



Rasch Model as a Tool for Strategic Positioning of Commercial Seaports

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ABSTRACT

Since the nineties, when substantial changes took place in the management and financing model of the Port Authorities, these have been operating in a highly competitive environment. Against this background, and considering that the Spanish Port System may be oversized, it seems worthwhile verifying the position of each Port Authority by analyzing its strengths and weaknesses. The objective of this study is to conduct a comparative analysis of two competing Port Authorities, potentially in competition with each other, according to the variable "innovative effort". First we analyze their strengths and weaknesses compared to the national situation and then we carry out a comparative analysis or benchmarking between the two authorities.

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1. Introduction

The existence of an efficient port system is a key factor in ensuring the competitiveness of a country. Ensuring the efficiency of that port system is not an easy task and one of the first issues to address is how many ports are needed (Blanco et al. 2011) p.77-78.

This question arose some years ago in the Spanish port system which, given its high costs, seemed to be oversized. Given that situation, it was necessary to make a decision and select which ports would "survive". There were two alternatives: either to decide centrally from the institution of the Public Authority of State Ports which ports would survive or to let ports pursue their activity in a purely competitive system so that they self-selected themselves.

In the Spanish case, the second option was chosen. Thus, in the nineties, there was a paradigm shift. Port Authorities saw how their dependence on the state was reduced, becoming

more independently managed and, most importantly, more self-financed. As a result of this transformation, Spanish ports of general interest were immersed in a highly competitive environment in which the equity financing and financial sufficiency became priorities (Arévalo Quijada, Castro Nuño & Castillo Manzano 2005).

In a scenario like this, knowing the position of commercial ports and their strengths and weaknesses is essential. To accomplish this, a variable has to be selected depending on where the subject (commercial Port) will be positioned. The variables to be analyzed can be of a very different nature (economic, financial, environmental, infrastructure ...), however in our case we use the variable "innovative effort of the Port Authority".

Innovation, as outlined in previous studies, is an extremely important factor for port operations (Serrano, Blanco & López 2009, Blanco et al. 2010, p.72). Therefore, we consider innovation to be an important factor to take into consideration when positioning ports. Then, if it were necessary to select which Port Authorities should "survive" considering this variable, the most innovative Port Authorities or, in other words, those who have made the greater innovative effort would be selected.

Therefore, the aim of this paper is to use the Rasch methodology to verify the strengths and weaknesses of two Port Authorities, and to perform a benchmarking analysis be-

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tween them to know which one is better positioned, all of this based on the innovative effort made by them.

The selection of the two Port Authorities analyzed, whose identities will remain anonymous, has been based on geographical proximity (not only do they belong to the same geographical zone, but also they are close to each other) as well as their similar characteristics (size, type of goods, target market ...), factors that make them potential competitors.

Ideally, the best option would be to perform this analysis on each and every one of the Spanish Port Authorities and to apply different positioning variables. However, this is an ambitious goal that exceeds the scope of this study.

Once the goal has been defined, the rest of the paper is structured as follows. The first section is devoted to the methodology where the techniques used are described in full (PKMAP and Guttman scalogram). Then, in section 3, the results are presented and, finally, section 4 includes the main conclusions of the study.

2. Methodology

This paper is based on the findings of two previous studies which analyzed the innovative effort made by the Port Authority on a national level (Blanco et al. 2010, Sánchez, Blanco & Pérez-Labajos 2012). As explained in the aforementioned studies, the data for analysis were obtained from a questionnaire focused on innovation in the Spanish port system, whose technical data is shown in Table 1. The questionnaire was comprised of 15 questions, question 10 being the one on the “innovative effort made by the Port Authority” and thus the one analyzed in this study (see Appendix 1).

Table 1: Specifications of survey.

Universe	Spanish Port Authorities
Geographical scope	Ports of General interest in Spain
Sample size	28 Port Authorities (100% of the population)
Field work	July- August 2009
Response rate	89,28% (25 Port Authorities)

In the above-mentioned research, as well as checking the reliability and validity of the measures related to the construct “innovative effort of Port Authorities,” the items were ranked. Thus, the resulting list of items ordered from highest to lowest in importance was as follows (Table 2).

One of the most interesting applications offered by the Rasch methodology is the identification of the strengths and weaknesses of a subject based on the hierarchy formed by the total sample of subjects. The program performs a comparison between the individual assessment of each item and the general assessment of items made for all subjects (see (González Aponcio, Calvo Aizpuru & Oreja-Rodríguez 2012, Oreja-Rodríguez, Montero-Muradas 2012).

In the present case, the program will compare the scores that each subject (Port Authority) has given to each of the 16 items that make up the construct “innovative effort made by

Table 2: Item hierarchy.

Position	Item Number	Item
1	P10-1	Strategic planning
2	P10-13	Contingency plans and security systems for protecting infrastructure and the environment
3	P10-11	Information systems and certifications
4	P10-12	Plans and Protection systems
5	P10-14	Projects and construction
6	P10-3	Port services
7	P10-15	Maintenance
8	P10-10	Environmental issues
9	P10-9	Quality
10	P10-16	Promotion and Sponsorship of scientific and technological R&D
11	P10-2	Human Resources
12	P10-4	Management of concessions and authorizations
13	P10-5	Sales and marketing
14	P10-8	External relationships
15	P10-6	Finance and economics
16	P10-7	Legal services and administrative management

Source: Adapted from (Blanco et al. 2010)

the Spanish Port Authorities,” with the scores given by the 25 Port Authority to each of items (Table 2). For instance, if one Port Authority had given a score of 5 to item P10-7, this would constitute a strength, since the innovative effort made by this Authority in that item is much higher than the effort made by the whole set of Port Authorities . By contrast, if a Port Authority had given a score of 1 to the item P10-1, it would have a weakness, as its innovative effort is small in an item in which, generally, the innovative effort made is larger.

The result of this comparative analysis is presented in a diagnosis map (diagnostic person map) offered by the Winsteps program (Figure 1).

The map is divided into four quadrants into which the four items are distributed according to the answers given by the subject for each of them. The shaded zone represents the level of the subject. The items placed above this level will be items which are difficult for the subject, while those below will be easy items. Finally, those that are in the shaded zone will be items which are of average difficulty for the subject.

Items in which the subject has a strength are included in “quadrant 1”. These are the difficult items that the subject has answered correctly. In terms of the current study, these would be activities in which the Port Authority makes a larger innovative effort than the average.

In “quadrant 2”, difficult items answered incorrectly by the Port Authority are included. In the current research, those activities in which the Port Authority does not make a great effort will be found in this quadrant. However, these are not weaknesses because the innovative effort made in these activities by the whole set of ports is not great either.

Easy items answered correctly are in “quadrant 3”. That is, activities in which the subject makes an innovative effort similar to that made by the mean of the Port Authorities included here. Since the effort made is similar, there is neither an advantage nor a disadvantage. The result for this authority is the same as the average.

Finally, “quadrant 4” contains easy items answered incorrectly; that is, activities in which the subject is making less of an innovative effort than the average for all the Port Authorities. Therefore, these are weaknesses of the Port Authority.

Figure 1: PKMAP quadrants interpretation.

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

Source: The authors

After analyzing the strengths and the weaknesses of the two Port Authorities with respect to the overall national situation, we then compared them directly with one another, using the information provided by the Guttman diagram, another tool offered by the Rasch Model.

The Guttman diagram is a two-way table: each row represents the responses of one Port Authority and the columns represent the responses to each item. Therefore there will be as many rows as Port Authorities and as many columns as items. In addition, the better positioned Port Authority will be on the top row, while the most important item will be in the first column on the left.

We will take the data on the two Port Authorities from the Guttman diagram and we will proceed with the benchmarking analysis.

The computer software used to process the data was Ministeps in version 3.71 (Linacre, 2011).

3. Results

3.1. Analysis of strengths and weaknesses

The PKMAPs of the two Port Authorities are represented below (Figure 2). In order to preserve their anonymity, the Port Authorities will be called “Port Authority 1” (PA1) and “Port Authority 2” (PA2).

As we can see in the PA1 diagnosis map (Figure 2 left), the strengths of this Port Authority, starting with the most important, are:

- P10-14: Projects and construction
- P10-9: Quality
- P10-16: Promotion and Sponsorship of scientific and technological R&D
- P10-8: External relationships
- P10-1: Strategic planning
- P10-10: Environmental issues
- P10-2: Human Resources

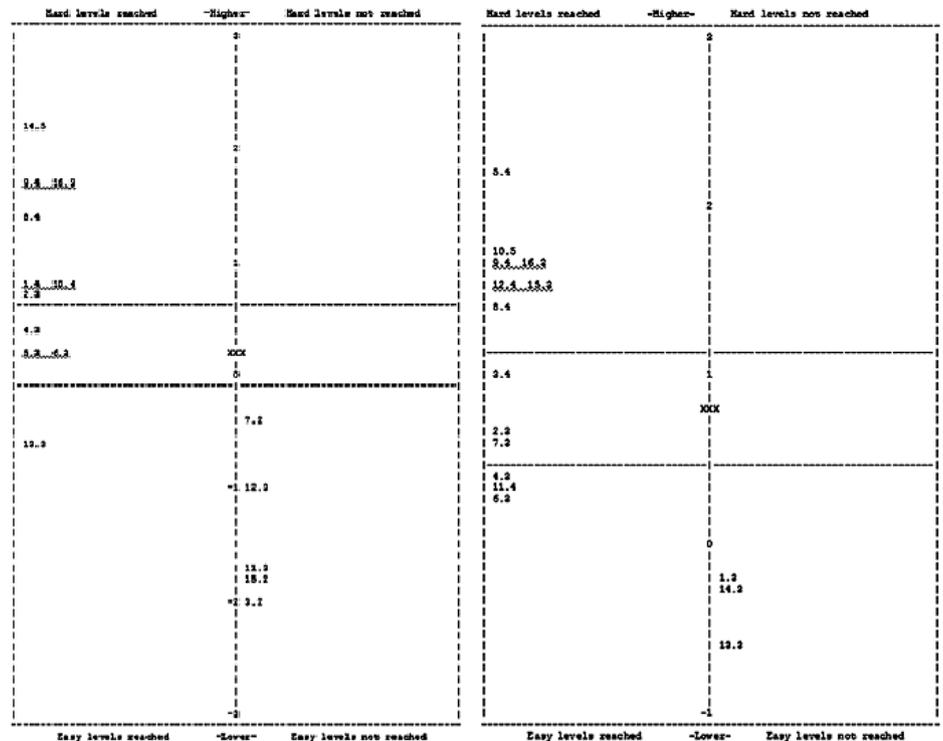
However, this Authority has also some weaknesses. These are the following:

- P10-3: Port services
- P10-15: Maintenance
- P10-11: Information systems and certifications
- P10-12: Plans and Protection systems

The main strengths of PA1 seem to be associated to the external image (P10-8 and P10-16) and to management issues (P10-1, P10-2 and P10-4). However, it has a weakness related to maintenance in both port infrastructure and vessels (P10-12 and P10-15).

The PA2 diagnosis map (Figure 2 right) shows that the strengths of this Authority, ranked from the most to the least important, are the following:

- P10-5: Sales and marketing
- P10-10: Environmental issues
- P10-9: Quality



Source: Results obtained from Winsteps

Figure 2: PA1 PKMAP (left) and PA2 PKMAP (right).

- P10-16: Promotion and Sponsorship of scientific and technological R&D
- P10-12: Plans and Protection systems
- P10-15: Maintenance
- P10-8: External relationships

Meanwhile, the weaknesses of this Authority are, also ranked according to their relevance:

- P10-13: Contingency plans and security systems for protecting infrastructure and the environment
- P10-14: Projects and construction
- P10-1: Strategic planning

Overall, PA2 seems to have two major strengths. The first one related is to promotion and external image (items P10-5, P10-8 and P10-16) and, the second one related to corporate social responsibility issues (items P10-9 and P10-10). It is true, however, that “plans and security systems” is the most important weakness. It would be advisable to make a greater effort in this activity because, alongside the two already mentioned items (quality and environment), this activity is a key issue in developing an efficient integrated system.

Regarding the weakness that this Authority has in item P10-14 (Projects and works), it is worth noting that this may not be too important. This Authority may not make a greater innovative effort in developing new infrastructures because the characteristics of the environment where it is located do not allow it. Thus, rather than investing in new infrastructures, it should maintain the existing ones. In fact, the item “Maintenance” (P10-15) is one of its strengths.

3.2. Benchmarking analysis

In order to complete the results obtained in the previous section, where each Port Authority was compared with the national set of Authorities, in this section we will compare PA1 and PA2 with each other. Thus, Table 3 includes the score given by each of the Port Authorities to the 16 items contained in the construct “innovative effort made by the Port Authority”.

Table 3: Scores given to the items by PA1 and PA2.

ITEMS	PA1	PA2
P10-1. Strategic planning	4	3
P10-2. Human Resources	3	3
P10-3. Port services	2	4
P10-4. Management of concessions and authorizations	3	3
P10-5. Sales and marketing	3	4
P10-6. Finance and economics	3	3
P10-7. Legal services and administrative management	2	3
P10-8. External relationships	4	4
P10-9. Quality	4	4
P10-10. Environmental issues	4	5
P10-11. Information systems and certifications	3	4
P10-12. Plans and Protection systems	3	4
P10-13. Contingency plans and security systems for protecting infrastructure and the environment	3	3
P10-14. Projects and construction	5	3
P10-15. Maintenance	2	3
P10-16. Promotion and Sponsorship of scientific and technological R&D	3	3

According to the results, it can be concluded that the two Port Authorities are in a very similar situation as they have the same score for 7 of the 16 items. This backs up the selection of authorities that we have made, since it makes more sense to compare subjects which have similar characteristics, which are at a similar level of innovative development and which, in addition, are close geographically.

Regarding the items which were scored differently, PA2 apparently presents a better position because it has a higher score for 7 items, whereas PA1 only scored higher in two cases. Thus, the first conclusion to be drawn is that PA2 is, in general, better positioned than PA1.

The two items where PA2 is outscored (P10-1 and P10-14) have already been discussed in the previous section because these are the main weaknesses of this Authority. Therefore, for future investments in innovation, PA2 should reinforce these points because they represent a weakness compared to the complete set of national port authorities, but especially compared to one of its main competitors, PA1.

In the case of PA1, its weaknesses in comparison to PA2 include, firstly, the weaknesses detected in the first analysis where its responses were compared to the national level and 3 additional activities. Overall, it seems that PA1 has plenty of room for improvement as far as innovative effort is concerned. It should first improve the effort made in those activities that represent a weakness against the whole national system and then improve the activities which represent a weakness in comparison with PA2. All this, of course, should be done while maintaining its strengths.

4. Conclusions

The present study has analyzed the positioning of two Spanish Port Authorities. First the strengths and weaknesses of each national authority with respect to the whole set of Port Authorities have been identified. Secondly, a benchmarking analysis was performed between the two selected port authorities.

The main conclusions obtained from the analysis are:

- Overall, PA2 is better positioned than PA1.
- PA1 strengths are related to its external image and to management issues. Its main weaknesses, however, are in maintenance issues.
- PA2 has two main strengths: one related to external image and the other related to corporate social responsibility. Nevertheless, this last strength should be improved by reducing its weakness related to Security issues.
- PA1 should focus its efforts on improving the weaknesses detected from the PKMAP analysis first and, later, it should address the weaknesses detected in the benchmarking analysis.
- PA2 should improve two main activities: strategic planning (P10-1) and projects and construction (P10-14).

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Appendix 1: Question 10

According to your point of view, and with reference to the last five years (2004-08), give a score between 1 (no effort) and 5 (extremely 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 (business plan development, annual reports, planning for the use of port areas, objective monitoring, etc.) |
| 2 | Human resources (selection, training, internal promotion, labor relations, etc.) |
| 3 | Port services (the control of operations, the regulation of services, etc.) |
| 4 | Management of concessions and authorizations |
| 5 | Sales and marketing (Searching for new traffic, relationships with clients, carrying out studies, etc.) |
| 6 | Finance and economics (economic management, coordination and budgeting, internal financial control, etc.) |
| 7 | Legal services and administrative management (e-administration) |
| 8 | External relationships (corporate image, web, community relationships with the port and city communities). |
| 9 | Quality (quality systems and certifications, etc.) |
| 10 | Environmental issues (environmental impact, sustainability, waste management, certifications, etc.) |
| 11 | Information systems, communication and control systems (IT, telematics, cameras and sensors, etc.) |
| 12 | Plans and Protection systems (ships and port facilities) |
| 13 | Contingency plans and security systems for protecting infrastructure and the environment (port operations and services, monitoring and forecasting of environmental effects). |
| 14 | Projects and construction (the design and development of new infrastructure and port facilities). |
| 15 | Maintenance (the management of a preventive maintenance plan and a plan for the maintenance of infrastructure) |
| 16 | Promotion and Sponsorship of scientific and technological R & D within the port (agreements with universities or research centers, research grants and doctoral programs and the development of patents, etc.) |