

Guidelines and Perspectives to Enhance Italian Port Competitiveness

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Abstract - Ports, as well as other important transportation infrastructures like railways, motorways and airports, play a great role in the economy of a nation, because, if properly managed, they can strongly affect the Country competitiveness and its economic development; this is true especially for Italy, which can take great advantage from its geographic position of peninsula. In fact Italy can heavily exploit seas using the so-called “Seas Highways” system – a series of alternative links between Northern and Southern Italy, and also Mediterranean Countries – devoted to lighten vehicular traffic on the most important Italian motorways (like the Milan-Naples or the Adriatic Motorway, just to quote two of the busiest), but also to reduce atmospheric pollution and to guarantee a cheaper way of transportation, especially for goods which are not perishable. Although also European Union is strongly recommending this solution, even inserting Seas Highways inside the Pan European Corridors (as “Corridor 21”), the Italian ports have many difficulties to face the international competition, especially with Northern Europe ports, despite their privileged position on the routes coming from the Far East, because of different reasons, first of all the inadequacy of the infrastructures internal and external to the ports (especially railroads, exploited a little respect to other European Countries), the high fragmentation of the Italian port realities (every Port has in Italy its own Port Authority), that causes fund dispersion and organizational problems, and a regulation out to date. All this problems are also amplified by the actual international economical crisis, which contributes to increase competition among the ports. For these reasons the authors are presenting a project proposal, in cooperation with the Italian University and Scientific Research Ministry, devoted to analyze the current situation of Italian ports and logistic facilities, underlining points of strength, points of weakness, opportunities and criticalities and analyzing the common factors of behavior of the ports considered. This is a prerequisite to define a simulation model implemented using the System Dynamics methodology, which is suitable for the study of high uncertain scenarios, as the Italian port reality is, allowing the formulation of so-called “What if” analysis. The aim of this model is to simulate the effects of the infrastructural, organizational and normative changes on the Italian port system, acting as a powerful Decision Support System (DSS) for all the stakeholders involved in the system, in order to identify a common solution devoted to improve Italian ports competitiveness. Moreover, the authors provided a deep literature review on works concerning port competitiveness worldwide, analyzing what has been done in the Far East, in India and in Europe, in order to find interesting starting points for the research proposed.

Key Words - System Dynamics, Simulation, Italian Ports, What if analysis, Logistics

1. Introduction

Preeminent studies in the transport and logistics sector (see report on "The competitiveness of the Italian port" commissioned by CNEL in 2004) show that there is a close trend among the competitiveness of Italian portuality and the competitiveness of the Country. The ports have a key role in the economic development of Italy, as critical hubs of the transport and logistics network, as well as generating wealth and employment. Moreover, it is not possible to forget their role in the rebalancing of the modal split of the national transportation system.

However, the Italian ports, although located in a privileged position in relation to the major traffic routes of the motherships coming from the Far East, is struggling to cope with the international competition, especially with the ports of the Northern Range. The reason for this is due to many causes, including the inadequacy of infrastructure networks both inside and outside ports, the high fragmentation of the national port system with relative dispersion of funds, major organizational problems, a regulatory framework -the 84/94 law- now outdated. Moreover, the current economic crisis in the world did exacerbate these problems, intensifying the competition between the ports for capturing traffic flows.

In light of this, the research project has the aim to analyze the current Italian logistics and port situation highlighting criticalities, opportunities, strengths and weaknesses, and identifying the common factors of behavior (archetypes) of the various ports analyzed. This will be a prerequisite to reach the definition of a simulation model, developed in accordance with the methodology of System Dynamics (useful for the study of complex systems such as the port one), capable of simulating, in a strong uncertainty regime, the Italian logistical-port reality in the light of different scenarios (what-if analysis).

In other words, this model will allow simulating the effects on the logistics-port system generated by in organizational, infrastructural and policy management changes. This will be a decision support system for the various port stakeholders with the final goal of identifying the best solutions to be adopted to allow an improvement of the Italian ports competitiveness.

2. The Italian Port System Background

Therefore, in spite of the importance shown and recognized by this sector, the Italian ports, which, according to a research about data of 2007 carried out by Censis and Assoporti, generated a yearly output of 21 milliards of Euros as contribution to the Italian GDP and employed more than 100000 people (moreover each adding working unit involves the creation of further 2032 working units in the whole Country), have difficulty to keep pace with the international competition, particularly with the efficient North European Ports. As pointed out by a research commissioned in 2005

by CNEL about "The Italian Port Competitiveness" (2005), this should be due to a variety of causes. Among the main problems afflicting the Italian Ports: an insufficient infrastructural network often inadequate inside and outside the ports, organization difficulties, inefficient and non competitive port services which are inhomogeneous in the different ports, a non optimized logistic network, a port governance often inadequate with fragmented skills among the different parties from the Port Authorities until the central government, a law ruling the port matter (the law 84/94) by now outdated, bureaucratic inefficiencies, poor cooperation among the port stakeholders and limited financial autonomy.

It should be added the current worldwide business crisis causing the traffic growth decrease, greatly stressing the competitiveness among the ports for the interception of these flows.

Considering that, the proposed research project aims to study the logistic and Italian port situation by highlighting its criticalities, opportunities, strong and weakness points trying to identify archetypes that are problems and typologies of behaviors common to the Italian logistic-port operation model base. All that shall allow attaining the definition of the measures that the parties concerned in this sector (Port Authorities, terminal operator, forwarders, shipping agents, customs, central government, carriers, etc.) should adopt, in the short and long time, to favor a strengthening of the Italian port system competitiveness.

3. State of the Art on Port Competitiveness

Port competitiveness in the last years has been analyzed and discussed by several authors worldwide, in order to define points of strength and weaknesses devoted to enhance the port system of a country and, consequently, its economy.

In [13] Teng et al. have evaluated the port competitiveness with a Multi Criteria Decision Making (MCDM) and a Grey Relational Analysis (GRA) on eight different Asian container ports, Keelung, Taichung, Kaohsiung (all in Taiwan), Kobe (Japan), Hong Kong, Shanghai (China), Pusan (South Korea), and Singapore. The authors utilized a hierarchical structure based on seven levels, plus the alternatives' level represented by the eight ports compared in detail, in particular, level 1 is represented by the goal, while level 2 contains internal and external environment and level 3 strengths, weaknesses, opportunities, and threats (SWOT). Level 4 is an expansion of level 2, dividing the internal and the external environment into different sub criteria: the former includes manpower, organization and physical facilities, while the latter includes politics, society, economy, and finance. The fifth level represents all the objectives, including labor quality, operation style, efficiency, location and cargo source, hardware and software, comprehensive plan, as well as external environments that include political stability, social stability, economical stability, financial

stability, and productivity, while the 31 evaluation criteria are shown on the sixth and the seventh level. Secondly, in the competitiveness analysis framework, the Hierarchy Scoring Method (HSM) has been applied in order to have simplicity of operation, a synthesis of opinions from most experts and decision makers, and quantitative analysis.

The HSM foresees a step-by-step procedure as follows:

1. Define research problem.
2. Select member of interviewees.
3. Construct a hierarchical structure and criteria.
4. Propose evaluated ports.
5. Propose questions and undertake questionnaire survey as follows:
 - a. Interviewee ranks criteria's orders according to their importance;
 - b. Interviewee score criteria in scale 1-100 on each level.
 - c. Interviewee score ports' performances under each criterion in scale 1-5 excepting some criteria with statistical data.
6. Calculate weights of criteria.
7. Compute the synthesized performance values via GRA method.

Once determined the criteria importance, the synthesized performance are evaluated using the gray relational grade of the GRA methodology; on the results achieved by this step, a port ranking has been proposed, classifying the ports in different grades: first (for the ports with best performances, above 0.95), second (with performances of about 0.9-0.95) and third (less than 0.9). The authors identified only Singapore port in the first grade, while the other Asian ports belong to second and third grade. This happens when all the 31 criteria determined are evaluated, but, screening only the 13 criteria that cumulate the 80% of the overall weight in a sort of ABC analysis, the situation is similar but a little bit different in the ranking, with the Hong Kong port that leaves the second position in favor of Kaohsiung, one of the three ports of Taiwan study of the competitiveness and development analysis.

The authors analyzed in particular Taiwan situation, depicting two different scenarios: the first with a worsening political and economical situation for Taiwan and a stable situation for Korea and China; as a result of this situation, the three Taiwan ports classify at the last three position of the ranking; while the second scenario foresees a general improvement for the ports of Kaohsiung, Keelung and Taichung, with a consequent rising in the ranking for the Taiwan Ports: Kaohsiung is near to the performance of Hong Kong and the other two earn many positions in the overall ranking.

Summarizing, Teng et al. in [13] analyzed how to improve competitiveness of Taiwan ports versus other 5 Far East ones using ad hoc techniques like GRA and HSM, but, still in Asia, Yeo and Song [14] used another methodology suitable to identify the main competitiveness factors for

ports: Thomas Saaty's AHP (Analytic Hierarchy Process). This methodology is suitable for this kind of problems because it is designed for particular issues like decision theory and conflict resolution, where many criteria impact on the target function.

The two authors, in particular, applied the AHP technique to the competitiveness for Chinese and Korean ports, identifying the criteria and their weights on the basis of questionnaires distributed to different port stakeholders (ship owners, shippers, terminal operators, institutions, etc...).

The authors, as a result of these questionnaires returned, identified four main evaluation criteria:

- Cargo Volume
- Port Facility
- Port Location
- Service Level

with the weight factors derived from the pair comparison performed on the basis of the questionnaire results, ranging from the lowest "1"(same importance/preference) to the highest "9" (extremely important/preferable), as shown in the Table 1 below:

Table 1: Saaty's pair comparison scale

Value	Importance
1	None (Same)
3	Weak
5	Strong
7	Very Strong
9	Extreme
2;4;6;8	Intermediate Values

On the basis of the survey's results, those who participated prioritized emphasis starting with location (0.452), which was followed by facility (0.198), freight volume (0.178), and service level (0.174), scoring an inconsistency of 0.026. As the critical value was less than 0.1, it was confirmed that questionnaire result was effective and answering minds were consistent.

Once determined the priorities of the different criteria, the competitiveness evaluation of Chinese ports has been performed computing each criteria's weight, using a known percentage. The evaluation value depicted Hong Kong as the most competitive port (0.2097) with Shanghai immediately following (0.0866), then Yantian (0.0717), Qingdao (0.0449), Shekou (0.0385), Dalian (0.0348), Tianjin (0.0339), and Xiamen (0.0298).

In a second step, Yeo and Song introduced in the study also the Korean ports, which in the past years supplemented Chinese ones but now are in competition with them; considering the same four criteria depicted also for Busan and Incheon ports.

The results of the study highlight a unsuccessful situation for Chinese ports, except Hong Kong, that lag behind Busan

port in Korea in terms of competitiveness; however, Chinese ports seem to have somewhat more competitive elements that will give China the power to bypass Busan port in the competitive aspect, if taking into consideration of port facility investment, colorful incentive policies for liners, uninterruptedly increasing freight traffic, increased awareness of ports, and so on.

In fact China, after its agreement to WTO, registered an average growth rate of 10% per annum and continues its rapid growth; but such remarkable growth in China gives a great effect on Korean ports, since both China and Korea are located at the same region in Northeast Asia, the two lie in direct competition and they have their ports among the world's 100 largest container ports in terms of container cargo handling.

From the above results, port location plays the most significant role in the evaluation of port competitiveness, but, however, it is impossible to move from one place to the other physically; likewise, elements of cargo volume also have a close relationship on port location; so the two are considered fundamentally difficult elements to increase port competitiveness.

Anyway, both elements of facility and service were deemed workable, when aided by government policies focused on increased investment and management efficiency. Therefore, making strenuous efforts focusing on both elements of facility and service with a hope to enjoy competitive edge over others, this will greatly contribute to the betterment of port competitiveness, which brings a greater share of freight treatment volume.

Competitiveness in ports is also an opportunity to enhance the economic situation of a Country, especially in a crisis period like the actual one: this is highlighted in [Pallis and Vaggelas, 2010] where it is discussed if the investments in infrastructures should be the only strategy to improve port competitiveness, or other ways have to be reached.

The study of the two authors considers firstly the Mediterranean port region, which is an important market with powerful players because of its increasing traffics arriving from the Euro-Asian regions. However, a port on the Mediterranean region has to work harder in order to develop a competitive advantage with respect to ports centrally located near maritime networks or large domestic market, as it happens in the Northern Europe ports (Antwerp, Rotterdam, Hamburg). Thus Mediterranean ports, which Italian terminals belong to, need more than simple investments in infrastructures and inland transport connections; they have to grasp the opportunities provided by the supply chains, such as better performing inland transport network, a more customized client approach, a more flexible business environment (quickly adapting to changing customer requirements) and/or the greater reliability that comes from some availability in assets.

The authors proposed for all the ports around the world two growth strategies, based on coordination and cooperation.

For the former it is intended, for instance, to provide an integrated transportation service that is beneficial to all actors involved in relevant supply chains. For what concern the latter, it is important to develop business with the other ports within a coastal port range.

Coordination among supply chain actors focused on servicing a port and its hinterland has a significant impact on the port's ability to contribute to an efficient regional port infrastructure and also ensuring an adequate service for inland hinterland areas in terms of transportation and logistics for the companies using the port.

Coordination guarantees also benefits in a public perspective in terms of social welfare deriving from addressing, or even eliminating, bottlenecks, in order to better serve the interests of citizens through a more efficient trading network.

For what concern cooperation, there are two main reasons to adopt this solution: Cooperation might consist of a common marketing strategy that drives growth in total traffic for the entire port range. Alternatively, it might include an agreement with provisions for specialization in, or even exclusive provision of, certain services at each involved port.

Cooperation benefits could lead to strategic alliances among ports premised on the belief that seamless customer service does not require ownership of all the assets and results from Cooperation could increase the market size of the port and give the ability to facilitate niche market capturing based on cargo specialization. This strategy could be either formal or informal. It certainly needs port authority and policy makers to advance the formation of initiatives having onboard all stakeholders. In the Mediterranean region cooperation takes mainly the form of common port marketing initiatives, like the MEDCRUISE organization, devoted to promote the Mediterranean area as a cruise destination, or the newly-formed cooperation between four Northern Adriatic ports, involving also three Italian realities: Venice, Trieste and Ravenna, which concluded on the establishment of North Adriatic Port Association.

These ports cooperate in the development of maritime and hinterland connection, in information technology, safety and environmental protection issues.

Anyway, the most advanced cooperation example in Europe has been developed by the ports of Malmo (Sweden) and Copenhagen (Denmark): the two port authorities have been merged into one company offering port services for every type of cargo and passengers.

On the other hand there is the coordination strategy, that gives to a port the opportunity to take into advantage the stakeholders (the port and supply chain players) networks in order to attract users via the availability of "best practices" and supply chains offering the highest value to the cargo, and thus to the user of the port. This strategy is quite complex, and conditioned by the presence of leading firms (or port authorities), and the commitment of various players in such projects.

Finally, according to Pallis and Vaggelas [15], the role of investments in port modernization remains important, but also coordination and collaboration stand as two alternative, or additional, strategies worth to be considered by all those seeking to improve the competitiveness of a port.

An aspect taken into account for improving port competitiveness is the development and the growth of dry ports, which play a pivotal role in new emerging markets and economies such as in India; in fact Ng and Gujar [16] highlighted how in the Indian subcontinent the performances of dry ports have significantly improved since the introduction of foreign private participation, which strongly augmented competitiveness.

The research of the two authors firstly focused on interviewing several firms that have invested, operated or worked in Indian dry ports, in order to clarify the contents and the details of the policies carried out by the government and their impacts on the competitive platform and, although in the details of the interviews some differences have emerged, discussions were conducted about these major questions:

1. What are the major impacts of Indian government's dry port policies on your firm's operation and strategies?
2. What are the major impacts of Indian government's dry port policies on the competitive structure of the industry as a whole?
3. In the case of foreign investors, despite the possible existence of a 'controlled' competitive platform favoring towards state-owned firms in dry ports, why your firm continue to invest and station in India?
4. If any, what are your major comments and recommendations to the Indian government on the implementation of dry port policies?

At the end of 2008, about 200 dry ports have been established all over India, and 40 of them are located in the surroundings of the major gateway seaports like JNPT Port in Maharashtra, Mundra and Chennai. For what concern the modal split, according to Hariharan [17], 58% of the container handled between ports and dry ports are moved by road and 42% by train. In the past, Indian dry ports were completely owned by the public entity of the Indian government and, due to the uneven distribution of dry ports in the country, with the Eastern and the Central regions almost completely uncovered, the situation had led to congestion of facilities and breakdown of infrastructure on one hand, while capacity underutilization on the other hand.

Also, according to the information collected in the interviews, Indian dry ports were affected by scarcity in financial resources, technological and management know-how, so, as a consequence, they have never been innovative, and long-term efficiency-enhancing investments, research

and development, such as RFID, GPS, etc., were never considered, even not helped by the Indian government's labor protective policies. Indeed, the almost complete monopoly of state-owned corporations, notably CONCOR and Central Warehousing Corporation (CWC), had contributed to the problems as mentioned above especially since, as government-approved monopolies, different dry ports often provided generic solutions to non-standardized demands between different regions, raising the question on whether dry port services were really customer-oriented [18],[19]. The price of such problem was dismal performance, amplified by over regulation, poor quality service levels, inadequate infrastructure investments and under-utilization, which in turn affected the competitiveness of Indian manufactured products in the international market.

Such inefficiency had often resulted in the reluctance of dry port operators to offer time bound commitment to cargo owners and shipping lines, resulting in the inability of the latter in planning connection of the hinterland containers to specific ships. Indeed, these factors had also led to poor perception of dry ports (and logistics industry) by the general public. According to the answers provided in questionnaires, in India, the logistics industry, including dry port, was often perceived as 'backward' and 'bleak', thus finding it very difficult to attract necessary quality talents, nor has it been able to impart necessary skills and vision, leading to sloth and inefficiency.

To address this problem, the Indian government embarked upon a massive capacity enhancement program, as well as loosening the grip of its control on dry port operation through private participation mainly through the sale and/or leasing of facilities, joint venture and/or Build-Operate-Transfer (BOT) arrangements.

In other words, in India, the government only sustained regulatory functions in dry ports while leaving the operational and management aspects to private operators.

An inter-ministerial committee for approval of applications for dry ports had been established so as to facilitate single window mandatory clearances, payments, incentives, certifications, customs presence, etc.

These steps, together with an estimated 15% container trade growth per year, will lead a number of dry port users, including multinational logistics service providers (like Schenkers, Kuhne & Nagel and Prologis) and several major liner shipping companies (like APL and Maersk), to join the Indian dry ports sector.

As a result, the participation of foreign firms in the operation and management of dry ports can seriously improve the abysmal condition of India's transport infrastructure, as poor communication and transportation infrastructure could tarnish the country's image for potential investors (including different sectors) in a very tangible way.

Moreover, the lack of competition within the dry port industry had inserted little pressure to improve the factor conditions, leading to mediocre performance.

Indeed, the encouragement of private, especially foreign, investments can address the imbalance in the Indian port industry through enhancing its quality, in order also to boost the quality of India's supply chain, and thus boosting the competitiveness of Indian manufactured products in the global market. On the other hand, however, foreign participation, often with superior technology, marketing strategies, management know-how and, more importantly, willingness to provide time-bounded guarantee to cargo owners and shipping lines, would pose significant threats to the survival of local, state-owned and operated, dry ports, especially if they had lost the advantages of government protection umbrella.

In addition, foreign investors, which had entered the dry port industry usually, have captive cargoes, and by controlling dry ports and cargo's inland transportation, these firms could potentially generate synergetic benefits leading to significant competitive advantages of which local, state-owned, dry port operators could find it very difficult to match. Also, given the massive number of such dry ports established within the country (and the number of employees), it would potentially be a political tragedy to the Indian government if these new competitors knocked their dry ports out of the industry.

Indeed, being the world's largest democracy (in terms of population), the Indian government is trapped in a dilemma: on one hand they would like foreign investors to assist the country's development, especially improving transport infrastructure and efficiency, but on the other hand protecting local interests from being exploited by these investors through abusing market power. This situation causes a sensitive dualism to be properly managed. In this direction Indian government carried out three main initiatives devoted to overcome these issues helping state-owned corporation against the challenging foreign dry port operators:

1. land pricing and distribution;
2. dry port operation;
3. dry port's connectivity.

For what concern the first initiative, the biggest landowner within the country, the Indian government, also had a major presence in the land's sale and lease.

While charging market prices to foreign investors, except areas around JNP, lands had been leased out to state-owned firms, especially CONCOR, for very long periods, usually 99 years, at very favorable rates, significantly under market values. Also regarding land distribution policy the government offers preferential treatment to state-owned corporations, which often enjoyed the privilege of obtaining the required land against other private operators.

Apart from land policy, the Indian government also carried out policies devoted to allow dry ports operated by state-owned corporation to grow, mature and compete. For

instance, state-owned dry ports were allowed to suffer a financial loss in the initial period of 2 years. During this period, on the one hand, the operator was expected to make every effort to keep its overheads low, while, on the other hand, canvassing for more businesses. Such scenario had largely advantaged such state-owned corporations as it implied that the government offered a guarantee in absorbing any losses that had incurred during this period.

Given such substantial assistance in both capital and operational costs, state-owned dry ports were often able to make extensive use of discounts, preferential and predatory pricings to attract customers.

Finally, on dry ports' connectivity, Indian government granted to 14 foreign private companies to operate container trains between dry ports and the gateway seaports through concession agreements, but with costs higher than 1 million USD per year. Through the same agreement, private operators would deploy their own containers, wagons and handling equipment, building their own terminals, and marketing for customers. Under such arrangement, the participation of the private sector is expected not only to attract traffic from the road sector but is also expected to enhance rail transport capacity without burdening the government. But, after acquiring expensive licenses from the government, foreign operators often found it difficult to sustain operation as this had adversely affected their initial pricing structure, not to mention the substantial capital costs of purchasing land for building of terminals as discussed before.

In conclusion, the work proposed above had the aim to highlight how political regulation can significantly affect the competitiveness in port sector; this is particularly true in India, where in the past the dry port management was only under control of the government, with a consequent scarcity of performance and service level. After the new regulation, in fact, introducing the possibility for foreign companies to invest in Indian dry ports, the performances significantly increased, also for the dry ports still managed by state-owned corporations, because of a favorable regime devoted to sustain the local economy.

In Europe port competitiveness issue has been faced in Spain, in fact in [Castillo Manzano et al., 2008], it is underlined that, since 1990s, Spanish ports have known a significant increasing in terms of competition because of a quick development of the whole country due also to particular events like the Olympic Games in Barcelona or the World Expo in Sevilla in 1992; it is also important to highlight the fact that the Spanish port authorities were in a similar situation to the Italian ones (in Spain there are 28 port authorities and 25 in Italy), so the work here proposed should be an important inspiration for the Italian port system.

The Spanish researchers have identified two categories of methodologies for solving competitiveness problems: one grouping quantitative methods like Data Envelopment Analysis (DEA), regression techniques and productivity analysis, and the other including a set of procedures, which, under the multi- criteria decision-making method (MCDM), allow to consider qualitative and quantitative indicators.

The MCDM method has many applications in economic analysis. When compared with conventional optimization methods that provide a single solution (such as cost-profit analysis), MCDM permits a combination of different perspectives on conflicting issues to reach a balanced solution or consensus. Therefore, MCDM is appropriate for contexts where decision-making is based on a variety of viewpoints that are not always quantifiable.

For these reasons, also taking inspiration from the work of Teng et al. [13] mentioned before, the Spanish researchers adopted MCDM to analyze competitiveness factors for Spanish ports, using in particular the Promethee analysis, which provides an overall ranking of alternatives (similar to AHP) but it also partially organizes rankings and allows the detection of possible incompatibilities (two or more alternatives where the difference cannot be determined) while allowing for additional assessment if needs arise.

This work defines the competitiveness as the capacity of a port to create added value, generate a nucleus of business, and produce productive or industrial activity in the surrounding area. Thus, the most competitive port will be able to develop and apply a differentiated strategy, attracting more customers and traffic than its competitors. The complexity of this concept means that various aspects must be taken into account when identifying the decision factors for port competitiveness. For each one of the competitiveness aspects a decision criterion corresponds and, in order to determine a low-cost synthetic index of competitiveness, direct, quick and low-cost statistical sources are needed: for this reason annual port reports or information published by the Spanish Statistical Institute have been used, identifying, at the end of the criteria definition phase, seven main decision criteria defined in Table 2:

Table 2: The Decision Criteria (*Source: Castillo Manzano et al.[20]*)

Criteria
Economic profitability: a standard formulation, measuring the result of exploitation on the business asset
Dynamism of port activity: an annual growth rate of total port traffic
Specialisation in containers: it can become a proxy variable to show the degree of involvement of each port in the gradual process of containerisation of international shipping.
Investment in fixed capital: measured through the growth rate of fixed capital of each Port Authority
Importance of the Strictly port business: measured by the revenues from tariffs to the passage and cargo ^b , against the total port revenues, including concessions ^c
Productivity of labour factor: the numerator is a representative magnitude for the "port throughput" (revenues coming from port tariffs), and the denominator is only referred to the workers of the different Port Authorities, so the workers of private terminals were excluded ^d
Economic dynamism: (measured by the growth rate of GDP at constant prices ^e) of the port hinterland, it starts from the premise that a competitive port affects positively to the evolution of the economic activity of its hinterland or zone of geographical influence, and vice versa: that is, a dynamic hinterland must impact on port competitiveness

As happens in all the MCDM analysis, it is necessary to establish the importance of each criterion by giving them weightings or adjustments, because relative importance of the criteria may not be the same when ordered by the Promethee MCDM.

For what concern the scenarios analyzed by the authors, the assessments were based on three different subjects: the academic sector (researchers in transport management), Port Authorities and the Spanish Port State Agency (experts from the public sector) as well as the port community. The three groups of adjudicators were consulted throughout appropriated survey campaigns. The main features of these campaigns are outlined below.

- **Scenario I: Survey campaign to the academic sector.** The survey was sent by mail to faculty members and researchers at different Spanish universities. The expertise of this panel was in Transport Economics in general, and Maritime and Port Management in particular, with specialized publications on these matters.

- **Scenario II: Survey campaign to Port Authorities and managers of the Spanish Port State Agency.** This survey was sent by mail to all Port Authorities with a letter from the Managing Director of the Spanish Port State Agency (SPSA) supporting this research. The campaign was successful, as almost all Spanish Port Authorities answered the survey (by mail, e-mail or fax) and also four top-level managers for the Spanish Port State Agency responded to the survey.

- **Scenario III: Survey campaign to shipping associations and maritime operators.** The survey was sent to all national associations of port businesses, as well as different operators working in the different Spanish ports. The rating technique was used to aggregate the assessments by the various expert panels. This method was chosen because it simplified the survey design and the rules that were imposed on the experts. This was done to maximize the number of answers from non-academic adjudicators who may not be familiar with more complex assessment techniques.

In order to achieve a higher level of discrimination between criteria, the adjudicating panels were homogenized and the number of adjudicators was reduced to 12 per panel, generating three new scenarios:

- **Scenario I.H:** Selection of twelve researchers who had the best curriculum vitae in Transport Economy and published on Maritime and Port Management;

- **Scenario II.H:** Selection of the top manager of the Spanish Port State Agency and the directors of the 11 most important ports in terms of traffic volume.

- **Scenario III.H:** Involving the six national associations that responded to the survey, together with the six businesses that had the greatest invoice volumes of 2006. The results obtained applying MCDM Promethee analysis illustrate that there are two different visions of the understanding of port competitiveness: the economist vision of the academy (Scenarios I and I.H), that gives greater importance to managerial aspects such as the productivity of labor and economic profitability, and the engineering and geographic vision of the professionals in the other four scenarios (II, II.H, III and III.H).

Summarizing, in order to select a specific scenario from the six outlined, two procedures based on the weight sensitivity analysis are proposed. For each weight, the Promethee method provides a sensitivity interval, which indicates the values that the weights may oscillate between without changing the solution.

For what concern the first procedure, the optimum scenario will be the one that minimizes the average for the 12-year period under consideration and the total distance of weight for each criterion to the centre of its interval. This distance has been homogenized by dividing by the amplitude of each interval.

For the second procedure, the scenario in which the average maximum distances of each weight to the centre of its interval will be the minimum, during the time period under consideration, will be also the optimal solution.

Using both procedures the best scenario has resulted the Scenario I.H because it is the more robust and it has the minimum average value.

Choosing Scenario I.H, the ranking of the best Spanish ports is the following: Algeciras in the first place, Valencia in the second and Barcelona in the third, as shown in Table 3,

which considers all the 27 ports ranked on the basis of the 12 best academic adjudicators.

Table 3: Ranking of the Spanish Ports according to Scenario I.H (Source: Castillo Manzano et al. [20])

RANK	PORT
1	Algeciras
2	Valencia
3	Barcelona
4	Cartagena
5	Almeria-Motril
6	Tenerife
7	Las Palmas
8	Baleares
9	Bilbao
10	Vigo
11	Alicante
12	Ferrol-San Cibrao
13	Aviles
14	Castellon
15	Huelva
16	Tarragona
17	Bahia de Cadiz
18	Ceuta
19	Villagarcia
20	Marin-Pontevedra
21	Gijon
22	A Coruna
23	Melilla
24	Santander
25	Pasajes
26	Sevilla
27	Malaga

In conclusion, in literature, the port competitiveness topic has largely faced by the researchers, and in some cases can provide very useful and precious information and methodologies to successfully address this issue; this is particularly true in the case of Spanish ports, which were affected by the same situation of the Italian ports.

Any case, the authors propose a different approach to study port competitiveness using a simulation model tool based on System Dynamics methodology, which has been used in the port framework, like in [21], but never applied to competitiveness.

4 Methodology

The main tool, which will support the above-described targets, will consist of a suitable simulation model elaborated according to the System Dynamics methodology, which will build a decision support system (Decision Support System-DSS) able to support the different port

stakeholders in the decision processes, above all through the what-if scenario analysis.

The system dynamics is a discipline developed by J. Forrester toward the end of the '50s at the MIT (Massachusetts Institute of Technology) of Boston, which studies the complex dynamic systems, by analyzing their inner structure with particular attention to the cause-effect relationships characterizing it, to the feedback circuits and the time delays deeply affecting its behavior. Considered then the high complexity of the port environment, both in terms of carried out tasks, transport modes and concerned parties, we consider that the SD is the most suitable to analyze this context.

This methodology is particularly suitable because, differently from Discrete Event Simulation models, which are implemented using a "bottom-up" approach, is able to capture complexity from a "top-down" approach, that is more appropriated for data driven applications. Moreover, with System Dynamics, it is possible to see not only events, but also behavioral patterns over time, and it is a powerful tool for decision-making.

System Dynamics allows also, with some of the commercial software (i.e. PowersimTM), optimization and integration with ERP systems, like SAPTM, or Databases, providing the possibility to use input data deriving from real cases and to export directly the simulation results inside the system. Figure 1 shows how the System Dynamics software can integrate with other IT systems.

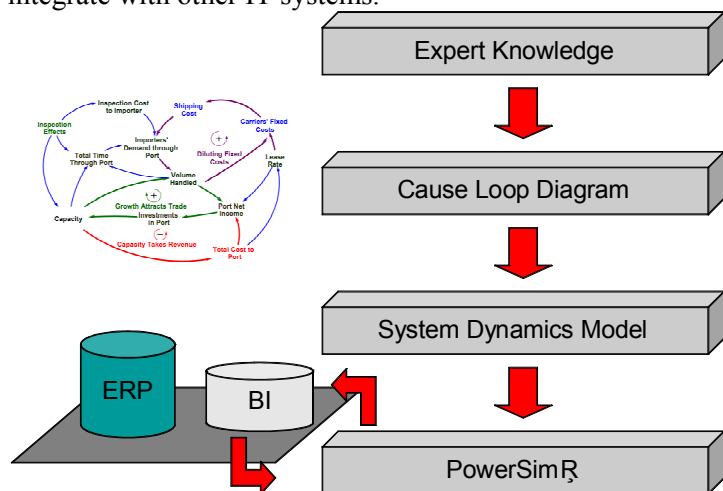


Fig 1 – Integration of System Dynamics with IT systems

For these reasons, the main result of the research activity will be represented by a technological model able to simulate and analyze, on different conditions of scenario both stochastic and chaotic, the effects generated by changes of the logistic and port system in terms of infrastructures, organization, technology or other so as to detect the best solutions to adopt.

In this context, it will be important to verify, through its quantification, the additional impact that these changes will

have from the point of the fiscal variables in the context of the recent financial autonomy of the Port Authorities.

In particular, among the components evaluated in terms of the individual scenarios it will be analyzed the elasticity of revenue to the composition and volume of port traffics, the possibility of introducing additional shipping fees and its impact on the margins of tax autonomy and competitiveness of Italian ports compared with those abroad.

Moreover the research work shall allow to attain to the definition of a so called "action list" containing the actions to put forward - in order of priority - allowing a re-launching and improvement of the Italian port competitiveness.

In order to achieve the objectives that the research project aims to achieve, the methodology to be adopted includes the following phases of the project:

1. Italian Port State of the art analysis, even through suitable bibliographic research;
2. Definition of the concerned system and subsystem targets;
3. Definition of the reference case studies (ports concerned by the analysis) and contextual analysis of the historical data if available;
4. Enriching of the database with the available information through ad hoc interviews to the port stakeholders;
5. Data analysis and re-elaboration of the acquired information;
6. Formalization of a logic-mathematic simulation model through the System Dynamics (SD) methodology;
7. Definition and implementation of a decision support system, based on the simulation model, which can be interfaced with database and ERP systems;
8. Methodology validation on ports concerned by the case study as well as on some chosen problems;
9. Model and decision support system testing;
10. Reporting, documents and result dissemination;
11. Basing on the what-if analysis carried out through the built simulation model, definition of an opportune action list with the action to put into practice.

5. Conclusion

Several aspects can affect the competitiveness of a national port system and, consequently, the competitiveness of a whole country. The world economical crisis has also increased and amplified the problem of a competitive port system, which has already to cope with infrastructural, organizational and, especially in Italy, normative factors. In

order to find a common strategy devoted to strengthen the Italian port System, a project proposal has been presented, with the aim to firstly identify all the possible points of strength, weaknesses, opportunities and criticalities of the Italian ports and then to find the possible points of common behavior – the so-called archetypes - between the various national realities. After this phase, all the data retrieved work as a prerequisite for the implementation of a simulation model devoted to analyze the possible scenarios derived from a change of the current situation on infrastructures, organization and regulation, hypothesizing a new Italian normative which substitutes the now obsolete Law 84/94. The model should be developed using the System Dynamics methodology, which has resulted to be the most suitable to analyze a complex reality as a port system, allowing not only “what if” analysis devoted to support decision makers involved in the system, but also guaranteeing another series of features like the optimization function and the DB or ERP integration, provided by some of the most important SD commercial software. Finally the project proposes to draw up a so-called “action list” containing all the steps devoted to improve the Italian port competitiveness.

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