INNOVATION MANAGEMENT AND PORT GOVERNANCE: AN APPROACH TO MODELS AND PRACTICES IN THE WORLD

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Abstract

The main objective of the research was to prospect the state of the art in the management of innovation and port governance in order to identify models and practices in the different ports around the world, through the international scientific bases Web of Science and Scopus, which allowed the exploratory study. More specifically, we sought to raise the level of development in the field of scientific production in the areas of innovation management and port governance. Scientometric methods were applied to prepare graphs that reflect the treatment of data and information generated from selected publications, as well as the search in the patent database of the National Institute of Industrial Property – INPI. In general, a gap in scientific production related to the researched field of knowledge was evidenced, which may be associated with the low level of port innovations which, therefore, may also reverberate in the search for patent protection. Thus, it is recommended that scientific productions be encouraged to support innovations in the port sector, in addition to incremental innovations, playing a prominent role in the collaborative action of agents in the port cluster and scientific, technological and innovation institutions (ICTs).

Keywords: Innovation; Port Innovations; Innovation management; Port Governance.

1. Introduction

The need for adaptation of maritime companies, including ports, to the new demands of global trade, including those related to population growth and environmental issues, directly reflects in the formulations and definitions of maritime business strategies (ITF, 2020). Such factors imply an increasingly professional performance of ports and other members of the maritime logistics chain, with the definition of governance arrangements that are appropriate to the specificities of each port context being relevant (ITF, 2017).

In addition to the challenge of meeting a global demand for responsible port development, ports around the world are seeking solutions to face technological, economic and social problems. The increase in world trade has been driven by new and emerging participating economies, such as China and Brazil, reverberating in the need for greater port efficiency. (RAVESTEIJN; LIU; YAN, 2015).

In addition to the aspects described, in Brazil, public ports (in their role as port authorities) are moving towards improving management and self-sustainability, being critical factors to control charges and port efficiency, especially when considering the increase in private participation in the sector. As governance measures arising from public policies that reflect on innovation processes, there are master plans and logistics plans, in addition to the Port Management Modernization Program - PMGP and investments in technologies for managing the logistics chain (ANDRIOTTI et al., 2021).

Brazil still faces difficulties within the scope of the Port Authorities to exercise governance, critical control factors (charges and port efficiency), since both are related to the tariff policies practiced. The works by Andriotti et al. (2021) and Sousa et al. (2021) reveal governance challenges at both the government (policy formulation) and managerial (Port Authority management) levels, and greater efforts are recommended in

standardizing port pricing methods to support these organizations to act competitively, improve management strategic and adhering to market needs. The studies by Andriotti et al. (2021) and Sousa et al. (2021) provide elements of analysis to improve the tariff management of Port Authorities.

Also for the Brazilian case, a tool for analyzing the efficiency of the sector and adjusting the management model of Port Authorities is the application of Data Envelopment Analysis (DEA), which can be used as a comparative basis for the performance of ports, especially with the same characteristics, in order to allow evaluation for benchmarking practice or adjustments in governance (BEUREN, 2016).

Considering the relevance of the port sector for commerce on a global scale and the need to act efficiently to meet market and legal requirements, the practice of corporate governance as a source of innovation is considered to be critical for the competitiveness of port organizations. In this sense, for the production of this study, a survey of publications was carried out aiming to identify, in the world production, the initiatives of the port sector, notably the Port Authorities of public control, about the governance practices with reflections for innovations in the sector.

The main objective of the research was to prospect the state of the art in the management of innovation and port governance in order to identify models and practices in different ports around the world. As a research problem, the question was raised about which models of management of innovation and port governance are being applied in different ports around the world and what are their main indicators.

With the need to understand how such models have been applied in ports worldwide, literature was searched based on international bases, in order to understand the phenomenon in the macro sectors (public and port) and locate it more specifically in port organizations.

Thus, the various experiences observed in the literature in relation to innovation initiatives and port governance practices are brought up. The research bases used provided elements for the elaboration of graphs and tables for a better understanding of the context of scientific production in the area.

As a way of analyzing the activity of a sector, the construction and application of scientific production indicators to support new research has traditionally been used. This movement, supported by scientific production, contributes to the understanding of phenomena and analysis of the stage of innovations and aspects related to science, technology and competitiveness. Among the advantages of scientific production indicators is their use by national and international agencies aimed at promoting scientific and technological research, application within the scope of public policies and facilitating access to methodologies and resources electronically (FARIA et al., 2011).

Next, the methodological path for the preparation of this study will be presented, as well as the graphical representations and analyzes of the selected scientific production and the patent base, in order to describe the various innovation initiatives in ports around the world.

2 Methodology

This research has a qualitative, exploratory and bibliographic nature, in which a survey of publications available in international databases was carried out to carry out the analysis. As an analysis technique, scientometrics combined with literature review was applied, in order to locate the state of the art about research in port innovation management and to verify the models presented in scientific articles. Lianou

and Ftchenaks (2020, p. 2) refer to scientometric articles as a "measurement study and analysis of the scientific literature" and, through previous research, it is possible to produce new data, while the review articles discuss this research and expert opinions.

For the exploratory study, the international scientific bases Scopus and Web of Science (WoS) were used, whose choice, in detriment of other available options, was due to their multidisciplinary and international scope, being able to understand the phenomenon studied in the different port contexts of the world.

The search strategy was defined in order to verify governance practices that support port innovation, this study being a fundamental step for understanding the state of the art, supporting future analyzes concerning the port governance model. The first search was carried out in both databases with the term "port innovation management", which achieved the following results: for the Web of Science database, 149 results were obtained, published from 1993 to 2020, with 88 articles, of which only 35 were open access; for the Scopus database, 271 documents published from 1976 to 2020 were identified, with 110 articles, of which only 29 were open access. For a comparative analysis between the bases, the period from 2011 to 2020 was considered. The time frame is based on the approximate period in which new adjustments in port public policies around the world occurred, aiming at greater efficiency and modernization of the port sector, as discussed the studies by Baltazar and Brooks (2017). The patent database of the National Institute of Industrial Property – INPI was also used as a search source, using the terms "port or port", obtaining 16 results. For data processing and organization, the result for the year 1976 was excluded, as there was no information on the country of origin of the patent.

As a criterion for selecting articles, those that did not include in their title or abstract any mention of the terms "port" and similar, "innovation" were excluded, and this exclusion aimed at selecting literature with a specific focus on the port sector. Likewise, the inclusion criterion considered the articles that presented one of these terms, regardless of whether the port operates in the public or private sector. After this selection step, the content of the abstracts was evaluated and, in sequence, the content of the full document when it presented adherence to the study theme.

The results obtained in the two databases were compared to avoid duplication, having selected 25 publications that make up the analyzes of this study. From the exclusion, other publications were used in the sample, which served as a conceptual basis for discussion only those that focused on proposals, models or analyzes of works in the area of port innovation management. The methodologies used and the degree of development of the studies were observed, in order to locate the level of maturity of the sector in relation to the theme and to discuss new possibilities for advances in the area.

## 3 Global Time Evolution of Port Patent Deposits

For the organization of information in Graph 1, below, the INPI patent base was used, the main objective of using this base was to relate the production of knowledge in port innovations and the technologies produced and protected by the sector. In the search for filed port patents, there is a small number, especially considering the time frame presented in the search results (1976-2017), with only sixteen patents distributed among seven countries, among which Brazil had six patents. For the graph below, only those that contained identification of the country of origin were considered.

Graph 1 – Port Patents Deposit (Country x Year)
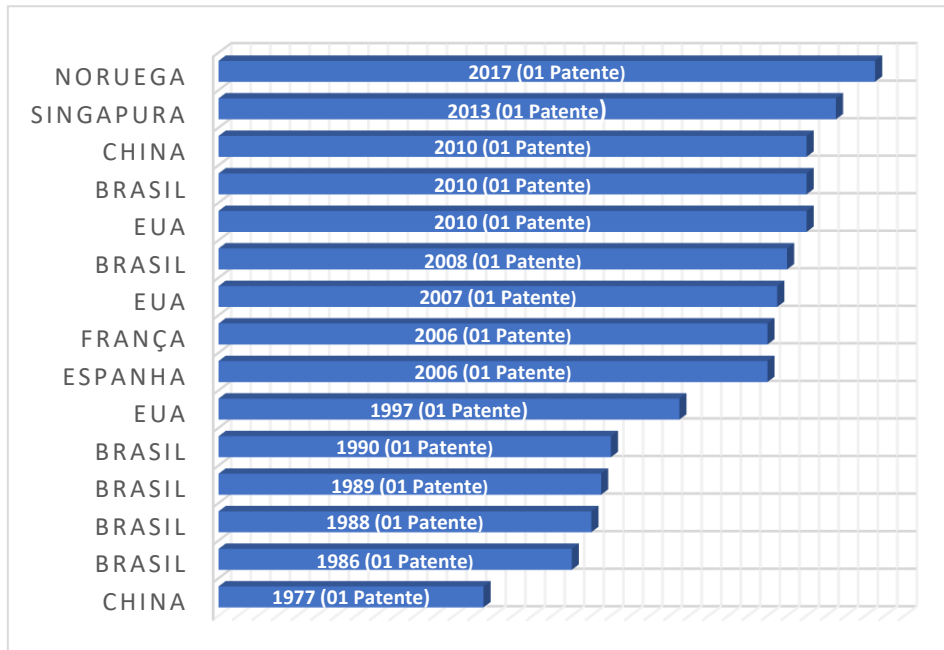
Source: Prepared from the INPI patent database (2021)

Graph 2 – Percentage of Port Patents by Country
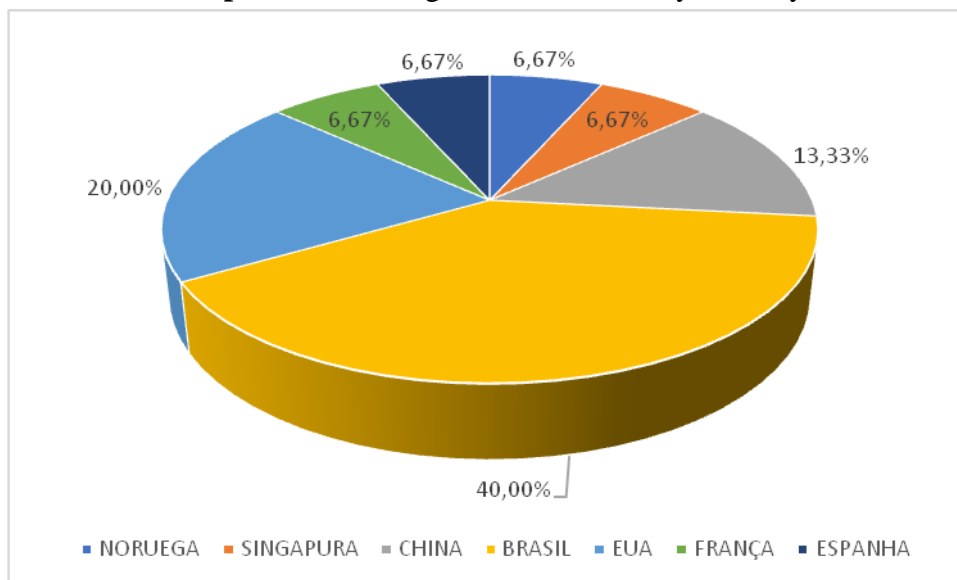
Source: Prepared from the INPI patent database (2021)

In the comparison of the charts above for port patents, Brazil led the number of deposits. However, considering the global scenario, in a 40-year time frame, only 15 filed port patents suggest a limited scenario of technological innovations in the sector worldwide, although it cannot be said that other factors such as the absence of Technological production is associated with the port strategy, or even difficulties in formulating orders, which may also impact these indicators.

Next, surveys will be presented in relation to world academic/scientific production on port innovation, which reveal challenges to be overcome by the sector to foster innovation processes.

3.1 Comparisons of Productions in the Area between the Web of Science (WoS) and Scopus Databases

In the last ten years, the world production of publications related to port innovations has as main names the authors highlighted in Graph 3, below. The result of the analysis of the bases can be seen in the publications selected for the theoretical framework regarding innovation and management of port innovation.

**Graph 3** - Number of publications and related authors
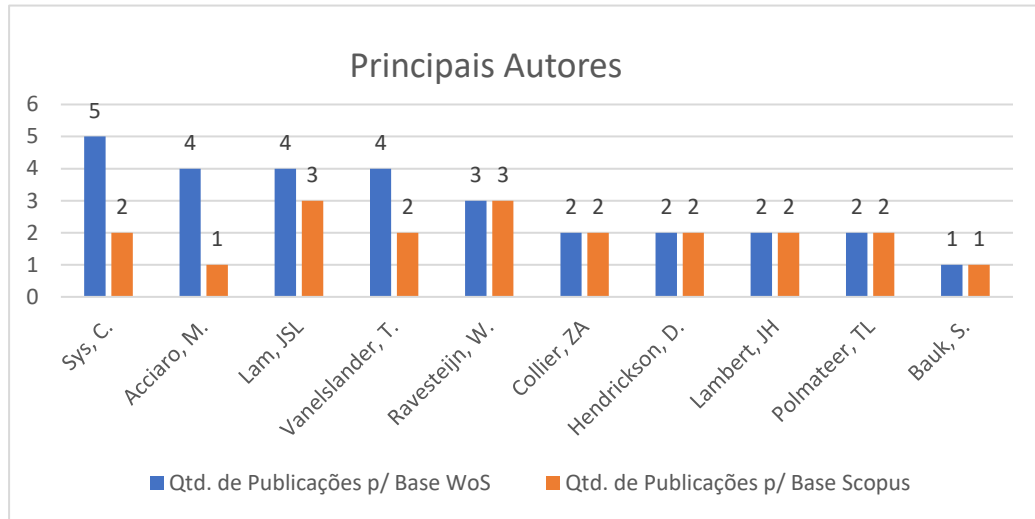
Source: Own elaboration (2021)

In this article, publications were used in which the researchers listed below figured as main authors or co-authors: Christa Sys (2018), Michele Acciaro (2018, 2019), Tierry Vanelslander (2019) and Sanja Bauk (2019). It is noteworthy that in the publications used, the article in which Michele Acciaro is the main author, appear as co-authors Christa Sys and Tierry Vanelslander, as well as the article by Tierry Vanelslander has as co-authors Christa Sys and Michele Acciaro. Thus, the same publication can be counted for more than one author, considering the co-authored works.

For both databases used, the leadership in number of publications is with the United States, Italy and China, occupying the first three positions, as shown in Graph 4 below. Brazil is among the twelve countries in the number of publications, revealing a gap in the field of research on port innovation in the country.

Graph 4 - Record Count by Country
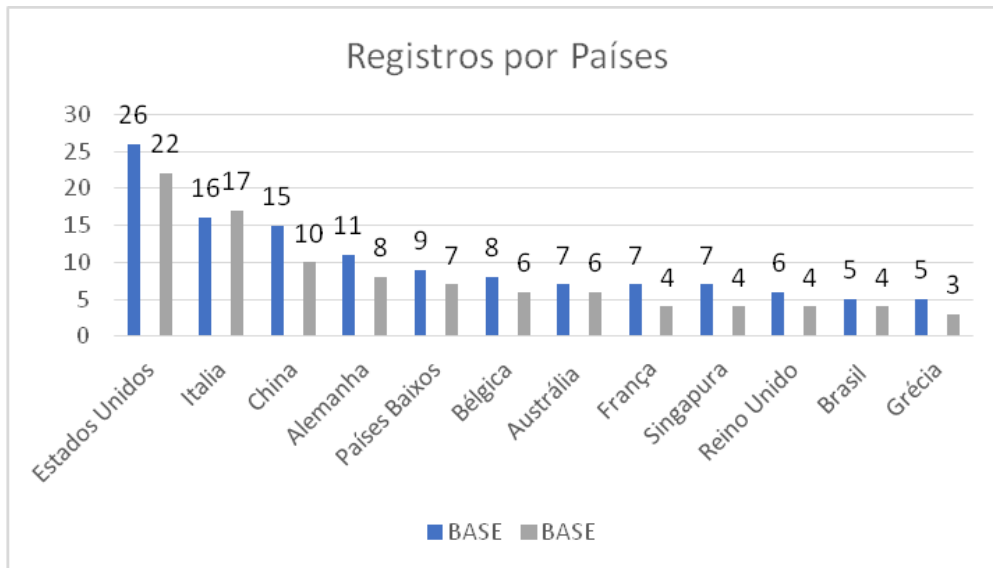
Source: Own elaboration (2021)

As can be seen, Brazilian production in the area is still small in the number of publications indexed in the databases used. With regard to Brazilian funding agencies, the list of world leaders includes the Foundation for Research Support of the State of São Paulo (FAPESP) and the National Council for Scientific and Technological Development (CNPq).

The National Natural Science Foundation, an agency of Chinese origin, stands out among the funding agencies for projects related to port innovation.

Graph 5 - Count of Records by Funding Agency
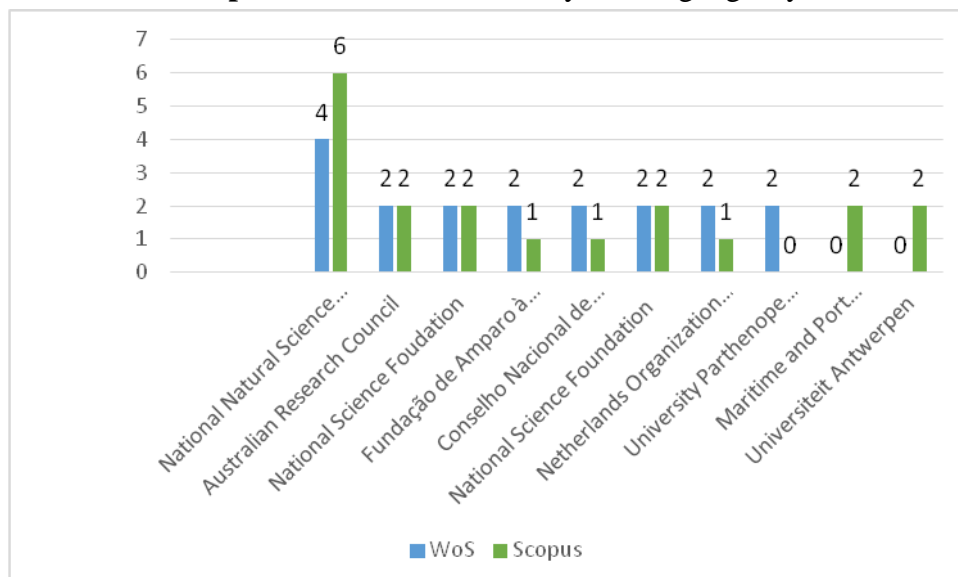
Fonte: Elaboração própria (2021)

The Brazilian performance in relation to the different areas of knowledge has been harmed by the gradual fall in investments in scientific and technological research, especially from 2013, according to a publication by the Institute for Applied Economic Research – IPEA (DE NEGRI, 2021). Due to the economic recession,

Brazil still suffers from cuts in investments in Research and Development (R&D), thus reducing the rate of innovation (DE NEGRI, 2020). The latest Innovation Survey - PINTEC 2017- released by the Brazilian Institute of Geography and Statistics (IBGE, 2020), reveals the drop in Brazilian government support for innovation.

"The 2015-2017 triennium recorded 26.2% in the proportion of innovative companies benefiting from some type of support for innovation, which indicates a sharp drop in relation to the 2009-2011 and 2012-2014 trienniums, when 34.2% and 39.9%, respectively" (IBGE, 2020, p. 3).

Also in relation to Brazilian production, Table 1 below shows the authors present in the records found in the databases used.

Table 1 – Brazilian Authors by Base

| **Brazilian Authors by Base**	**BASE**	
	WoS	_SCOPUS_
Moura, de D. A.; Andrade, de D. G. (2018)	X	
Gasalla, M. A.; Gandini, F. C. (2016)	X	X
Gonçalves, L. R; Fidelman, P.; Turra, A.; Young, O. (2020)	X	X
Vieira, G. B. B.; Neto, F. J. K.; Amaral, F. G. (2014)	X	

Source: Own elaboration (2021)

The work by Moura and Andrade (2018) was carried out at the port of Santos and focuses on innovations (technologies and methods) to improve environmental performance with the reduction of polluting gases and other environmental priorities. Gasalla and Gandini (2016) discuss the impacts of various activities, including port activities, on fishing activities in coastal areas in the State of São Paulo and possible social innovations in the legal field and public policies to better organize coastal activity and management, however, it does not provide contributions to port governance.In the research developed by Gonçalves, Fidelman, Turra and Young (2020), in general terms, it deals with the dynamic relationship between different institutions that make up the São Paulo Macro-Metropolitan Region, demonstrating the complex and necessary relationship between the different institutions that make up the system, including those responsible for maritime transport. Governance is characterized by being multilevel and involving federal, state, regional and local agents. Of the works by selected Brazilian authors, the one that made the greatest contribution to the discussions in this research was that of Vieira, Neto and Amaral (2014), as they carried out a systematic review of port governance models and their relationship with port performance.

3.2 Innovation Management, Transfer of know-how and Governance in the maritime-port scope

The research by Vieira, Neto and Amaral (2014) focused mainly on port clusters, more specifically on maritime transport and containerized cargo handling, through the analysis of published literature from 1992 to 2013. As a result, the research concluded that the studies on port governance showed a predominance of the qualitative approach and are consistent with other systematic research cited in the study and developed by Woo et al. (2011), in addition to being mostly developed for the treatment of specific cases with little general application. Furthermore, it was not possible to verify in the selected works the relationship

between the governance model and port performance. However, what is proposed in this study is to discuss the state of the art of innovation management and port governance in order to identify models and practices in different ports at a global level. In the searches carried out for this study, the results showed, in general, increasing numbers each year for research in the area of innovation, containing port governance practices. These works strengthen the conceptual framework and contribute to the improvement of analyzes in new studies, in addition to being an alternative to support managers in applying these models to their organizations. Graph 6 shows this evolution for the period of the last ten years (2011-2020):

Graph 6 – *Evolution of Publication of Articles on Innovation and Port Governance in the Period from 2011 to 2020*
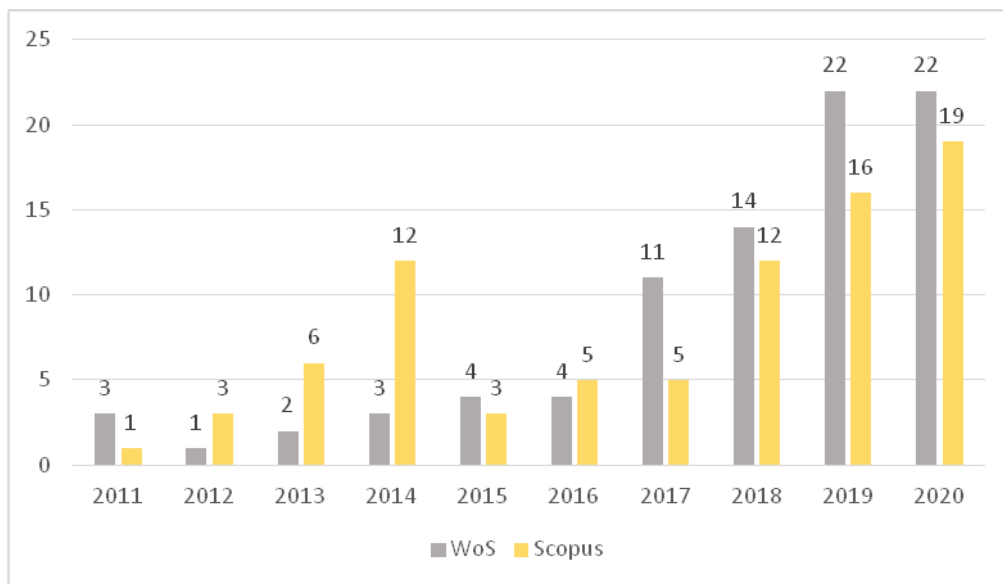
Source: Own elaboration (2021)

Even in face of the noticeable evolution of scientific production regarding port innovation, there is a small number of publications in the world context, considering the searches in the international databases used, and this performance is not clear to the academic community. Vanelslander et al. (2019) registers some possibilities, but which cannot necessarily define this trend with precision, namely: (i) limited involvement of the scientific community or port organizations; or (i) if the limited number of studies is not representative of the actual volume of innovation in the sector.

Given the possibilities raised in the work by Vanelslander et al. (2019), some possible questions were listed regarding the low expression of the production of port research and that can contribute to future investigations.

- Are there strategic reasons why the ports do not show their innovations?

- Would the low degree of relationship between port organizations and educational and research institutions be a representative factor for the low production?

- What is the degree of use of existing scientific research in the port area to improve the governance of these organizations?

The disquiet of Vanelslander et al. (2019) resulted in a robust study analyzing 75 port innovation initiatives, contained in studies published from 2011 to 2018. A typology of port innovation was proposed in five

dimensions by Vanelslander et al. (2019), given the complex and multiple nature of the port sector: 1) Background for innovation; 2) Openness of innovation; 3) Actors involved; 4) Magnitude of impact; and 5) Source of innovation. Table 2 presents these dimensions and their indicators.

Table 2 – Dimensions of port innovation

Dimension	Indicator
1- Innovation Background	It's about what the motivation to innovate is.
2 - Opening of innovation	Relationship between information, process and result, which can be linked to an open or closed innovation.
3- Involved actors	Number and type of actors directly involved in the decision process.
4- Impact magnitude	Impact Size/Scoring: Incremental, Modular or Radical.
5- Innovation source	Private Commercial Innovation; Public Innovation.

Source: Adapted by the authors from Vanelslander et al. (2019).

The typology proposed in the table above provides objective elements to scale port innovation. Based on these dimensions, other associations can be made, such as the relationship with indicators and governance models. In the work developed by Córdova, Duran and Palominos (2019), for example, the association of dimensions used in the Balanced Scorecard with the SWOT analysis (Strengths, Weaknesses, Opportunities and Threats) is verified.

It was observed that few initiatives related to port innovation, in the cases studied, are the result of a collaboration process, either between the agents that are part of the port cluster or through the relationship with teaching and research institutions, or even public-private partnerships. Most of them involve technological, managerial, organizational and cultural aspects, which are associated with the flow of cargo and information technology and correspond to incremental initiatives. The largest is in the private sphere and even its level of sharing is, understandably, closed, as information from tools that guarantee a competitive advantage can be used by potential competitors.

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Authors Córdova, Duran, and Palominos (2019) suggest that coinnovation is a positive path for the

maritime and port environment, which is understood in the study as the innovation that emerges from cooperative action among various industry actors.

Bauk et al. (2019) present a case study of the Port of Bar in Montenegro, Southwest Adriatic Sea and discuss port security, proposing a vehicular communication model to improve procedures involving equipment operators, vehicles, and workers during container handling. Some classifications of innovations are brought: public (promoting well-being); services (improving the level of performance); technological (developing technical applications); sustainable (improving the company's competitive performance); responsible (creating innovation networks). One of the conclusions presented by the study is that the culture of innovation should be encouraged on an ongoing basis in order to form collaborative networks with the aim of generating innovations specific to seaports.

In a case study on the Port of Rotterdam, the largest seaport in Europe, Huck, Liedtke, and Witte (2018) related competitiveness and sustainability and its integration into innovation ecosystems, in addition to its investment in startups. The study highlights the importance of there being cooperation between the Port and the Government, so that both business and society, especially the local community, benefit from the actions of the port complex (HUCK; LIEDTKE; WITTE, 2018).

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Thus, what is sought is for port development to be aligned with urban development. And, in this particular, the study highlights the performance of the Port Authority of Rotterdam to promote the management of innovation in the port and integrate different agents that cooperate so that everyone benefits; society, government, companies, and the Port Authority itself.

Lii, Su and Ye (2016) highlight the importance of innovation in port services, especially, when considering the complexity of international ports and the need to be connected to customer demands and the external environment in order to respond to changes and maintain their sustainability. The work was based on the port of Singapore, considering its prominence in the quality of service delivery, when compared to the ports of Shanghai, Hong Kong, Busan and Kaohsiung. A relevant point highlighted is the network

communication, that is, the interconnection between international ports to improve efficiency. Thus, collaborative action is indicated, considering the need for strong logistics chains and the interconnection between the local and the global.

A port is, in short, a service provider. Thus, innovation activities must reflect in the deliveries, that is, they must generate value to the final client. Port innovation, then, involves both internal aspects of the organization (training people, process improvement, organizational structure) and external aspects (collaboration networks, environmental changes). The process is gradual until it is incorporated into the culture and it is easier to adapt to environmental demands with innovative solutions for the efficient performance of the port (LII; SU; YE, 2016).

The study by Lii, Su, and Ye (2016) considered four main factors for innovation in services, as described in the table below:

Table 3 - Innovation in Port Services

Innovation management and organizational culture	Encourage a culture of innovation among employees, making room for failures to occur as well. In addition, implementing ideas, giving freedom to employees, reduces limitations. Companies with an open culture are more prone to these actions, allowing the exchange of ideas and more innovation actions in services, unlike organizations with poor communication.
Organizational structure and internal processes	Encourage a culture of innovation among employees by making room for failure as well. In addition, implementing ideas by giving employees freedom reduces limitations. Companies with an open culture are more prone to these actions, allowing the exchange of ideas and more innovation actions in services, unlike organizations with poor communication.
The source of service innovation	It is commonly pointed out in studies that innovation in services is generally the result of benchmarking with other companies in the same sector. However, new ideas can be stimulated within the environment itself and generate continuous innovation, generating more autonomy for the business and less dependence on reactive action in the face of competitors' innovations.
The internal and external connections of organizations	Contributing sources for the implementation of innovation are the public inside and outside the company, and it is important to maintain a good relationship with these publics.

Source: Lii, Su e Ye (2016).

The study by Acciaro et al., (2018) had as main objective to understand the conditions, interaction (physical and virtual) between the agents and factors involved in the innovation process and the consequent success of the actions planned for the port sector. That is, the focus of attention is the path of innovation in a broad sense. Nineteen cases were used, such as Antwerp, Genoa, Lisbon, Los Angeles, Piraeus, and Singapore,

involving private companies located in private and public ports in the landlord port system. As methodology, three methods were combined: index I and H (ACCIARO; SYS, 2016); Innovation Systems Analysis (ISS) (ROUMBOUTSOS, 2015; ROUMBOUTSOS; KAPROS; VANELSLANDER, 2014); Qualitative Comparative Analysis (QCA) (VANELSLANDER; SYS; CARLAN, 2016).

Authors Acciarro et al. (2018) record that the maritime and port industries still walk with less proactivity when it comes to innovation when compared to other industries. The innovations observed in ports, are usually linked to innovative solutions brought by logistics providers. In other industries, such as manufacturing, social innovations represent the majority of successful initiatives.

Acciaro et al. (2018) highlight that barriers to innovation in the port sector make technology-related innovations predominant, which is reflected in the literature that mainly looks at aspects concerning environmental performance and/or port congestion. The warning is for the importance of considering cooperation among the various agents for promoting innovation, their interactions and characteristics that can contribute to a successful innovation path (ACCIARO et al., 2018).

The study by Acciaro et al. (2018) also addresses aspects that differentiate innovations: 1) commercial versus welfare improvements, delving only on commercial innovations; 2) classified by the main aspect that characterizes them: technological, organizational, cultural, and managerial. Only one radical innovation initiative was observed, with the presence of incremental and system innovations being significant, and most cases of modular innovations, highlighting that many initiatives are focused on the green port (environmental innovations).

Acciaro et al. (2018) attribute importance of a collaborative performance to generate port innovations, making some recommendations, according to the following table:

Table 4 - Recommendations for Promoting Port Innovations

Port and Stakeholders	Public Politics
Cooperation among cluster members.	Develop a clear system of market rules and promote an environment of fair competition.
Need for a port innovation leader, aiming at coordination.	Promote cooperation within the port community to achieve gains in economies of scale among companies in the cluster, without inhibiting competition.
Independent innovation processes seem to prove less effective.	Knowledge transfer can be relevant sources for innovation processes.
Innovation in the industry is driven, in general, by a clustering between Research and Innovation.	
The innovation process must go beyond the port boundaries, involving markets related to the port environment.	

Source: Prepared from Acciaro et al. (2018).

A prominent element among the authors brought in this article is the importance of fostering collaboration to encourage maritime/port innovation internally in organizations, between the actors of the port cluster,

between the port and government, and international maritime organizations. The latter, aiming at strengthening logistics chains, integrating the local and the global (LII; SU; YE, 2016). Co-innovation should be encouraged considering the need for collaborative networking in the port environment (BAUK et al., 2019; VANELSLANDER et al., 2019). This interaction between the different actors of the port system presents itself as an essential element for innovation in the sector, attributing relevance to research and the involvement of public policies to strengthen the actors without inhibiting competition, as well as promoting knowledge transfer (ACCIARO et al., 2018).

3.2.1 Paths to Innovation in Port Organizations

Considering the limitations found about the discussions related to innovation management in port organizations, based on the Brazilian context, it was necessary to conduct broader searches, which were possible with the use of international databases with publications that allowed the creation of this document. Innovation management presents itself as an area of interdisciplinary application because of its essence; it is not just the application of the disciplines of business and management to the field of innovation, since it has been defining itself as a distinct field of knowledge. The challenge is that research in the area manages to enrich the field in a way that enhances models and enables broader applications, rather than being biased in contemporary fads (TIDD; BESSAN, 2018).

Kitssuda and Quadros (2019) argue that for the organization to orient itself to innovation management, one or more models must be elected to be adopted, in order to define organizational processes, routines, and practices. Innovation will be the result of a formal and planned process.

When discussing innovation and its process in organizations, Drummond (2018) says it is a complex concept, in which there is a difficult consensus even among great executives, and it is often confused simply with invention or creativity. However, more relevant than discussing concepts is to create conditions for the organization to remain sustainable and continue to generate value to customers, in addition to contributing to meeting their needs, especially profitably. In this sense, the author warns that the focus of organizations should not be on their product/service, technology, and other attributes, but should concentrate on knowing the problems that customers want to solve, what tasks/activities they want to perform, and how the company can help them in a profitable way.

Based on Drummond's (2018) approach and bringing it to the port context, when thinking about value generation for the customer, it is relevant that the various agents of the port community are involved in the governance cycle to generate innovations. This is because, for example, the port authority, the Private Use Terminals (TUPs), companies, regulatory agencies, community, and government are members of the port system with mutual relationships in which the performance of one agent reflects in the performance of the other. So, it is important that the performance is collaborative in a win-win perspective. In this collaborative process it is also essential that other agents can be included, such as educational and research institutions.

In the study developed by Ravesteijn, Liu and Yan (2015), a current academic concept about innovation is presented, the so-called responsible innovation, experimented in projects at the port of Rotterdam (Netherlands) and Dalian (China). The work details the technologies used in the projects (e.g. construction of low-carbon infrastructure, use of clean energy in port vehicles), but discusses the involvement of various actors, both internal (organized port companies, internal port sectors, governing bodies) and external to the

port environment (environmental NGOs, government, universities), in order to seek solutions for the economic development of the sector with less environmental impact.

These projects involved the reduction of CO^2 emissions, the use of transport with less environmental impact, prioritizing roads. It was evidenced that there were investments in green areas and clean energy in preference to traditional sources, which resulted in an experience that brought together economic, social and ecological development with society's approval and active participation of various stakeholders from the design of projects to their implementation (RAVESTEIJN; LIU; YAN, 2015).

Considering that environmental issues are increasingly present in the global economic agenda, with social pressure for sustainable business, the challenges of innovation in the business sphere must observe, especially, the relationship of business with society and its effects on the environment.

Port infrastructure projects, especially, generate public debate and protest because they involve not only business objectives (microeconomic), but also socio-environmental (macroeconomic), which is why it is relevant to think about responsible innovation. It is the role of responsible innovation to act with the diversity of interests of different stakeholders and affected parties (RAVESTEIJN; LIU; YAN, 2015). It was observed, then, that responsible innovation in the case studies is aligned with business values (technical; business and economic development; ecological and social).

Lili and Ravesteijn (2015) published an article that is closely related to the work cited in the previous paragraphs (authored by Ravesteijn, Liu, and Yan, 2015), as both address responsible innovation and discuss the case of the port of Rotterdam and a Chinese port. Responsible innovation applied to the Shanghai Yangshan port extension project in China was discussed, taking the Rotterdam Port Maasvlakte 2 project as a basis. The focus was on the search for the alignment of the port's micro and macroeconomic objectives, considering the importance of these structures and the need to make their development compatible with the social aspirations of environmental preservation. The authors point out that most of the studies prior to this publication were based on ex ante analyses, in order to subsidize decision-makers regarding the economic viability of port extension projects. However, considering the dual purpose of ports (economic and social), it is important that studies are developed to evaluate and orient ports to issues related to the environment, biological diversity, community relations, and others.

Especially in a fast-growing economy like China, economic and social interests are divergent and conflicting, and therefore, Lili and Ravesteijn (2015) propose a model of sustainable port development and expand on the concept of responsible port innovation by relating systems, stakeholders, values, and external impacts. Figure 1, below, demonstrates port development as the result of the interaction of four subsystems:

Picture 1 - Components of Sustainable Port Development
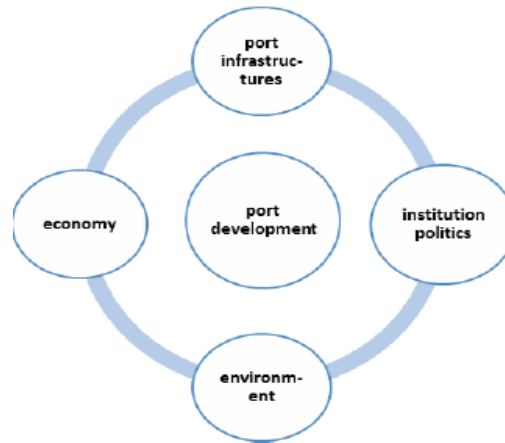
Source: Adapted from Lili and Ravesteijn (2015, p. 301)

The interactions presented in the figure reinforce the view of the complexity of the port system, which is impacted by these four elements. To generate value for its operators in the process of entry (berthing) and exit (unberthing) of ships, it is essential to equip the port with infrastructure for operations, because institutional policies reflect directly on the governance structure and the way the port promotes innovations. The environmental demands require, either by social pressure or legal dictates, an increasingly sustainable performance and the economy reflects in the movement of goods, which is the main reason for the existence of a port.

Sustainable port development is defined by Lili and Ravesteijn (2015, p. 301) as "a balanced set in the fields of infrastructure, economy, port institutions or institutions, policy subsystems, and environment." Several actors must be considered to practice responsible port innovation, with port authorities and government having the most power to intervene.

Through Chart 11, it is possible to observe the different values involved in port development, drawing attention to the importance of carefully analyzing each stakeholder, in order to anticipate existing conflicts and seek to balance interests. This previous evaluation allows development projects to be more fluid and transparent, and reduces the possibility of interruption of their execution due to complaints from some of the parties involved.

Quadro 5 – Partes interessadas e seus valores no desenvolvimento portuário

Interested parts	Values
Government (Local and Central)	Macroeconomic growth in terms of GDP and employment; high tax revenue; growing international trade; strengthening of transport networks; etc.
	Respect for the environment: limited CO2 emissions; low energy consumption; good air and water quality; sustainable ecosystems; etc.
	Social harmony: well-being; social stability; equality; accountability; etc.
Port authority	Rentabilidade: grande quantidade de carga e movimentação de contêineres; serviços portuários diversificados; operações eficientes no porto; etc.
	Accessibility: good intermodality; high connectivity with other modes of

	transport – such as roads, railways and inland waterways; etc.
	Social responsibility: employment for the local community; good air and water quality in the port area; sustainable ecosystems; clean production; etc.
Port Companies	Profitability: high port efficiency; high quality port services; high industrial connectivity in the port and inland; etc.
	Accessibility: good intermodality; high connectivity with other modes of transport such as roads, railways and inland waterways; etc.
Comunidade local (cidadãos, turistas, empresas não portuárias e organizações etc.)	Economia: oportunidades de trabalho interessantes; etc.
	Habitabilidade: boa qualidade do ar e da água; pouco barulho; paisagem atraente para recreação; etc.

Source: Adapted from Lili and Ravesteijn (2015, p. 301).

All of these values presented in the table above related to each interested party allow the port authority to better align its strategies and guide innovation processes to add value to the business, to customers by improving the provision of services and, consequently, meeting their needs, greater financial sustainability and more trustworthy relationships with its stakeholders.

The sustainability aspects brought into the Rotterdam project for responsible innovation were: design (the new port was connected to the sea through the old port); construction (reuse of blocks and quarries and intelligent sand extraction); layout (efficient land use); operation (industry and sustainable distribution; tenders with sustainability criteria with 20% representation in the evaluation of proposals); energy industry and ecological processes; transport (change from road modal to rail and waterways); dialogue with Non-Governmental Organizations (NGOs). Furthermore, according to Lili and Ravesteijn (2015, p. 312).

In general, process management can be used to support and model socio-technological development processes of invention, innovation and diffusion, in which design, monitoring, evaluation and adjustment are essential alongside redesign and co-construction [sic].

In general, the authors demonstrated that responsible innovation, applied to the port environment, involves social cost-benefit analysis, and for the case studied (Yangshan project, in China). convincing, even with proven financial and economic feasibility. Thus, the authors highlighted that it is about:

[...] a new technological and institutional approach to the development and exploration of ports, with the objective of promoting and implementing paths of ecologically and socially sustainable innovation and port operations. Dealing with all the divergent values in the innovation and development processes, it offers an expanding toolkit, with spending methods and stakeholders, design and development. Consequently, responsible innovation is a new and promising factor for port development, in which value creation occurs in the economic and social domain, meeting the present and future demands of all parties involved (LILI; RAVESTEIJN, 2015, p. 313).

Among the limitations of the study, according to Lili and Ravesteijn (2015), is the access to more specific information from the parties involved in the case of China, as it was only possible to analyze the project from the perspective of the Shanghai Port Company and published documents. But it registers that the port development project still needs adjustments to better adapt to the responsible innovation proposal.

Wang et al. (2020) addressed the port environmental issue and, once again, researchers turn to Chinese port cases, such as Ye, Qi and Xu (2020), Ravesteijn, Liu and Yan (2015) and Lili and Ravesteijn (2015), since they are responsible for a considerable volume of movement, especially of containers, which results in high emission of polluting gases. The 11 most important ports in China were analyzed and relationships were made between the movement of cargo and vessels and the consequent emission of pollutants, as well as the environmental policies of local and central governments, and their effects on the economic performance of ports.

Wang et al. (2020) evidenced the dichotomy between port economic development and the reduction of environmental damage. For the maintenance of port business, as well as for the development of port cities itself, there is an interest in attracting the greatest number of cargoes and vessels, often encouraged by local policies. On the other hand, the restrictions established by environmental policies, in some opportunities contrast with local policies and even with the capacity of ports to adapt to the requirements, in addition to representing an increase in costs and a reduction in revenue, such as the restriction on the entry of vessels that do not fit the environmental profile desired by the government and society.

Thus, there is a demand for coordinated and collaborative actions between different social actors, as discussed by Ravesteijn, Liu and Yan (2015) and Lili and Ravesteijn (2015) in their work on responsible innovation in ports. What is extracted from the approach of Wang et al. (2020) is the need for the sum of efforts so that the ports are more viable in carrying out less polluting activities and meeting social concerns and legal restrictions.

Thus, when establishing restrictive policies and legislation, it is also necessary that governments can create opportunities for companies in the port sector to adapt, including credit policies to encourage access to more ecological technologies to reduce pollutant emissions. The idea is of shared responsibility and not just severe restrictions in the legislation that may make its practice unfeasible for some actors in the port chain.

It is also worth reflecting on the extent to which certain restrictive measures in the legislation and some policies will actually be effective. If the penalties and restrictions represent a bearable cost in relation to the gains obtained from the greater movement of cargo in ports, for example, the business may choose to assume such costs and the expected social result will not be generated. Therefore, the relevance of cooperation between the different stakeholders in the port system is highlighted, such as those described in Table 11, as emphasized by Acciaro et al. (2018), Bauk et al. (2019), Lii, Su and Ye (2016) and Vanelslander et al. (2019).

Thus, port organizations are advised to invest in clean technologies, more sustainable vessels, economic incentives and even efficient means of monitoring pollutant emissions that become essential to achieve the objective of reducing the environmental damage of the activity port. Such actions must have the participation of society, government and port authorities, including the entire cluster, as already highlighted.

In addition to the relevance of environmental issues in port development, creating value for stakeholders requires the practice of governance that reflects better efficiency and financial performance. In this sense, some researches approach strategic tools to support port performance analyzes as seen below.

3.3 Strategic Tools for Port Performance Analysis

Córdova, Duran and Palominos (2019) defend in their study the relevance of using the Balanced Scorecard (BSC) to create a sustainable competitive advantage through the creation of knowledge. In the proposed model, the BSC is related to the Cognitive SWOT Matrix, which can be defined as a cognitive strategic map in which the objectives and indicators are projected in the dimensions: customer, processes, learning and growth with application in the port and port community. The model presented is the Knowledge Strategy Management model suitable for complex organizations, considering the influence of the structural, intellectual and social capital of the port community.

Still within the scope of the application of generic models of strategic management, Stavroulakis and Papadimitriou (2017) propose a model of quantitative analysis for the strategic management of maritime clusters, based on the European case. Essentially, the analysis is applied to the SWOT matrix, using the relationship between variables (crosstab) and their conditional probabilities, creating a Markov chain. The Makov chain refers to a particular case of stochastic process, in general, the parameter is temporal and depends on the current state and not on events that precede it.

Considering that the proposed model depends on current scenario calculations for future projections, the main limitation is that it will depend on the rigidity and reliability of the data/information for the initial calculations. Thus, the authors suggest that the model proposed by them be tested based on analysis contingencies of reliability and applicability in factual strategic management scenarios. In this regard, the contribution of research to the aggregation of the innovation process stands out, as defended by Acciaro et al. (2018). Among the actors who work collaboratively for this process, education and research institutions stand out (universities, federal institutes, among others) in support of port innovations, relating to governments and sector organizations.

Lachininskii, Semenova and Anatoly (2016) advocate the use of combined tools to analyze the competitive advantage of Russian ports. Different methods of data analysis, correlation analysis, geospatial tools for calculations and graphs were combined. The Boston Consulting Group (BCG) matrix was also used to divide the ports (leadership, perspective and outsiders) based on the growth rates of sales and market share, however it does not make clear the application of the categorization, with the exception of ports leaders, who have better revenue growth rates and market share. As a limitation of the study, it is observed that the practical model of applied analysis for the Russian case is not clearly presented. It is suitable for regional analysis, as in the case that involved several ports, and can be effective for economic analysis for decision-making also at the governmental level, providing important data and information for public policy makers.

3.3.1 Development of Human Resources and Reflections on Innovation Management

For the effectiveness of applying strategic management tools or other methodologies to structure governance in the port environment, it is essential that human resources are trained to promote the expected improvements.

Turgut and Sökmen (2018) discuss the role of ethical behavior of leaders and organizational values in encouraging innovative work. These aspects are related to self-efficacy, that is, individuals with greater confidence in their values and who find fertile ground to present ideas and solve problems are more capable of bringing innovative solutions to work.

The work was carried out in an important port in Turkey, with a sample of 160 employees. It was observed that individuals who perceived the organization as an ethical place, the occurrence of innovative work was higher. Thus, the recommendation is that the hiring of highly self-efficacious employees be prioritized, in addition to the role of the people management area in monitoring the environment to generate trust and positive perception about the ethical behavior of leaders and managers (TURGUT; SÖKMEN, 2018)

Based on a critical analysis of the literature, Kearney, Harrington, Kelliher (2018) addressed the executive capacity for innovation, based on an Irish port. In the strategic sphere, it was observed that seaports have limitations in relation to innovation. This position is due to the difficulties in responding to environmental changes, mainly due to the lack of execution of business models with a greater focus on sustainability and that allow the integration of intermodal supply chains.

A relevant point in the article is related to innovation management and human resources development. Despite being complex, investments in the development of human capital to promote innovation at its various levels are a fundamental role for executives. This role of human resources involves, then, the managerial capacity for innovation.

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Innovation management is related to the form of strategic involvement of executives with risk and uncertainty, as well as with the environment in which organizations are inserted. More stable environments support more hierarchical business models, while organic (fluid) organizations are better suited to the changing environment. This ability to strategically align the organization to different environments and guide human resources on the path of innovation, allows the management of innovation to be more focused and effective (KEARNEY; HARRINGTON; KELLIHER, 2018).

In developing port innovation management, executives must look at all stakeholders, including the supply chains on which ports depend. The management of relationships with these interested parties can allow more agile organizational forms to be created with the involvement of employees and management to set up new relationships. In addition, it is indicated that the strategic analysis of the business value is under the aegis of the chain and not just a micro perspective of the organization (KEARNEY, HARRINGTON; KELLIHER, 2018).

The authors register the conceptual nature as a limitation of the research, recommending that other analyzes be carried out with the application of quantitative techniques, in order to develop metrics related to the elements of the conceptual structure. They also recommend that, within the scope of technological innovations related to the port sector, topics such as Blockchain development and automation solutions (KEARNEY; HARRINGTON; KELLIHER, 2018) be considered.

From the analysis of several computerized solutions for ports where the main limitation was the difficulty

of integrating information from port processes (micro and macro), a Geospatial Platform was proposed by Oliveira, Santos and Dias (2016). This proposal aims to fill a gap by integrating port information systems in the various domains of activity and decision support, based on quality georeferencing and up-to-date information.

In general, the proposal by Oliveira, Santos and Dias (2016) aims to integrate the areas: Registry and Heritage; Hydrography (dredging and navigable areas); Port traffic; Ownership (licenses and concessions); Studies and Works; Prevention and Security; Environment. The work proved the gap in the port sector for systems capable of integrating business processes in a geo-referenced context. The methodology used in the development of the research is based on an articulation between three fundamental actors: (i) the entity taking the solution, which identifies the requirements; (ii) the science and innovation producer; and (iii) the entity taking the innovation and producing the solution.

The method allows us to confirm the importance of the port environment acting collaboratively with other entities, especially those promoting science and technology, such as universities. The proposal can be the object of evaluation of public policies that encourage these partnerships and promote greater port efficiency through innovation processes, being collaborative with external agents, motivated by ideas from employees or brought from experiences in other ports.

A. Mondragon, C. Mondragon and Coronado (2017) published a study with a methodology that presents a specific approach to port case studies. The article presents a qualitative approach and reflects on the adoption of Information and Communication Technologies (ICTs) in the context of ports. In order to validate the discussion, some organizational theories were used to explain the adoption of ICTs in ports, as shown in the summary table below. The unit of analysis is the port terminal, where seven medium and large terminals in Europe and Asia were analyzed.

Table 6 – Various institutional theories used to explain the adoption of ICTs in ports

THEORY	GOALS
Supply chain acceptance and adoption model (Autry et al., 2010) based on the Technology Acceptance Model (TAM) (Parasuraman, 2000; Teo et al., 2003).	Individual differences, system characteristics, perceived usefulness of the technology and its perceived ease of use.
Diffusion (Hu et al., 1997; Lai et al., 2006)	Based on the assumption that rational adopters make decisions and choices based on information that is received through communication and social networks, but fail to deal with isomorphic institutional processes.
Institutional isomorphism (DiMaggio and Powell, 1983)	A restrictive process that forces one unit in a population to look like other units that face the same environmental conditions.
Main types of institutional isomorphism (Lai et al., 2006; DiMaggio and Powell, 1983)	It bases decisions on three main types: 1. Coercive pressures are exerted on a dependent company by other organizations and by cultural expectations in the society within which the

THEORY	GOALS
	dependent company operates. 2. Mimesis is associated with motivations (eg uncertainty) that encourage imitation of practices. 3. Regulatory firms are subject to norms, standards and expectations in order to achieve effective coordination.
Teoria institucional (Wong *et al.*, 2009b)	The desire to reduce costs or improve efficiency with external entities and for organizational legitimacy represent engines that encourage the institutionalization of ICT development.

Source: A. Mondragon, C. Mondragon and Coronado (2017, p. 74)

It was observed in the study by A. Mondragon, C. Mondragon and Coronado (2017) that, basically, the decision to adopt ICTs is associated with three main groups or clusters: 1) Independent local influence: decision at the local level; 2) Influence of the dominant organization: the main organization imposes adoption by others; 3) Influence of government legislation: model established by legislation and/or government. As benefits to be evaluated in the decision to adopt ICTs, the tracking of operations, interoperability and connectivity in terminal operations in a multimodal network are mentioned.

Some regions still have a low level of technological development with regard to informational technologies applied to the port sector. Alfaro, Choe and Le (2017) present the case of Central America and the action plan for the adoption of some systems, such as Community Port Systems (PCS) and Simple Port Windows (PSW), highlighting the importance of public policies in implementing partnerships public-private.

Information systems of international standards, which allow for better management of the port system, must be high-level priorities for public policy makers in Central America, with the objective of overcoming low productivity when there is no management through the connectivity of logistical chains. In addition, actions to overcome low productivity related to infrastructure aspects related to land management, connectivity of port logistics chains, port-city relationship, citizen participation, access, interport services, among others (ALFARO; CHOE; LE, 2017).

As shown, for the analysis of port performance, there are strategic tools to support human resources, which must be qualified to better manage the business. This includes the selection of management measures aimed at promoting and managing port innovations.

3.4 Management Measures to Support Port Innovations

The research developed by Duran and Cordova (2016) aimed to analyze the strategic environment of a Chilean port community and its synergistic relationships. From the corporate strategies of the different port organizations, advantages can be obtained from the synergistic relationships between them. In particular, in the area of governance, synergy expands the opportunities for obtaining resources, as it allows the coordination of bilateral and multilateral relations, in order to complement resources and increase the possibilities for transformation (DURAN; CORDOVA, 2016).

According to Duran and Cordova (2016), one form of synergy analysis is when two or more actors share one or more multi-criteria (political, economic, social, technological and environmental) in their missions or strategic statements. It is from this intersection that forms of cooperation can be structured. The result of the work of Duran and Cordova (2016) showed that Chile, contrary to world-class ports, mainly develops economic and, partially, technological synergy, without specifying such world-class ports. Strategic innovation actions based on synergy can promote the use of technology for knowledge management in the Port Community.

The research by Duran and Cordova (2016) had limitations as it did not go deep into quantitative analyses, which is a suggestion for continuity of analysis, as well as being carried out in a Chilean medium port with a reduced synergy dynamics in relation to other ports international.

Regarding organizational processes, the study by Elbert, Pontow and Benlian (2017) is limited to the analysis of container movement organizations in relation to their business processes and corresponding information flows. The focus is on transport and transhipment processes and their corresponding information processing activities, in addition to explaining important organizational communication interfaces. The main contribution observed was in relation to the Business Process Management (BPM) tool for process designs and their stages: 1) Process Identification; 2) Discovery of the Process; 3) Process Analysis; 4) Process redesign; 5) Process Implementation; 6) Monitoring and Process Control.

Halunko, Chyzhmar and Kurkova (2018) focus on surveying the main obstacles to technological development in the Ukrainian transport sector and, consequently, in the companies that comprise it. It reveals the low level of service, safety and technological development, which is far from European standards, in addition to environmental consequences. The study proposal ranges from the adoption of more advanced technologies in the transport sector, already applied in other countries, to the review of public policies for innovation and investments in transport infrastructure.

The main contribution of the work by Koliousis et al. (2019) takes place in the theoretical field, considering the analysis of documents related to strategies related to the maritime sector and its academic impact. The article was dedicated to building a sort of literature inventory on strategic management applied to maritime clusters. From the survey and analyzes carried out, it will be possible to carry out further studies and more detailed analyzes to look for similarities and possible discrepancies that may contribute to the elaboration of models for practical application and/or development of new proposals.

It is observed that regardless of the approach of port surveys applied in different countries, each with its governance structure that defines its institutional arrangement in the port system, efforts are being made to promote innovation in the maritime/port sector. But what can be inferred from the literature is that the approaches are geared towards specific cases, and it is important that before adopting models or practices in a given port, the specific case is analyzed.

Based on the observation of Vieira, Neto and Amaral (2014) that port research and, particularly, those dedicated to port governance, some basic questions related to the theme that still need to be answered are incipient: 1) Who governs? 2) What is governed? 3) How is it governed? 4) For what is it governed? Such guiding questions, added to the research already carried out, can encourage new analyzes that provide better application of governance models to the practice of port organizations.

4 Final Considerations

The development of this study was based on the objective of prospecting the state of the art in the management of innovation and port governance, with a view to identifying models and practices in the various ports around the world. The work allowed the identification of several innovation initiatives, however the selected studies do not make it clear whether the innovations result from innovation management processes and/or port governance.

The analysis of scientific production contributed to the identification of gaps related to the generation of knowledge about port innovations and their governance, demonstrating their level of development from the collection and treatment of publications available in the databases used. As the main limitation, which was also brought up in the systematic analysis by Vieira, Neto and Amaral (2014), there are specific case studies that may not be applicable to other contexts, as well as a model of governance or management of the innovation with clear methodology for its application in port organizations.

It was observed, with the analysis carried out in this study, the effort of researchers to deliver analysis methodologies (macro) for the port sector. Thus, it is recommended that these productions be evaluated by governments as sources of analysis and monitoring of public policies, in order to support public governance actions.

From the theoretical analyzes discussed in the researches carried out in this study, some relevant dimensions stand out, but not exhaustive, for the definition and/or proposal of port governance models, mainly in Brazil, due to the low participation in research in the area at a world level. The dimensions considered in this study as essential to support continuous improvement and allow ports to generate value for stakeholders:

- Responsible Governance: highlighting the importance of pursuing innovations to improve environmental performance (RAVESTEIJN, LIU; YAN, 2015; MOURA and ANDRADE, 2018), especially with a view to overcoming the dichotomy between reducing environmental damage caused by port activities and port development (WANG, 2020).

- Qualification of Human Resources (TURGUT and SÖKMEN, 2018; KEAREY et al., 2018).

- Innovation in Port Services: they must be developed based on the demands of customers and the external environment (LII et al., 2016), so as to also overcome the limitation of being an industry (port and maritime) with less proactivity to innovation when compared to other industries (ACCIARO et al., 2018).

- Use of strategic tools: strategic management analysis model for maritime clusters (STAVROULAKIS and PAPADIMITRIOU, 2017), combined use of strategic management tools for analysis of competitive advantage and efficiency between ports (LACHININSKII et al., 2016; BEUREN, 2016).

In this sense, port surveys, after analyzing adherence to each context, can gain practical application in monitoring these policies. And, in addition, they reinforce the university's contribution to governments and their bodies, and the relevance of establishing partnerships that promote interaction between ports, government, companies, universities and research and development institutions. Furthermore, as a suggestion in this study, it is recommended that ports, especially those with a low degree of innovation, are receptive to Open Innovation, having as their main collaborators the teaching and research institutions, in addition to the agents that are part of the port cluster.

The participation of development agencies in port research reflects on the encouragement of scientific production in the sector, in addition to providing more scope for these studies. In the case of China, for example, the volume of production places it among the three main countries in the bases used for this analysis and as the agency that most financed projects in the port area.

The articles analyzed present guidelines that are close to each other when dealing with innovation and its application in the port environment. Considering that the port has different relationships through its internal and external agents, it is recommended that innovation be thought of in a collaborative context, as gains in competitiveness in international maritime trade depend on the coordinated action of different agents (such as governments, companies and port authorities).

It was observed as an element of attention to the development of innovation and, consequently, gains in efficiency, the formation of public-private partnerships, in order to allow the integration between port cluster agents and allow the government's role in the formulation and execution of public policies is leveraged with capital and private expertise. In addition to the aforementioned points, the relationship between the port and the community, commonly called the port-city relationship, must be considered for innovation strategies, since in port activities there is a direct interaction with the community and it is necessary to think about the consequences of sector activities for local development.

With this gap, it is suggested that further research focus on the analysis of port innovation, as a result of management processes and which governance indicators can be applied, mainly, to Brazilian public ports to enhance the alignment between economic and social development. Especially in Brazil, it is significant that these researches are developed, considering that few works were found in the researched databases. The proposition of a governance model with a clear methodology despite its application, as well as for the analysis of the studied contexts, proves to be opportune for use as strategic management tools for public ports.

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