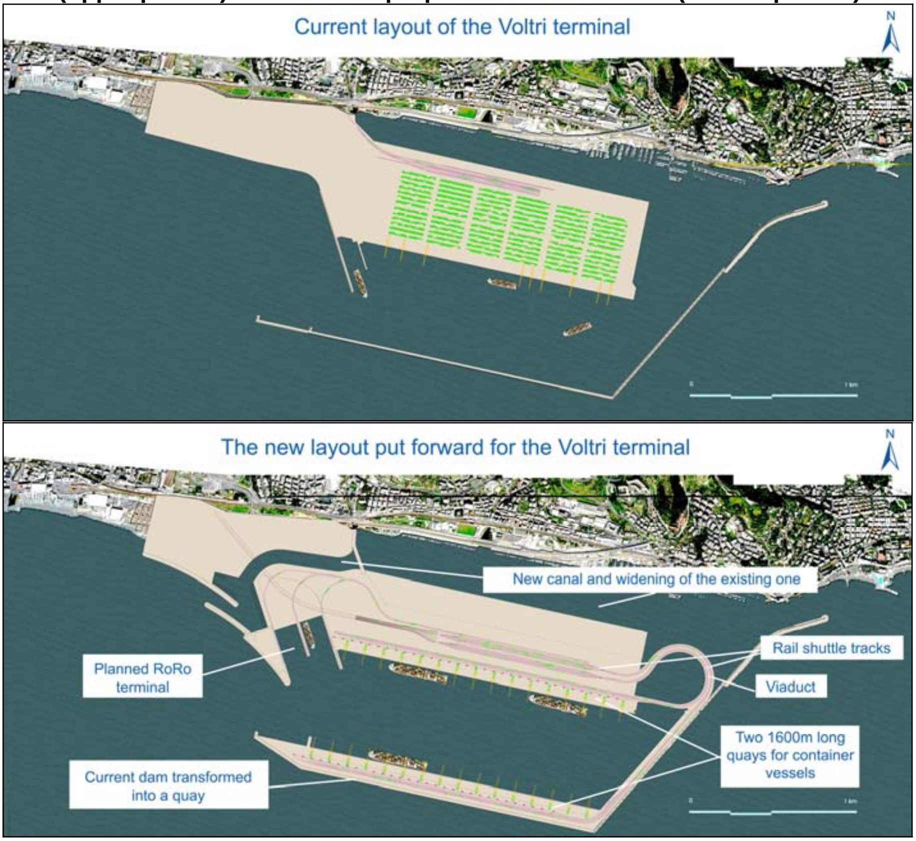
B. The rail shuttles

The possible design for the shuttles has also been reconsidered during the advancement of the study in connection with the operations they should carry out. It is expected that a uniform set of shuttles will run within the system. They will be totally automated block trains, travelling at relatively low speed (30-40 km/h) and consisting of a locomotive and five flat wagons, all derived from standard railway rolling stock with limited changes. Each wagon will carry containers on two tiers (i.e. doubly stacked) on an 80-ft serviceable platform. Thus, the maximum payload for each wagon will be 8 TEUs, resulting in a maximum payload of 40 TEUs per shuttle. The actual payload for a particular mission of a shuttle will be the result of the size and weight of the containers carried. For instance, the shuttles clearly allow for 45-ft or 53-ft containers, but in those cases their full payload would not be exploited. The preliminary dimensioning of the shuttles has considered typical weights of containers so that weight should not be a limiting factor on the actual payload.

C. The new layout and the transformation of the seaport

Figure 4 shows the current layout of the Voltri container port and the new layout being put forward. The latter entails the widening and redevelopment of the current dam into a quay, its connection to the existing section of the terminal with a viaduct and a transformation of the equipment of the current terminal. In the final configuration the port will have two 1,600-m long quays equipped for mega containerships. The work carried out has also involved nautical simulations with an experienced port pilot simulating manoeuvring and berthing very large containerships such as one 400 m in length (comparable, for dimensions, to the Emma Maersk).

Figure 4. Artist's impressions of the layout of the terminal at Voltri as it is (upper picture) and after the proposed transformation (bottom picture)



Source: SiTI and collaborators (2009).

The two quays are designed to work independently in terms of tracks: the shuttle yard shown in figure 4 is actually divided into two identical yards, one for each quay. The main line tracks departing from the yard in the terminal reach the dry port via a tunnel which could begin directly from the seaport, avoiding the need to build a viaduct across the urban area, the motorway and the railway along the coast.

Some of the transformations have been conceived during preliminary discussions of the idea with the urban planners of the city of Genoa. In particular, the idea of widening the canal between the coast and the terminal as well as linking it to the small port planned on the west side of the terminal (see again figure 4) have been put forward in order to obtain a general improvement of the urban environment around the port area. Similarly, the suggestion to link the current terminal to the dam redeveloped into a quay by using a viaduct rather than filling the space comes from the intention of leaving the area open for the circulation of the water. First investigations on the coastal environment and the circulation of the water within the current and the redeveloped terminal have been carried out while the layout was being drawn.

While outlining and investigating the technical aspects of the Voltri seaport/dry port system once operational, care has also been taken to envisage a viable set of steps for the transformation. For instance, civil engineering work stages have been outlined so as to keep the terminal in operation while it is enlarged. The tunnel out of the seaport may be excavated in stages working from the northern part of the current terminal. The reusable material resulting from the excavation of the tunnel should be transported, at least in part, through the tunnel itself and used in the civil engineering works for the construction of the new quay. Thus, the widening and transformation of the dam to build the southern quay will take place along with the excavation of the tunnel. The construction of the dry port, at least of a first part of it, and of its connection to the rail and road networks, should be carried out at the same time. Once the Southern quay along with a first set of shuttle tracks, including a yard in the seaport, is operational and connected to the equally operational dry port, maritime transport operations would move to the new quay and system and the transformation of the existing one (the northern terminal) would start, again without hindering container traffic in the open part of the new terminal.

D. The tunnel between the seaport and the dry port

Early study of the geology of the mountains to be crossed by the tunnel between the seaport and the dry port have led to assume that it should be possible to use tunnel boring machines (TBMs) to excavate much of it (Barla and Amici, 2007). The final internal diameter of a tunnel for a double track line will be 11 m, due to the loading gauge of the shuttles carrying doubly stacked containers. The underground link is for the exclusive use of the automated shuttle so it is assumed that a double track line can be accommodated in a single tunnel. Actual profile of the tunnel and timing of the excavation will depend on how many excavation faces will be employed.

E. The dry port

When the shuttles reach the dry port, travelling along a dedicated line, they enter yards similar to those provided in the seaport, built for the same purpose (queuing, overtaking and storing of shuttles, performing manual operations) and then proceed to the actual dry port.

Several layouts have been studied, allowing for separate spaces for each terminal operator. All of the layouts explored share similar features such as:

- facilities for unloading and loading the port shuttles to/from container storage yards
- rail yards able to accommodate container block trains assumed, in the first instance, to be 750 m long
- truck loading/unloading area along with customs facilities and services for terminal operators

The possibility of adopting a structured automated container transfer system for the dry port, with automated gantry cranes over the tracks, the truck loading/unloading areas and the yards, is compared in the study with a less structured solution involving automated gantry cranes over the container yards and the railway yards, and straddle carriers to exchange containers among yards, shuttles, and trucks. Thus the two options explored for the dry port are similar to those put forward for the seaport.

Current estimates for the space required by the dry port are of the order of 500-600 hectares, compared to an area of 90 hectares in the seaport. It should be noted that the dry port is intended as a transport facility for container storage, sorting, reception, distribution via rail and road links and does not accommodate value added services. Those are expected to locate nearby, as are production and service industries.

One of the key points of the project is that the dry port is both an extension of the seaport and the land access to it. Containers are delivered or picked up from it as if from a seaport, which hosts customs and similar operations. A similar arrangement, initially as a test trial, is already part of daily activities at Voltri: since November 2008, some of the containers discharged at Genoa Voltri have been taken by conventional trains to the freight centre of Rivalta Scrivia, about 80 km from Genoa, where they clear customs. What is particularly relevant for that train service for the project discussed in this paper is the admission of the inland freight centre as a port of discharge for customs purposes, thus making it effectively a dry port.

The study being finalized involves also non-engineering issues such as an early investigation of the territorial and socio-economic effects of the project and of the reorganization and possible relocation of service and production industries that the project may be expected to bring about.

F. Environmental issues

The first stage of the study included early work on environmental issues with Bottero et al. (2007) looking at the relevant evaluation, regulation and planning frameworks. More recent work includes a preliminary sustainability assessment which has looked at different issues albeit with the level of detail allowed by the early stage of the idea development. Particular attentions have received the environmental issues related to the development of the port, the coastal environment, the water movements and sediments due to different port layouts as well as the treatment of port refuses. Other issues have been treated, so far, with broader details performing an analysis of the general areas where the dry port might be located and of the possible corridor for the shuttle link.

G. Financing design and construction

As mentioned above, the project idea of the Voltri port extension is taken forward on the principle that it could pay for itself and as such be put forward for project financing. Early estimates indicate a total cost of around 3.7 billion euros, over a billion of which is for cranes and automated shuttles. On the basis of the same early estimates, it has been evaluated that the project could reach the break-even point after 16-17 years from its inception.

CONCLUSION

This paper reviews the progress of an idea to develop the Voltri container terminal, located within the port of Genoa, and expanding it with a dry port so as to make it able to accommodate mega containerships and deal with a throughput of up to 10 million TEUs a year, thus becoming an important gateway port for Southern Europe. The evolution of the study has been reported summarising some of the strands of work carried out so far and some of the options explored as well as mentioning the progress in stakeholders' involvement and, in particular, which steps the public administrations have taken so far to foster the development of the seaport/dry port system idea. It is important that stakeholders are involved in the further development of the study since what it envisages is a transformation so important as to imply a step change for both the port of Genoa and its hinterland.

The points outlined above are documented in detail in the study by SiTI et al. (2009). That report cannot be considered a complete feasibility study, yet. In fact, there are a number of points still requiring investigation, including the following:

- the simulation of the operation of the elements of the port/dry port and of the system as a whole
- an in-depth market/catchment area study for the new port system
- an in-depth analysis of project's effects in terms of economic impact, employment, and local area governance
- the refinement of dry port feasibility study according to possible location(s), and the characterization of the links to rail and road network
- the environmental impact and its mitigation

- the characterization of management and control options for the whole system
- their development will also allow a further refinement of the financial evaluations to draw the general picture towards the case for a project financing operation to implement the project

A point of general interest of the project idea is that, although it is developed with Genoa Voltri as a guiding application, it can be adapted to other situations where there are similar issues: lack of space, congestion of infrastructures in the vicinity of the port and, in general, a need to expand/relocate a section of the port space away from the quays.

REFERENCES

Barla, Giovanni and Riccardo Amici (2007). Inquadramento geologico del progetto di collegamento ferroviario transappenninico. In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian), Lami I.M., ed. (CELID, Torino).

Belforte, Guido and Bruno Musso (2007). “Ipotesi di riorganizzazione della banchina”. In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian) Lami I.M., ed. (CELID, Torino).

Belforte, Guido, Terenziano Raparelli and Angelo Costamagna (2007). “Linea di collegamento ferroviaria della banchina con il porto decentrato”. In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian), Lami I.M., ed. (CELID, Torino).

Bottero, Marta, Giulio Mondini and Marco Valle (2007). “Le relazioni tra ambiente e progetto“. In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian) Lami I.M., ed. (CELID, Torino).

Lami, Isabella M. (ed.) (2007). *Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale* (in Italian), (CELID, Torino).

Leveque, P. and Violeta Roso (2002). *Dry port concept for seaport inland access with intermodal solutions*. Master thesis. Department of Logistics and transportation, Chalmers University of Technology.

Musso, Bruno (2007). “Il porto di Genova: dalla riforma degli anni novanta alla sfida trasportistica del XXI secolo”. In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian), Lami I.M., ed. (CELID, Torino).

Roscelli, Riccardo (2007). “Origine e finalità dello studio”, In: Genova: il porto oltre l’Appennino—Ipotesi di sviluppo del nodo portuale (in Italian) Lami I.M., ed. (CELID, Torino).

Roscelli, Riccardo, Bruno Musso, and Isabella M. Lami (2007). “Una nuova logica di collegamento tra il porto a mare ed il porto decentrato”, In:

Genova: il porto oltre l'Appennino—Ipotesi di sviluppo del nodo portuale (in Italian), Lami I.M. ed. (CELID, Torino).

Roso, Violeta, Johan Woxenius and Kenth Lumsden (2009). "The dry port concept: connecting container seaports with the hinterland", *Journal of Transport Geography*, vol. 17, No. 5, pp. 338-345.

SiTI and collaborators (2009). *Genova: il porto oltre l'Appennino. Studio di pre-fattibilità fase 2. Internal report* (in Italian).