



## Port System of the Spanish Mediterranean Coast Side

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### ABSTRACT

This study aims at doing a comparative analysis of the Mediterranean Port Authorities and their positioning based on their perception about the “innovative effort they have made”. In order to achieve this aim, first, a comparative analysis has been carried out in order to obtain an overview of the Mediterranean watershed; secondly, the strengths and weaknesses of each Port Authority have been identified based on the variable “perceived innovative effort”.

The main results obtained have allowed us to detect the existing expertise on the Mediterranean Port Authorities. For instance, Tarragona is specialized in coal traffic, while Barcelona is specialized in natural gas and oil. Valencia holds the first position regarding traffic of goods. It also shares the first position with Barcelona in reference to container traffic.

From the infrastructure analysis, it has been concluded that Tarragona is the Port Authority with a higher number of specialized facilities, followed by Barcelona, Castellón and Valencia. In addition, a detailed analysis of the specific facilities of each Port Authority has allowed us to get more information about the specialization of Port Authorities. Thus, it has been found that Tarragona is the only one that has coal facilities, Baleares is the only one with a dock for unloading butane and Barcelona is the only one with specific facilities dedicated to food (soybean, cocoa, coffee ...).

Finally, the strengths and weaknesses analysis provides an overview of the situation of each Port Authority, indicating the potential lines of action and improvement that they can follow.

We consider that this study may be useful for the Port Authority managers and policy makers due to it offers an overview of the situation of the Port Authority compared to its nearest competitors, helping with decision making and resource allocation.

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### 1. Introduction

The Spanish port system consists of 44 ports of general interest, managed by 28 Port Authorities (PA), which are also

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dependent on the Public Authority *Puertos del Estado*, which in turn depends on the Ministry of Public Works. At an earlier time, characterized by a centralized decision-making system, *Puertos del Estado* marked tariffs, financed infrastructures and covered the ports deficit. However, since the introduction of competition and the application of the principle of financial sufficiency to Spanish ports in the 1990s, ports have developed their activity in a highly competitive environment, especially between nearby ports. Given this situation, and considering that the Spanish port system could be oversized, it is interesting to know the position of the PAs by analyzing their strengths and weaknesses. Especially interesting is the competition between ports of the same watershed.

On the other hand, in the search for competitiveness, innovation is said to be a source of sustainable competitive advantages.

Figure 1: Port Authorities of the Spanish Mediterranean Watershed.



Source: Puertos del Estado (2014).

It is in this context that the objective of the present work is set, which is to carry out a comparative analysis of the PAs, in particular those of the Spanish Mediterranean Watershed, and their positioning based on their perception of the “innovative effort made”.

First, a comparison of all the ports is made so that an overall view of the situation of the watershed can be obtained. This comparison will be made by analysing traffic and infrastructure data. In the second part, we include an analysis of the strengths and weaknesses of each port, in relation to the total score of the watershed, based on the variable “perception of innovative effort carried out by the PAs”. In order to do this, Rasch Measurement Theory has been applied to the information obtained through a survey.

The PAs of the Mediterranean Coast are (See Figure 1): Alicante, Baleares, Barcelona, Cartagena, Castellón, Tarragona and Valencia.

The Port Authority of the Balearic Islands is integrated by the ports of Alcúdia, Eivissa, Maó, Palma and La Savina. The other Port Authority branched in different ports is the one of Valencia, integrated by the ports of Valencia, Sagunto and Gandía.

The first part of the comparative analysis of the ports of the watershed is made taking into account the evolution of the traffic of goods from 2008 to 2012; either in the form of liquid bulk, solid bulk or general merchandise, as well as distinguishing what goods are transported in containers or using Ro-Ro systems. The objective was to make a comparison of the ports to deduce the specialization of each of them and their market shares.

In the second part, the number and characteristics of the infrastructures, facilities and cranes that each port has are compared. The infrastructures for the deposit of containers, the specific facilities of liquid and solid bulk, as well as the dock cranes and automobiles cranes with which each Port Authority handles the goods were analyzed. Through the observation of their infrastructures, the specialization of the ports and the possible causes of the greater or lesser traffic of goods could be evidenced.

In the third part, the weaknesses and strengths of each port are analyzed through the Rasch Measurement Theory.

Finally, a chapter of conclusions, the bibliography and the appendixes are included.

## 2. Compared Analysis of the Port Authorities

The objective of the comparative analysis of the ports is to establish the specialization of each one of them and their market shares. This section compiles the comparison for the different traffic types and infrastructures.

### 2.1. Comparison of Traffic

Figures 2, 3 and 4 show the evolution of traffics (liquid bulk, solid bulk and general goods) during the period 2008-2012, comparing the ports of Mediterranean watershed. Quantities are expressed in Tm. In addition, figures 5 and 6 present the distribution of container traffic and ro-ro transport in 2012, the last year analyzed, for each port.

#### 2.1.1. Liquid Bulk Traffic

Figure 2 shows how, during the 5 years of study, there have been no great variations. The most important ports in the traffic of bulk liquids are Cartagena and Tarragona. The port of Barcelona has always remained in the third place, followed by the ports of Castellón, Valencia, Baleares and Alicante.

#### 2.1.2. Solid Bulk Traffic

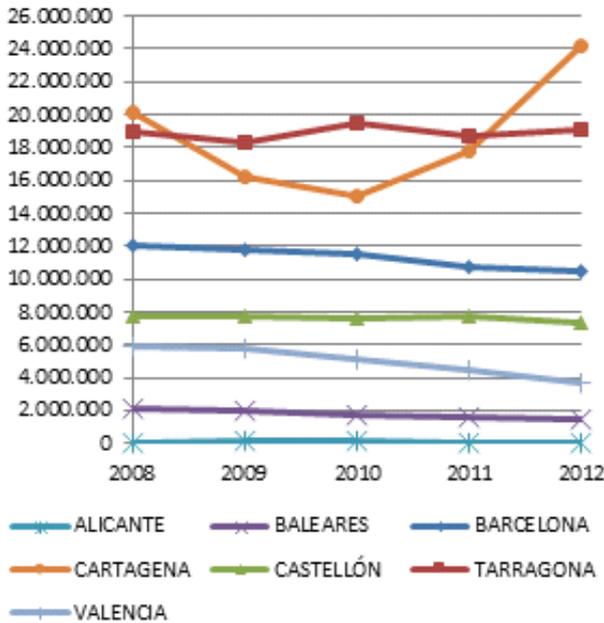
Figure 3 shows that the most important port in terms of solid bulk traffic is Tarragona, followed by the ports of Cartagena and Barcelona in a second position and the ports of Castellón, Valencia, Baleares and Alicante afterwards.

Since 2008 solid bulk traffic has been reduced in all PAs, with the largest reduction corresponding to the port of Valencia which has moved from the second to the fifth position.

#### 2.1.3. General Goods Traffic

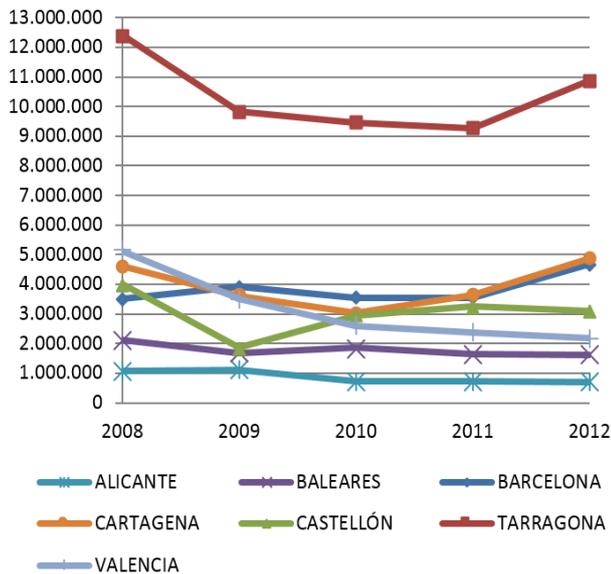
As it can be seen in figure 4, the port of Valencia is the one that moves the greater quantity of general goods, and it has continued to grow despite the crisis. The port of Barcelona is in the second place, with less than half of traffic than Valencia. The ports of Castellón, Tarragona (which has not reduced its volume of merchandise), Cartagena and Alicante distantly follow them.

Figure 2: Liquid bulk traffic of the Spanish Mediterranean Port Authorities (2008-2012) (Tm).



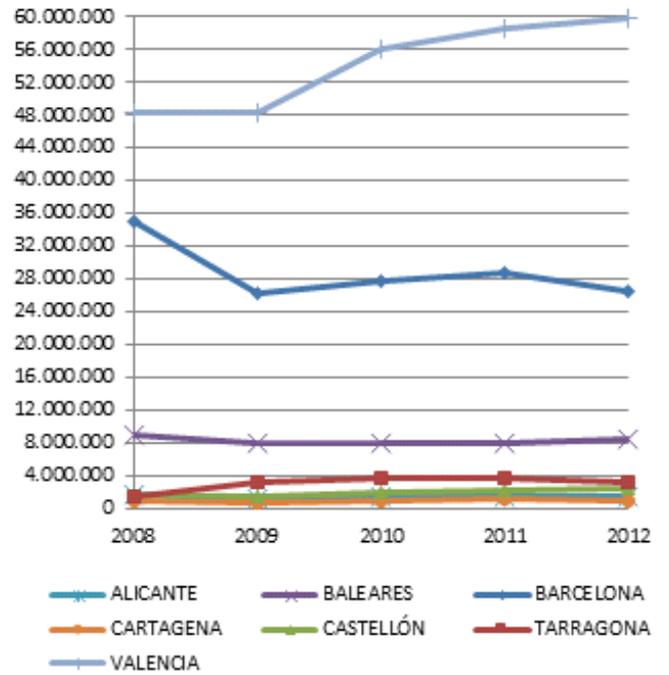
Source: Authors.

Figure 3: Solid bulk traffic of the Spanish Mediterranean Port Authorities (2008-2012) (Tm).



Source: Authors.

Figure 4: General goods traffic of the Spanish Mediterranean Port Authorities (2008-2012) (Tm).



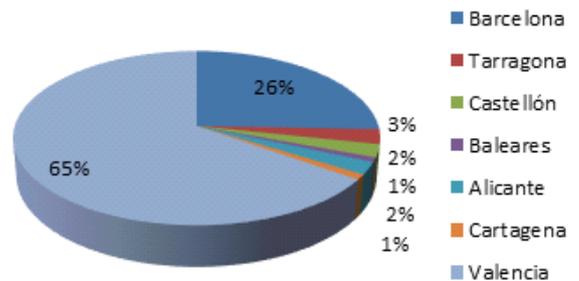
Source: Authors.

#### 2.1.4. Containers Traffic

In the year 2012 a total of 6,858,764 containers were moved by the ports of the Mediterranean watershed. Figure 5 shows its distribution by PAs. The port that covers more than half of the traffic of containers is Valencia, with 4,469,754 units. This could be due to the fact that more than 85% of the general good traffic is containerized. The second port with the highest traffic of containers is Barcelona (with 1,756,429).

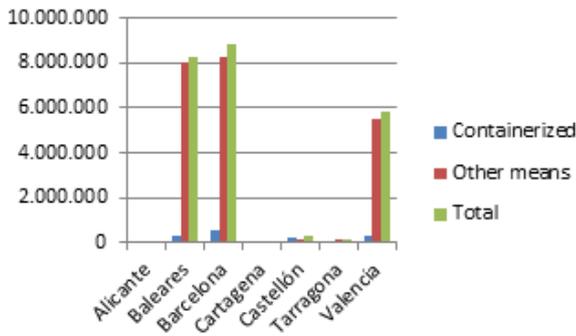
The rest of ports as a whole reached 9% of the total number of containers, which shows their lack of specialization in this type of traffic.

Figure 5: Percentage of containers traffic of each Port Authority in 2012 (% of TEUs).



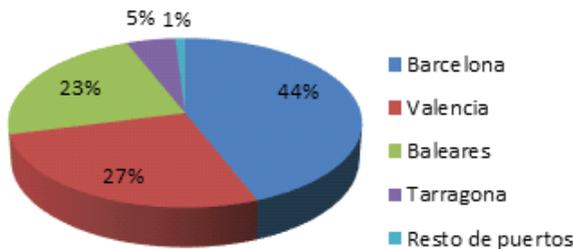
Source: Authors.

Figure 6: Goods moved in Ro-Ro traffic of the Mediterranean Port Authorities (2012) (Tm).



Source: Authors.

Figure 7: Vehicles under the Ro-Ro good system in the Spanish Mediterranean APs (2012).



Source: Authors.

### 2.1.5. Ro-Ro Traffic (Roll-on, Roll-off)

Figure 6 shows the ro-ro traffic of the Mediterranean PAs in 2012. The ports of Barcelona, Baleares and Valencia are the three most important in ro-ro traffic. In these three ports the goods transported in the ro-ro traffic are mostly non-containerized and transported through other means. Whereas for the transport of containers the use of container ships predominates (with the exception of the port of Baleares whose container traffic is minimal).

The ro-ro traffic specific of cars (as a good), and their distribution among the PAs of the watershed in 2012, is shown in figure 7. Barcelona is the most important port in the ro-ro traffic of cars with 44% of the total number of vehicle units moved on the Mediterranean watershed. It is followed by the ports of Valencia and the Balearic Islands with 27% and 23% of the total respectively. Further away, there is the port of Tarragona with 5% of the total. The ports of Castellón, Alicante and Cartagena jointly reach only 1% of the total. By type of vehicles, cars are the main good of each port, except for the ports of Castellón and Cartagena that are specialized in vehicles for the transport of goods and in special purpose vehicles respectively.

## 2.2. Comparison of Infrastructures

This section compiles the comparative analyses of the special facilities and cranes of the Mediterranean PAs.

### 2.2.1. Special facilities

Table 1 summarizes the special facilities that each of the PA has, where x indicates that the special installation is available. As it can be seen, the port of Tarragona is the one with the higher number of special facilities with a total of 16, which are mainly for coal, petroleum products, the car depot and cold stores of perishable products.

The ports of Barcelona, Castellón and Valencia have at their disposal 10 specific facilities each. The facilities for oils and grease, as well as those for cement and clinker, are present in the three of them. All of them have also facilities for the deposit of containers, which, as we have seen in the previous section, is especially important in the ports of Valencia and Barcelona. The port of Barcelona is the only port that has specific facilities for the deposit of soybeans, potash and storage of cocoa and coffee.

On the other hand the port of Castellón is the only one with specific facilities for the deposit of phosphoric and sulfuric acids; while the PA of Valencia is specialized in molasses.

The special facilities of the port of Cartagena are dedicated to the storage and handling of cement, fertilizers, petroleum products and natural gas because it focuses almost all its activity on the movement of liquid and solid bulk.

Despite its small size, the Balearic Islands' PA has all its facilities, such as refrigerated warehouses or ice, cereal and gasoil facilities among others, distributed among the different ports which it is integrated in. In addition, it is the only PA in the Mediterranean watershed that has a pontoon for the discharge of butane. The PAs of the Balearic Islands and Cartagena lack container facilities. Finally, the port of Alicante has 4 specific facilities that are destined to plastic bitumen, cement and clinker and chemical products. It also has a large area used in the container tank.

### 2.2.2. Cranes

The comparison of cranes is summarized in table 2. The ports that have the highest number and largest cranes are those of Valencia, Barcelona and Tarragona (these three ports are the ones which move more goods in the entire Mediterranean watershed). Castellón and Cartagena are located at an intermediate level while the ports of Alicante and the Balearic Islands have very few cranes when compared to the rest of ports on the slope.

For this specific document, Section 2 is devoted to explaining how to format the text, Section 3 gives recommendations on style and structure, Section 4 explains how to present the supplements to the text, that is, the Figures, Tables and Equations. Section 5 deals with the subject of intellectual property and, finally, the conclusions are presented..

## 3. Strengths and Weaknesses Analysis

The objective of this section is to analyze the strengths and weaknesses of the Mediterranean PAs, based on the variable "perception of the innovative effort made".

Table 1. Comparison of the special facilities of each PA

Special facilities	Port Authorities						
	Alicante	Baleares	Barcelona	Cartagena	Castellón	Tarragona	Valencia
Ammonia					✓		✓
Asphalt bitumen		✓				✓	
Butane		✓					
Cement and clinker	✓	✓	✓	✓	✓	✓	✓
Cereals		✓					✓
Chemical products	✓				✓	✓	✓
Coal						✓	
Coffee and cocoa			✓				
Containers	✓		✓		✓	✓	✓
Diesel oil		✓			✓	✓	
Fertilizers				✓			
Food products						✓	
Fuel		✓				✓	
Gasoline					✓	✓	
Grains and seeds			✓			✓	✓
Hydrocarbons				✓			
Ice factories		✓	✓				
Liquid gas			✓	✓		✓	✓
Molasses							✓
Naphtha		✓				✓	
Natural gas				✓			
Oils and fats			✓		✓		✓
Phosphoric acid					✓		
Plastic bitumen	✓						
Potash			✓				
Raw materials						✓	
Raw oil				✓	✓	✓	
Refrigerated stores		✓				✓	✓
Soybean			✓				
Sulfuric acid					✓		
Vehicles			✓			✓	

Source: Authors.

Table 2. Comparison of cranes in the Spanish Mediterranean APs

	Spanish Port Authorities						
	Alicante	Baleares	Barcelona	Cartagena	Castellón	Tarragona	Valencia
Spring cranes							
Between 1 and 10	✓	✓					
Between 10 and 20				✓	✓	✓	
>20			✓				✓
Cranes for automobiles							
Between 1 and 10	✓		✓	✓	✓		
>10						✓	✓

Source: Authors.

3.1. Methodology

The present study is based on a survey carried out among the 28 Spanish PAs in a previous study (Serrano, Blanco and López 2009). In that survey, among other issues, the Spanish Public Administrations were asked what they perceived to be the innovative effort they made in various activities or areas of innovation (see Appendix 1). The reliability and validity analysis can be found in Blanco et al. (2010).

Rasch Measurement Theory was used for the analysis. The computer software used to treat the data was Winsteps 3.75 (Linacre 2011). Specifically two of its applications were used:

a) Variable Map

A first positioning, both of ports and of items, is obtained in the variable map. On the left side the subjects (the Port Authorities in this case) are located: those located above have a better positioning than those located below. On the right side the items are located (innovation activities in this case) ordered from most important (at the bottom) to least important (at the top). See Figure 9.

b) Diagnostic Maps: PKMAP

For the strengths and weaknesses analysis, one of the applications of the Rasch methodology has been used, namely the PKMAP (diagnostic maps). In this respect the works of Sánchez, Blanco and Pérez Labajos (2012) and Sánchez et al. (2013) incorporate a brief explanation of these tools. It should be noted that, unlike the two studies mentioned above, in the present work a more detailed study of the watershed is made since it is understood that the competition is much greater between the nearest ports.

Through the PKMAP, the program makes a comparison between the individual evaluations of each item and the global evaluation of each item for the whole set of subjects. The result is displayed on a diagnostic map (PKMAP).

In the case of this study the assessments that a Port Authority gave to each of the 16 items that make up the construct “perception of the innovative effort made by the AAPPs of the Mediterranean slope” are compared with the average importance given jointly to each of the items. Thus, for example, if a Port Authority has a 5 (máximum value) in an item that is not valued by the PAs as a whole, it would have a strength since the innovative effort that the Authority made in this aspect is much greater than that made in general terms by the set of Port Authorities. On the contrary, if a Port Authority has a score of 1 (minimun value) in a highly valued item, it has a weakness, since its innovative effort is very small in an item in which, in general, the innovative effort made is great.

The diagnostic map is divided into four quadrants in which the different items will be distributed according to the response given by the subject to each of them (Figure 8). The middle zone in grey represents the level of the subject.

In the upper left quadrant, quadrant 1, those items in which the subject has a strength are located. These would be activities in which the Port Authority makes a bigger innovative effort than the average. In the lower right quadrant, quadrant 4, the weaknesses of the Port Authority are located. They are the activities in which it does not make enough innovative effort, while the other Port Authorities do.

Figure 8: PKMAP Quadrants Interpretation.

	ANSWERED CORRECTLY	ANSWERED INCORRECTLY
DIFFICULT ITEMS	QUADRANT 1 (STRENGTHS)	QUADRANT 2 (EXPECTED)
EASY ITEMS	QUADRANT 3 (EXPECTED)	QUADRANT 4 (WEAKNESSES)

Source: Authors.

The other two quadrants have less interest. Quadrant 3, which is the lower left quadrant, indicates the activities in which Port Authorities have made some effort, but that it does not suppose any advantage, since the others also have made it. The upper right quadrant, quadrant 2, includes the activities in which no effort has been made, but neither the other Port Authorities, so it is not a disadvantage.

3.2. Results

With the objective of positioning and analyzing the strengths and weaknesses of the Mediterranean AAPPs, an analysis based on the variable “perception of the innovative effort made” by the PAs in different management areas was carried on. In order to do it, first, the map of variables is obtained and analyzed and, secondly, the diagnostic maps.

Due to the analysis is focused only on the Mediterranean PAs, firstly the different activities have been ranked according to the greater or lesser innovative effort that the Mediterranean PAs perceive to have developed. The results are presented in Figure 9 and in Table 3.

Based on this ranking, the next step is to identify the strengths and weaknesses of each PAs using the PKMAP. Through this application, the program makes a comparison between the individual evaluations of each item and the importance of the items for the set of subjects. The result is presented in a diagnostic map (PKMAP). Appendix 2 presents the PKMAPs of all the Mediterranean PAs. However, to facilitate the interpretation of the data, Table 4 schematically includes the strengths and weaknesses that each of the PA has in the different items with respect to the total of the watershed.

For more information, Table 5 includes, for each of the PAs, the measure, the standard deviation (S.E.) and the score. These values indicate respectively the average value of the distribution (where the xxx are in each graph) and the horizontal lines that represent the average values plus or minus the standard deviation, resulting in the positioning of each port (central strip). The higher the value of this measure the better positioned the

Table 3. Items ranking

Position	Item number	Items
1	P10-11	Information systems, communication and control systems
2	P10-10	Environmental issues
3	P10-12	Plans and protection systems
4	P10-1	Strategic planning
5	P10-13	Contingency plans and security systems for protecting infrastructure and the environment
6	P10-3	Port services
7	P10-9	Quality
8	P10-14	Projects and construction
9	P10-6	Finance and economics
10	P10-8	External relations
11	P10-7	Legal services and administrative management
12	P10-5	Sales and marketing
13	P10-4	Management of concessions and authorizations
14	P10-2	Human resources
15	P10-16	Promotion and sponsorship of scientific and technological R&D within the port
16	P10-15	Maintenance

Source: Authors.

Table 4. Summary of the strengths (S) and weaknesses (W) of the Spanish Mediterranean PAs with respect to the total of the watershed, based on the PKMAPs

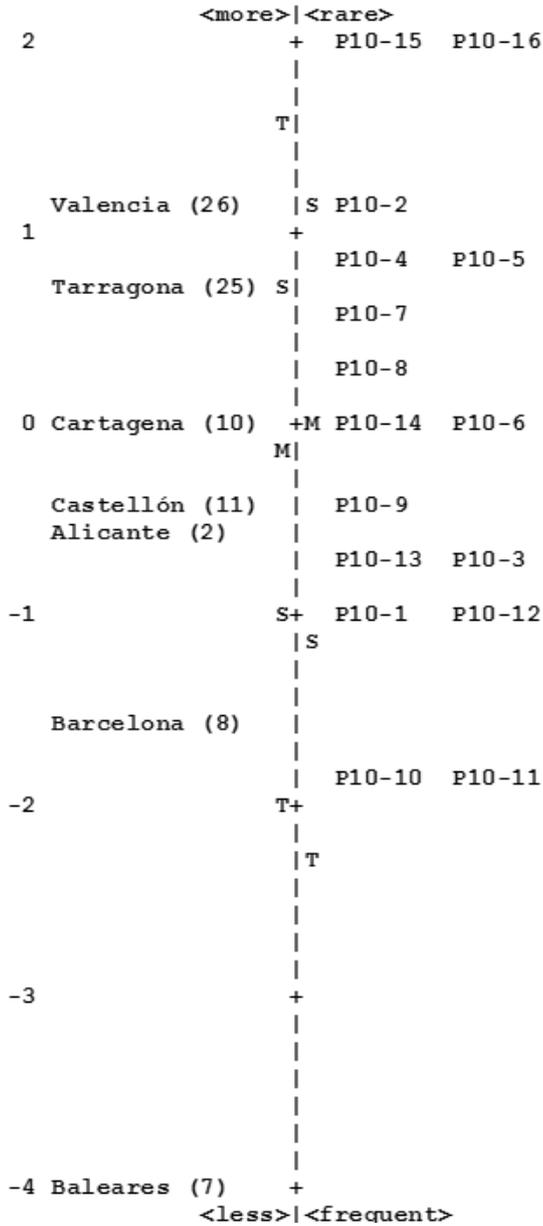
Position	Items	Port Authorities						
		Alicante	Baleares	Barcelona	Cartagena	Castellón	Tarragona	Valencia
1	11. Information systems, communication and control systems			S				W
2	10. Environmental issues			S		W		
3	12. Plans and protection systems			W				
4	1. Strategic planning				W	S		
5	13. Contingency plans and security systems for protecting infrastructure and the environment	S				W	S	
6	3. Port services	S		W		W	S	
7	9. Quality			S	W	W	S	
8	14. Projects and construction			S	W	S	W	
9	6. Finance and economics	S			S	S	W	W
10	8. External relations	S			S	W		
11	7. Legal services and administrative management			S	S	W	W	
12	5. Sales and marketing	W			S			S
13	4. Management of concessions and authorizations	W			S	S	W	S
14	2. Human resources			S	W	S		S
15	16. Promotion and sponsorship of scientific and technological R&D within the port					S		
16	15. Maintenance	S						

Source: Authors.

Table 5. Summary of PKMAPs information

	Measure	S.E.	Score
Valencia	1,12	0,38	65
Tarragona	0,7	0,37	62
Cartagena	-0,06	0,35	56
Castellón	-0,44	0,35	53
Alicante	-0,56	0,35	52
Barcelona	-1,63	0,39	44
Baleares	-6,01	1,82	32

Figure 9: Variable map.



Source: Authors.

port will be. The lower the value of S.E. the more central will be with respect to the average. The score is the sum of the raw scores that the Port Authority gave to all items.

From the observation of the values “measure” and “score”, it may be concluded that Valencia would be the best positioned PA followed by Tarragona, Cartagena, Castellón, Alicante, Barcelona and Baleares.

Finally, the analysis of strengths and weaknesses shows some discrepancies with the traffic analysis. These discrepancies could be due to:

- a) Subjectivity: due to PAs are asked about their “perception” of the effort made in the last years, and perception is always subjective.
- b) Relativity: depending on the size of the port the same effort could be perceived as greater or lower. Thus, in a small port, a small amount of time or money can be perceived as a great effort; whereas in another port, however, a greater absolute amount may be perceived as a small investment because it is relatively less important compared to its total investments.
- c) Different starting situation: investments may have been made prior to the period requested in the survey and this effort is not reflected in the results.
- d) The impact of the Hinterland: as it was shown by Blanco et al. (2011), the biggest effort in innovation is made by the hinterland companies of each port.

#### 4. Conclusions

In the present study an analysis of the positioning of the Mediterranean Port Authorities (Alicante, Baleares, Barcelona, Cartagena, Castellón, Tarragona and Valencia) has been carried out.

Firstly, a comparison between the different ports, based on traffic and infrastructures, has been made. Secondly, a strengths and weaknesses analysis has been carried out based on their “perception of the innovative effort made” in various activities of its daily operation. The individualized analysis has allowed us to visualise the degree of specialization of the different ports. Specifically, in reference to the liquid bulk Tarragona and Cartagena stand out for their specialization in crude oil; whereas

Source: Authors.

Barcelona stands out in natural gas and diesel. Regarding the solid bulk, the most outstanding result is the specialization of Tarragona in coal.

In relation to the freight traffic of coal, petroleum products and natural gas, it is worth noting that importations are higher than exportations. This result is logical and consistent with the reality of the country, since Spain is characterized by not being self-sufficient in terms of energy.

Additionally, from the comparative analysis, it has been concluded that in 2012 Cartagena and Tarragona, which also occupy the top positions for liquid bulk, were the ports with the highest volume of solid bulk traffic. On the other hand, Barcelona and Valencia are the first in terms of volume of general goods traffic, container traffic and ro-ro traffic.

On the other hand, the comparison of infrastructures has reinforced some of the conclusions obtained from the analysis of traffic. Thus, each of the PA seems to have sought its niche of specialization on the watershed.

In terms of container traffic, Valencia, Barcelona and Tarragona are the ones with the best specific terminals for this purpose. In addition, Barcelona and Valencia are the two PAs with the largest number of cranes for the movement of goods.

The above results give an idea of the specialization of each PA. Knowing the specialization of each PA will allow, in future work, to identify more easily which the companies of the hinterland of each PA are. This is important in order to deepen the analysis of the innovation and competitiveness of the PAs since, according to Blanco et al. (2011), the companies installed in the PA are responsible for making the investments. Identifying them is a vital first step.

According to the results obtained, based on the variable innovative effort, the best positioned port would be Valencia followed by Tarragona, Cartagena, Castellón, Alicante, Barcelona and Baleares. In reference to the better positioned ports, a similarity is observed between these results and those obtained from the comparative analysis. Thus, Valencia is the port with the highest movement of general goods since 2008 followed, at a notable distance, by Barcelona. Tarragona and Cartagena, on the other hand, maintain the first positions in terms of liquid bulk traffic. In addition, in the case of Tarragona, it leads the bulk traffic figures. On the opposite side the Balearic PA can be found which, as can be seen, is in the last positions of both solid and liquid bulk. It is true that their position improves in the case of general goods, but we must not forget that given its island nature it can be due to captive trafficking and supply to the Islands.

Despite finding some agreement in the data, we must be cautious with interpretation. Due to ports are asked about “perception”, there is a subjective component. In addition, the possible influence of size has to be taken into account: in a small port, a small amount of time or money can be perceived as a great effort; whereas in another port, however, a greater absolute amount may be perceived as a small investment because it is relatively less important compared to its total investments.

On the other hand, the starting situation may be also different from each other. Thus, if a port had previously made innovation, the effort required to perform later is less, but this would

not be reflected in the results. This may be the case of Barcelona that appears as the second port that perceives a smaller effort, behind the Balearic Islands. If we check the infrastructures data of Barcelona it is observed that most of them had been developed before the year of the survey (2009), then its innovative effort could have been made previously to the other ports.

On the other hand, according to the study by Blanco et al. (2011) the greatest innovative effort is made by the companies located in the hinterland of each port, so the total effort, not just the one made by port authority, should be analyzed. This is an aspect that opens new lines of research.

The results obtained in the work may be of interest to the managers of the PAs, since they allow them to know their situation in front of other competing ports, indicating for example their strengths and weaknesses. All this can be useful for them when making decisions about where to invest their resources to improve their competitiveness.

There is also the need to study in depth private innovation and its impact on the development of the hinterland and the port itself. Analyze the circle of synergies: the port contributes to the economic development of its hinterland, but also the development of the hinterland contributes to the growth of the port.

Overall, it may be concluded that specialization has been a source of competitiveness and survival for the ports of the Mediterranean.

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high level of effort) for the degree of effort to innovate that has been made within the Port Authority in the following areas:

1. Strategic planning
2. Human resources
3. Port services
4. Management of concessions and authorizations
5. Sales and marketing
6. Finance and economics
7. Legal services and administrative management
8. External relations
9. Quality
10. Environmental issues
11. Information systems, communication and control systems
12. Plans and protection systems
13. Contingency plans and security systems for protecting infrastructure and the environment
14. Projects and construction
15. Maintenance
16. Promotion and sponsorship of scientific and technological R&D within the port

## Appendix A. Survey

According to your point of view, and with reference to the last five years(2004-2008), give a score between 1 (no effort) and 5 (extremely

Figure 10: Alicante PKMAP.

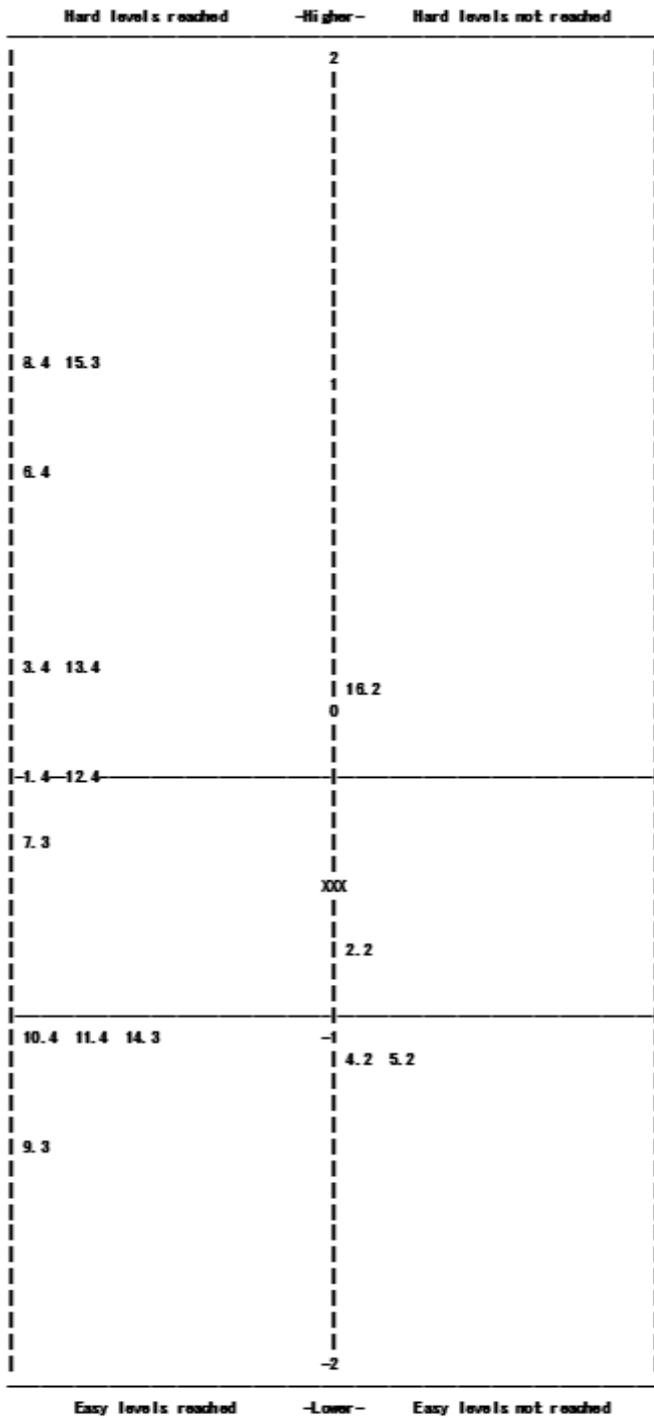
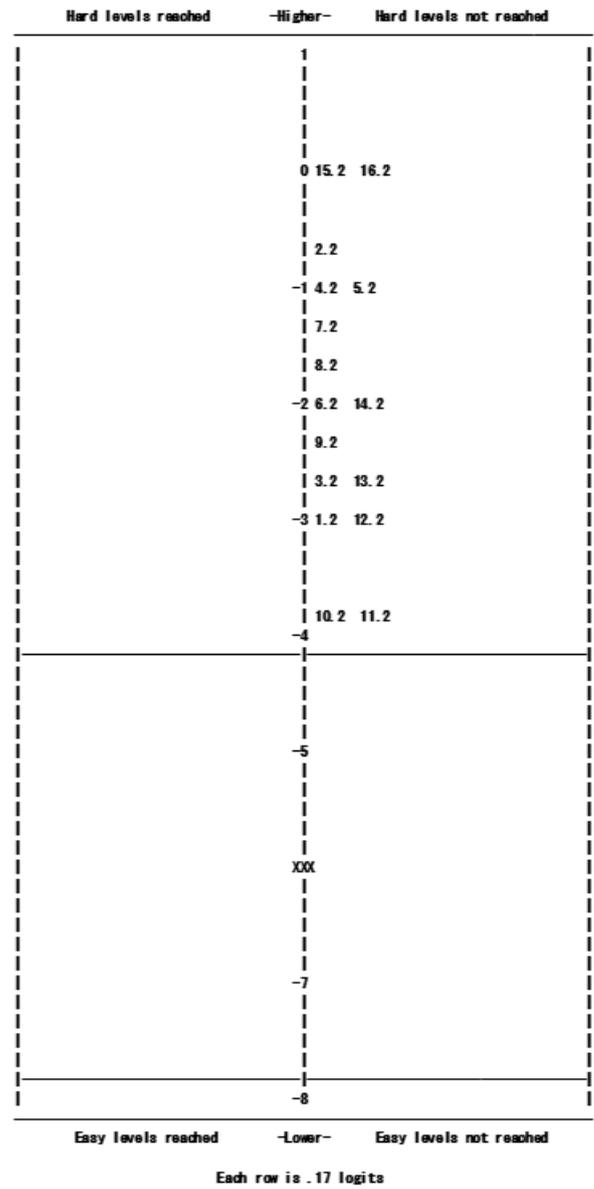


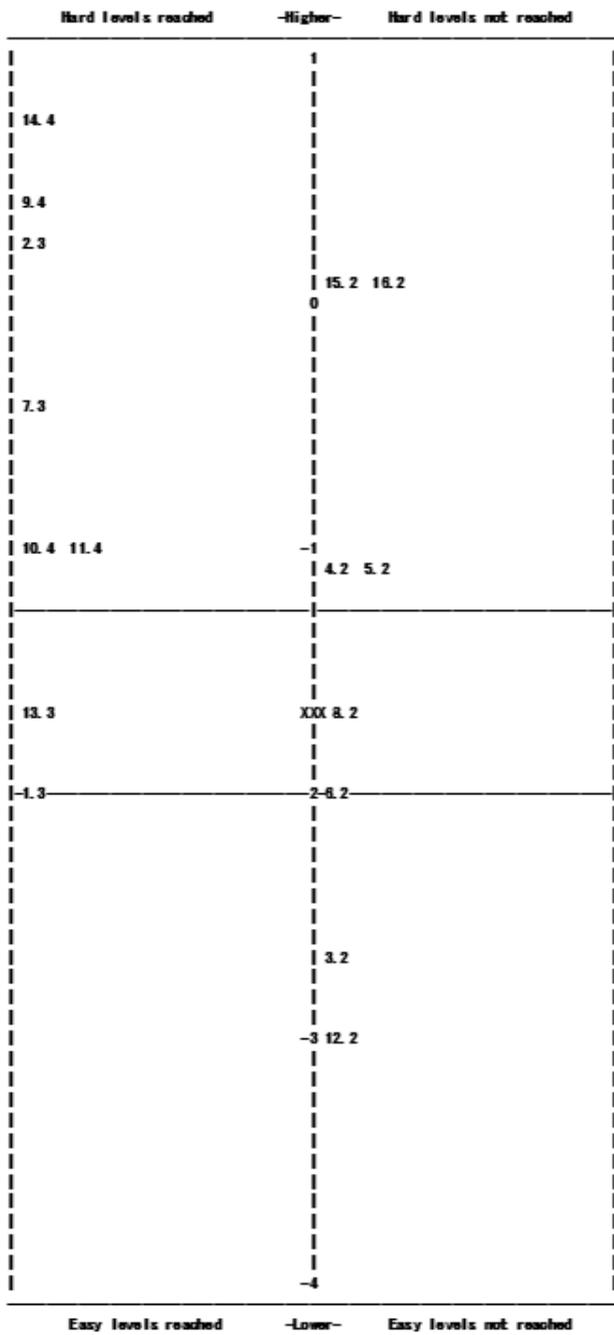
Figure 11: Baleares PKMAP.



Source: Authors.

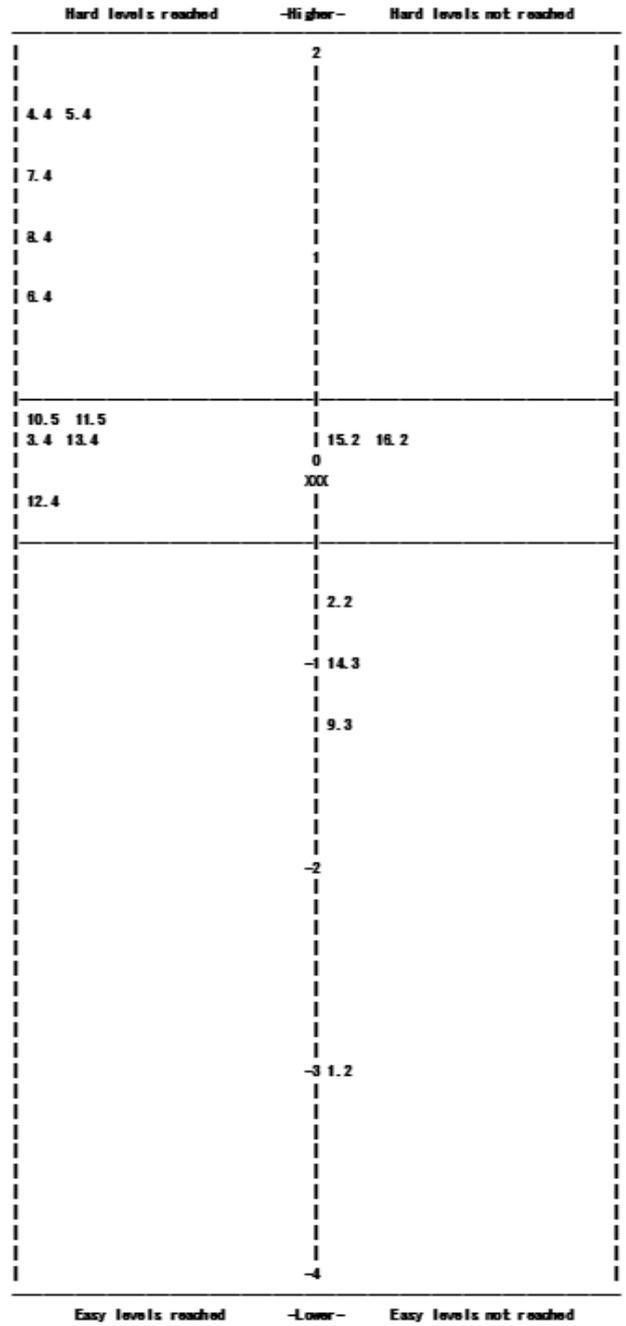
Source: Authors.

Figure 12: Barcelona PKMAP.



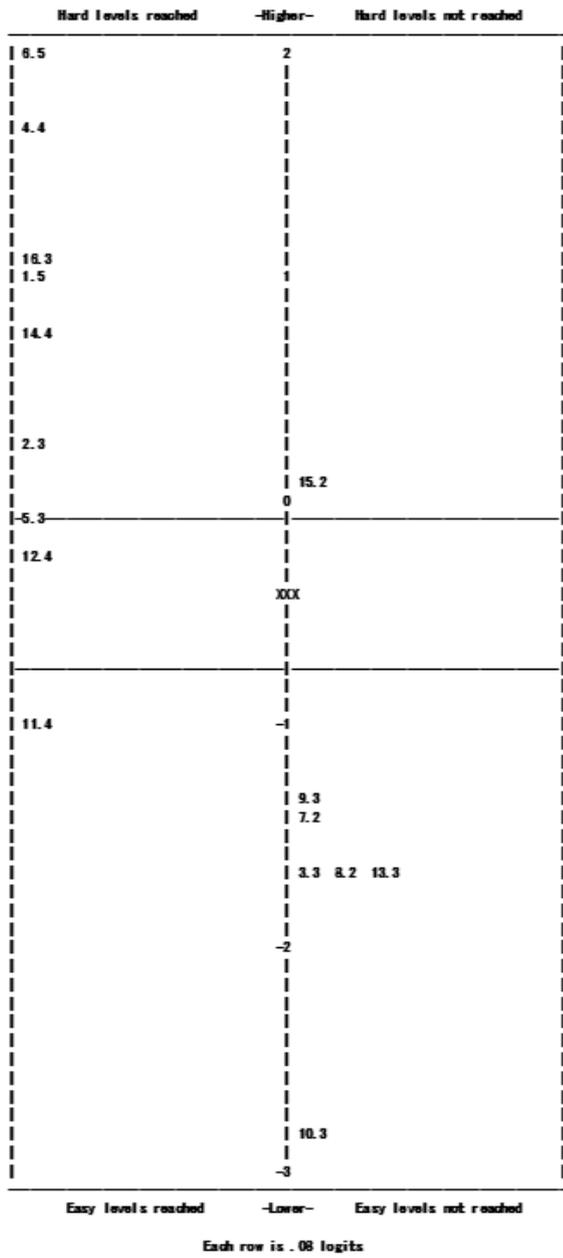
Source: Authors.

Figure 13: Cartagena PKMAP.



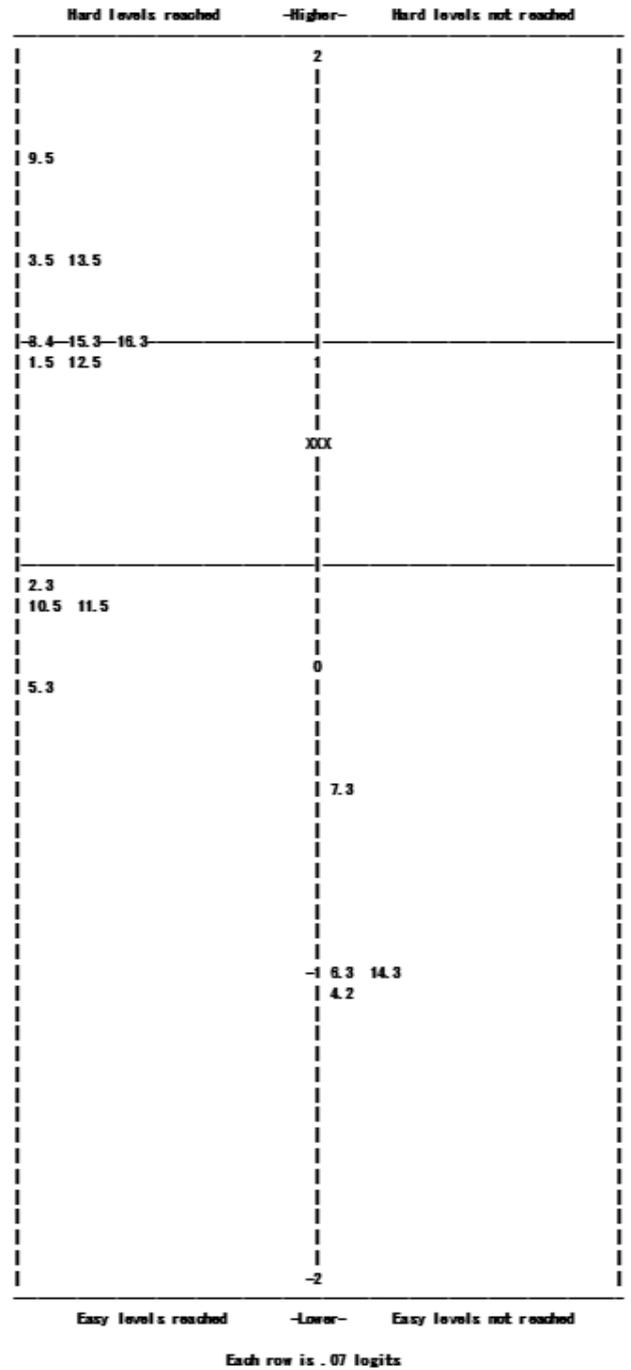
Source: Authors.

Figure 14: Castellón PKMAP.



Source: Authors.

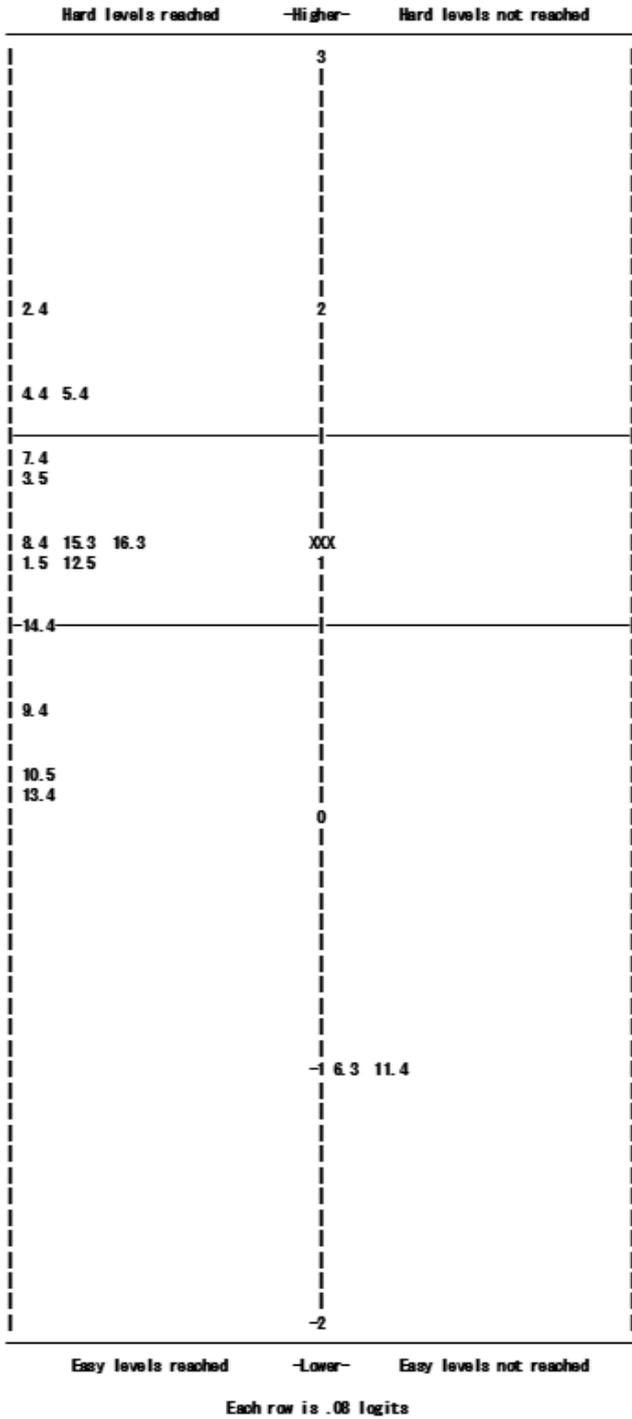
Figure 15: Tarragona PKMAP.



Source: Authors.

Appendix B. PKMAPS of the Spanish Mediterranean APs

Figure 16: Valencia PKMAP.



Source: Authors.