EXTERNAL INTERACTIONS FOR A THIRD GENERATION PORT: FROM URBAN SUSTAINABLE PLANNING TO RESEARCH DEVELOPMENTS

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ABSTRACT

The paper describes the external structural factors required for the development of a port towards third generation. Following the UNCTAD definition, a port qualifies as third generation if the activities performed on the premises increase the added value of freight in transit.

The analyzed factors concern infrastructures and services, either material or immaterial, which contribute to the increase of freight value, in the process of interaction with the port surrounding area.

The problem studied is that of a container port which, from a simple transit node, aims to become a third-generation port. The problem has been studied in the literature for what concerns the activities within the port. The paper considers the interactions activated with the external areas, both in terms of integration with urban areas, and their sustainable development, and in terms of relationships with research centers to improve the processes of transformation of goods in transit.

The Italian port of Gioia Tauro is presented as case study in the final part. The external interactions connected to urban development, and the external interactions connected with university research near the port, are examined.

Keywords: third generation port, port competition, urban sustainable development, urban regeneration, new town, port research.

1 INTRODUCTION

The port's function evolution is depicted by the theoretical model of classification introduced by United Nations Conference on Trade and Development (UNCTAD) [1], [2], in terms of port generation. According to UNCTAD schematic classification, each port can be attributed to a specific generation.

Ports of the first generation concern the past centuries, until the first part of the 20th century. Ports operate in strict relation to the city's needs, ensuring commercial interchanges between the city and other territories linked with maritime connections. Historically, the best natural locations are identified first as ports, and then the cities develop around them.

Ports of the second generation characterize the second part of the 20th century. Ports serve the needs of the large industrial areas located in their surroundings. Large industrial settlements (petrochemicals, steelworks and power stations) require large transport capacities. For industrial ports, it can be assumed schematically the opposite dynamic of the city port, as first the large industrial areas are developed, and then the ports to serve the area are created.

Ports of the third generation were born with the container revolution, in the last decades of the 20th century. The container is the main unit for the transport of goods, both intermediate and finished, between productions and consumers. The container introduction consists of standardization of the container (Twenty Equivalent Unit, TEU) transferred by ships suitable for unitized transportation. Containerization allows the globalization of the economy. The sizes of ships increase in terms of number of containers transported. At the same time, the ships suitable for containers and therefore hyperspecialized are born. The development of containerized cargo volumes and the realization of intermodal connections networks make it possible to create global interconnections. Ports of the third generation play a relevant role

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in the international supply chain. These ports have deep docks, gantry cranes, large squares parking, intermodal equipment, spaces of service. Fundamental characteristic is the simplification of procedures related to freight transport and to logistic supply chain's needs. An analysis of the factors that define the generation of ports with the application to a national real case is reported in Russo and Musolino [3].

The historic industrial plant, where raw materials entered and finished products came out, is replaced by the modern plant that operates on some production parts and is deeply integrated with other plants that can be found at any distance, even in other continents.

The third-generation ports assume both the role of unloading port of goods for final consumption and that of embarkation port in the production areas. The distinctive feature of a third-generation port is given by the increase in value of the goods passing between the entry into the port and the exit.

From a territorial point of view, third generation ports are not close to highly urbanized areas or even close to highly heavy industrialized areas.

The problem that arises therefore has a double aspect: on the one hand it is necessary to identify the contribution that the territory can make to increase the added value (AV) of goods in transit in the port, on the other it is necessary to guarantee the sustainable development of the urban areas adjacent to the port.

To give an answer to the problem raised, it is therefore necessary to identify the external factors connected with port activities, in terms of physical (material) and intangible (immaterial) development components of the territory.

The paper is divided into various sections. Section 2 presents the problem of strategic economic goal for a third-generation port. Section 3 deals with the methodological problem of territorial and urban planning for a low-density area where there is a large port infrastructure. In section 4, the methodological problem of increasing the AV correlated to the development of research necessary to the port is presented. In section 5, an illustrative case study of the posed problems is examined, considering the Trans-European Networks – Transport (TEN-T) core port of Gioia Tauro, a hub of the TEN-T located in southern Italy. In the conclusions, the main elements are evidenced to develop further research and applications.

The novelty of the work consists in defining the problems of integration with external areas, material and immaterial, for a third-generation port. The scientific literature has dealt with deepening the characteristics, territorial and economic, internal to the port [4]–[10] while the characteristics relating to external interactions have been only introduced [11]–[13]. The investigated problem has general implication for all territories where a big transport node falls.

In this context, it is important to insight the possibility of integrating urban areas into a major transport infrastructure.

The work can therefore be of great interest: for national and international transport network planners, for regional and local planners who work on territorial plans, for the technicians of the port system authorities who must prepare internal plans to ports, for universities and research centers that collaborate in the development of third generation ports.

2 PLANNING GOAL FROM GLOBAL TO LOCAL

2.1 Functional relation between costs and benefits for a third-generation port

The main theme of the paper is the evolution for a port to be classified as third generation. In this process all ports, at international scale, optimize the internal characteristics of

the port area, considering almost adiabatic to the outside territory. In this note, instead, the interactions with the external territory are considered, interactions which allow an achievement of the objectives. The interactions considered are in line with the Brundtland report [14], and Agenda 2030 [15], [16], that can be studied for group of goals [17], [18].

Focus is therefore placed on the interventions that can be carried out in the areas outside the port. The formulation proposed by Russo and Chilà [5] regarding the infrastructural interventions to be carried out inside the port can be recalled. In the same way it is necessary to consider both the interventions connected to the increase in transport performance and those related to the increase in AV. In line with the aforementioned paper, interventions that reduce transport disutility are perceived- in any case- by users as costs, interventions that increase AV are considered as utility. Literature [19]–[21] underlines from one side the role of high levels of performances in transport operations, and from other side the operations on goods in transit, that increase their AV.

Considering costs and benefits in absolute value, the potential optimal situation for a third-generation port can be written as:

$$|\textit{costs in the port a (by transport)}| < |\textit{benefits in the port a (added value)}| \quad (2.1)$$

It should be noted that as long as the port remains a place of transit for goods, the management will try to improve the performance of transport, trying to reduce costs more and more. It is evident in this case, when the eq. 2.1 is not true, that there will always be the probability that another port *b*, in the same economic regional area, will be able to give better performance. Therefore, said *a* the considered port and *b* a generic other port, it could happen that:

$$|\textit{costs in the port b (by transport)}| < |\textit{costs in the port a (by transport)}| \quad (2.2a)$$

In the event that AV is created in the port *a,* and that its absolute value is greater than the cost, then the eq. 2.1 is true, the possibility that there is a port *b* in which greater AV and lower cost are created is, at today, negligible. In another world other than eq. 2.2a must be true that:

$$|\textit{benefits in the port a (added value)}| < |\textit{benefits in the port b (value added)}| \quad (2.2b)$$

In any case, as the difference in absolute value between benefits and costs (eq. 2.1) increases, the port will tend to become increasingly non-replaceable in the economic market. Note that this is the situation today, with the presence of few ports that have been created for transshipment. The evolution of ports, with the creation, for example, of special economic zones close to transshipment ports where to create AV, increasingly leads ports to compete both in cost reduction (eq. 2.2a) and in the increase of AV (eq 2.2b) generating an increasingly competitive situation. Competition in the same areas leads on the one hand to maximizing the conditions referred to in eq. 2.1, even with a massive use of ICT, and on the other hand to find forms of cooperation with neighboring ports.

An even important effect is that deriving from external characteristics of the port area. If the external territory also provides conditions, both material and immaterial, so that the costs of transit decrease and the AV increases, the strategic advantage of the port becomes not fungible and replaceable.

The chosen model is the one proposed by Lowry [22] and following developments [23] –[25]. However, the model must be seen in a new perspective in which the external sectors are known and connected to port activities.

The model divides the activities present within the study area into three sectors: basic sectors; non-basic sectors; household sectors.

Following Lowry's generalized approach, the basic sector includes the port (third generation) whose customers are non-local. In fact, the port is chosen by the shipping companies 'regardless' of the local market, and employment depends on events outside the local economy. The residency-oriented sectors are: commercial and administrative businesses, local authorities, schools, and others that relate to the local resident population. For these sectors, it is assumed that the location is constrained by the accessibility of the residents, and therefore the employment is connected to the local population growth. The household sector consists of the resident population.

In an urban system the total uses, in terms of activities (E_{tot}) are equal to the sum of the uses in the basic sector (E_{b}) and the uses in the non-basic sector (E_{nb}):

$$E_{tot} = E_b + E_{nb} \tag{2.3}$$

The model thus formalized, allows to segment the activities of the port, E_b, and those of the population E_{nb}, regardless of the port, highlighting specific contributions on the total activities

The issue is particularly important because, on a European and global scale, in many cases the big transport nodes have been created 'ex-novo' and are completely free of interactions. with the territory: high-speed railway stations, international airports, third generation intercontinental ports. It is therefore useful to recall in an extreme synthesis just the international objectives and those of a local scale to which a port aims, in order to analyze in the next sections, the external interactions material, with the physical territory, and immaterial, with the developed research, which can contribute to the target achievement in terms of sustainable development and conditions to increase value added.

Figure 2.1 represents the external interactions of ports.

2.2 Local goals and material territorial integration

Many large container ports share a situation that sees them with poor territorial integration. The port produces value only from transport activities, with no further AV on goods in transit. In eq. 2.1 the value of benefits is zero. This limit arises firstly from the lack of services and suitable industrial areas, so that particularly high performance in internal handling does not correspond to any further activity capable of increasing the value of the goods.

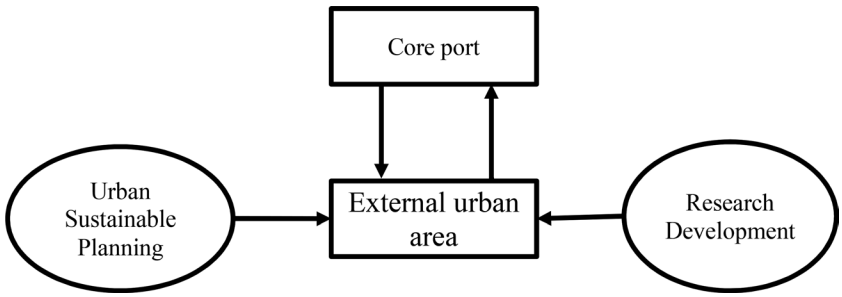

Figure 2.1: External port's interactions.

Alongside the port, there are often low-density urban areas with high unemployment rates and a lack of adequate services [13], [26] – [28]. Today, many ports in the world find themselves in these two conditions: only transfer inside and low-density/high unemployment outside the port.

A port becomes of third generation when it is able to produce AV beyond that connected with container handling activities. These activities can develop if services are available that allow to create AV. AV is a measure of increase in value of goods that is obtained thanks to the intervention of specific production factors. The local objective is therefore to develop the activities that can increase the AV of the goods.

The production factors that are considered in this work are those connected with the integration of the areas outside the port, if these can contribute to the development of the port itself and do not, on the contrary, turn into weighting or brake. The focus here is on urban integration and not on industrial areas which is developed in other works [10]. The contribution that urban areas can make is to supply more or less centralized services.

Specifically, from one side, infrastructures can be created for the localization of financial, economic and commercial services activities to be shared with urban areas; from the other side residential areas can be defined to support port employees, with territorial protection process that provide for the regeneration of already urbanized areas, or, in case of completion of existing urban areas, the definition of new settlements as new town.

The construction of the business center and the activation of the specific services is a prerequisite for the development of the AV. The territorial integration, in the immediate future, allows to drastically reduce the overall transport costs (monetary and environmental) of the employees, while, in a strategic horizon, it allows to raise the knowledge and skills of the community with respect to port activities, creating activities that generate AV. The integration of the population in the development of the port must take place without inducing constraints on port activities. In other words, the port must be an opportunity for the sustainable development of the hinterland (Fig. 2.2).

2.4 Local goals and immaterial territorial integration

Research plays a relevant role in the port's sustainable development to a third-generation port. Crucial to creating a third-generation port is, as previously introduced, to modify the AV for in transit goods. The increase of AV must be realized not only with the transport actions

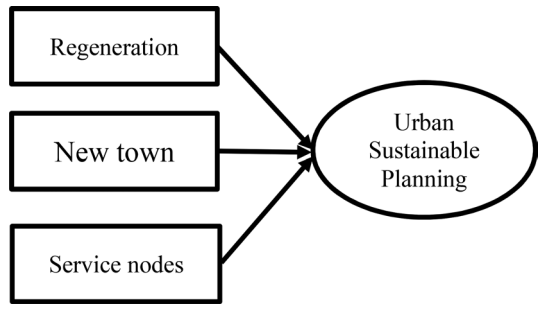

Figure 2.2: Material territorial interactions.

that modify the AV for the new spatial positioning but through new products or new processes that modify the goods. Product and process modifications can be induced by the internal knowledge within the specific company or imported from outside.

Innovation can therefore be generated by development of research derived from (Fig. 2.3):

- research developed within the company;
- contribution from the economic district;
- contribution from external research centers.

This note focuses on the increase in AV given by external research centers. The creation of a general climate of knowledge is an important factor, but the development of research is a crucial factor.

In literature, as seen, AV is defined as the measure of the increase in value that occurs in the production of goods, based on the intervention of production factors. It is therefore necessary to highlight the increase in AV connected to the knowledge derives from a process of collaboration with research centers outside the port.

To activate these virtuous processes, two parallel analyses are necessary [12]. On the one hand, it is necessary to define the economic sectors directly involved in port activities because they can increase the AV. The generic sector is indicated with s and S is the set of all sectors. The second analysis concerns the research centers present in the study area, which carry out research relating to the economic and industrial sectors, obtaining the set R of the research centers, with r the generic center.

Then, it is possible to know the set C of the centers that can support the development of the port, c being the generic center, as:

$$c \in C = S \cap R \quad with\ s \in S;\ r \in R \tag{2.4}$$

Since the identification of set C, it is possible to estimate the needed financial resources:

- to organize the minimal infrastructures for research development in the port area;
- to activate the necessary professional figures among junior and senior researchers;
- to start projects aimed at increasing the AV.

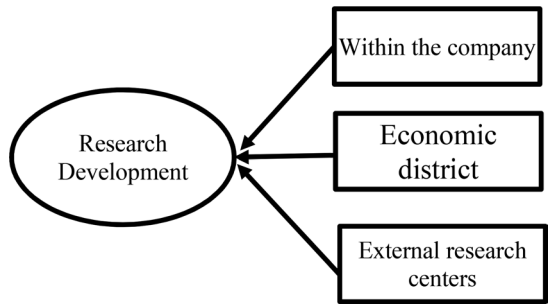

Figure 2.3: Immaterial territorial interactions.

3 URBAN SUSTAINABLE PLANNING

3.1 The main urban problems

Container ports have the potential to evolve into third-generation ports, by producing AV on goods in transit. This assumption arises from the careful observation of the territories in which the infrastructures fall. The analysis allows to structure the vision of the port's evolution, towards a third-generation. From literature about demographic and urban planning, it emerges that a territory, characterized by the presence of a relevant infrastructure such as an intercontinental port, has different development dynamics compared to a territory without such a port [29]. The interest is on the territory surrounding the port and on its interactions with urban areas. This paper focuses on the territorial external interactions, that potentially contribute to the port's development.

It is necessary to bring together urban planning theories, legislative standards and implementations of reality, one in the other, exchanging objectives and results [30] and ensuring the integral sustainable development of the territories.

In some cases, it happens that the large infrastructures invented from scratch are totally disconnected from the urban planning of the territory, with which they have no relationship, neither physical nor historical [31]. This determines a condition of separation between the large infrastructural work and the territorial heritage. If the port is not integrated into the territory, it does not benefit of the territorial context potentialities. If it does not share the service infrastructures and territorial facilities, it does not produce the maximum possible AV for goods in transit; in this case the port produces only the base value, determined by the transport activities and by internal activities. The port belongs to the third generation, when it produces maximum AV. Part of the AV is determined by the services. The external area must develop service activities and effective interactions with the port that generates AV.

Literature previously recalled about ports and maritime transport at global level [12], [13], underlines the issues of the third-generation ports. Territorial problems concern two macro categories: (1) the built environment for residences and facilities; (2) insufficient, non-interacting and obsolete services.

3.2 Urban regeneration and new town

The port has to be integrated into the territory. Potential territorial degradations in which the port is located must be solved with territorial rebalancing measures. The choice of territorial rebalancing actions is decided with the support of demographic data analysis and estimations for future urban developments. The total population, from eq. 2.3, corresponds to the sum of the population generated by port activities plus the local population. It is possible to consider a variable relating to the activities defined by eq 2.3, using a variable 'surface' which represents the total land consumed. Then it is possible to link this variable to land consumed for residences relating to the basic and non-basic sectors:

$$SUP_{tot} = SUP_{b} + SUP_{nb} \tag{3.1}$$

Where:

SUP_{tot} is the total surface of residences, and is obtained by solving the Lowry model [22]-[24];

SUP_{b} is the surface of residences relative to the basic sectors working into the port;

SUP_{nb} is the surface of residences of the non-basic sectors.

The urban regeneration is chosen if the data, related to the total population (related to basic e non basic sector), compared with the volumes already built, indicate that the redevelopment of the building is sufficient, without consuming further land [32], [33], [34]. On the other hand, if the total population data indicate that it is necessary to construct new buildings, it is possible to intervene using the validated model of the new town. The land subject to regeneration process is indicated with $SUP_{urban\_regeneration}$, the land voted to new town is indicated with SUP_{new_town}, the proposed process relative to the total land SUP_{tot}, can be formalized:

$$SUP_{tot} = SUP_{urban\_regeneration} + SUP_{new\_town} \tag{3.2}$$

From which it follows that:

$$SUP_{new\_town} = SUP_{tot} - SUP_{urban\_regeneration} \tag{3.3}$$

The two possibilities are analyzed and following eq. 3.3, it is concluded that if the total area required is greater than the area obtainable with urban regeneration, it will be necessary to build the new town. If, conversely, the total area is smaller, the new town is not built because the urban regeneration of the existing one is sufficient.

The uncontrolled growth of the inhabited centers around the port area generates a situation of widespread degradation. The territory loses its initial connotations and without an integrated urban plan, it does not develop [33].

Urban sprawl leads to uncontrolled and disordered growth of buildings [35]. The massive extension of the buildings occupies the spaces and generates a strong negative impact, due to the excessive and superfluous land consumption [36]. The rehabilitation and renewal of the territory will be possible with new sustainable projects, both economically and landscaped, aimed to increase the quality of life in the places. The smart proposals, applied according to the smartness categories indicated by the European Union, operate in this direction [37] - [39]. Urban regeneration is achieved with the implementation of projects designed for the recovery and redevelopment of degraded territorial areas, thus ensuring cultural, economic and social growth [40]. The first examples of urban revitalization of the territories were proposed as early as 1960 by Samonà, in Italy and by the urban design movement New Urbanism in the United States [41], [42]. Planning urban regeneration is a basic condition for increasing the well-being of the inhabitants. Urban regeneration carried out with integrated principles will be a smart regeneration [43].

In the case that the existing surfaces are not sufficient to meet the housing needs, new constructions will be built and territorial demands will be compensated by applying the urban planning model of the new town [42]. Urban regeneration is replaced by the design of new urban settlements, suitably located to meet the development trajectories of the area. This operation makes it possible to branch out the existing built-up settlements and reassign new functions with high technological innovation, in a compliance way to the sustainability's

principles. The smart territory is the new smart expression of the integrated unifying system between new towns and urban regenerations.

3.3 Service nodes

The territory that encompasses a port of intercontinental importance must supply integrated services with significant dimensions.

The port has the indispensable need to take advantage of the services offered by the area in which it is integrated and also of strong and distinctive nodes for transport infrastructures. It is considered necessary to carry out interventions for the territorial rebalancing of services and the special endowment of high-quality infrastructures.

The regenerated territory that contains the intercontinental port needs to concentrate the services and management functions in a single space. Metropolitan areas allocate urban or peri-urban spaces to create business centers in which to concentrate tertiary activities, financial functions, commercial enterprises and high-quality services. These places take on significant architectural aesthetic connotations, in order to be immediately recognizable and visually transfer the role they invest. The urban planning choice of the site respects the general canons of accessibility, connection with transport infrastructures and services.

The design of the business center is a decisive step for the transformation of the territories subjected to urban regeneration projects. It is a way to convert disjointed areas, without infrastructural connections, productive interrelationships, cultural exchanges, technological services, territorial coherences, environmental balances, into new towns.

The regenerated territory by an urban project has the ability to support the activities of the port, increasing the AV that the infrastructure, if isolated, closed within its borders, unable to interchange, cannot return to the territory. The business center would accommodate decision-making and management functions, supporting the development and integration of the port with the surrounding area, as well as contributing to the assignment of order and dignity both urban and architectural. It is the physical space in which the integration of smart services takes place. The railway stations of the Italian high-speed network, Mediopadana in Reggio Emilia and Naples-Afragola, are typical examples, as the Valencia station in Spain [44]. These are cases in which the territory regenerates itself by building a quality infrastructure.

4 RESEARCH DEVELOPMENT

4.1 Port activities

In the case of ports that operate only as transport and handling hubs, the AV production is very limited. The efficiency of transport and logistics operations with the large availability of spaces on the land-side, support the realization of industrial and productive activities in retro port areas. It is necessary a strict connection between port operations and industrial development.

The two more diffuse typologies of industrial and productive activities that can be supported by a port of third generation are connected to the mechanical/automotive and agricultural/food sectors. For example, in the Mediterranean Sea, the Tanger Med gateway port, located on the Strait of Gibraltar, is an industrial hub for more than 1,100 companies operating in various sectors. Tanger Automotive City and Renault Tanger Med realize automotive activities, representing the largest assembly site in Africa of the manufacturer Renault. Another

relevant sector is the food industry that produce for instance activities of food packaging, seafood processing. The entire ecosystem, as well as the maritime pole, comprehends the industrial, services and social poles [45], [46]. Other examples concern the East Port Said in Egypt [47] and Enfidha in Tunisia [48].

More in general it is possible to recall the concept of 'industrial symbiosis', according to Neves et al. [49]. It regards the cooperation among entities and companies in order to share resources (material, energy, information) contributing to economic, social and environmental sustainability. In this framework, the research regarding the economic sectors developed and developing in the port assume a relevant role.

Port's activities benefit of the contributions deriving from the research development by internal company, economic districts and in near research centers (section 2.4). It is possible to recall the equation 2.3 for research's development relative to the basic sector, writing:

$$R_{btot} = R_{bc} + R_{bed} + R_{bu} \tag{4.1}$$

Where:

R_{btot} is the total contribution to sectors in the port from research;
R_{bc} is the within company research;
R_{bed} is the economic districts research;
R_{bu} is the university's research centers, on which this paper focuses.

4.2 The main research problems

The port's development, in the perspective of a third-generation, implies a set of investments in research. According to the port activities introduced in section 4.1, it is possible to identify specific thematic of research that are essential for the development of a port towards the third-generation. Research topics concerns issues that directly regards the port or indirectly regards the industrial and economic activities located in the land side.

The challenges related to port's efficiency operations and to economic developing sectors require a support from research about:

- transport and logistics science in order to develop transport system models (TSMs) relative to port management and developing, and logistics models; research products are useful for advancing evaluation methods to compare effects of alternative assets of infrastructures and services (planned scenarios); an integrated set of TSMs represent the support for port operators and decision makers in their planning or managing activities;
- production science for sector connected to mechanical, for instance focusing on automotive sectors, agri-food industry, focusing on the processes for producing and conserve food products and more in general for manufacturing sustainability.

All research sectors benefit of potentialities offered by ICT tools and their applications for increase knowledge about transport and logistics operations and industrial productive processes, o advance in technology readiness level (TRL), in line with EU Commission indications.

4.3 Needed research sectors

In general, it is possible to insight the potential contribution of the research into the port's activities. For this reason, it is useful to recall the classification of the European Research

Council (ERC) that groups all research topics in three main classes and twenty-five sub classes:

- Physical Sciences and Engineering (PE) that comprehends ten sub-classes;
- Life Sciences (LS) that comprehends nine sub-classes;
- Social Sciences and Humanities (SH) that comprehends six sub-classes.

Table 4.1 reports in a qualitative way, the potential contribution that each ERC group could offer to the activities of a third-generation port. Each group could match with the activities in a range delimited between a minimum and a maximum contribution. Table 4.1 represents the minimum contribution with the symbol * and the maximum with the symbol ***.

The research topics must be defined inside a research program that determinates financial resources needed to develop research activities that support direct (transport and logistics) and industrial activities (mechanic and agri-food).

5 THE GIOIA TAURO CASE STUDY

5.1 The study area

The port of Gioia Tauro insists on a land area of about 240 km^2. This area comprehends 33 autonomous municipalities with separated activities with a minimum level of interactions. Even the three main municipalities of Gioia Tauro, Rosarno and San Ferdinando, are not integrated with each other. Figure 5.1 shows the planned study area.

The area has expanded without following the indications of an integrated planning process, therefore: it is not connected by infrastructures; it is not equipped with services; it has no business centers; it is not integrated with the neighboring territories; it does not benefit from the transport logistics system.

The port of Gioia Tauro is a core node of TEN-T network and the Italian transport and logistics plan [50]. The port is configured as an area delimited by artificial borders engraved on the territory. In the world, it often happens that large container ports have poor integration with the surrounding area and therefore cannot use the potential that the area offers.

5.2 Urban sustainable planning: residential area and service nodes

The major problems highlighted in many ports around the world (see section 3), whose solutions make it possible to transform the port into a third-generation, also exist in the study

Table 4.1: Potential matching between ERC classes and port's activities.

Class	Name	Transport	Logistics	Mechanic	Agri-Food
PE	Physical Sciences and Engineering	***	**	***	*
LS	Life Sciences	*	*	*	***
SH	Social Sciences and Humanities	***	***	*	*

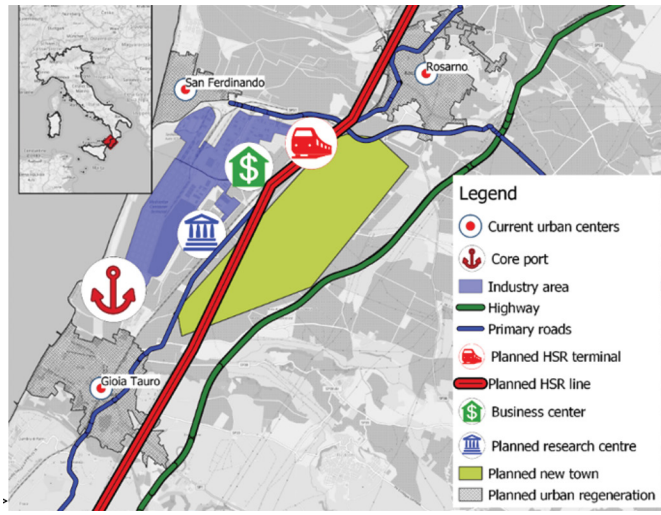

Figure 5.1: Planned configuration of the study area.

area of the port of Gioia Tauro. The proposal is to develop the territory in an interconnected sustainable system, considering also the smart aspects. The planning activities will make the territory reach high levels of sustainability and smartness. Urban regeneration makes it possible to recover and redevelop the severe degradation of the territory in which the port is inserted. Urban sprawl has caused disorganized territory, lacking in transport infrastructures, primary services and innovative quality services. The volumes built without urban planning have led to the waste of soils. Regeneration makes it possible to design and implement sustainable projects to rebalance and restore the territory with actions of rehabilitation, renewal and technological innovation.

The regeneration of the extended territory around the port of Gioia Tauro must develop in a balanced way with the new area by applying the model of the new towns. The evaluation of the surfaces already built, will allow to estimate the superfluous surfaces and convert them into missing services and equipment, with regenerative interventions according to the sustainability's principles. In the opposite case in which the surfaces are insufficient, new calibrated settlements will be built to equip the territory with services and infrastructures by applying quality urban standards.

From the experiences of other international and Italian contexts, the business center will provide the territory with a place in which to create an efficient and integrated management of services. The urban planning choice of the site will be strategic for supporting the dynamics of the entire territory which will thus be able to collaborate and share equipment, services and management activities with the mega port infrastructure [51], [52].

At the same level of importance, it will be the choice of enhancing an interchange infrastructure node to allow the construction of a high-speed support railway station.

5.3 Research development: demand and supply

According to the indications reported in section 4, the development of services and innovation process are basic conditions for developing Gioia Tauro port towards a third-generation. Figure 5.2 synthetizes the interactions that produces a research program for the Gioia Tauro port.

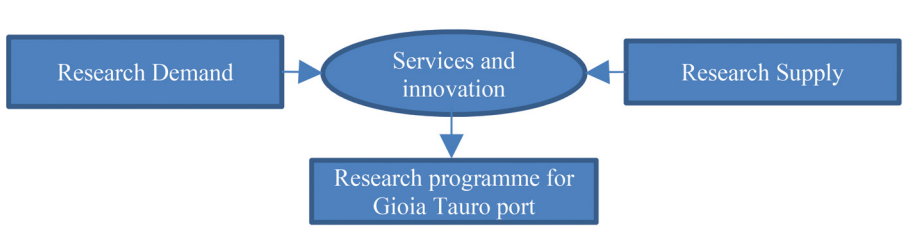

Figure 5.2: Research supply and demand to define a research program for Gioia Tauro.

Research demand indicated in section 2 with the set *S*, is related to the current Gioia Tauro port's functions (e.g. transshipment and gateway) and future perspectives TEN-T core node, special economic zone (SEZ), integrated logistic area.

The port's perspectives are related to European, [53] - [55], National [50], and regional [56] plans. According to European, national and regional goals, vision and objectives, Integrated Logistics Areas (ALI) and SEZs of Gioia Tauro must include specific investments in research interrelated with production developing sectors.

Research supply, indicated in section 2 with the set *R*, comprehends the potentialities of the university located in the territory near the port, and specifically the Mediterranea University of Reggio Calabria. The University is organized in six departments, and it develops research in engineering, architecture, agriculture, economics, law and human science. The developed research covers great part of ERC classes and sub classes.

Inside the Mediterranea university departments, specific laboratories operate developing research themes related to material and services port's activities. Among these, there are a set of laboratories (set intersection *C*) that are working on topics of interest for the port:

- LAST works in the field of intelligent transportation systems applied in different contexts of sustainable mobility;
- Noel works on research about ocean/marine engineering, focusing on wave modeling related aspects and wave energy harvesting;
- NeuroLab works in the field of remote with applications in the health context.
- FoodTec works on advanced technologies to support food industry;
- ARTS works on research about protocols and applications for advanced telecommunication systems and services;
- LEMMA works on research about of inverse synthesis problems, high-performance antennas and advanced microwave devices design;
- LOGICA works on interdisciplinary research related to the development of the Technological District of the Logistics in Gioia Tauro.

According to the general approach described in section 4, a research program is developed to support the process of transformation of Gioia Tauro port towards the perspective of a third-generation port, by considering the research sectors in the *C* intersection set. Table 5.1 reports the interventions of the program indicating the priority level, the kind of intervention for supporting research or education processes, with the financial resources.

The research program includes a set of interventions on material and immaterial infrastructures for supporting Gioia Tauro port development, for a total cost of about 40 million Euro, evaluated in the ALI program.

Table 5.1: Interventions related to research's development.

ID	Title	Priority level	E: Education R: Research	Financial resources (MEuro)
1	Services integrated center for supporting education and research activities	1	E-R	3.00
2a	Training center: realization of laboratories	1	E	2.50
2b	Training center: technical expertise (HTS)	1	E	2.00
2c	Training center: upper secondary schools	1	E	2.00
3a	Campus: Research & Development infrastructures (I step)	1	R	10.00
3b	Campus: human capital Research & Development	1	R	6.50
3c	Campus: human capital for university courses	1	R	4.00
3d	Campus: Research & Development infrastructures (II step)	2	R	10.00

6 CONCLUSIONS

Container ports have been built separated economically and socially from urban centers, even if very near physically. These ports try to modify their nature from only points for transshipment to points where value is added.

The addition of value is mainly achieved in areas within the port's boundaries. Only recently attention has been given to the possibility to support the addition of value, by means of external areas.

In the paper external interactions for a third-generation port have been considered, analyzing material and immaterial factors that external territory can supply to the ports. The urban planning and the research developments have been considered.

Urban sustainable planning processes aimed to the integration of existing infrastructures, has been examined. Sustainable planning approach allows the definition of spaces, according to the urban regeneration (first) and new town (second) principles. Using Lowry's model can be studied the economic value generated by the interaction.

Research development can support the development of new production activities. But it needs to create conditions to supply at the enterprises locating in the port area, advanced education and useful research. The main result obtained in this work is the identification of interactions between the port economic sectors and the university laboratories which do technology transfer. The proposed matching between demand and supply of research can be an important route to increase value added in the in transit good.

The paper presents the proposed methodology and a specific study case relative to port of Gioia Tauro, that is a TEN-T core node. The port is following a process to become a third-generation port. The proposed methods can be applied in other ports that aim to be classified as third-generation.

The paper proposes a new approach to the study of the interactions of the port with the external areas. In this way it can be useful both to national planners and to the managers of the port

and of the neighboring municipalities, as well as of the reference universities. The proposed approach can be developed by specifying and calibrating the values of the functions proposed for urban integrations and by estimating the impact of the research on the increase in AV.

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