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Digital Governance Approach to the Spanish Port System: Proposal for a Port

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Abstract: The global changes that are currently taking place and which are driven by new forms of communication, behaviours, innovative technologies, etc., mean that ports have to be aware of or take into account these new trends. They have and must actively participate in this global change and become the leaders of the transformation. The main objective of this study was to carry out an in-depth analysis of the digital governance approach to the Spanish Port System. The Business Observation Tool (BOT) was used with a SWOT matrix to identify how the study environment is doing and to be able to identify those indicators that have the potential to form, as far as possible, a better approach to digital governance in Spain. The aim is to ensure that in the current technological era, the Spanish port sector evolves in terms of port digitalisation in order to adapt to the coming changes and continues to develop towards a more digitally interconnected future. It can be concluded that the indicators obtained from the technological field are the most predominant in the analysis carried out.

Keywords: digital port governance; Business Observation Tool (BOT); SWOT matrix

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1. Introduction

Society is currently in a technological era in which ports both in Spain and worldwide are increasingly immersed.

There is no doubt that digital transformation is necessary in the business sector, causing impacts in those sectors that are related to it.

Ports are currently considered key points in transport chains [1]. The agents involved in the port sector are affected by this technological wave, which will have a direct impact on seaports.

Nowadays we can find a lot of information about the different existing port governance models and the elements that link ports to their governance—being a difficult union. The aim is to achieve efficient and competitive ports that are able to maintain relevance in the international market.

The Spanish state-owned port system is made up of 28 Port Authorities, which manage and administer 46 ports of general interest, and the public entity Puertos del Estado (State Ports), under the Ministry of Public Works, which is responsible for executing national port policy and coordinating the system. The management model for Spanish ports is the so-called landlord model, in which the Port Authority (PA) is limited to the provision, planning and management of port infrastructures and spaces and the regulation of port services, the provision of which corresponds to the private sector [2].

We are currently in a stage of evolution in terms of the global market system in the field of port management in Spain, in which a high level of competitiveness and free competition markets must be implemented.

Moreover, we are in the Fourth Industrial Revolution, which requires a shift from electronic ports to interconnection ports. This means that changes will be made in the port management model, not because ports will be more public or private, but because competition and efficiency will be different, so management needs to be adjusted.

India is currently undergoing massive port development. If China and India cooperate in port construction and infrastructure development, this will undoubtedly create a win–win situation for both states [3]. All ports must try to evolve and improve their facilities and their partnerships without neglecting digitalisation.

The global changes that are currently taking place and which are driven by new forms of communication, behaviours, innovative technologies, etc., mean that ports have to be aware of or take into account these new trends. They have and must actively participate in this global change and become the leaders of the transformation. Due to the circumstances encountered during the COVID-19 crisis, there were forced advances in digital transformation; the port is no stranger to this digital wave.

Recently, the integration of marine environmental law and policy has been introduced as a new approach to the problem of fragmentation [4]. This approach can be seen in two ways, reflecting external and internal changes. External integration addresses the problem of coordination between all public authorities responsible for ocean governance by promoting the consideration of marine environmental issues at all policy levels. Internal integration addresses the problem of fragmentation among the various regulatory bodies by bringing together under one authority the regulatory responsibilities for different emissions and environmental impacts [5–7].

The main objective of this study was to carry out an in-depth analysis of the digital governance approach to the Spanish Port System. The Business Observation Tool (BOT) was used with a SWOT matrix to identify how the study environment is doing and to be able to identify those indicators that have the potential to form, as far as possible, a better approach to digital governance in Spain. The aim is to ensure that in the current technological era, the Spanish port sector evolves in terms of port digitalisation in order to adapt to the coming changes and continues to develop towards a more digitally interconnected future.

These two methods of the Business Observation Tool (BOT) and SWOT matrix were used to identify how the study environment is doing and to be able to identify those indicators that have the potential to explain what is needed for a better approach to digital governance in Spain [7].

Digital government services (also called e-government) are defined as service delivery within government—and between the government and the public—using information and communication technologies. For example, digital governance enables organisations to standardize systems and processes, which ultimately bring greater efficiency and reduced costs.

This document follows the structure of any scientific document, starting with an introduction, followed by summary of the state of the art, highlighting of the most current trends in the port sector and delving into the concept of digital government and its global implications. In the methodological part, the Business Observation Tool and SWOT tools are developed; based on their development, data analysis is presented and conclusions are drawn.

2. State of Knowledge

2.1. Trends in the Port Sector

Ports have always played a key role in social development and are therefore a basic element in the economic development of the countries that have them and which also occupy a strategic position in the world [8].

Modern seaports play an important role in ensuring the safe and efficient movement of goods within the global logistics network. In addition, they also provide various types of value-added logistics services; for example, these services can promote the postponement strategy of the global supply chain. On a global scale, due to the influences of new

communication methods, new behaviours, innovative technologies and other factors, ports cannot be separated from these new trends. They must play an active role in this global change and become the leaders of the transformation. Ports have always played a key role in social development and are therefore a basic element in the economic development of those countries that have them and are also in strategic positions in the world.

Digitalisation in logistics is the key to becoming a smart port. Therefore, to improve efficiency, a port should be committed to improving and modernising the technology of maritime transport [9]. However, the efficiency and safety of the related cargo flow is highly dependent on the flow of information [10].

Digitalisation has pushed the maritime industry beyond its traditional boundaries and provided new opportunities to improve the productivity, efficiency and sustainability of logistics.

In terms of digitalisation, what is most urgent is to invest in technology and for the different actors involved in the port sector to cooperate, allowing for information exchange, coordination and collaboration between them, which is usually an obstacle in environments that are highly competitive.

Regarding sustainability and governance, ref. [11] can be consulted. The focus of this article is on how to better govern the marine environment.

An example of governance in maritime clusters is the study in [12], which has a special focus on the current development of maritime clusters in the southwest of England.

Increasing competitive pressures and regulatory and management complexity mean that port managers and administrators are looking for ICT solutions that can maintain efficiency and improve customer relations and enable that service differentiation that can create value for their customers.

2.2. Digital Governance

Governance is defined as the art or way of governing that aims to achieve sustainable economic, social and institutional development by promoting a healthy balance between the state, civil society and the market economy. Governance refers to the process of decision making, the negotiation of priorities, the use of power and the values expressed in the process itself [13].

Digital and internet technologies are pervasive in modern life and enable the near-limitless generation, storage and exchange of private data and information. Global digital governance encompasses the norms, institutions and standards that shape the regulations around the development and use of these technologies [14].

It is often unclear what "digital" means for a port organisation. To understand what it means, one must know that Digital Governance has four key "legs" on which it stands [15].

In order to digitise, four fundamental pillars must be taken into account [16]:

1. The need for a long-term plan supported by technology.
2. The need to rely on data for better customer service.
3. The need to increase performance—e.g., by lowering costs.
4. Finally, the need to improve processes.

Digitalisation requires a review of processes (use of digital technologies to change a business model and provide new revenues), especially in the sector under study: ports [16].

Therefore, the use of digital technology and an improvement of current digital competencies will be necessary, considering that new roles will appear in the process. This digital empowerment process is based on [16]:

1. Own decision-making power.
2. Having access to information and resources to make an appropriate decision.
3. Having a range of options to choose from.
4. Having the ability to exercise assertiveness in collective decision making.
5. Having positive thinking and the ability to make changes.
6. Having the ability to learn and to improve one's own personal or group power.
7. Having the ability to change perceptions by democratic means.

8. Improving self-image and overcoming stigmatisation.
9. Engaging in a self-initiated process of continuous growth and change.

There are a number of stepping stones to digital transformation:

- At the base is "digitisation"; in this first step we have to transform the data we currently have into digital format.
- The second step consists of "real digitisation", in which processes have to be transformed.
- At the bottom rung and top of the pyramid, you have the "digital transformation", in which it is the whole company as a whole that will undergo this transformation.

2.3. Port Involvement

The interconnection between the digital platform of the entire logistics chain and the collaborative economy itself (both derived from digitalisation and port 4.0) may require the development of methods to change or modify the state port governance model itself.

In the new model of digitalisation of the port industry, it will be the port communities themselves (not only the port authorities independently) that will jointly and collaboratively develop those strategies to adapt this new digital model to their own reality towards improving the competitiveness of the global port service, supported by the aforementioned technological innovation. Port communities are made up of public–private logistics entities associated with a particular port facility [16].

The processes of Industry 4.0 go esfar beyond production. Industries are growing together through data exchange and logistical developments, and these industries are growing together with Industry 4.0 development. Thus, the logistics sector is now also using the term Logistics 4.0. [17], and new terms such as Ports 4.0 [18] and Supply Chain 4.0. [19] have emerged. All of these have been used, among others, to show that these industries are ready to face the challenges associated with the digital revolution.

Digitalisation has been identified as one of the main drivers of change for ports in the future. Its role in maritime logistics chains is, however, more complex to assess. The idea of Ports 4.0 is closely related to the concept of Industry 4.0, which can be considered more as a declaration of intent than a real description of the current trends in the sector [20].

Similarly, also in the case of ports, digitisation should be seen as an enabler and not as a goal in itself. Digitalisation processes should be driven in the direction of the strategic objectives set by port managers and oriented towards solving the most urgent sectoral challenges.

In contrast to the environment defining the activities carried out by all port operators based on the traditional governance model (port authority), smart governance is characterised by:

1. Decentralisation. The large administration must be abandoned and replaced by hyper-connected actors who will be the decision makers, thereby forming an e-government [21].
2. Participation. For participation to exist, communications between port and management should be sufficiently fluid, accompanied by a rapid form of interaction [22].
3. Transparency. Here we have what is nowadays called open data, which provide access to information, and port agents will have authorisation for such access through platforms designed for this purpose [23].
4. Efficiency. Proper horizontal communication between port stakeholders and better access to the necessary information will make port management more efficient, shaping its basis. This will make it possible to anticipate inefficiencies and resolve them in a timely manner [24].
5. Sustainability. In this way, the role that new technologies can play in the intelligent management of energy, environmental protection, waste disposal, etc., is promoted [25].
6. Innovation. Strengthening entrepreneurship, with links between universities and research centres, in addition to the R&D projects that are being promoted, will form the basis of the new governance [26].

7. Collaboration. Between all the parties involved—administrations, companies, public-private entities, etc. [27].
8. Security. It is important to have a good security system for the data to which access will be given, and for all the information. It is necessary to protect them virtually from cyber-attacks without forgetting their physical protection, in order to preserve the privacy of the documents [28].

As far as social and public opinion is concerned, it has not been taken into account in previous years but is now becoming increasingly important in the port sector.

The field of action in which digitalisation [29] can play an important role covers the whole range of port activities, and its main potential for improvement covers the field of increased efficiency in operations (which leads to better economic returns), the field of workers' safety and active and dynamic communication with the social environment, port management at the institutional level and environmental and energy sustainability [30].

The quick and easy flow of this information facilitates decision making for both port authorities and port customers. Ultimately, this leads to higher productivity, lower costs, a greater ability to compete in the market, lower emissions, greater energy efficiency and greener logistics [31].

Digital technologies are a key element in the development of the logistics sector. The so-called digital revolution that began in the 1980s, based on the increasingly widespread use of automation, artificial intelligence and robotics in production processes, is changing the face of global logistics, a change often referred to as Logistics 4.0. Building on the impact of digitisation in other sectors, port cities are also expected to see the emergence of new business models in the coming years, made possible by the advancements in digital technologies [32]. Ports are potentially an indispensable player in the digital revolution, as they are critical links in global supply chains and the main international gateway to a country or region. However, as logistics networks become more efficient, cargo owners and logistics service providers cease being tied to a specific port.

2.4. Current Status at an International Level

The global landscape as hitherto understood is changing rapidly, and change is always accompanied by uncertainty. Ports, key nodes in the global production–transport–distribution theatre, cannot remain oblivious to this, and gone are the days when, with little data on consumption, revenues and trade, the port needs of the future could not be foreseen [33]. The port ecosystem is affected by a wide range of economic, social, institutional and environmental trends and disruptions, and above all, by a dynamic and highly unpredictable demand for port services.

Reference [34] analyses how port governance systems in Europe have influenced the implementation of port initiatives focused on promoting modal shifts in freight transport. Through a comprehensive review of port strategies, this research identified 49 individual modal shift initiatives among 21 port cities in Europe. In fact, the application of technological solutions can be related to the fact that port authorities tend to be more proactive in collaborating with private companies.

In Latin America, they are ahead in terms of digital governance, as all data are open there, unlike in Spain, where everything seems to be closed. Proof of this is the amount of accessible information that can be found on the Internet, unlike in Spain [35].

In today's digital age, it is not surprising that in a few years' time, in terms of transport, documents that provide information about the goods being transported will be more expensive than the actual goods being transported. For this reason, more and more companies are emerging for the logistics process that is being mentioned, so that the documents or data they have will be secure and protected by encryption codes, so that the customer can be completely sure of the transactions they are making [36].

Advanced digital collaboration platforms exist in the port sector, providing shipping companies with highly secure codes for more effective decision making, in terms of optimising rates, costs and environmental emissions.

It is possible to have a global view of what is happening, for each agent separately. This gives you more control over what is happening in real time, which means you can make better decisions and take advantage of opportunities, saving time in the process and thereby planning better.

The European Committee of the Regions advocates a people-centred digital transition and calls on all levels of government to work to increase the participation and empowerment of citizens in the context of digitalisation, allowing them to play a role in the co-creation of new digital solutions [37].

In Spain, digital transformation is currently not widely implemented, although there is an awareness that we need to undergo a digital transformation in terms of port digital governance.

The port authorities themselves and other agents in the sector have seen that in order to gain in competitiveness, they have to start to seriously consider digital transformation and the incorporation of new technologies [38].

We are currently immersed in the ICT digital revolution, which, together with automation, is revolutionising all sectors of industry and services [39]. Therefore, the two biggest drivers of change in port management systems today are the digitisation and automation of ports in order to achieve ports 4.0 [9].

Concrete examples of digital port governance initiatives can be found in Ghana. The Government of Ghana introduced on 1 September 2017 the Paperless Port System (PPS) to its ports for the clearance of goods and also for all port-related activities. The introduction of this PPS was intended to improve Ghana's trade competitiveness and also help avoid problems such as unexplainable fees, delays, lack of transparency, bureaucracy and complexity of port operations that have been attributed to all previous port reforms. However, barely a year after its implementation, numerous studies have revealed numerous challenges, from stakeholder acceptance to IT support issues [40].

Sustainable awareness was born and is currently a key factor for change in the port sector. Proof of this is that in recent years, all the changes introduced in management systems are viewed through the lens of environmental sustainability—that is, seeking a port system that is respectful of the environment and tries to avoid, as far as possible, impacts on it [41].

There is a growing need for security and trust, together with digitisation, to move towards the "logging of things" (Lot), which means the recording of all data or information, contracts and transactions that have to do with digitisation.

The basic idea is that port and logistics communities must move from decentralised network structures to distributed network structures, something typical of a collaborative economy that requires transparency, security and trust, and which raises the need for different governance models. Spanish ports—both Port Administrators and the companies and operators of port and logistics communities—must take advantage of the opportunities arising from technological changes and digital transformation to make the port community as a whole more efficient and competitive.

We should also talk about the negative effects that can occur as a result of digital governance. In [42], digital inequality and the digitised welfare state were studied to elucidate an underexplored way in which the rise of e-government platforms further disadvantages already marginalised people: by requiring citizens to have access to e-government platforms. E-government platforms further disadvantage already marginalised people who possess a verifiable digital footprint distributed across multiple public and commercial platforms.

Reference [43] shows the analysis that the adoption of an optimised port governance model can promote trade growth in the Beijing–Tianjin–Hebei context. The paper analyses the information construction of a port spatial structure control project and provides a new impetus for the development of the port economy in China.

Reference [33] calls on the research community to consider the development of continuous and more fluid approaches to port management governance models, a more area-specific approach to individual port governance challenges, research on the conditions

and ramifications of an increasing regional and global interrelation of ports and the resulting governance solutions, the advancement of performance measurement in the field of port governance and the exploration of new revenue/business models for port authorities.

The Business Observation Tool (BOT) model has been used for this study. The BOT is used as an alternative to other planning models for the identification and study of business environments. It contains factors related to the conditions of the business macroenvironment and group work actions for strengthening the business idea studied. It is understood as a previous step to the use of business model tools.

3. Proposed Methodology and Results Obtained

In order to achieve the objective, the methodology represented in Figure 1 has been followed.

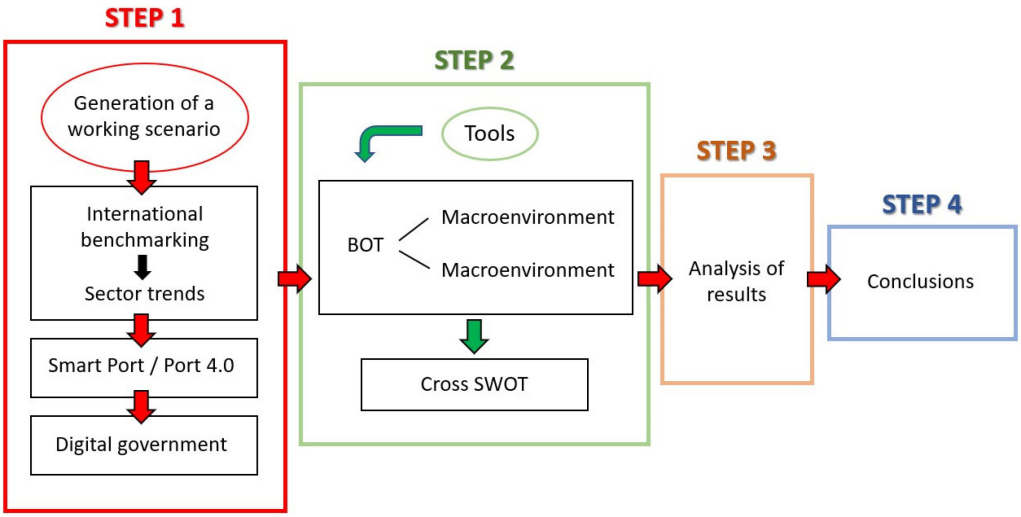

Figure 1. Proposed methodology for the study. Source: own elaboration.

3.1. Generation of the Working Scenario

The working scenario corresponds to the structuring of the state of knowledge of the research topic and corresponds to the previous sections, the most important of which are the points in Figure 2.

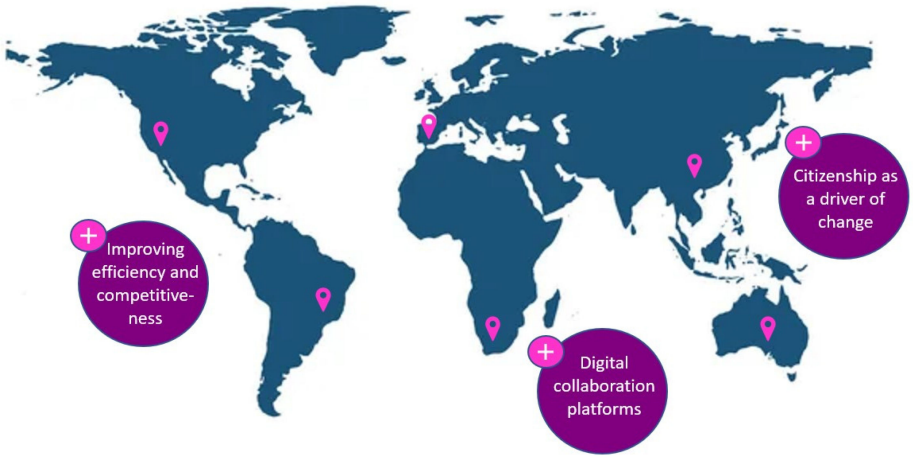

Figure 2. Essential elements of the work scenario. Source: own elaboration.

3.2. Business Observation Tool (BOT)

The Business Observation Tool (BOT) is used as a tool to better understand and visualise the working environment. An analysis was performed of the study environment, in this case the Spanish Port System in terms of digital governance. This resulted in indicators

that we can see below, thereby obtaining a database, obtained from the compilation of data from various sources, which are duly documented. Figure 3 shows the procedure followed by this tool:

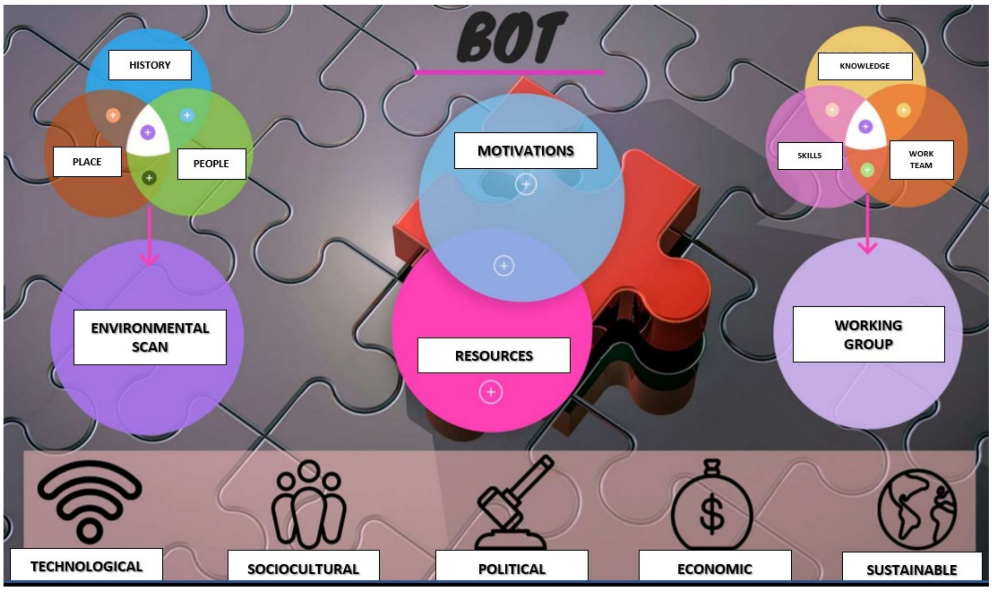

Figure 3. BOT tool. Source: own elaboration.

The use of the BOT methodology involves working on four blocks or work scenarios, as the necessary work scenarios are generated to be able to study them separately. This provides a "snapshot" of the current situation, allowing decisions to be made and future scenarios to be considered. In total, there are four main blocks to be used: motivations and capacities to move forward, establishing the working group, characterising and understanding the development environment and factors that alter or intervene in that environment. Each block has to explain the following:

- Motivations and capacities to move forward. This topic could be considered as the central one of this tool, as it allows one to know what the existing motivations are to carry out the project and how to do it in the most efficient way possible. In addition, it allows one to know all the resources currently available to be able to develop the project.
- Establishment of the working group. In this section, the training of the staff is identified in order to be able to carry out the project and study their knowledge, skills, etc. Based on the data, the activities that can be carried out by each of the members of the group are defined, and the different work teams are established.
- Characterise and understand the development environment. In this scenario, the technological evolution and the functioning of the ports of the Spanish Port System throughout its history are observed.
- Factors that alter or intervene in this environment. This last stage is based on obtaining all the technological, socio-cultural, economic, political and environmental information that affects the project, both positively and negatively.

The authors considered that this tool covers the desired objectives for the first step in e-government of the Spanish Port System. It is a model of observation of the environment for the generation of ideas, so that it contains factors related to the macro-environment and group work actions to strengthen the idea studied. Therefore, the tool was used as a guide to understand the basic conditions, requirements and desires that must be considered together with the idea of e-government in Spanish ports. In order to go deeper and further, it was necessary to develop a SWOT crosswalk with the Business Observation Tool.

In order to analyse each scenario, research was carried out on the current state of the Spanish Port System in terms of digitisation. Subsequently, the entire database was classified into the corresponding scenarios.

The analysis and the process carried out during the data collection, and the sources of the data, are shown below. For the data collection and subsequent classification, an Excel spreadsheet has been used for better visualisation.

The steps to follow within the tool are as follows:

1. Analysis of motivations and resources (connections). Responding to: What is the motivation for developing digitalisation in the Spanish Port System? How can it be done with a high impact? What resources are available to develop this project?
2. Study of the environment (observation): This is made up of the history, the place and the people in the study environment. They respond to: What elements external to the project can alter future decisions and strategies?
3. Working group (staff). Consisting of the knowledge, skills and working equipment belonging to the study environment. They explain: What are they and how can the talents of each team member be harnessed to the project's advantage?
4. Macro-environmental study in relation to the factors that alter or intervene in the environment. It is made up of different scenarios:

- Technological
- Sociocultural
- Political
- Economical
- Sustainable

They explain:

What characterises the observed environment, and how can we make use of it to support the project? The indicators for each scenario analysed are detailed below (Tables 1–5 and Figure 4).

Table 1. BOT motivations and resources. Source: own elaboration.

Motivations	Resources
Reduced costs of physical storage of documentation and reduced use of paper and printing.	Fund Ports 4.0
Protection and better conservation	Technological development of the tax office
Decentralisation of information	"SIMPLE" Logistics Platforms
Medium to long-term investment	"Estiba + 2022" Programme
Increased productivity	State Ports Port Governance Observatory
Improved access and time management in data queries	e-government
	Challenge IOT Project (Andalucia)
Attract and retain talent	Digital platforms
Digital age	International
Exploiting new technologies	TRADELENS Project
Much more efficient port tracking	European Union
Better interconnection between the different port actors	One-stop shop
	Data Ports Project
Increased competitiveness	NextGenerationEU (Post COVID-19)
Greater inclusion and citizen participation	GMN Project
Increased sustainability	gloMEEP Project
Greater transparency	GreenVoyage2050 Project (Norway)
Reducing risks	GHG TC-Trust Fund
Higher quality	Innovation Fund

Table 2. BOT study of the environment. Source: own elaboration.

Study of the Environment (History, Place and People)
Electronic port
Connected port
Smart Port
Ports 4.0
Moving from Competition to Collaboration
More citizen- and customer-centred government
Information flow/collaboration
Moving from Decentralised to Distributed network
Well-being of citizens
Providing access to the internet in more remote locations to make it accessible
Demand to become competitive ports
Requirement for financial self-sufficiency
Constant technological evolution
Change in the profile of the classic port user

Table 3. BOT working group. Source: own elaboration.

Working Group (Knowledge, Skills and Equipment)
Lack of technological training
New employee profiles and job opportunities
New working methodologies
Non-presential work
Social networks and apps
Lack of motivation

Table 4. Technological part of the BOT. Source: own elaboration.

Technological	
Consultancies specialising in digitisation	"Adhoc" tools
Internet of Things	
Process and operational automation	IA
Blockchain	BigData
Drones	RDIF
Augmented reality	Robotisation
Regarding the load	Sensors
Security	Efficient information
Transparency	Security and data protection
Open information	Unmanned vehicles
Open-source software (FIWARE)	Cybersecurity
Short-term vision in investment (security and data)	

Table 5. Sociocultural, political, economical and sustainable parts of the BOT. Source: own elaboration.

Sociocultural	Political	Economical	Sustainable
Cultural change	New model of port communities	High financial resources	Control and optimisation of resources
Smart cities Socio-cultural factors	Political aspects Data registration Legal disparity and scope of application Open, transparent and accountable government New governance model	State funds State finances Specialised markets Private initiative New business models	More sustainable port Efficient and predictive supply chain Port-Nature-Environment Relationship Efficient resource management Waste management

As an example of the development of each block, see Figure 4.

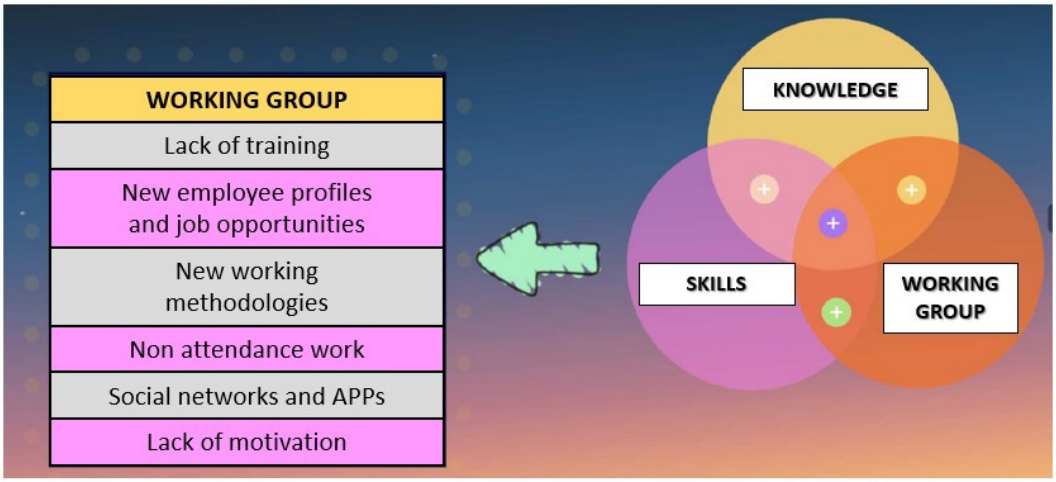

Figure 4. Example of indicator selection in the working group. Source: own elaboration.

3.3. Application of the Selected Model to Digital Governance

The SWOT (Strengths, Weaknesses, Opportunities and Threats) matrix is a tool that allows for the analysis of the reality of the study environment, and based on this, decisions can be made based on the results obtained.

For the port environment, we can find important works that used SWOT as a main tool [44]. The following has been gathered via interview, supplemented by generally available existing information on individual ports. Key policy drivers and operational objectives for governing the ports in the southwest of England are provided, after a discussion on SWOT analysis.

The SWOT matrix establishes different strategies depending on how you connect the results obtained. The SWOT matrix is also very useful for reflecting on how the current study environment is doing.

The SWOT matrix analysis is divided into two parts:

1. Internal analysis: (strengths and weaknesses)
2. In this first module, the strengths and weaknesses of the study environment are analysed.
3. External analysis: (threats and opportunities)
4. In this second module, the threats and opportunities of the matrix are analysed. Both correspond to the external parts of the field of study—things that do not depend on the internal environment and cannot be controlled by it. They have to be taken into consideration in order to overcome the threats and take advantage of the opportunities.

In order to go deeper and further, it was necessary to develop a SWOT crosswalk with the Business Observation Tool, taking advantage of the advantages of SWOT:

1. It facilitates the understanding of the data extracted from the company.
2. It encourages the development of strategic thinking.
3. It helps one to make the most effective decisions.
4. It allows one to exploit positive results and address internal problems.
5. Its development is simple.

In this case, the elements of the matrix are the indicators obtained from the BOT in order to know which of them would be used to promote:

6. Offensive strategies.
7. Defensive strategies.
8. Adaptive strategies.
9. Survival strategies.

Based on the strategies, a series of actions are defined for each strategy, which are more concise and detailed in terms of how they are to be carried out.

A SWOT analysis makes it possible to delimit all the strategies to be developed, and in turn, to determine the order in which they should be carried out. At the beginning of the SWOT, it is necessary to specify the value we assign to each section, and subsequently, the strategies that are related to these values will have a greater or lesser importance.

Once the analysis has been carried out, it is necessary to define a strategy that leads to enhancing strengths, overcoming weaknesses, controlling threats and benefiting from opportunities.

Once the SWOT matrix is obtained, it will lead to its analysis and the definition of the best strategies for the study environment.

As an example of the generation of the SWOT crossed with the BOT, Figure 5 shows for each block of the study the elements counted as weaknesses, threats, strengths and opportunities by colour code and size of the radius (Figures 6 and 7).

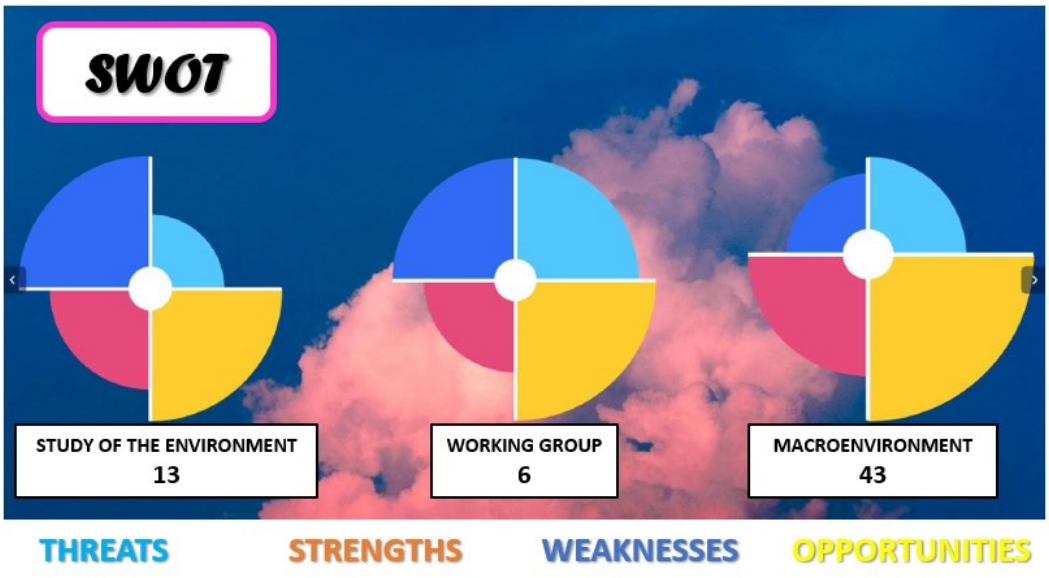

Figure 5. Elements included in weaknesses, strengths, threats and opportunities by colour code and radius size. Source: own elaboration.

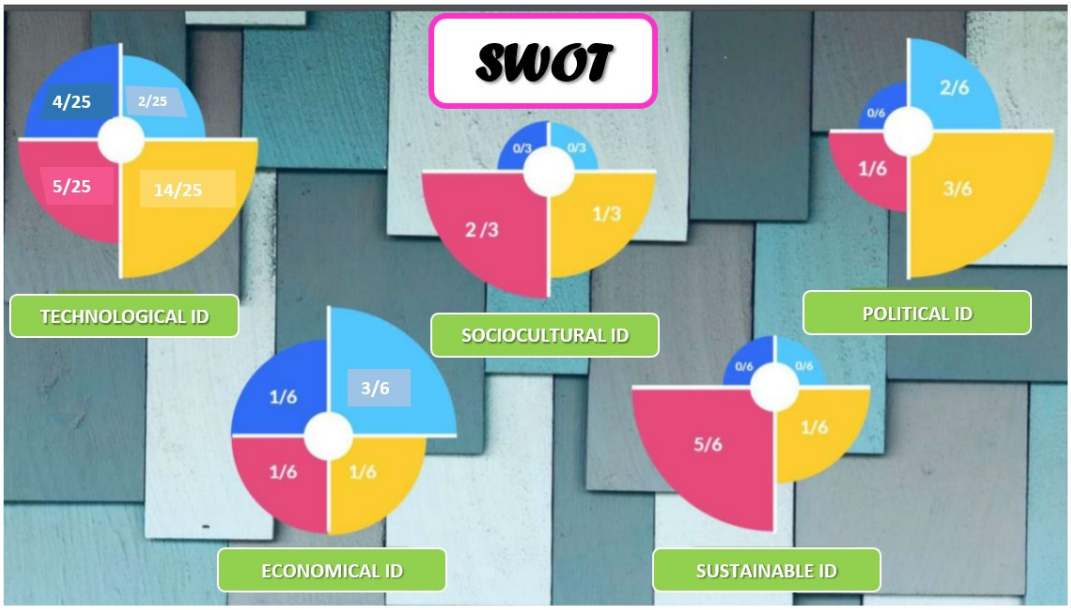

Figure 6. Percentage of indicators from each BOT block in each SWOT element. Source: own elaboration.

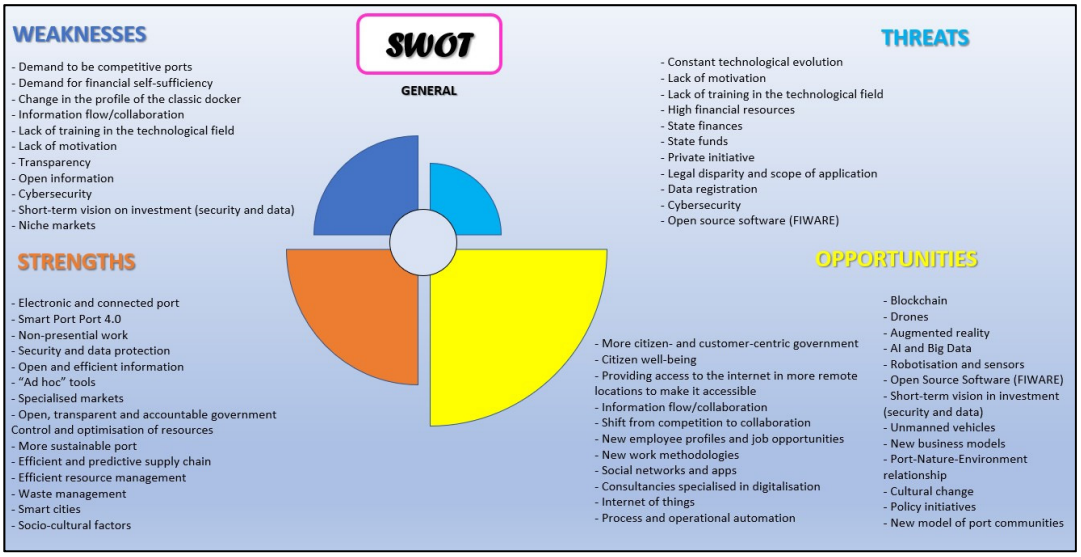

Figure 7. BOT indicators in each element of the SWOT. Source: own elaboration.

The indicators obtained with the BOT were applied to a SWOT matrix.

4. Discussion

This looks at the results obtained in the previous sections.

As can be seen in Figure 8, the scenario belonging to the BOT analysed above tends equally towards weaknesses and opportunities, as they have the same number of indicators.

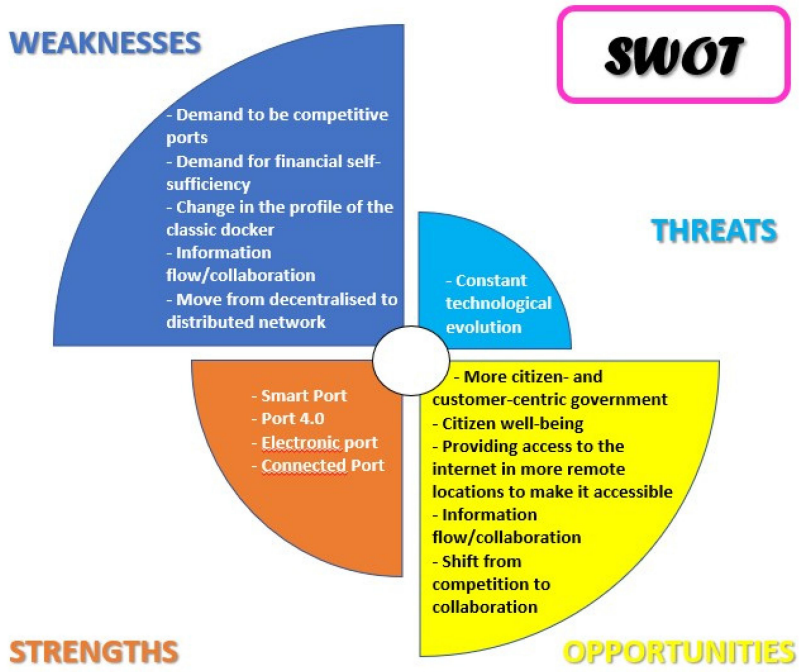

Figure 8. SWOT study of the environment. Source: own elaboration.

It is also observed that within the SWOT matrix itself, there are repeated elements; this is because depending on the point of view from which one is looking at an element, it is possible to locate it in different areas of the matrix.

Working group

As can be seen in Figure 9, this scenario tends towards opportunities; threats and weaknesses are equal in indicators. In this case, threats and weaknesses depend on how you look at them, whether they are internal or external elements, which is why they are repeated and equalised.

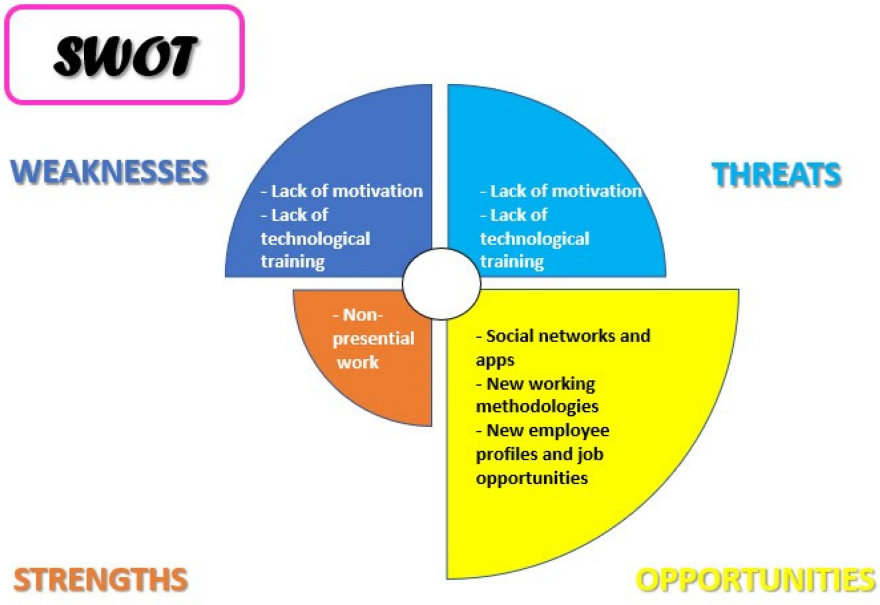

Figure 9. SWOT working group. Source: own elaboration.

Macro-environment

It can be seen in Figure 10 that the macro-environment tends towards opportunities at first.

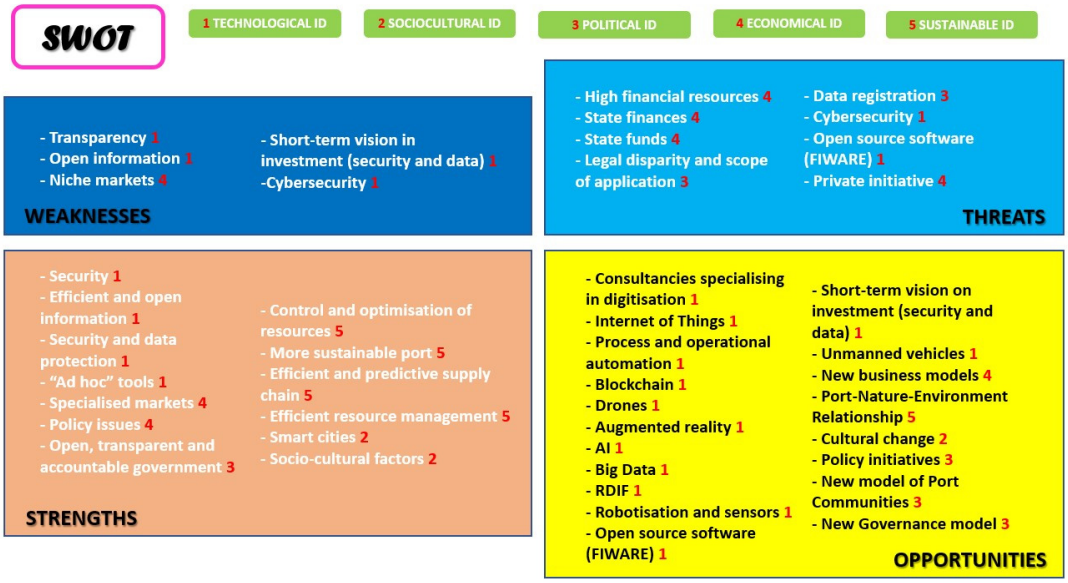

Figure 10. SWOT macro-environment. Source: own elaboration.

In Figures 11 and 12, the SWOTs of each ID are shown separately to see the results obtained from the SWOTs carried out in the previous section and to be able to see which way each of them tends towards separately. As can be seen in Figures 9 and 10, each element analysed (ID) tends towards a different part of the matrix.

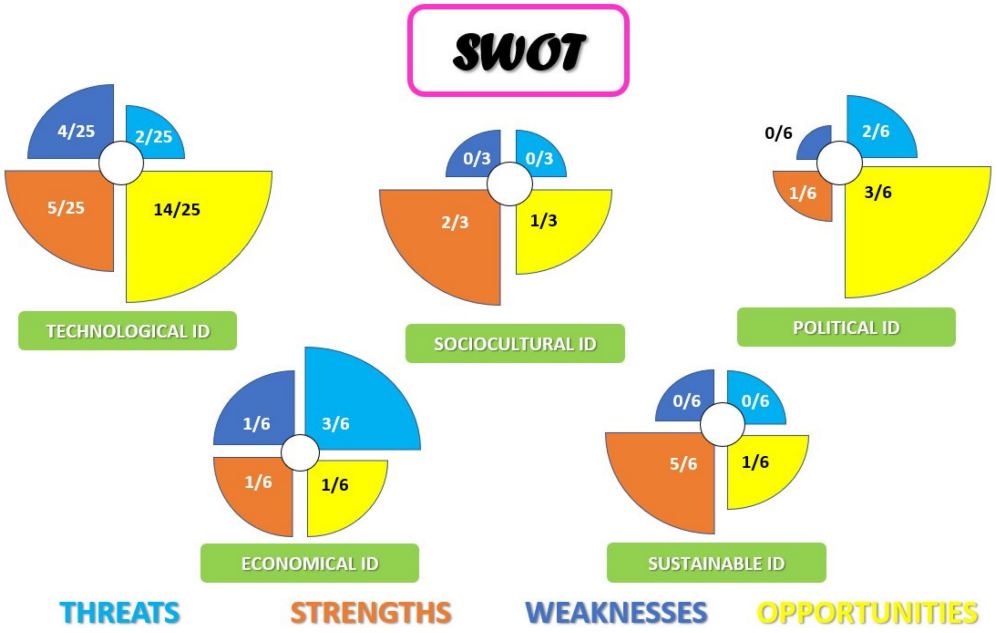

Figure 11. SWOT macro-environment by ID indicators. Source: own elaboration.

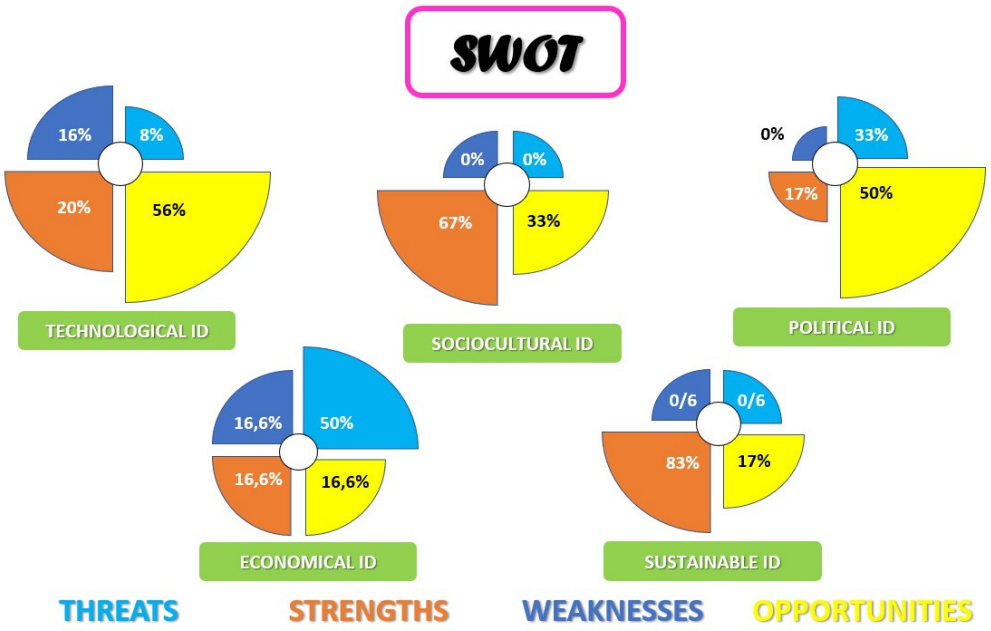

Figure 12. SWOT macro-environment by ID percentages. Source: own elaboration.

In the technological domain, 67% or 14/21 of the indicators belong to opportunities. In the socio-cultural domain, 67% or 2/3 of the indicators belong to strengths. In the political domain, 50% or 3/6 of the indicators belong to opportunities. In the economic domain, 67% or 4/6 of the indicators belong to threats. In the sustainable domain, 83% or 5/6 of the indicators belong to strengths.

Therefore, it can be observed that each ID (within the macro-environment matrix) cannot be quantified in the same way, as some have more indicators than others, as has been observed, and each one tends towards a different part of the matrix, although in support of the theory of what for, it can be seen that they tend towards opportunities for the most part. This is not only the case in the macro-environment matrix, but also in the other two scenarios analysed above.

The weaknesses, threats, strengths and opportunities analysed are listed below in order to see them as a whole (Figure 13).

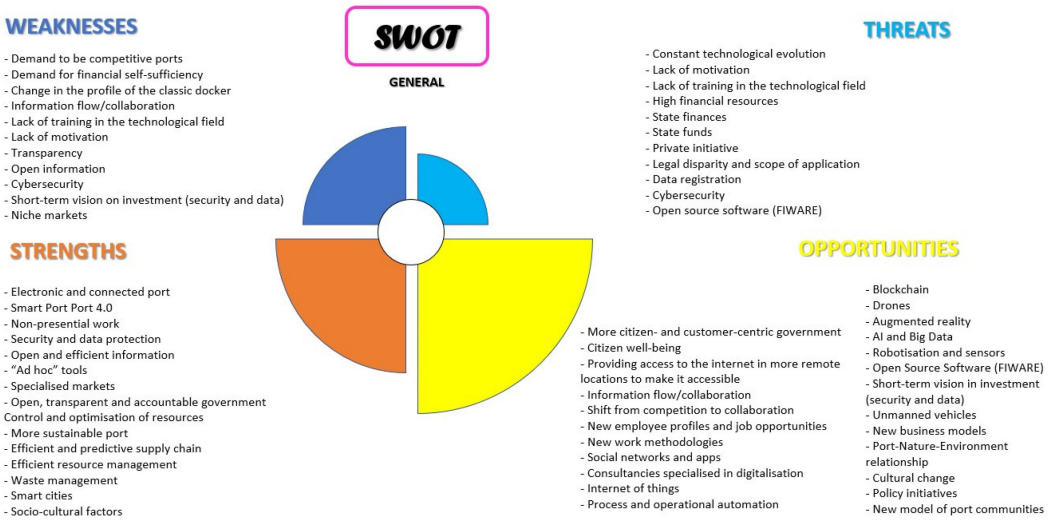

Figure 13. Overall SWOT. Source: own elaboration.

As can be seen in Figure 13, most of the indicators are in the area of opportunities, so it can be supported and verified that the research is directed towards the "what for"; that question that gives an answer with the opportunities of the SWOT matrix based on the BOT indicators. Below, in Figure 14, we can see a summary diagram of each element of the BOT in colour, each one representing what we have seen in the previous figures, in weaknesses, strengths, threats and opportunities. This gives us a global vision of what is happening in our study environment, thanks to the joint application of the BOT and the SWOT.

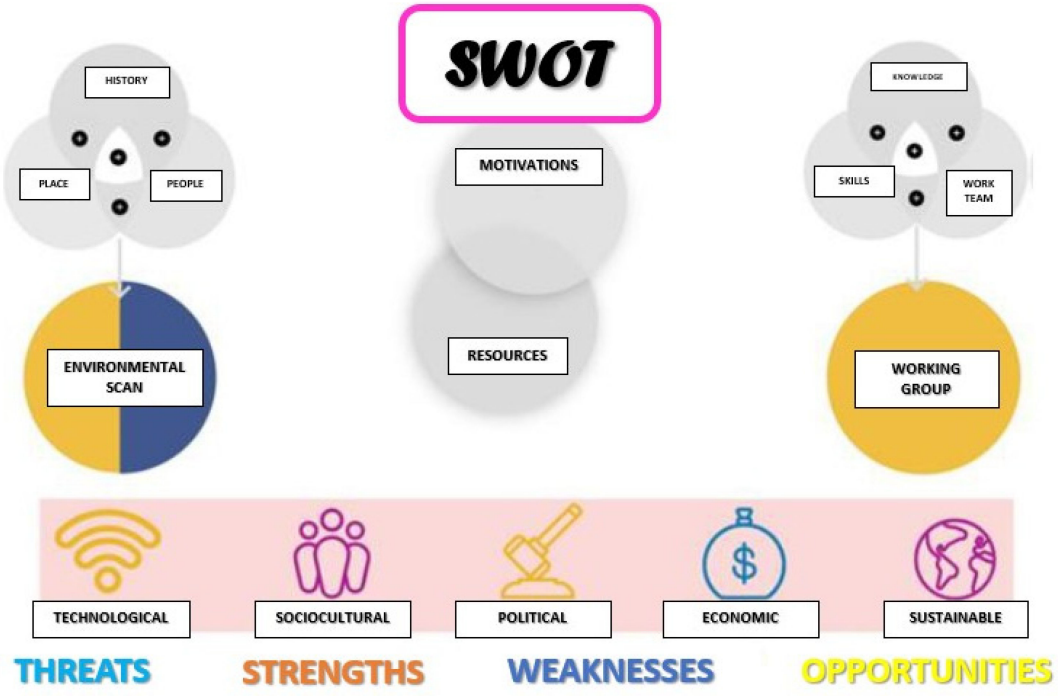

Figure 14. BOT according to SWOT. Source: own elaboration.

5. Conclusions

A snapshot of the Spanish Port System in terms of "Digital Governance" can be generated through a BOT with a total of 97 indicators.

The indicators obtained from the technological sphere are the most predominant in the analysis carried out between the BOT, SWOT and subsequent links between them to obtain the motives. As can be seen in Figure 14, the technological environment is in yellow, forming part of the opportunities from the SWOT matrix, which is the solid foundation of this work.

With this we can conclude that, in addition to other sectors, the technological environment is closely linked to digital transformation, being essential to achieve it.

The general conclusion drawn from the study is that it is possible to apply digitisation strategies in the Spanish port sector, where, depending on the client's needs, a customised methodology will be applied in each case.

Therefore, in order to be able to face the challenges that will arise in the future, the port sector, in terms of digitalisation, must commit to strategic alternatives that promote digital transformation in the Spanish Port System and be able to develop and enhance the opportunities and advantages that this entails.

Thus, the digital transformation needs to be applied in the Spanish port sector, since otherwise, we would be left behind in this process and in the digital era in which we are living and which is constantly evolving, in comparison with the rest of the world's ports.

This whole process of transformation to digital governance has meant that the ports are asking themselves certain questions in relation to digitalisation which must be answered by creating a new model that brings out the full potential of Spanish ports.

Finally, to conclude, Spanish ports must move towards becoming more digital ports, because new technologies are constantly being invested in and the ports must take advantage of them and gain an advantage with them, reaching a series of goals. In short, they must aspire to be:

- More innovative
- More agile
- More connected
- More collaborative
- More flexible
- More open

To meet the growing demands of the customers they serve.

All of the above can be achieved through the following elements of the study which form the building blocks of the BOT: (see Figures 15–22).

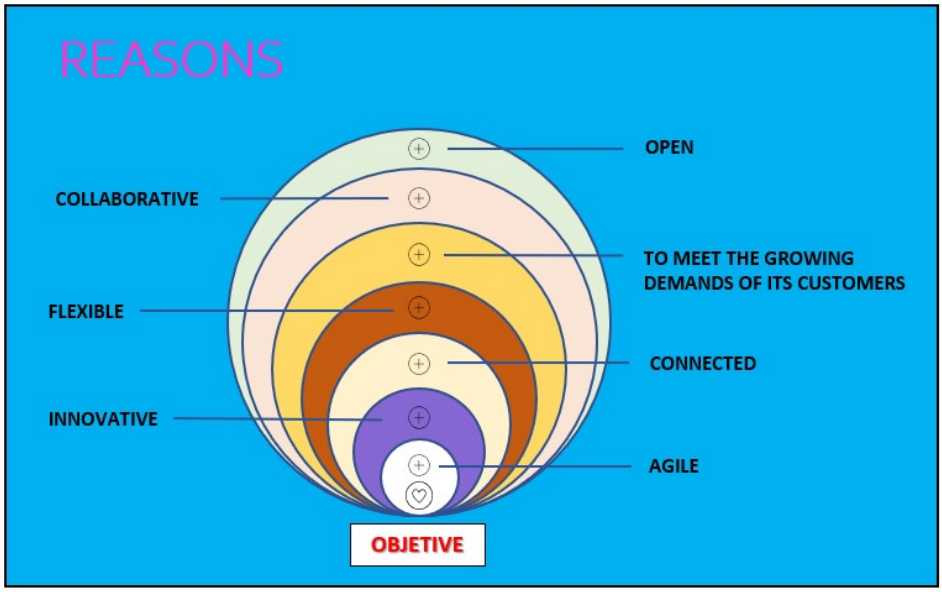

Figure 15. Targets for e-governments in ports. Source: own elaboration. It can be seen that in order to make ports more open, there are many blocks, and within them there are many indicators necessary

to achieve this goal. Most of the indicators that support this progress are technological characteristics such as big data, AI and Internet of Things. To a lesser extent, indicators of sustainable characteristics appear; in this case, only the port–nature–environment relationship indicator would be relevant. In the sociocultural field, which only includes one related indicator, it will be necessary to promote cultural change.

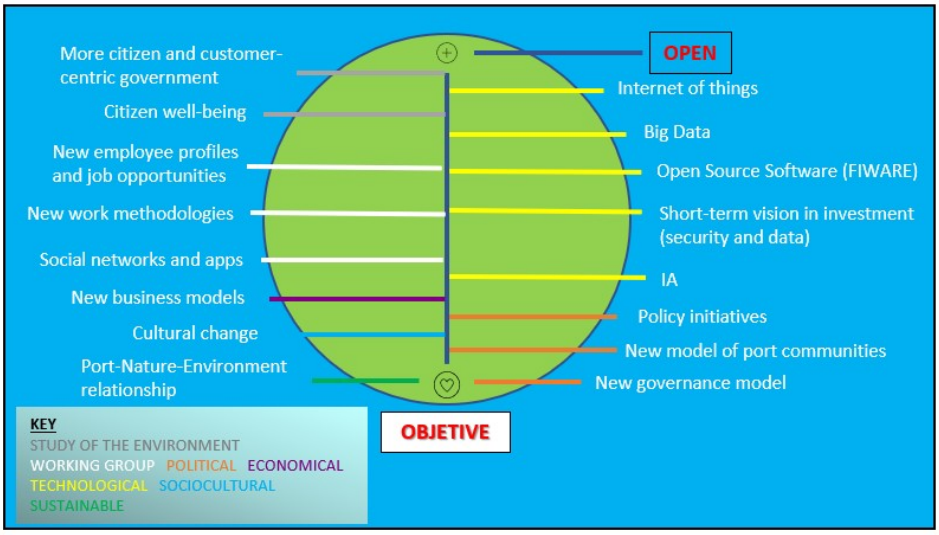

Figure 16. Elements of open ports. Source: own elaboration. In order to generate more collaborative ports, technological indicators will be the most relevant—again big data, AT, Internet of Things, firmware, sensors, robotisation, etc. In this case, to a lesser extent, indicators of sustainable characteristics appear—in this case, only the port–nature–environment relationship indicator would be relevant. In the sociocultural domain, which only includes one related indicator, it will be necessary to strengthen the cultural change.

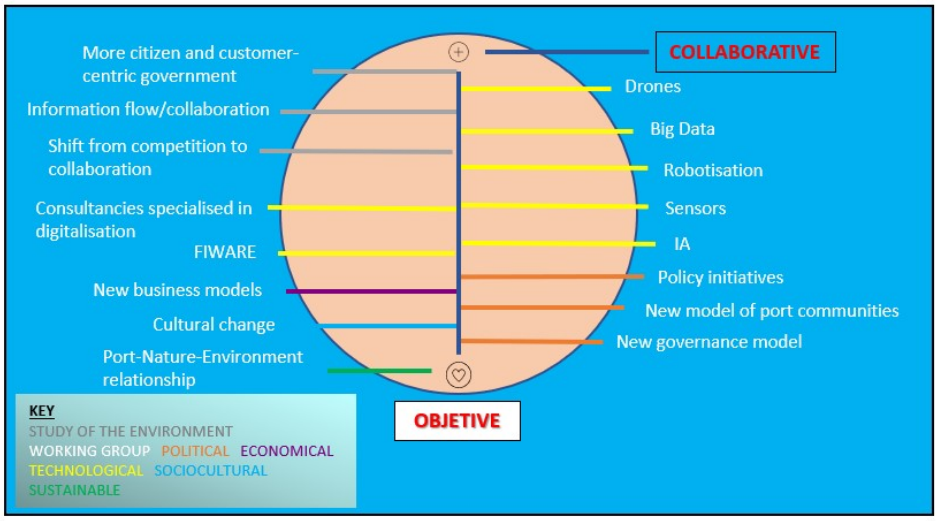

Figure 17. Elements of collaborative ports. Source: own elaboration. In order to meet the growing demands of its customers, it is necessary to involve far fewer blocks and indicators. There are only indicators from the following blocks: study of the environment, working group and technological. It is important to highlight the new employee profiles and job opportunities indicator, which is very important for the future of digital governance.

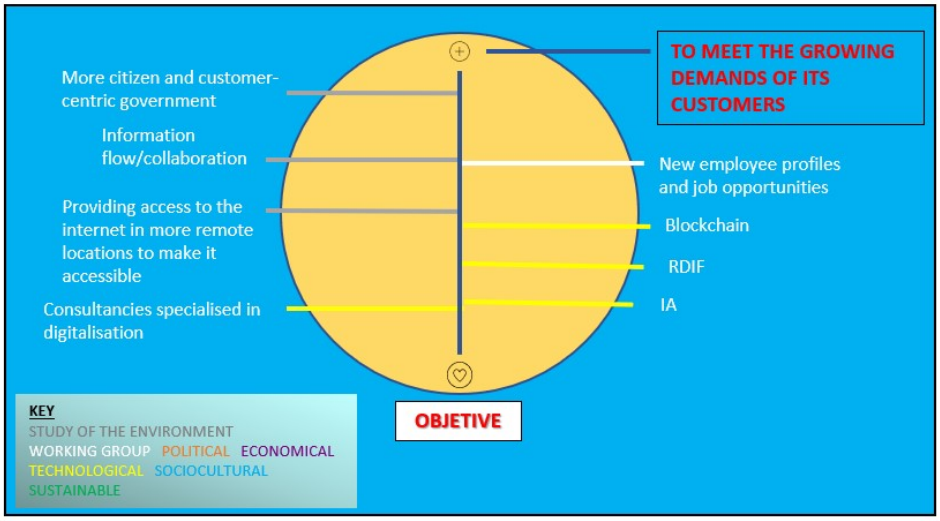

Figure 18. Elements of ports to meet the growing demands of their customers. Source: own elaboration. Flexible ports will need technological, political, working group, economical, sociocultural and sustainable indicators. In the economic block, the reference indicator is new business models. Once again, new employee profiles and job opportunities and cultural change will be necessary to achieve more flexible ports. In the political block, government initiatives will be very important, along with the adaptation of new port models.

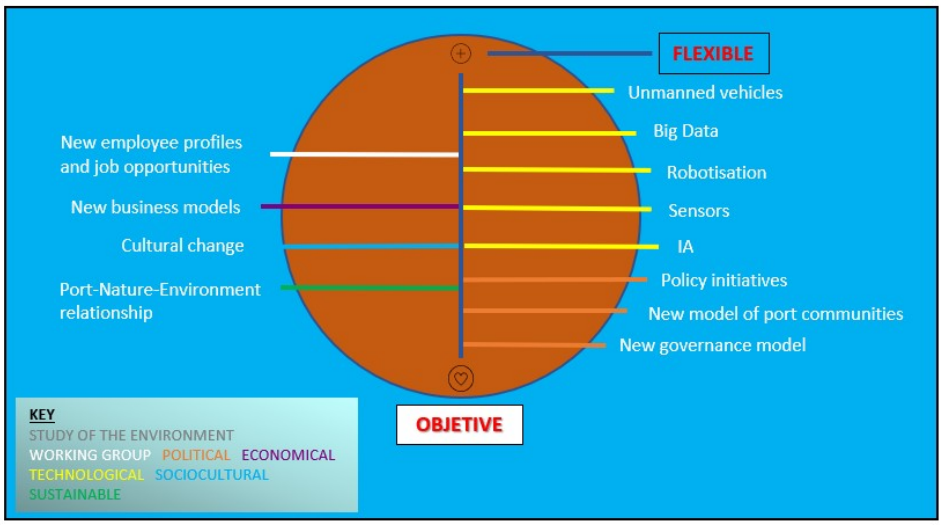

Figure 19. Flexible port elements. Source: own elaboration. Connected ports will primarily need indicators from the technology block, as would be expected, in addition to indicators such as providing access to the Internet in more remote locations to make it accessible and the shift from competition to collaboration. In the working group block, social networks and apps stand out.

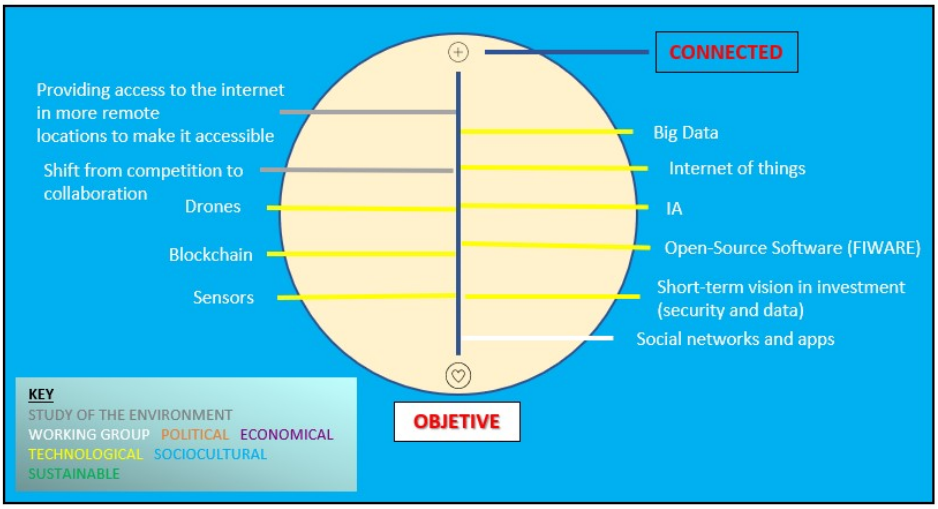

Figure 20. Elements of connected ports. Source: own elaboration. In order to be more innovative, ports will need as differentiating element indicators from the working group block, including new employer profiles and job opportunities, new work methodologies and social networks and apps.

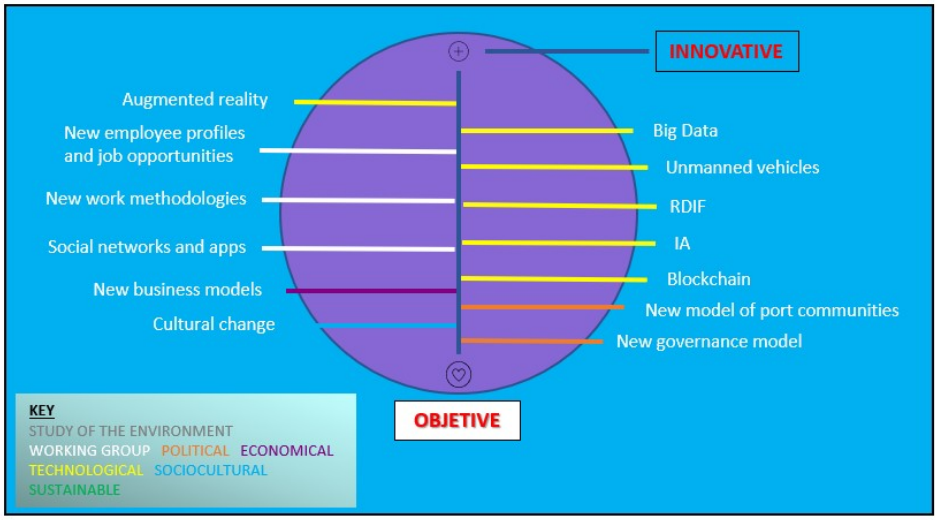

Figure 21. Elements of innovative ports. Source: own elaboration. In order to achieve more agile ports, technological indicators must be supported by institutional policies and environmental studies.

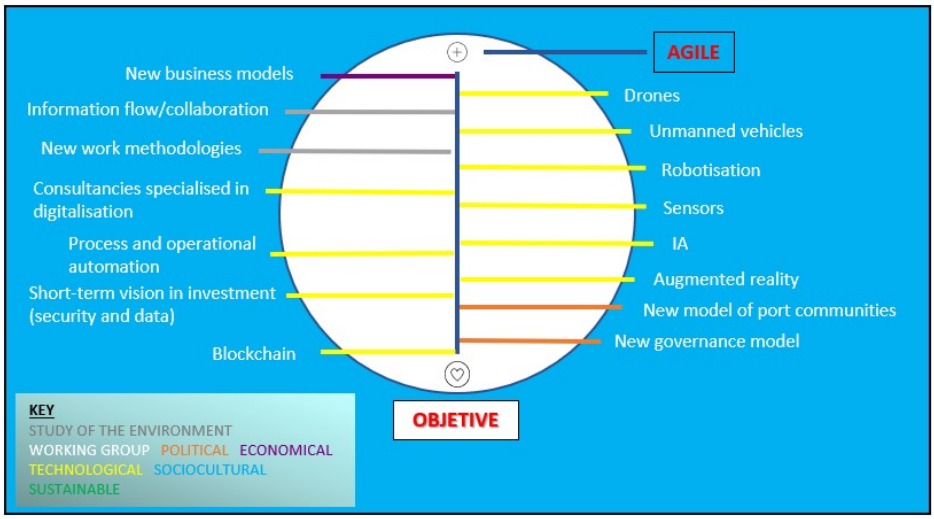

Figure 22. Elements of agile ports. Source: own elaboration. It can be seen that modern ports that develop digital governance models will have to develop mainly technological indicators.

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