Proposing a System Dynamic approach to assess and improve Italian ports 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, exploiting 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.

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 mothers ships 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. The Proposed 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. Powersim™), optimization and integration with ERP systems, like SAP™, 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.
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.

4. 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.
References


[6] Caballini C., Carpaneto L., Parola F. "Italian Port Authorities approaching the post-reform: the Ligurian Case", proceedings of "International Congress on Ports in Proximity: competition, cooperation and integration" Antwerp/Willenstad/ Rotterdam, 5-7 December 2007 (Belgium-Holland) and in "Ports in proximity: essays on competition and coordination among adjacent seaports" by Ashgate international Editor, 2008;


[9] Choi, Joo Park, Ho Yoo, Hong Kang, Jin Yoon "A study on system dynamics modeling to strengthen the competitiveness of a container terminal", Proceedings of the 2007 annual Conference on International Conference on Computer Engineering and Applications;

