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Port Cooperation Policies in the Mediterranean Basin: an Experimental Approach using Cluster Analysis

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Abstract

The great potential of the Mediterranean area, as yet not fully tapped due to the lack of the integrated management of its ports, calls for innovative management policies for achieving competitiveness within the Mediterranean port system. To this end, the current regime of intra-port competition has proven highly unproductive and needs to be rethought, implementing new cooperation policies.

The aim of this study is to identify, by means of traditional clustering techniques, homogeneous groups of ports within the Mediterranean region. In so doing, it would be possible to propose new cooperation policies between ports of the same cluster, but also between different clusters, on the basis of their specific features. A data set has been created for 34 major Mediterranean container ports. Relations between ports have been evaluated from a quantitative perspective through traditional statistical techniques: hierarchical cluster analysis based on the Ward method. Different sets of homogeneous ports have been obtained alternating different combinations of input variables and varying these over suitable ranges, in line with the assumed cooperation policies. The findings provide the basis for exploring the strategic functional relationships among ports, in order to promote collective integrated actions that could prove essential for the competitiveness of the Mediterranean port system.

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Keywords: Cluster Analysis; Port Cooperation Policies; Mediterranean Port System.

1. Introduction

Historically, the Mediterranean Sea has played a key role in the development and growth of Southern European, North African and Asia minor countries. Moreover, the widening of the Suez Canal has, over the years, consolidated the strategic role of the Mediterranean also for East-to-West transoceanic routes. However, this potential is hampered by the limitations imposed by the lack of a management and organizational policy of the Mediterranean

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port system as a whole, which has led to the slow, but progressive decline of competitiveness of its ports to the advantage of North European ports in particular. In this context, the current intra-port competition regime impedes achievement of a common policy, resulting in limitations associated also with the strong fluctuations in the shipping market and the dwindling profit margins. Establishing spontaneous and synergistic collaboration between ports through cluster policies could be a lever for recovery throughout the entire Mediterranean region. Creating a system comprising numerous ports would enhance overall competitiveness and could be achieved by: (i) traffic sharing; (ii) developing common management policies; (iii) implementing integrated marketing policies; (iv) resource sharing (material, immaterial and human). In so doing the potentiality of the port system as a whole would undoubtedly be greater than that of the single ports collectively.

This work aims to identify, using traditional clustering techniques, homogeneous groups of ports within the Mediterranean basin, determined on the basis of their technical, management, organizational and geographic affinities, such that any cluster strategies can be based on real intra-port synergies and common features. We examined 34 container ports in the Mediterranean. For each port we collected and processed detailed information concerning demand (traffic handled in the 10-year period 2002-2011) and supply (infrastructure, organization and geographic position) characteristics. On the basis of the data gathered and of the pertinent literature examined, we opted for a hierarchical cluster analysis based on Ward's method.

2. The Mediterranean setting

The Mediterranean sea is the natural passage for trade between the Far East (India, China, Indonesia, etc.) and continental Europe. The role of the Mediterranean has strengthened gradually over the last twenty years to become the focal point for international maritime shipping. The drivers of this change can be attributed chiefly to three main factors:

- The change in round-the-world routes due to the ever-increasing size of ships, which has resulted in ships bypassing the Panama canal, has made the trans-Mediterranean route via the Suez canal the privileged freight route for trade with the Far East;
- The economic growth in the Far East and the emerging countries along the North African shores has resulted in an increase in maritime trade along the routes from/to Europe and between the two Mediterranean shores. Between 2005 and 2011 traffic volumes in the Mediterranean hub ports increased by some 44%;
- The incentives granted by EU to short sea shipping, in an endeavor to ease congestion on the roads.

The competitive advantage of Mediterranean ports lies primarily in their geographic position. In terms of transit time this means that supply to European markets from Suez competes very favourably with the North European ports. Thus the Mediterranean basin represents an essential port of call for reaching destination markets as quickly and economically as possible. Notwithstanding this, only 40% of trade volumes for Europe passes through Mediterranean ports, the remainder being bound for North European ports via the Atlantic routes.

The future trend in maritime trade in the Mediterranean over the medium-to-long term will be determined and significantly influenced by a number of factors, that have led to the formulation of more or less prudential estimates, for the different traffic segments. But the general consensus points towards an increase. These factors are: (i) the constant increase of the population along the southern Mediterranean shores, estimated to reach 420 million by 2020; (ii) the growth of Eastern European countries and the role of the Black Sea for connections with them; (iii) the growth of Far East countries and the new trade routes to Europe via the Suez canal; (iv) the coming into effect of the Mediterranean free trade area.

However, one factor that will restrain this growth process is the widening of the Panama Canal, due to be completed around 2014. The opening of the new Canal needs to be associated with the opening of the planned new mega port at Mumbai which together with the Cochin port are the gateways for India's expanding economy towards the Suez Canal. These aspects, together with the fierce competition already existing between the Mediterranean and northern range ports for Europe-bound traffic from the Far East and the American Pacific ports, will be decisive in establishing the future re-balancing of sea freight traffic. In addition, over the last few years Mediterranean ports have begun to compete with one another in the strive to increase their share of traffic. The strongly fluctuating

nature of the maritime shipping sector and the increasingly narrow profit margins make this tendency extremely threatening for the future of the Mediterranean sea.

Intra-port competition in the Mediterranean is in fact a false problem insofar as the Mediterranean basin is not perceived as comprising the single ports operating therein. For the large transoceanic ships sailing along routes connecting the Far East, the northern range and North America, shipping companies view the Mediterranean as a single transit area where one or at the most two calls are made. For this reason common cooperation strategies need to be put in place and internal competition processes discouraged. Integration of seaports could provide the answer to maintaining competitiveness in an ever-expanding and fiercely competitive market. In this regard, it is essential to provide the knowledge elements underpinning the Mediterranean port system as well as its characteristics so as to stimulate the debate about intra-port collaboration and cooperation issues, viewed as an alternative to the traditional, and today ineffective, competition policies.

3. State of the art

A seaport cluster can be viewed as the outcome of policies, economies and social institutions in the geographic region concerned and as the dynamics between the different organizations involved (competent authorities, companies cooperating therein). The concept of port cluster is essential for the economic competitiveness of port systems. It has become increasingly clear that port competitiveness does not depend solely on its intrinsic characteristics but also on the activities engaged in outside the port, in terms of the production, economic and logistic system of shipping. The competitiveness of a cluster lies in its ability to create a network of excellence comprising businesses, transportation systems, institutions, training and innovability: "*Skills, education, innovation, productivity and also sustainability reinforce each other in cluster; clusters have the potential to excel in these issues*" (De Langen, 2002 - 2004). Haezendonck (2001) was the first to use the term port cluster, that he defined as "*the set of interdependent firms engaged in port related activities, located within the same port region and possibly with similar strategies leading to competitive advantage and characterized by a joint competitive position vis-à-vis the environment external to the cluster*". However, a new concept of port cluster is gaining ground, intended as the conditions in which different ports, also located within the same geographic region are closely interconnected and have common targets, objectives and management bodies.

Several intra-port cooperation initiatives are now being launched for the purpose of promoting the improvement of port services. These include the Regional Port System of the ports in the Friuli Venezia Giulia (Italy), the Rotterdam port cluster in North Europe (EMCC case studies, 2008), the Durban maritime cluster in South Africa and the Lower Mississippi port cluster. One recent example in the Mediterranean is Medports (Medports, 2011), a project co-funded by the European Union through the INVEST IN MED programme, aimed at helping to improve advanced port logistic services in European and Southern Mediterranean countries by promoting integrated management policies.

Examination of literature has shown that several authors propose intra-port management policies and strategies based on demand and supply characteristics (Kaysi et al., 2010), but none of them use clustering techniques to support those policies. On the other hand, there are numerous applications of clustering techniques in the air transportation sector: Adikariwattage et al. (2012) have examined major airports in the USA and identified, using traditional clustering techniques, homogeneous groups of airports using as classification variables the number of gates and annual international and domestic and transit passenger traffic. Malighetti et al. (2009) classified the 467 European airports examined into 8 strategic groups on the basis of the specific characteristics of each airport and the role covered within the network. They used hierarchical cluster analysis techniques adopting Ward's method of aggregation. Madas and Zografos (2008) developed alternative slot allocation strategies for different types of airports again using hierarchical cluster methods. Sarkis and Talluri (2004) assess the operational performance of the 44 major airports in the USA using hierarchical cluster methods for benchmarking performance to improve that of the less efficient airports. Lastly, Burghouwt and Hakfoort (2001) use hierarchical clustering with Ward's method to classify all airports in the European Union during the period 1990/1998 into 5 classes based on three types of variables.

4. Methodology

On the basis of the characteristics of the port network concerned and of the similarities with the literature examined, it was decided to adopt hierarchical classification using Ward's method† to agglomerate the ports into homogeneous groups according to demand and supply characteristics.

The existence of inter-variable correlations made it necessary to conduct a factor analysis prior to clustering.

Factor Analysis – is a method whereby a certain number of intercorrelated variables Y_1, Y_2, …, Y_p, can be reduced to a smaller number of uncorrelated factors F_1, F_2, …, F_k. Thus factor analysis extracts from a set of variables a smaller set of orthogonal factors, each of which is a linear combination of the original variables. The generic factor F_i ($i=1, ..k$) can be written as follows:

$$F_i = \lambda_{i0} + \lambda_{i1}Y_1 + \lambda_{i2}Y_2 + \ldots + \lambda_{ik}Y_p + \varepsilon_i \quad (1)$$

Where: λ_{i0} is the intercept, λ_{ik} are the factor loadings, F_i is the factor value, ε_i are the residuals.

Cluster Analysis - is a method for partitioning a set of observations into groups so as maximize both within-cluster homogeneity and heterogeneity among clusters. Starting with *n* classes, representing the n statistical units, hierarchical clustering produces a single class containing all the *n* units. Thus the final result is not a single partition of n units but a series of partitions that can be graphically represented by means of a dendrogram. A commonly used approach in hierarchical clustering is Ward's Method. The Ward's method (Ward 1963) differs from other aggregation methods insofar as the merging criterion is based on the analysis of the – within clusters variance. Cluster analysis techniques can be classified as hierarchical or partitioning. One of the attractive features of hierarchical techniques is that they do not assume any particular number of clusters fixed *a priori*. Instead any desired number of clusters can be obtained by "cutting" the dendrogram at the appropriate level.

5. Application

5.1. Database: Ports and variables

We have examined 34 ports in the Mediterranean basin. The database was created using data gathered for the PRIN project‡ (PRIN 2011), suitably corrected and updated. Some ports were added or deleted on the basis of their specific demand and supply characteristics, and also taking into account their geographic position, so as to cover the entire Mediterranean basin. The 34 ports are divided into transhipment ports, regional ports and ports that operate both as transhipment and regional ports.

Demand characteristics

The container traffic (TEUs) handled every year over the last 10 years[§] has been considered as demand data. For each port contained in the sample, the variables describing demand trend for the period considered were:[**]

- TEUs handled in 2011;
- Average growth (%) of traffic during the six years (2002 - 2007) preceding the global economic crisis;
- Average growth (%) of traffic during the economic crisis (2008-2009);
- Average growth (%) of traffic over the two years following the economic crisis (2010-2011).

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† Analysis were conducted using open source R software.

‡ Projects of Major National Interest funded by the Italian Ministry for Education, Universities and Research.

[1] Data were provided by Port Authorities, terminal operators and some major maritime consultants (OSC, Drewry Agency).

§ Port Said East and Tanger started in 2005 and 2007, thus growth rates have been calculated respect each year.

** This analysis was conducted to account for the effects of the global economic crisis that hit the sector in 2008 and 2009.

Supply characteristics

- Dimensional variables: (i) Quay length, (ii) Maximum draft , (iii) Yard area;
- Organizational variables: (i) Type of operating system[††], (ii) Quay Cranes, (iii) Other equipment[‡‡];
- Geographic variables: (i) Geographic location[§§];
- Hinterland connection/accessibility variables: (i) possible rail link; (ii) Road link.

5.2. Application and Results

We considered 34 Mediterranean ports, that have been clustered according to their different demand and supply characteristics. Factor analysis reduced the number of original variables to a smaller number of independent factors which were then used for creating the clusters.

Focusing on the factor loadings that exceed 0.4 in absolute value, it is possible to identify three different factors, measured as shown in Table 1. These three factors together explain most (about 80%) of the (explained) variance, 53%, 71% and 81% respectively. The three factors identified represent the main trends of the observations relative to the variables considered. Based on the level of information provided, these factors have been renamed:

Table 1. Factor loadings

	Length	Depth	Yard	QC	Equipment	Teus 2011	% growth 2002-2007	% growth 2008-2009	% growth 2010-2011	% Explained Variance
Factor 1	- 0,425	- 0,325	- 0,422	- 0,434	- 0,406	- 0,414	-	-	-	53%
Factor 2	-	- 0,141	-	-	-	- 0,126	- 0,607	- 0,612	0,362	71%
Factor 3	-	- 0,358	- 0,237	-	0,163	-	- 0,306	-	- 0,778	81%

- Factor 1 – Dimensional factor; provides an indication of the size of the terminal, considering both the dimensional characteristics (infrastructure and equipment) and the number of TEUs handled in 2011.
- Factor 2 – Pre-crisis growth factor: provides an indication of the percent growth rate over the last ten years referring to the years of the global economic crisis and the preceding years.
- Factor 3 – Post-crisis growth factor; provides an indication of the percent growth rate over the last ten years referring to the years of the global economic crisis and the following years.

The next step consisted in conducting a cluster analysis of the 34 ports. As the number of clusters was not known a priori, we decided to use hierarchical classification adopting Ward's method for the aggregation algorithm. Numerous sub-sets of input variables were tested, obtained by considering alternately, in addition to the three factors, the organizational, geographic and connection variables for the type of traffic handled, so as to privilege different aspects of the phenomenon under study each time. The dendrograms constructed for some of the tests, showing different port clusters are given in Fig. 1, placing greater emphasis on: (i) Organization of yard operations (Fig. 1a); (ii) Type of traffic handled (Fig. 1b); (iii) Location of the ports within the Mediterranean basin (Fig. 1c); (iv) All the three factors above, at the same time (Fig. 1d). Here we describe in detail the test that produced the best results in terms of interpretability for the purpose of the present study, in line with the possible collaboration and cooperation policies that can be formulated for the 34 ports. The input variables used in the test were: the 3 orthogonal factors; organization of yard operations; geographic belt; type of traffic handled.

[††] This variable specifies the type of operating system used. The operating system is called "pure straddle carrier" (or two loops) when the equipment comprises quay cranes and straddle carriers; "Gantry Crane system" (or three loops) when the equipment comprises quay cranes, yard cranes and truck trails; "mixed" when the various terminals of the port employ different operating systems.

[‡‡] For ports that use quay cranes/straddle carriers for handling operations, we have considered only the number of straddle carriers or similar. For ports using quay cranes/yard cranes we have only considered the number of yard cranes. For those ports using a combination of the two, we have considered the number of straddle carriers plus yard cranes.

[§§] Mediterranean sea has been divided into 5 areas: Western, Tyrrhenian, Adriatic, Eastern and Aegean.

The structure of the dendrogram (Fig. 1d) generated by clustering suggested dividing the ports into 9 homogeneous classes. The characteristics of each cluster are shown in Tables 2 and 3.

Cluster 1. Includes 5 ports: Alicante, La Spezia, Livorno, Naples and Venice. The variables best characterizing this cluster are organization of yard operations and type of traffic handled. All the ports in cluster 1 are regional ports and have mixed organization of yard operations. The variable for geographic location is not particularly discriminating. In terms of infrastructures, these ports can be considered as "medium sized". As for traffic, in the period 2002-11 the ports show similar trends in the pre-crisis (+4.5% on average) and post-crisis years (-9.5% on average), with a slight recovery in the following years.

Cluster 2. Includes 2 ports, Gioia Tauro and Tunis-Radès. The most discriminating variables in this case are organization of yard operations, with a 2-loop arrangement, geographic area (Tyrrhenian) and type of traffic handled (transhipment). Both ports have negative growth in the post crisis years.

Cluster 3. Includes 2 ports, Latakia and Marseille, both regional ports and where yard operations have a 2-loop arrangement. These two ports have very similar dimensional characteristics and type and number of mechanical handling equipment.

Cluster 4. Includes 3 ports, Barcelona and Valencia and Genoa. These three ports, that operate both as transhipment and regional ports, have excellent road and rail connections. Because of their high values for size and traffic handled, they can be classified as large sized ports.

Cluster 5. Includes 3 ports: Piraeus, Thessaloniki and Izmir. They operate both as transhipment and regional ports. Traffic shows a negative trend during the crisis and subsequent years with the exception of Piraeus which, like Naples in cluster 1, has an average recovery rate of over 60% in the years 2010-11.

Cluster 6. Includes 4 ports: Damietta, Haifa, Mersin and Port Said West. Apart from geographic location, the other two variables strongly characterizing this cluster are organization of yard operations with a 3-loop arrangement, and type of traffic handled (both transhipment and regional). They present similar dimensional characteristics and volume of traffic handled and can be classed as "medium sized".

Cluster 7. Includes 3 ports, Alexandria, El Dekheila and Limassol with mixed organization of yard operations. All three are transhipment ports, but Alexandria and Limassol operating also as regional ports. Respect to lay-out and TEUs handled, they can be classed as medium-to-small-sized ports.

Cluster 8. Includes 6 ports: Ambarli, Algeciras, Tanger, Port Said East, Cagliari and Marsaxlokk. These six ports all handle transhipment traffic and yard operations are organized in 3 loops. As for size, the six ports do not have much in common while all exhibit a moderate recovery of traffic in the post-crisis.

Cluster 9. Includes 6 ports: Beirut, Rijeka, Taranto, Ravenna, Trieste and Vado Ligure. Yard operations have a 3-loop arrangement and the ports have similar infrastructure. Apart from Beirut, where traffic handled exceeds a million TEUs, the other ports in the cluster have small-to-medium traffic volumes.

5.3. Discussion

Clearly numerous different clusters can be generated for the ports examined, depending on whether the emphasis is to be placed for example on geographic location, infrastructure, traffic handled or yard organization.

In this application, in line with the collaboration policies outlined below, we opted for a scenario that made it possible to take into account the differences and similarities among the 34 ports examined, in terms of organization of port operations, geographic location and size, without neglecting their individual characteristics.

The similarities and profound differences among ports that the descriptive cluster analysis produced, provide in this sense the knowledge base for formulating and proposing strategies aimed at incentivizing and consolidating management, organizational and technological policies underpinning intra-port cooperation.

From this perspective, systemic management is based primarily on two aspects:

- re-organization of the feeder distribution network, to be achieved by container shipping connections between ports in the same "system";

- integrated port management, to be achieved through: specific information system integration policies, common personnel training and exchange policies, common maintenance policies, common integrated commercial and marketing policies.

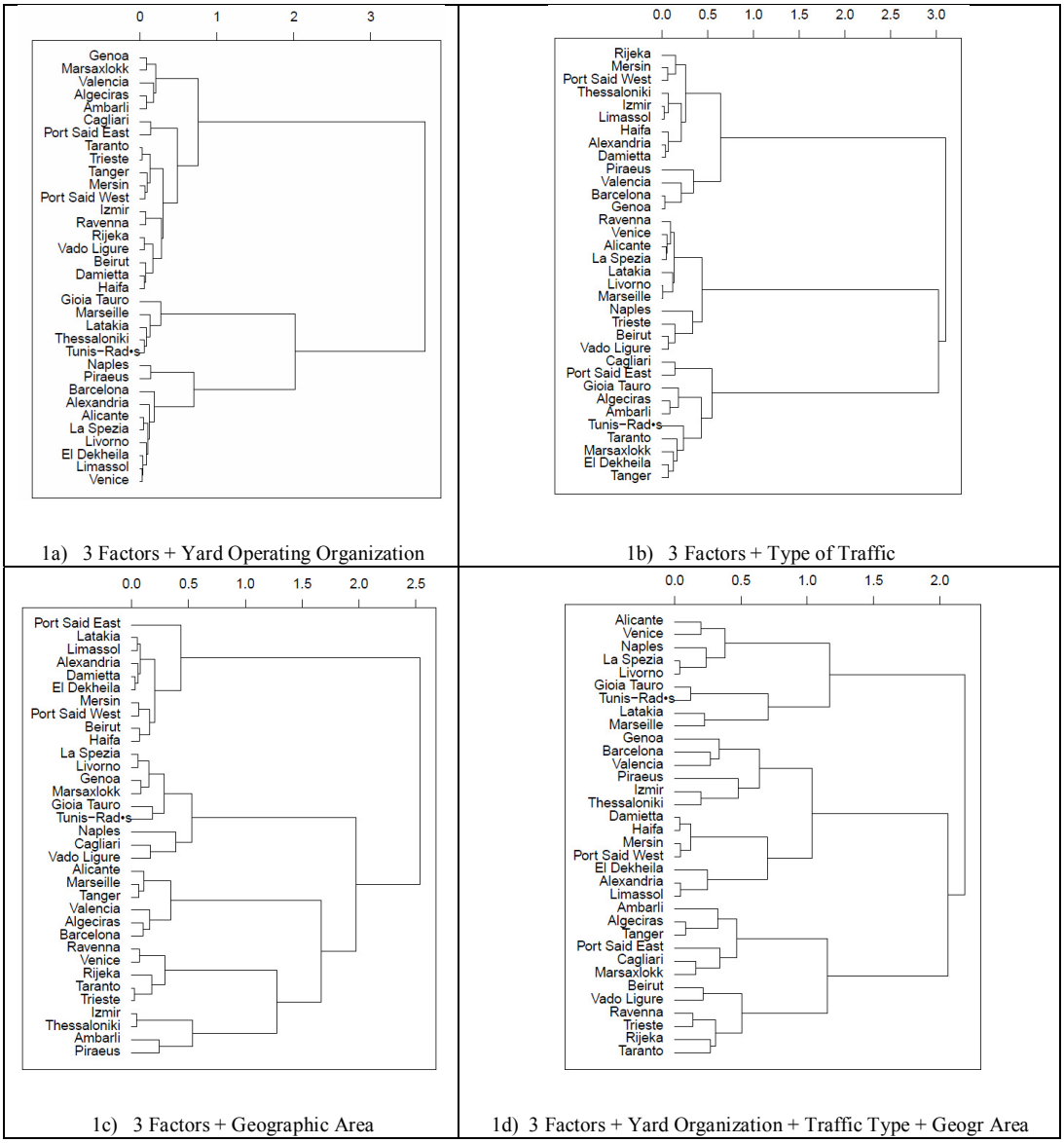
Table 2. Average characteristics – continuous variables.

	Length [m]	Depth [m]	Yard [m2]	QC [n. of units]	Equipment [n. of units]	2011 [TEUs]	2002-2011 [%]	2002-2007 [%]	2008-2009 [%]	2010-2011 [%]
Cluster1	1661	13.8	314 033	10	18	604 785	29.1	4.5	-9.5	19.6
Cluster2	2221	13.8	812 500	14	79	1 339 237	10.8	4.9	-0.1	-6.8
Cluster3	1428	13.9	505 000	7	27	734 807	60.2	10.2	1.1	-2.3
Cluster4	3675	15.7	1 029 667	27	69	2 735 884	65.8	9.1	-5.0	8.4
Cluster5	1229	14.2	360 667	9	37	882 668	21.7	7.1	-4.0	14.4
Cluster6	1270	14.5	335 408	10	16	1 153 621	116.9	12.0	7.7	10.0
Cluster7	877	14.0	293 635	6	28	551 846	102.1	11.4	10.9	1.0
Cluster8	2290	16.8	588 667	21	47	2 425 935	179.8	29.8	15.1	7.0
Cluster9	1060	14.3	243 000	6	11	428 048	253.0	27.6	0.9	11.2

Systemic management based on these policies would likely result in: a reduction in the length of shipping routes, higher occupancy coefficients of cargo ships, more efficient management of empty containers, temporary interchangeability of ports undergoing maintenance, more efficient use by ports comprised in the system of available resources, better management of traffic congestion and contingency planning (strikes, etc.).

Many actions can be put in place through savings and by exploiting the economies of scale to be gained from operating as a Mediterranean system and not as single terminals. We propose 4 main cooperation policies:

1. Common maintenance scheduling. By exploiting ports' geographic proximity and dimensional and organizational similarities, scheduled maintenance could be planned by creating a shared spare parts warehouse. This would reduce costs substantially compared to ports each with their own warehouses. Additionally, the temporary interchangeability of geographically close ports during maintenance works would result in more efficient management of empty containers. The ports belonging to clusters 2 and 6, which have similar arrangements of yard operations, handle the same type of traffic and are geographically close are ideal for implementing this kind of cooperative action.
2. Common personnel training and exchange policies. By exploiting the geographic proximity of ports and their organizational similarities, common personnel training and, when necessary, exchange policies could be formulated. All the ports in cluster 7, situated in the Eastern Mediterranean area and all having mixed organization of yard operations, would lend themselves to implementing policies of this kind.
3. Congestion management. For geographically close ports handling the same type of traffic, it would be possible to divert traffic, when necessary, to a less congested port, thereby optimizing productivity as a whole. The ports belonging to clusters 4, 5 and 8 correspond to these characteristics.
4. Systemic organization. The possibility of offering round-the-world ships a single port-of-call in the centre of the Mediterranean would optimize feeder distribution. This could be achieved by shipping the containers within an optimized network, thereby reducing delivery times, shipping routes and hence the overall cost of container transport. Ports belonging to the same cluster or even to different clusters could be organized in this way. In the former case the ports belonging to cluster 9 could exploit the central position of Taranto port. This port could then operate as a single port-of-call for mother ships and in so doing optimize feeder distribution towards the other ports in the cluster. On the other hand, for ports belonging to different clusters, the port system comprises three different clusters: cluster 2 provides the two transhipment ports, situated close to the ideal route, that handle transoceanic mother ship traffic, while the peripheral ports in clusters 1 e 3 are connected via feeder routes.



1a) 3 Factors + Yard Operating Organization

1b) 3 Factors + Type of Traffic

1c) 3 Factors + Geographic Area

1d) 3 Factors + Yard Organization + Traffic Type + Geogr Area

Fig. 1. Dendrograms.

Table 3. Nominal variables.

Cluster ID	Ports	Yard Organization	Rail	Road	Geographic Area	Traffic type
Cluster 1	La Spezia	mixed	yes	yes	Area 2	Regional
	Livorno	mixed	yes	no	Area 3	Regional
	Naples	mixed	yes	no	Area 4	Regional
	Alicante	mixed	yes	yes	Area 1	Regional
	Venice	mixed	yes	no	Area 3	Regional
Cluster 2	Gioia Tauro	two loops	yes	yes	Area 2	Transhipment
	Tunis-Radès	two loops	no	no	Area 2	Transhipment
Cluster 3	Latakia	two loops	no	yes	Area 4	Regional
	Marseille	two loops	yes	yes	Area 1	Regional
Cluster 4	Barcelona	mixed	yes	yes	Area 1	Both
	Valencia	three loops	yes	yes	Area 1	Both
	Genoa	three loops	yes	yes	Area 2	Both
Cluster 5	Piraeus	mixed	no	no	Area 5	Both
	Thessaloniki	two loops	yes	no	Area 5	Both
	Izmir	three loops	yes	yes	Area 5	Both
Cluster 6	Damietta	three loops	yes	yes	Area 4	Both
	Haifa	three loops	yes	yes	Area 4	Both
	Mersin	three loops	yes	yes	Area 4	Both
	Port Said West	three loops	no	no	Area 4	Both
Cluster 7	Alexandria	mixed	yes	yes	Area 4	Both
	El Dekheila	mixed	yes	yes	Area 4	Transhipment
	Limassol	mixed	no	no	Area 4	Both
Cluster 8	Ambarli	three loops	no	no	Area 5	Transhipment
	Algeciras	three loops	yes	no	Area 1	Transhipment
	Tanger	three loops	yes	yes	Area 1	Transhipment
	Port Said East	three loops	no	no	Area 4	Transhipment
	Cagliari	three loops	no	yes	Area 2	Transhipment
	Marsaxlokk	three loops	no	no	Area 2	Transhipment
Cluster 9	Beirut	three loops	no	no	Area 4	Regional
	Rijeka	three loops	yes	no	Area 3	Both
	Taranto	three loops	yes	no	Area 3	Transhipment
	Ravenna	three loops	no	no	Area 3	Regional
	Trieste	three loops	yes	no	Area 3	Regional
	Vado Ligure	three loops	yes	yes	Area 2	Regional

6. Conclusions

The current intra-port competition regime that exists in the Mediterranean is incompatible with the need to gain a competitive edge over the other large geographic areas. In fact, the outside perception of the Mediterranean is as a single large transit area for the major routes linking the Far East, the northern range and the USA, and through which North-African and South-European markets can be reached. The intra-port competition regime is not appropriate for

tapping the potential of the Mediterranean also and above all because of the limitations resulting from the lack of synergistic integrated management of its ports. Thus, new management policies need to be put in place aimed at developing a new, more efficient and competitive "Mediterranean system", that is able to establish close relationships among ports and create new synergies. Statistical analysis of the 34 ports examined here, has demonstrated that it is possible to identify alternative strategies to overcome the fierce competition between ports in the same geographic region.

The application described aims to provide the knowledge elements underpinning the Mediterranean port system and its characteristics, with a view to stimulating the debate on issues concerning intra-port collaboration and cooperation, the alternative to today's inefficient competition policy. Clustering into 9 different groups according to the variables used here is the first real attempt to find a way towards identifying, in the short-to-medium term, forms of collaboration that will lead to formulating a cooperation policy within the Mediterranean, already internationally agreed but yet to be translated into real actions.

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