



## INNOVATION IN SPANISH PORT SECTOR

B. Blanco<sup>1,3</sup>, C. Pérez-Labajos<sup>1,4</sup>, L. Sánchez<sup>1,5</sup>, A. Serrano<sup>2,6</sup>,  
M. López<sup>2,7</sup> and A. Ortega<sup>1,8</sup>

Received 15 November 2009; in revised form 20 November 2009; accepted 25 March 2010

### ABSTRACT

**Globalization has generated a dramatic increase in freight traffic worldwide and, in particular, in maritime transport. In response to increasing load capacity requirements, there has been a steady increase in the size of the international merchant fleet, accompanied by a parallel increase in new requirements for ports. This has raised the need for ports to innovate.**

**If countries want to be competitive, they need a port system that allows them to be part of international supply chains. In addition, each individual port must be competitive with the other ports operating within their national port system. Therefore, competitiveness and competition must be understood from two perspectives, international and national.**

**This paper analyzes the perception of Spanish Port Authorities on innovation in the national port system. The goal is to establish the innovative activities that are perceived as the most important, those in which there has been an increased effort, and the obstacles facing innovation. These factors have been assessed using the Rasch methodology.**

**Key words:** Innovation, ports, Rasch.

### INTRODUCTION

Today, innovation is one of the most influential phenomena worldwide. The continued increase in spending in R & D, both by companies, countries and international agencies, is, to a greater or lesser extent, proof of this.

<sup>1</sup> Ocean and Coastal Economics and Management R&D Group. University of Cantabria. Gamazo 1. 39004 Santander. Spain. <sup>2</sup> Dinámica Estratégica R&D Group. University of Cantabria. Avda Los Castros s/n. 39005 Santander. Spain. <sup>3</sup> Corresponding author: E-mail address blancob@unican.es Tel. +34 942 201897 Fax +34 942 201890 Postal address: Departamento de Administración de Empresas. Facultad de Ciencias Económicas y Empresariales. Avda Los Castros s/n. 39005 Santander. Spain. <sup>4</sup>E-mail address: clabajos@unican.es <sup>5</sup>E-mail address: lidia.sanchez@alumnos.unican.es <sup>6</sup>E-mail address: ana.serrano@unican.es <sup>7</sup>E-mail address: concha.lopez@unican.es <sup>8</sup>E-mail address: andres.ortega@unican.es



Innovation can be defined as “the introduction of a new product, a new production method, a new market, the discovery of new supplies of raw materials in manufactured products, and even the emergence of a new sector or redirection of an existing one” (Schumpeter, in Solé 2008 p.14). It is also one of the key drivers in improving social welfare and a crucial factor in the growth and survival of long-term business (Schumpeter, 1939, Baumol 2002). It is also considered a key element for achieving the sustainable development of economies (OECD).

The development of innovation can take place internally (internal development within the company) or externally (within the market) (Veugelers and Cassiman, 1999; Cassiman, 2004, Cassiman and Veugelers, 2006). Some authors identify a third hybrid form (Pisano, 1990) which consists of the development of innovation through cooperation between various parties (Navarro, 2002; Hull, 2003, Chen and Yuan, 2007).

That said, one might ask, “what are the main reasons that lead a company to innovate?” From a microeconomic perspective, the development of new products or processes lead to the improvement of the products and services offered by a company and the use of fewer resources in the production process. This ensures greater value creation by the company and a reduction in production costs (Mulet, 2005).

On the other hand, from a macroeconomic perspective, innovation is a response to the competitiveness that exists in an increasingly globalized world. The OECD defines competitiveness as the degree to which, under free market conditions, a country can produce goods and services that go beyond the consideration of international competition and, simultaneously, serve to maintain the sustained growth of national income (Mulet, 2005). Therefore, the survival of a company may only be possible if there is innovation.

Why is innovation necessary for ports? The response to this question is related to freight traffic growth and competitiveness.

Globalization has resulted in a spectacular increase in international transactions and freight. It has also required increases in the capacity and speed of the movement of goods, accompanied by a need for lower unit costs of transport.

Most international trade in goods is by sea, especially in transoceanic trade. The responses were not long in coming. There has been a steady increase in the international merchant fleet, both in terms of the number and the size of vessels. This increased load capacity has required a parallel expansion in the ability of ports to facilitate the growing traffic, raising the need for them to innovate. For ports to be competitive, they must be able to move (load, unload & transfer) large quantities of merchandise and do so quickly. In addition, they must be able to incorporate other value adding activities and logistical services. This has led to adaptation through multiple actions. Some of these include:

- The construction of new infrastructure including: Terminals and accesses to them that are larger and deeper and so can accommodate larger vessels. Spe-



cialized terminals for the movement of specific goods (containers, vehicles, bulk, etc.) Terminals for connecting the various modes of transport; rail, truck and ships of different size and tonnage (short-sea shipping). The development of LAZ's (logistics activity zones) with special provisions for all logistical needs including storage areas and facilities such as storage yards, silos, warehouses, workshops, factories, etc. The establishment of dry ports for the grouping of goods.

- The provision of new equipment (cranes of greater tonnage capacity and specialization, conveyors, ramps, platforms, vehicles, special facilities for all types of logistical services and value adding activities such as cargo inspection, etc).
- The creation of telematics platforms, which incorporate ITC's, to streamline document management, allowing information to flow more quickly and with a lower list of errors. Examples include the transmission of data via EDI and the computerization of management and documentation procedures such as inspection and control, etc.
- The need for certification (prevention, environmental and quality) to show that certain services can be offered with a guarantee.
- Management and organizational change (The introduction of flexible schedules, outsourcing and the involvement of private initiative through administrative concession, etc.).

If countries wish to be competitive, they must have a port system that allows them to be part of international supply chains. In addition, each individual port must be competitive with the other ports operating within their national port system. Therefore, competitiveness and competition must be understood from two perspectives, international and national.

The aim of this paper is twofold. In addition to establishing what are the innovation factors that are perceived to be the most important, those in which there has been an increased effort and the obstacles which they face, we aim to determine an order or establish a ranking between them. The study focuses on the Spanish port system.

## METHODOLOGY

In Spain, the port system is state-owned. It comprises of 44 General Interest Ports, managed by 28 Port Authorities, dependent in turn on the Public Authority of State Ports within the Ministry of Development. In addition to external competition, these ports compete against each other, especially those located within the same geographical zones (North coast, Mediterranean, etc.).

This study was based upon the completion of a survey. The questionnaire was developed in two phases. The first phase was comprised of the performance of a national and international literature review of material related to our subject, meet-

ings between members of the research team and representatives of the State Ports and the Port Authority of Santander, and the drafting of the first version of the questionnaire. In the second phase, the content of this first version was shown to industry representatives in order to gain their opinions and suggestions for adapting the questionnaire to the specific reality of the port environment. With the incorporation of these suggestions, the final questionnaire was produced.

The questionnaire was sent out by mail and e-mail to all Spanish Port Authorities (100% of the population). The final number of valid responses received amounted to 25, representing 89.28 percent of the total population studied.

The questionnaire indicated that the research group’s work would focus on analyzing the results associated to questions 1, 6, 10 and 12 through the application of Rasch. These questions are shown in Appendix A.

All questions were based on a Likert type scale, in which subjects were asked to give scores between 1 (no importance) and 5 (extremely important).

The chosen analysis methodology is the Rasch technique. This is because this methodology allows one to work with categorical variables and, among other things, order the factors by level of importance. This makes it the most appropriate methodology for the objective of our work.

The software used for data processing and obtaining the results was Winstep.

**RESULTS OF THE ANALYSIS**

**Analysis of the reliability and validity of measures**

The validity, reliability and correlation of the results are presented in Tables 1 and 2, with the 1st table relating to individuals and the second to items. These have been drawn from the information presented in the table of results 3.1. which Winstep refers to as “Summary Statistics”.

Table 1. Reliability and validity of “Individuals”

	INFIT		OUTFIT		RELIABILITY	CORRELATION
	MNSQ	ZSTD	MNSQ	ZSTD		
Question 1	0,95	0	0,98	0,1	0,81	0,99
Question 6	1,02	-0,1	1,01	-0,1	0,74	0,83
Question 10	0,99	-0,2	1,04	-0,1	0,93	0,92
Question 12	1,02	-0,1	1,08	-0,1	0,6	0,52

Table 2. Reliability and validity of “Items”

	INFIT		OUTFIT		RELIABILITY	CORRELATION
	MNSQ	ZSTD	MNSQ	ZSTD		
Question 1	0,99	0	0,98	-0,1	0,79	-0,97
Question 6	0,99	0	1,02	0	0,71	-0,23
Question 10	0,98	-0,1	1,04	0,1	0,8	-0,48
Question 12	0,98	-0,1	1,08	0,3	0,63	-0,9



The overall validity of the measures can be evaluated from the INFIT and OUTFIT indices. As noted, the values obtained are consistent with those required (Linacre, 2009; Oreja, JR 2005, p.40, and Febles, 2008), both for the case of the measures (MNSQ valid in the range (0.5 to 1.5)) as the standard of variances (ZSTD close to 0) and for all questions asked, both to individuals and items.

In terms of reliability, we can see that it is of an acceptable level for questions 1, 6 and 10 (values close to 1), but lower for question 12.

When the information or data is complete, the correlation should be 1 for subjects and -1 for items, (Linacre, 2009). In our application, it is acceptable in the case of the subjects (except question 12) but not in the case of the items.

Furthermore, in the analysis of the results of the Winstep tables, 13: Item and 17: Person, show the existence of anomalous cases (values of infit or outfit greater than 1.20). For several of these, we have found a logical explanation. For the rest, we do not have enough knowledge and information to justify them. In any case, a detailed analysis of each of the subjects and items is beyond the scope of this study.

### **Results concerning innovation in the port sector**

In this section we discuss, for each of the selected questions of the survey, the results that relate to the following Winstep tables: 1 “Variable maps”, 13 “Item: Measure”. They are listed in Tables 4 to 8 of Appendix B.

The commentaries were jointly presented in this section grouped around 3 main blocks. Firstly, the importance of innovation activities. Secondly, the effort to innovate, and finally, the barriers to innovation. All of the concepts relate to the perceptions of the Port Authorities.

### **Perceived importance of innovation activities**

This refers to the results of questions 1 and 6 of the survey, listed in tables 4 to 6 of Appendix B.

All Port Authorities considered innovation to be important, as is demonstrated by the scores. In question 1, the lowest score is 3 and 20% of subjects gave all items the highest score. In question 6, the majority of responses are above 3, with just a single score of 2 and none of 1.

On the maps of the variables, (Table 4) some gaps appear, especially at the extreme sides of the items. In order to improve the questionnaire, more items should be included in order to eliminate these gaps. In this way, the analysis would be more complete and allows us to discriminate between subjects located at these extremes.

All the innovation activities introduced in Question 1 are significant. Ranking them from the highest to lowest importance, the result are: (see tables 4 and 5 of Appendix B): (P1-3) Making changes to the organizational structure, introducing new working procedures, and the facilitation of internal information sharing; (P1-4)



Staff development and business and knowledge management training; (P1-7) Quality of service, customer acquisition and retention; (P1-2) The implementation of new or significantly improved processes; (P1-1) The introduction of services and/or new or significantly improved products; (P1-5) The enhancement of external relationships with the business and academic sectors; and (P1-6) The promotion and marketing strategy of the port.

The items P1-3 and P1-4 appear together, indicating that they explain the same thing. They are, however, distinct concepts, but all of the innovation in item 3 (amendments of the organizational structure, adoption, new working procedures and facilitating the sharing of internal information) is innovation that requires training. Training is accounted for in item 4 (staff development and business and knowledge management training).

There is also an overlap of items 1 (innovation in new services) and 5 (empowerment of external relations). These would be very different categories if we were to think of item 5 in terms of co-operative innovation. It may be that both activities are very important and although they are at the same level, they relate to or explain different things. However, on the other hand, cooperation may come from the part of companies with activities such as the building of new terminals or the addition of new equipment (cranes, etc.). This would enable the offering of new services and therefore overlaps with item 1. In this case, they would reflect the same concept.

In question 6, a more disaggregated analysis has been performed than that in Question 1, allowing us to complete the above (see Appendix A). In this case, the order, from the highest to the lowest level of importance of the innovation activities introduced in Question 6, are (see tables 4 and 6 of the Appendix B): (P6-15) Maintenance (the management of a preventive maintenance plan and a plan for the maintenance of infrastructure); (P6-8) External relations (corporate image, web, community relations with the port and city communities); (P6-13) Contingency plans and security systems for protecting infrastructure and the environment (port operations and services, monitoring and forecasting of environmental effects); (P6-3) Port services (the control of operations, the regulation of services, etc.); (P6-9) Quality (quality systems and certifications, etc.); (P6-4) Sales and marketing (Searching for new traffic, relationships with clients, carrying out studies, etc.); (P6-1) Strategic planning (business plan development, annual reports, planning for the use of port areas, objective monitoring, etc.); (P6-7) Legal services and administrative management (e-administration); (P6-10) Environmental Issues (environmental impact, sustainability, waste management, certifications, etc.); (P6-6) Finance and economics (economic management, coordination and budgeting, internal financial control, etc.); (P6-12) Plans and Protection systems (ships and port facilities); (P6-16) 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.); (P6-11) Information systems, communication and



control systems (IT, telematics, cameras and sensors, etc.); (P6-2) Human resources (selection, training, internal promotion, labor relations, etc.); (P6-5) Sales and marketing (Searching for new traffic, relationships with clients, carrying out studies, etc.); (P6-14) Projects and construction (the design and development of new infrastructure and port facilities).

Here we can see three overlaps, but we understand that in no case is this a result of the incorporation of the same information when dealing with very different concepts.

### **Perception of the effort to innovative**

In question 10 (see Appendix A) the Port Authorities were asked what, according to their point of view, was the level of effort to innovate in each of the activities or areas raised in the question.

The result show, in descending order, that the activities in which there is most effort to innovate are (see tables 4 and 7):

Strategic planning (business plan development, annual reports, planning for the use of port areas, objective monitoring, etc.) (P10-1); Contingency plans and security systems for protecting infrastructure and the environment (port operations and services, monitoring and forecasting of environmental effects) (P10-13); Information systems, communication and control systems (IT, telematics, cameras and sensors, etc.) (P10-11); Plans and Protection systems (ships and port facilities) (P10-12); Projects and construction (the design and development of new infrastructure and port facilities) (P10-14); Port services (the control of operations, the regulation of services, etc.) (P10-3); Maintenance (the management of a preventive maintenance plan and a plan for the maintenance of infrastructure) (P10-15); Environmental Issues (environmental impact, sustainability, waste management, certifications, etc.) (P10-10); Quality (quality systems and certifications, etc.) (P10-9); 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.) (P10-16); Human resources (selection, training, internal promotion, labor relations, etc.) (P10-2); Sales and marketing (Searching for new traffic, relationships with clients, carrying out studies, etc.) (P10-5); The management of concessions and authorizations (P10-4); External relations (corporate image, web, community relations with the port and city communities) (P10-8); Finance and economics (economic management, coordination and budgeting, internal financial control, etc.) (P10-6); and Legal services and administrative management (e-administration) (P10-7).

A more detailed analysis of the map of variables (see Table 4, Appendix B) allows us to identify, as previously discussed in questions 1 and 6, two gaps at the extreme sides of the items (above and below the T). This coincidence is not surprising since the items in question 10 coincide completely with those of Question 6. In



order to improve the questionnaire, more items should be included in order to eliminate these gaps. In this way, the analysis would be more complete and allows us to discriminate between subjects located at these extremes.

There are also several overlapping items. In some cases we believe it may be that some concepts are included in more than one item (eg P10.13 in P10.1). In other cases, the concepts are different, but are within the same line of work, as is the case with the P10.9 and P10.10 items, that are each considered to be a component part of the “integrated management systems (prevention, environment and quality)”. In the remaining cases, the concepts are distinct from one another, but carry an equal level of importance.

If we compare the importance given to different innovative activities and the effort devoted to them, we see that there is a clear distance or difference between them (see Table 4, Appendix B). Specifically, the effort to innovative is smaller than the importance attached to it. We therefore need to ask, “What are the factors causing this shortfall in the effort to innovate”? This is addressed in the following paragraph which looks at various obstacles to innovation.

### **Perceived barriers to innovation**

In order to explain what are the obstacles to greater innovative effort by the Port Authority, question 12 was included in the survey (see Appendix A).

The results (see Table 8, Appendix B) show that, according to the perception of the subjects, the obstacles facing innovation, in descending order of importance are: Inadequate staffing for the activity (P12-3); A poor innovation culture (P12-5) Difficulties in finding cooperation partners for innovation (P12-6); A lack of information about technology (This stems from an insufficient observation of technology developments) (P12-4); limited financial resources (P12-1) A lack of demand for innovations (P12-7), and insufficient information about programs and guidance for accessing external finance (P12-2).

## **CONCLUSIONS**

The main conclusions drawn from this study, in addition to the rankings established in the previous paragraphs, are as follows:

- 1) Innovation is perceived to be highly important within the Spanish port system and particularly by the Port Authorities. Innovation in ports has many facets, both organizational, technological and commercial and are all perceived to be relevant.
- 2) Although an effort to innovate by Port Authorities exists, it appears to be insufficient when compared with the importance placed upon it.



- 3) The principal obstacles to innovation in ports are both internal and external, being perceived as the inadequate allocation of scarce resources and the lack of a culture of innovation.
- 4) All of the factors we have discussed are relevant, but the Rasch technique has detected that they are insufficient to discriminate between the behavior of all ports. Therefore, in order to improve aspects of this work, the Rasch methodology would suggest the need for further future research.

## REFERENCES

- Baumol, W.J. (2002): *The Free-Market Innovation Machine*. Princeton: Princeton University Press.
- Cassiman, B. (2004): Cooperar para potenciar la innovación, *Iniciativa emprendedora y empresa familiar*, Vol. 45, pp. 7-11.
- Cassiman, B.; Veugelers, R. (2006): In Search of Complementarity in Innovation Strategy, *Management Science*, Vol.52, No.1, pp. 68-82.
- Chen, Y.; Yuan, Y. (2007): The innovation strategy of firms: empirical evidence from the Chinese high-tech industry, *Journal of Technology Management*, Vol. 2, N. 2, pp.145-153.
- Febles Acosta, J. (Coord.) (2008): *Los Modelos de Rasch en Administración de Empresas. Aplicaciones avanzadas*. Santa Cruz de Tenerife: Fundación FYDE-CajaCanarias.
- Hull, E.C. (2003): Innovation strategy: An empirical investigation of the antecedents of innovation modes, Ph.D., Indiana University, 2003; AAT 3094133.
- Linacre, J.M. (2009): WINSTEPS Rasch measurement computer program. Chicago. Winsteps.com. URL: <http://www.winsteps.com>.
- Mulet Meliá, J. (2005): La innovación, concepto e importancia económica. Comunicación presentada al VI Congreso de Economía de Navarra, Navarra.
- Navarro Arancegui, M. (2002): La cooperación para la innovación en la empresa española desde una perspectiva internacional comparada, *Economía Industrial*, N. 344, pp. 47-66.
- Oreja Rodríguez, J.R. (2005): Introducción a la medición objetiva en Economía, Administración y Dirección de Empresas: El Modelo de Rasch. *IUDE. Documento de Trabajo. Serie Estudios 2005/47*. Instituto Universitario de la Empresa de la Universidad de la Laguna. Santa Cruz de Tenerife.
- Pisano, G. (1990): The R&D boundaries of the firm: An empirical analysis *Administrative Science Quarterly*, Vol. 35, pp. 153-176.
- Schumpeter, J.A. (1939): *Business Cycles: A Theoretical, Historical and statistical Analysis of the Capitalist Process*. New York: McGraw-Hill.
- Solé Parellada, F. (2008): La innovación: ¿ventaja competitiva?, en Solé Parellada F; Rodríguez, I (Directores): *Innovación: Clave Estratégica para La Productividad y Competitividad de los Puertos* (pp. 11-22). Santander: Autoridad Portuaria de Santander.
- Veugelers, R.; Cassiman, B. (1999): Make and buy in innovation strategies: evidence from Belgian manufacturing firms. *Research Policy* 28 (1), pp. 63-80.



## APPENDIX A: Questions and associated items

### Question 1

In the specific field of port activities, and according to your point of view, give a score between 1 (no importance) and 5 (extremely important) to the following activities to reflect the level of importance assigned to them by the Port Authority:

- P1-1 The introduction of services and/or new or significantly improved products.
- P1-2 The implementation of new or significantly improved processes.
- P1-3 Making changes to the organizational structure, introducing new working procedures, and the facilitation of internal information sharing.
- P1-4 Staff development and business and knowledge management training.
- P1-5 The enhancement of external relationships with the business and academic sectors.
- P1-6 The promotion and marketing strategy of the port.
- P1-7 Quality of service, customer acquisition and retention.

### Question 6

According to your point of view, give a score between 1 (no importance) and 5 (extremely important) for the importance of the following innovative activities in achieving the proper functioning of the responsibilities assigned to the Port Authority in the following areas: (see the table of items for Questions 6 and 10).

### 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 developed within the Port Authority in the following areas: (see table of items for questions 6 and 10).

### Question 12

According to your point of view, and with reference to the last five years (2004-08), give a score between 1 (no importance) and 5 (extremely important) for the degree of importance that the following factors have played in hindering innovative activities or influencing the Port Authority in the decision not to innovate:

- P12-1 limited financial resources.
- P12-2 Insufficient information about programs and guidance for accessing external finance.
- P12-3 Inadequate staffing.
- P12-4 A lack of information about technology (Insufficient observation of technological developments).
- P12-5 A poor innovation culture.
- P12-6 Difficulties in finding cooperation partners for innovation.
- P12-7 Lack of demand for innovations.

**Table 3.** Items for questions 6 and 10

- 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 The 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 relations (corporate image, web, community relations 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.).



APPENDIX B Tables of Results

Table 4. Variable Maps

Question 1 importance of general innovative activities	Question 6 Importante of specific innovative activities	Question 10 Effort in innovation
<p>PERSONS - MAP - ITEMS &lt;more&gt; &lt;rare&gt;</p> <p>4 XXXXX + X     3 X + S   2 XXXXX +T XX P1-6   1 XX M P1-1 P1-5   0 XXX +M P1-2   -1 X +S P1-7 P1-4 S P1-3   -2 XXX +T     -3 T+   -4 X +   -5 X + &lt;less&gt; &lt;frequ&gt;</p>	<p>PERSONS - MAP - ITEMS &lt;more&gt; &lt;rare&gt;</p> <p>3 X +     2 X + T   X   X T P6-14 XX X 1 XX S+     P6-5   P6-2 X S X   P6-11 XX M P6-12 P6-16 XX   P6-10 P6-6 0 XX +M P6-7 XXXXX   P6-1 X P6-4 P6-9   X S   S P6-3 X P6-13 X P6-8   -1 X + X   P6-15 T T   -2 + &lt;less&gt; &lt;frequ&gt;</p>	<p>PERSONS - MAP - ITEMS &lt;more&gt; &lt;rare&gt;</p> <p>3 T+   X   2 X + XX X S P10-7 X   T P10-6 1 X + XX S P10-8   X XX P10-2 P10-4 P10-5 XX M P10-16 X +M X P10-10 P10-9 X P10-15   X P10-11 P10-12 P10-14 P10-3 S P10-1 P10-13 -1 X + S T   X   -2 X +   X   T -3 +   -4 X + &lt;less&gt; &lt;frequ&gt;</p>

Table 5. "Item: Measure" for question 1.

ENTRY NUM	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ ZSTD	OUTFIT MNSQ ZSTD	PT-MEASURE CORR. EXP.	EXACT OBS%	MATCH EXP%	ITEM	G
6	98	25	1.68	.44	1.09 .4	.99 .2	.79 .80	63.2	66.2	P1-6	0
1	102	25	.75	.44	.64 -1.3	.61 -1.1	.85 .78	63.2	62.8	P1-1	0
5	104	25	.75	.44	.87 -4	.81 -4	.82 .80	63.2	62.8	P1-5	0
2	108	25	-.07	.46	.83 -5	.76 -7	.82 .79	89.5	65.8	P1-2	0
7	112	25	-.80	.46	1.27 .8	1.59 .9	.63 .69	63.2	69.8	P1-7	0
3	111	25	-1.16	.52	1.17 .6	1.13 .5	.74 .78	73.7	73.3	P1-3	0
4	111	25	-1.16	.52	1.07 .3	.95 .0	.78 .78	63.2	73.3	P1-4	0
MEAN	106.6	25.0	.00	.47	.99 .0	.98 -1		68.4	67.7		
S.D.	5.0	.0	1.02	.03	.20 .7	.29 .6		9.3	4.2		

Table 6. "Item: Measure" for question 6.

ENTRY NUM	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT		OUTFIT		PT-MEASURE		EXACT OBS%	MATCH EXP%	ITEM	G
					MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.				
14	92	25	1.31	0.36	1.08	0.4	1.09	0.4	0.5	0.55	54.2	57.3	P6-14	0
5	94	25	0.83	0.3	1.02	0.2	1.21	0.8	0.51	0.53	50	49.9	P6-5	0
2	84	25	0.72	0.26	1.09	0.5	1.08	0.4	0.54	0.57	29.2	42	P6-2	0
11	112	25	0.44	0.44	0.74	-1.9	0.71	-1.8	0.55	0.37	79.2	65.6	P6-11	0
16	97	24	0.28	0.3	1.34	1.4	1.47	1.8	0.32	0.47	43.5	48.3	P6-16	0
12	101	25	0.27	0.38	0.75	-0.9	0.74	-0.9	0.63	0.48	66.7	66.6	P6-12	0
10	102	25	0.15	0.33	1.02	0.2	1.02	0.2	0.46	0.46	62.5	56.2	P6-10	0
6	89	25	0.05	0.32	0.82	-0.6	0.81	-0.6	0.65	0.56	58.3	57.6	P6-6	0
7	91	25	0.01	0.32	0.78	-0.8	0.79	-0.7	0.65	0.54	75	55.1	P6-7	0
1	95	25	-0.21	0.26	1.39	1.5	1.39	1.4	0.36	0.51	41.7	44.2	P6-1	0
9	98	25	-0.25	0.34	1.42	1.2	1.48	1.3	0.26	0.48	58.3	64.5	P6-9	0
4	94	25	-0.28	0.29	0.85	-0.5	0.85	-0.5	0.59	0.52	45.8	48.5	P6-4	0
3	108	25	-0.63	0.36	0.71	-1.2	0.7	-1.2	0.58	0.41	70.8	62.2	P6-3	0
13	103	25	-0.67	0.28	0.96	-0.1	1	0.1	0.43	0.44	33.3	52.6	P6-13	0
8	107	25	-0.82	0.42	0.93	-0.2	0.91	-0.2	0.48	0.43	70.8	69.3	P6-8	0
15	88	25	-1.19	0.38	1	0.1	1.01	0.1	0.36	0.37	62.5	60.7	P6-15	0
MEAN	97.2	24.9	0	0.34	0.99	0	1.02	0			56.4	56.3		
S.D.	7.6	0.2	0.63	0.05	0.22	0.9	0.25	1			14.3	8		

Table 7. "Item: Measure" for question 10.

ENTRY NUM	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT		OUTFIT		PT-MEASURE		EXACT OBS%	MATCH EXP%	ITEM	G
					MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.				
7	73	25	1.49	.29	.80	-7	.81	-4	.65	.60	52.0	54.1	P10-7	0
6	76	25	1.19	.33	1.30	1.0	1.32	1.0	.47	.60	56.0	60.7	P10-6	0
8	85	25	.68	.30	.90	-3	1.61	1.5	.67	.68	60.0	57.4	P10-8	0
4	73	25	.35	.27	.90	-3	.90	-3	.74	.69	60.0	50.4	P10-4	0
5	75	25	.27	.29	.63	-1.4	.63	-1.4	.83	.70	60.0	53.4	P10-5	0
2	71	25	.24	.27	1.02	.2	1.03	.2	.68	.67	52.0	51.1	P10-2	0
16	61	25	.16	.33	.85	-5	.82	-6	.69	.60	56.0	59.1	P10-16	0
9	81	25	-.11	.28	1.69	2.1	2.01	2.8	.47	.73	36.0	52.3	P10-9	0
10	92	25	-.20	.28	1.12	.6	1.19	.8	.62	.68	36.0	49.4	P10-10	0
15	64	25	-.25	.35	.84	-5	.87	-4	.66	.58	60.0	60.9	P10-15	0
3	85	25	-.54	.26	.99	.1	1.02	.2	.71	.72	40.0	48.9	P10-3	0
14	83	25	-.56	.27	.78	-8	.77	-8	.79	.70	52.0	46.5	P10-14	0
12	86	25	-.59	.31	.98	.0	1.00	.1	.69	.70	60.0	56.4	P10-12	0
11	97	25	-.62	.32	.70	-1.1	.74	-1.0	.79	.69	60.0	57.2	P10-11	0
13	87	25	-.76	.27	1.30	1.1	1.30	1.1	.60	.71	40.0	45.9	P10-13	0
1	87	25	-.77	.24	.79	-7	.67	-1.1	.79	.72	52.0	48.0	P10-1	0
MEAN	79.8	25.0	.00	.29	.98	-1	1.04	.1			52.0	53.2		
S.D.	9.6	.0	.66	.03	.26	.9	.36	1.1			8.7	4.8		

Table 8. "Item: Measure" for question 12.

ENTRY NUM	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT		OUTFIT		PT-MEASURE		EXACT OBS%	MATCH EXP%	ITEM	G
					MNSQ	ZSTD	MNSQ	ZSTD	CORR.	EXP.				
2	74	25	0.39	0.2	0.8	-0.8	0.78	-0.8	0.64	0.49	48	36.9	P12-2	0
7	75	25	0.27	0.21	0.94	-0.1	0.93	-0.2	0.54	0.48	56	36.9	P12-7	0
1	79	25	0.22	0.17	0.75	-1	0.75	-0.9	0.67	0.56	28	27.8	P12-1	0
4	82	25	0.14	0.2	0.9	-0.3	0.87	-0.4	0.58	0.52	40	43.5	P12-4	0
6	77	25	-0.11	0.2	0.97	0	1.58	2	0.35	0.47	48	36.7	P12-6	0
5	88	25	-0.32	0.2	1.22	0.9	1.18	0.8	0.37	0.51	32	34.2	P12-5	0
3	99	25	-0.58	0.2	1.28	1	1.45	1.3	0.38	0.54	36	38.9	P12-3	0
MEAN	82	25	0	0.2	0.98	-0.1	1.08	0.3			41.1	36.4		
S.D.	8.2	0	0.33	0.01	0.18	0.7	0.31	1			9.2	4.4		



## INNOVACIÓN EN EL SECTOR PORTUARIO ESPAÑOL

### RESUMEN

La globalización ha generado un incremento espectacular del tráfico de mercancías a nivel mundial y en particular del transporte marítimo. En respuesta a las mayores necesidades de capacidad de carga se ha producido un constante incremento de la flota mercante mundial y también, de forma paralela, aparecen nuevos requerimientos para los puertos, surgiendo la necesidad de innovar.

Los países, si quieren ser competitivos, necesitan un sistema portuario que les permita formar parte de las cadenas logísticas internacionales. Además, cada puerto de forma individual, ha de ser competitivo respecto del resto de puertos del mismo sistema portuario. Por tanto, la competitividad y la competencia han de entenderse desde una doble perspectiva, internacional y nacional.

El trabajo analiza la percepción de las Autoridades Portuarias españolas sobre la innovación en el sistema portuario nacional. El objetivo es conocer las actividades de innovación que se perciben como más importantes, aquéllas en las que se ha efectuado un mayor esfuerzo y los obstáculos a la innovación, aplicando la metodología Rasch.

### METODOLOGÍA

En España, el sistema portuario es de titularidad estatal. Está integrado por 44 Puertos de Interés General, gestionados por 28 Autoridades Portuarias, dependientes a su vez del Organismo Público Puertos del Estado, del Ministerio de Fomento. Además de la competencia exterior, estos puertos compiten entre sí, especialmente con los de la misma fachada (Norte, Mediterráneo, etc.).

El estudio ha exigido como paso previo la realización de una encuesta.

El cuestionario se desarrolló en dos fases. En la primera se hizo una revisión de la literatura, nacional e internacional, sobre el tema objeto de estudio; reuniones del equipo investigador con representantes de Puertos del Estado y la Autoridad Portuaria de Santander; y elaboración de la primera versión del cuestionario. En la segunda fase se realizó un pretest de contenido entre representantes del sector a fin de recoger opiniones o sugerencias para adaptar el cuestionario a la realidad específica del ámbito portuario; incorporación de las mismas y obtención del cuestionario final.

El envío del cuestionario se ha realizado por correo postal y/o electrónico al conjunto de Autoridades Portuarias Españolas (100% de la población). El número de contestaciones válidas finalmente recibidas ascendió a 25, lo que representa el 89,28 por ciento de la población objeto de estudio.



Del indicado cuestionario, el presente trabajo se centra en el análisis de los resultados asociados a la aplicación del Rasch a las preguntas 1, 6, 10 y 12 que aparecen reproducidas en el anexo I.

Todas ellas tienen una escala tipo likert, con puntuaciones entre 1 y 5, donde 1 significa nada y 5 mucho.

La metodología de análisis elegida es la técnica Rasch, porque esta herramienta permite trabajar con variables categóricas y, entre otras cosas, ordenar los factores por grado de importancia. Y por lo tanto, consideramos que es una metodología especialmente apropiada para el objetivo de nuestro trabajo.

La aplicación informática utilizada para el tratamiento de los datos y la obtención de los resultados ha sido el Winstep.

## CONCLUSIONES

Las principales conclusiones que se derivan del estudio realizado, además de los rankings que se han dejado establecidos en los correspondientes apartados, son las siguientes:

- 1) La innovación se percibe como muy importante desde el sistema portuario español y en particular por las Autoridades Portuarias. La innovación en puertos tiene múltiples aspectos, tanto organizativos como tecnológicos y comerciales, todos ellos relevantes.
- 2) El esfuerzo innovador de las Autoridades Portuarias, aun existiendo, parece insuficiente si lo comparamos con la importancia asignada a las actividades de innovación.
- 3) Los principales obstáculos a la innovación en puertos vienen tanto del ámbito interno como externo, especialmente insuficiente dotación de recursos y escasa cultura innovadora.
- 4) Los factores analizados son todos ellos relevantes, pero la técnica Rasch ha permitido detectar que son insuficientes para poder discriminar los comportamientos de todos los puertos. En este sentido la metodología Rasch, al establecer aspectos a mejorar, orienta la investigación futura.