INTRODUCTION

In an international context where most of the international trade is carried by sea, connectivity constitutes an essential element for importing and exporting companies.

Thus, the fragmentation of global supply chains exerts pressure on ports to achieve greater integration of international transport networks with the aim of remaining competitive and to create value for companies.

Faced with this challenge, port connectivity has emerged as one of the principal factors of port connectivity. To do that, proof of the importance of this variable, port managers have been making great efforts in the design and implementation of policies that improve connectivity aimed at, among other things, incentivizing the establishment or regular maritime services and shipping companies. With this mission in mind, recent decades have seen ports embark on a process of transformation to adapt to the dynamic environment in which they operate and meet the needs of shipping companies. Measures like investment in port infrastructure and digitalization have been implemented to allow larger vessels to stop over and to improve the efficiency of operations.

As a result of this process, ports offer companies a greater range of maritime services to facilitate their access to international markets. It is important to point out that the availability of maritime services at a port is a key element in determining companies in their decision to choose a port.

So, given the importance of this variable in port competitiveness, it is important to develop a tool that allows us to systemically measure and compare port connectivity. Fundación Valenciaport and the Port Authority have jointly developed the Port Connectivity Index (or ICP, as per the Spanish). This Index measures the connectivity of SSS (SSS) traffic for container cargo from Spanish ports.

The index is particularly useful to port authorities by providing a tool that allows for self-assessment of current activity and comparison with competitors. It is also useful for companies by providing relevant information on how ports avail of greater connectivity for trade operations. Finally, shipping companies will have access to information on which ports are offering greater connectivity that can be useful in their decision in relation to stopovers.

LINEPORT DATABASE

The LinePort database, prepared by the Valenicaport Foundation, provides data on the maritime transport offering that are necessary for the development of the ICP.

This database provides standardised and detailed information on SSS service offered from Spanish ports. The wealth of data available allows us not only to enumerate the existing lines at each port under study, but it complements that information with data on the characteristics or regular lines (types of service,

frequency, rotation, transit time, number of vessels employed on service, etc.) and the characteristics of the vessels (speed, GT, maximum transport capacity for TEUs/platforms, age, consumption, engine power, etc.)

Data are obtained in minute detail, consulting the information provided by different sources, including the ports themselves, shipping agents, shipping companies, specialised press and the Automatic Identification System. After compiling the data, LinePort completes the task of validating and standardising the information from the different agents involved (shipping companies, shipping agents, ports and specialized press).

In terms of geographic coverage, adhering to the definition of the European Commission, the database encompasses any maritime transport service between Member States of the European Union and between Member States and coastal third countries on the Adriatic, Baltic, Aegean Sea, Mediterranean Sea, Black Sea and the North Sea (passenger, bulk, container, roro, vehicles, etc.) and the type of service (regular line service, feeder, interoceanic).

LinePort is an important tool for the analysis of SSS in Spain, proving standardized information quickly on SSS Services offered from Spanish ports, which is considered an essential aspect of the transport of goods.

ICP METHODOLOGY

The ICP arose from an Index developed by the United Nations Conference on Trade and Development (UNCTAD), which publishes a connectivity index called the Liner Shipping Connectivity Index (LSCI). The purpose of that index is to measure the connectivity of countries, so is calculated on an aggregated basis for each country. The variables used for the calculation of the Index, which exclusively measure connectivity for container traffic, are the number of shipping companies operating at ports; the number of regular services offered at said ports, the number of vessels they use in services to and from the ports of each country, average capacity in TEUS offered by the ships operating at said ports, and the maximum size of the vessels that enter/leave the ports located in a Member State in TEUs.

Therefore, taking the methodology proposed by the UNCTAD for the connectivity index by country, the Valenicaport Foundation has calculated an index focussed on the connectivity of Spanish ports (ICP). The Index proposed by the Valenciaport Foundation measures the connectivity of Spanish ports considering exclusively their regular SSS services, using the definition of the European Shortsea Network.

That is regular services that connect Spanish ports with the ports in EU Member States or those located in non-European countries with a coastline on the seas surrounding Europe.

As a contribution in relation to the index proposed by UNCTAD, it was considered appropriate for the ICP to incorporate two key variables to define the competitiveness of a port: the frequency of maritime services and the number of connection destinations connecting Spanish ports. After incorporating these variables, the index shall tale the following form:

$$ICP_{j,i}=\left(\left(\frac{N_j}{Max(N_{j\ldots n})}+\frac{L_j}{Max(L_{j\ldots n})}+\frac{C_j}{Max(C_{j\ldots n})}+\frac{B_j}{Max(B_{j\ldots n})}+\frac{TB_j}{Max(TB_{j\ldots n})}+\frac{F_j}{Max(F_{j\ldots n})}+\frac{PD_j}{Max(PD_{j\ldots n})}\right)/X\right)$$

Where:

ICP= Port Connectivity Index.

j= port under study. i= year for which the PCI is calculated. n= total number of ports included in the PCI.

S (Shipping companies): sum of the shipping lines offering services in each port.

L (LINES): sum of SSS line offered during year analysed.

C (Capacity): sum of DWT of vessels that offer services at each port.

V (Vessels): total number of vessels per line that are used in the rotation.

VS (Vessel size): maximum size of vessel operating at the port in question, expressed in DWT.

F (Frequency): number of departures per week offered by each port

DP (Destination ports): number of foreign destinations ports connected by Spanish port.

X: total number of ports included in the ICP.

As a result, the ICP generates a value of 100 for the port with the highest average index in the first half of 2016. For the upcoming semesters, the maximum value obtained for each variable in the first half of 2016. This way, in the following semesters the evolution of connectivity at each Spanish port can be analysed, assessing whether the policies implements to improve connectivity are effective.

RESULTS

The results obtain in the calculation of the Port Connectivity Index (ICP) for the second semester of 2022 show some significant changes with respect to the previous semesters.

PORT OF ORIGIN	ICP 1st Half 2016	ICP 2nd Half 2016	ICP 1st Half 2017	ICP 2nd Half 2017	ICP 1st Half 2018	ICP 2nd Half 2018	ICP 1st Half 2019	ICP 2nd Half 2019	ICP 1st Half 2020	ICP 2nd Half 2020	ICP 1st Half 2021	ICP 2nd Half 2021	ICP 1st Half 2022	ICP 2nd Half 2022
VALENCIAPORT	100.00	95.47	98.89	102.19	102.12	97.31	100.76	102.47	102.36	101.09	99.26	105.32	101.97	102.81
ALGECIRAS	75.26	78.44	87.64	88.75	85.86	83.85	92.14	93.2	96.33	94.46	92.57	94.92	85.53	84.02
BARCELONA	76.91	73.20	84.03	84.94	89.42	83.57	84.88	83.99	78.94	78.57	81.57	85.42	82.07	90.60
CASTELLÓN	26.63	24.10	31.88	28.37	29.55	29.45	31.42	31.88	29.57	28.35	23.60	22.55	21.45	18.64
LAS PALMAS DE GRAN CANARIA	26.42	26.89	26.94	27.98	29.54	29.55	27.75	28.8	27.18	29.11	28.50	25.03	26.42	28.31
VIGO	18.74	16.70	15.78	18.43	19.65	20.48	20.36	17.44	18.28	19.11	18.57	15.45	13.96	16.82
BILBAO	23.67	16.86	18.44	18.75	20.15	18.96	18.99	18.94	18.16	15.03	15.00	15.71	16.04	17.06
MALAGA	-	-	-	02.04	08.22	17.81	15.23	15.15	14.60	8.81	8.94	8.02	8.31	5.35
GIJÓN	12.82	6.15	9.15	9.24	11.91	12.87	10.89	11.31	11.45	10.10	9.55	9.98	10.37	9.54
TARRAGONA	12.38	13.40	15.71	14.95	11.33	11.58	14.54	11.19	10.74	10.84	8.81	7.83	7.83	7.86

In line with previous publications, Valenciaport maintains its position at the top of the ranking for port connectivity in the second half of 2022, with a modest increase compared to the previous semester. Despite a decline in the number of services calling at Valenciaport ports, operational capacity has remained higher than in the previous six months. In second place is Barcelona, which has experienced a notable increase, moving up one position. This has been primarily due to the increase in capacity of several services and the establishment of new ones, both SSS and DeepSea, the increase in frequency and the number of destination ports. In terms of Algeciras, it has lost its second position and now ranks third. The factors behind this decline are a reduction in the number of services, the number of destination ports and a lower frequency of operational services. It is evident that the three primary ports in the ranking demonstrate varied growth patterns. Barcelona has shown notable success in the latter half of 2022, while Algeciras has encountered challenges, and Valencia has maintained a steady performance.

Regarding the remaining primary ports, the notable increases in Las Palmas de Gran Canaria, Bilbao and Tenerife are particularly salient, marking a new six-month period of enhanced connectivity. In contrast, the ports of Gijón, Castellón, Cádiz and Málaga have seen a decline in connectivity, particularly evident in the latter three.