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“TEN YEARS WORKING TOGETHER FOR A SUSTAINABLE FUTURE”

Sustainability Management in Ports

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Abstract

The paper aims to present an analysis of the scientific production on sustainability management in ports. The main objective of the study is to quantitatively analyze what has been produced regarding the management of sustainability in ports and qualitatively examine the evolution of the studies, identifying gaps and research opportunities. Science Direct represented the database. For the data analysis, Microsoft Excel®, Wordle™ e Ucinet® were used. The terms “sustainability management in seaports and ports” were used as key expressions. This generated a sample of 36 papers on the topic. At the end of the study, the outcomes of the descriptive statistics with the identification of the most cited authors, papers and journals by researchers around the world, relationship network of citations and a keyword cloud were presented. Considering the research outcomes, it was observed that the majority of studies on sustainability management in ports has been developed in European ports and there is an exponential growth on studies related to the topic. This implies that journals and researchers have shown a growing interest in further investigate this area. Thus, this study becomes an important asset for the development of ideas, concepts and approach perspectives on the topic.

Keywords: *Sustainability management, ports, performance indicators.*

1 Introduction

The investments related to the port sector should be realized after a study on economic and financial viability, that is, the investment should be associated with profitability studies and the evaluation of environmental impact, since ports are regarded as an extremely polluting industry (LUNKES et al. 2013).

According to new Brazilian legislation, Law 12815/2013, due to high pollution levels coming from this sector, all ports should have an environmental license, which enforces measures to address environmental issues. Vençozzi and Carvalho (2013) state that the environmental performance of a specific region is highly relevant to the competitiveness of companies and its economic development.

In addition to environmental issues, there are problems related to social matters in port organizations. A survey conducted by Soares et al. (2007) showed that 45% of the workers state that they have been to work while intoxicated. More than 40% declared to be chemically dependent.

Considering this situation, it is observed that there is an elevated risk within this work environment that directly affects the life quality in a specific region. It is important to point out that a company that wishes to remain in the market should take care of the social wellbeing.

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Ports present conflicting scenarios between economic, environmental and social aspects. They compose a challenge for society, managers and competent bodies.

It is important to highlight that ports are essential to the economic development of a specific region, which reflects on the economic development of a country. However, this development negatively impacts the environment and life quality in port cities when they are not planned or appropriately managed.

Therefore, ports should have corporate sustainability management in order to achieve an efficient and effective development. Through this management, a strategic planning should be developed and interests of external and internal stakeholders should coincide.

Considering this context, the following question is to be addressed: What are the main characteristics of the research related to environmental management in ports, using bibliometric methods?

Based on this question, the main objective of the study is to evaluate its content and process to add to the knowledge of this specific field. The study focuses on content analysis of a descriptive nature, which is an effective way to supply information on the issues under investigation (TAYLOR; TAYLOR, 2009). Some of the main authors, countries with higher publication numbers, research progress/evolution, influence of geographical location on the network of scientific production authors and ports using more efficient sustainability management plans are presented.

In terms of methodological approach, the study is a systematic review of literature based on network analysis and theory.

This paper is divided in five sections and the Introduction: theoretical foundation (Section 2), methodological procedures (Section 3), results (Section 4), and final considerations and suggestions for further research (Section 5).

2 Theoretical Foundation

According to Secchi (2009), port regions are usually surrounded by a low income population and encompass significant environmental impact. Environmental issues have become meaningful over the last decades, since port regions represent critical scenarios regarding social and environmental issues. These regions constitute a challenge for their inhabitants and port sector managers. These conflicts can only be resolved over the long term, since there is a need to precisely evaluate problems, proposing the installation of technologies and innovation to adjust ports to a new reality.

The majority of Brazilian ports have been operating, as the those located in Santa Catarina, for centuries (KITZMANN; ASMUS, 2006). According to Carvalho (2008), nowadays, there is an obligation to issue some environmental reports such as: Environmental Impact, Environmental Control Plan, Individual Emergency Plan, Environmental Control Reports, among others. These reports can be issued only by companies and they are not used for the corporate management plan, i.e., these controls are not regarded as efficient and sufficient to guarantee the wellbeing of a community. The ports require reliable environmental data and this demands technical expertise; Brazilian universities and research institutes should be involved (LOURENÇO; ASMUS, 2015).

As per Soares et al. (2007), beyond the environmental issues, there are problems related to social aspects, since port regions are surrounded by poverty, prostitution, STDs and drugs. In addition to these problems, there are high volumes of solid and liquid waste pollution, dangerous cargo such as chemical products that may spill at the bay or even onto the soil. This can damage the ecosystem and public health. Within this context, Hall, O'Brien and Woudsma (2013) emphasize the importance of sustainability management in ports. According to the authors, sustainability is the contextual outcome associated with the ecosystem, economic efficiency and social equity. This should be evaluated and implemented in port regions so that a good economic, social and environmental development is obtained.

Patterson (1996) declares that sustainability management as well as energy efficiency management play an important role in the political agenda of the majority of countries, since it is connected to industrial competitiveness and environmental benefits such as reduction of CO₂ emissions. Nevertheless, there is a need to establish operational indicators to measure the development of managerial performance.

3 Methodological Procedures

Pilkington and Meredith (2009) indicate that bibliometric methods aim to investigate size, growth and bibliography distribution in a specific field of research. Cunha (1985) argues that bibliometric research allows the researcher to find a quantity of publications particular to a set subject or content one intends to scientifically investigate.

According to Araújo (2006), bibliometric methods were developed through the definition of empirical laws related to the behavior of the literature in a specific field of knowledge. Bufrem and Prates (2005) state that it is important to evaluate three basic bibliometric laws to improve data analysis: Zipf's Law that measures the frequency of word occurrence; Lotka's Law that deals with the productivity of the authors; and Bradford's Law, which is related to the productivity of journals.

These bibliometric laws employ mathematic analysis and data statistics that seek to investigate and quantify the scientific production on a specific subject. Araújo (2006) comments that citation analysis is a technique that allows the identification of several patterns in the production of scientific knowledge, such as: most cited and more productive authors, research elite and geographical origin.

Richardson (1999) indicates that this type of research aims to present the complexity of a set problem, analyzing the interaction of specific variables. This paper encompasses a qualitative study, since it seeks to analyze and interpret the research on sustainability management in ports.

Table 1 presents the protocol used to define the research sample. It contains information on keywords, research strategy and criteria for inclusion and exclusion of papers in the data analysis.

Research terms	<i>Sustainability management in seaports and ports.</i>
Reading	<i>Title, abstract, introduction, development and conclusion.</i>
Databases	<i>Science Direct.</i>
Exclusion criteria	<i>Sustainability management in maritime transports; sustainability management in airports; sustainability management in the supply chain; sustainability management in cruise ships.</i>
Inclusion criteria	<i>Sustainability management in ports.</i>
Language	<i>English.</i>
Types of publication	<i>Papers and Conference Proceedings.</i>
Period	<i>Up until July 30, 2016.</i>

Tab. 1. Research protocol. Research data.

The sample of papers on sustainability in ports was defined by the choices of database and types of publication, identification of keywords and exclusion criteria. The papers were evaluated through an initial reading of titles and abstracts followed by introduction, theoretical foundation, results and conclusion.

The Science Direct platform was selected as database. This platform was chosen since its search engines include papers published in other databases. Their impact factor is evaluated through the Journal Citation Report (JCR).

The content of Science Direct dates back to 1823. It includes 2500 Elsevier® journals and presents 25% of the worldwide scientific production (SCIENCE DIRECT, 2016).

The data analysis used the expression "sustainability management in seaports and ports". A total of 401 papers were found. Six papers were not available and 33 results were constituted by research notes. They were excluded from the sample. After reading the title of papers, 16 were eliminated. A

total of 232 papers were excluded after reading the abstract. Finally, 78 papers were excluded after reading the introduction, theoretical foundation, results and conclusion. A total of 36 papers were regarded as relevant to the topic.

Papers published in academic journals and conferences were considered. Usually, papers published through these means precede established books. This type of publication is also regarded as safer sources for research, since methodological rigor is present.

The bibliometric analysis of the collected papers was conducted in two stages. First, the descriptive statistics was applied and presented through network analysis. Tables and illustrative graphs generated through Microsoft Excel[®] were used. Second, the most used keywords were represented using the tool Wordle[™], producing a word cloud. Microsoft Excel[®] was used to assemble a matrix of citations from the research sample. The UCINET[®] program was used to code the relationships of the network of citations.

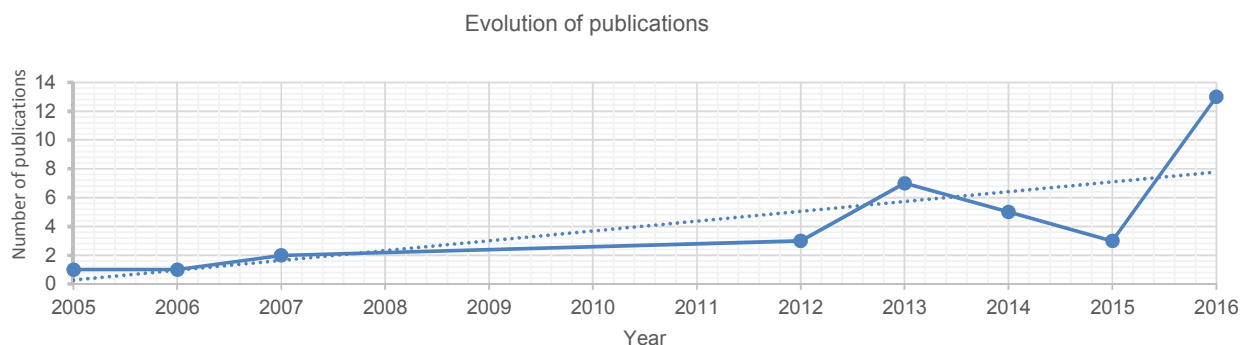
4 Analysis of results

During the first descriptive analysis, growth and decline trends related to the interest in developing studies in the sustainability management area were sought. The papers were classified per year of publication. It was observed that the development of studies on the topic is recent, since the first publication within the research sample dates back to 2005. Peris-Mora et al. (2005) report that over the last few years many environmental disasters have been seen. The maritime transport and ports have contributed to this reality, since they are regarded as the one of the most polluting sectors. Thus, the implementation of environmental management for companies is vital. However, in order to obtain efficient and effective results, sustainability management should be implemented with adequate performance indicators, evaluating social, environmental and economic issues.

It is possible to observe through Graph 1 that the volume of publications has risen in 2012, declining in 2015. In 2016, the publications related to the topic nearly doubled if compared to 2013.

When dealing with sustainability related to ports and port terminals, energy efficiency has been strongly emphasized. This is one of the improvements that should be implemented in ports. In addition, the automation of equipment by renewable energy sources has been cited as an improvement, which may considerably reduce the emission of polluting gases (MARTÍN-SOBERÓN et al. 2014).

Within the same context, Acciora, Ghiara, Cusano (2014) indicate that over the last years the need to monitor and better understand the activities related to sustainability management and energy efficiency management have become more evident in the port industry.



Graph. 1. Evolution of publications in the research sample over time. Research data.

During the second descriptive analysis, the evaluation of the dispersion of studies was made. It aimed to identify main authors, countries of origin of publications and journals (in terms of volume).

The analysis of the sample indicated that only two authors published more than one paper related to the research topic. Dooms, Verbeke and Haezendonck (2013) argue that port activities influence the

long term sustainability of a specific region. Moreover, the authors indicate that port authorities are often responsible for the sustainable strategic planning adopted by the port industry. In their second paper, Doms, Haezendonck and Valaert (2013) conclude that the green portfolio analysis conducted in the European ports influences the economic and environmental performance in the long term.

Langen (2007) also published more than one paper. The author points out that issues related to the development of ports and environmental development of port activities are present in nearly all port locations. However, there is a significant conflict of interest when dealing with sustainability in the industry.

The author reports that in Rotterdam the sustainability has been embedded in the Dutch culture. Because of this emphasis, the Port of Rotterdam aims to enhance both its economic performance and the environmental performance of its activities. Langen and Der Lugt (2007) state that the main Dutch ports operate within the same environment and strongly compete, using the same environmental regulations. This allows them to compete in the international market, emphasizing the importance of sustainable planning to maintain their competitiveness in the internal and external markets.

The stratification of publications includes 21 countries that published on the subject. There is a predominance of publications from Spain, The Netherlands and the United Kingdom.

It is important to point that Brazil published one paper related to the research topic. The authors Kaiser, Bezerra and Castro (2013) argue that the environmental sustainability introduced in the 20th Century is being gradually built since it involves several cultural changes, conflict of interests, political alliances, technology development, and other aspects. Moreover, the authors conclude that the environmental policy related to the coastline of Brazil is developed in a democratic and participative manner, even though there is a high degree of bureaucracy and lack of integration between governmental agencies. Furthermore, environmental laws in the port sector are important to establish environmental objectives and secure sustainable development. It is crucial to underline that the economic development of a country is closely connected to ports. Although environmental concerns are relevant and necessary, it also becomes clear that the bureaucracy, complex processes and utilization of outdated practices represent a hurdle to the development of ports and countries.

Regarding the distribution of papers pertaining to the research sample over a period of time, one can state that the prominent journals are Ocean & Coastal Management, which presented five published papers, the Journal of Cleaner Production with six published papers, the Research in Transportation Economics with six published papers, the Journal of Transport Geography that presented seven published papers and the Research in Transportation Business & Management with seven published papers related to the topic of research.

In the stratification of publications per University, the University of Genoa in Italy presented five publications. It is regarded as one of the largest universities in Italy and is highly ranked among the universities in Europe. This university is also highly ranked in terms of research on the sustainability of companies.

Vrije Universiteit Brussel is another university to stand out with five publications. It is located in Brussels and is classified among the best in Europe. Its main focus is the research in politics, economics and business.

Erasmus University Rotterdam is located in the Netherlands and presented three publications. Erasmus is classified as a first-rank business university in Europe. It promotes investigations and innovative education so that companies can achieve a sustainable future.

An evaluation on the most used keywords was also conducted, since it is a relevant element to be considered in the data analysis. Lunardi, Castro and Monat (2008) argue that word cloud allows the visualization of linguistic data, since its main goal is to present the frequency in which words appear in a set context. Considering the frequency of isolated keywords and more traditional terms which stand out as related to the research topic, Figure 1 presents the resulting word cloud.



Fig. 1. Cloud of most cited keywords within the research sample of papers. Research data.

This analysis contributes to a clearer identification of the interrelationship of main themes. The words “environmental”, “management” and “ports” stood out. This shows that there is a considerable number of studies related to environmental management in ports according to the sample definitions. Peris-Mora et al. (2005) state that the proposal of defining performance indicators related to environmental management in ports has been frequently discussed in order to improve environmental, social and economic sector performance.

Other words such as “sustainability”, “development” and “performance” underline themes related to sustainability, especially if connected to “port” or “ports”. According to Asgari et al. (2015), port authorities are the main organizations for the development of sustainable performance in ports.

Table 2 presents the characteristics of the research sample regarding the content of the selected papers.

Author (Year)	Researched ports	Observations
D. Puente-Rodriguez et al. (2016)	South-East Asian Ports	Evaluate the implementation of environmental management in ports.
E. Peris-Mora et al. (2005)	Shanghai, Singapore, Hong Kong and Shenzhen Ports	Evaluate likely pathways for growth and issues related to port sustainability.
E. Haezendonck, A. Verbeke, C. Coeck (2006)	Dry port in Spain	Investigate the variables that influence the sustainability in dry ports.
F. Iannone (2012)	European Ports	Sustainability management in European ports.
H. Haugstetter, S. Cahoon (2010)	Rotterdam and Barcelona Ports	Strategic reorganization of sustainability.
I. M. Kaiser, B. S. Bezerra, L. I. S. Castro (2013)	Dutch Maritime Ports	Governance structure of port authorities.
I. Vonck, T. Notteboom (2016)	Ports in general	Ports strategy and positioning.
J. M O’Keeffe et. al. (2016)	Maritime Ports of the Southern Region of Italy	The sustainability of maritime ports of the Southern region of Italy.
J. Park, G. Yeo (2012)	79 European Ports	Environmental management in ports.
J. I. Castillo-Manzano et al. (2016)	Europe and Asia Ports	Identify and evaluate the changes of social and environmental regimens.

J. Cerceau et al. (2014)	526 ports worldwide	Implementation of sustainability.
L. M. van der Lugt, S. B. Rodrigues, R. van den Berg (2014)	Ports in general	Green strategies used in ports.
L. Hou, H. Geerlings (2016)	Ports in general	Port resilience.
L. Holmstedt, N. Brandt, K. Rober (2016)	European Ports	Investigate the sustainability communication practices in the port sector.
M. Puig, C. Wooldridge, R. M. Darbra (2014)	Ports in general	Identification and selection of port performance indicators.
M. Dooms, A. Verbeke, E. Haezendonck (2013)	Marseille, Barcelona, Hamburg and Rotterdam Ports	Port sustainability agenda.
M. Dooms, E. Haezendonck, T. Valaert (2013)	Port authorities	Energy management and port sustainability.
M. Acciaro, H. Ghiara, M. I. Cusano (2014)	Dry ports in Spain	Variables that influence port sustainability/authorities.
M. Tichavska, B. Tovar (2015)	Brazilian ports and port authorities	Public and environmental legislation for the development of port management.
N. Asgari et. al. (2015)	Ports in general	Process of environmental management.
N. Mat (2016)	Ports of the United Kingdom	Sustainability performance.
P. Antão et al. (2016)	Antwerp Port	Sustainability pacts and port development.
P. V. Hall, T. O'Brien, C. Woudsma (2013)	Las Palmas Port in Spain	Eco-efficiency in ports.
P. W. de Langen (2007)	Stockholm Royal Seaport in Sweden	Sustainability programs evaluation.
P. W. de Langen, L. M. van der Lug (2007)	Port Kembla in Australia, Tianjin Port in China	Governance and structure of port authorities.
R. Bergqvist, N. Egels-Zandén (2012)	Port of Valencia	Environmental analysis and indicators system.
S. Roh, V. V. Thai, Y. D. Wong (2016)	Ports of Asia	Conceptual model of sustainability.
S. Awad-Núñez, F. Soler-Flores, A. Camarero-Orive (2016)	European ports and port authorities	Environmental performance improvement.
S. Awad-Núñez et al. (2016)	Ports of Ireland	Better international practices.
S. Santos, L. L. Rodrigues, M. C. Branco. (2016)	Port authorities	Role of port authorities and new environmental challenges.
S. Cahoon, H. Pateman, S. Chen (2013)	Spanish port legislation	Review of port legislation.
T. A. Daamen, I. Vries (2013)	Port of Vancouver, British Columbia, and twin ports of Los Angeles and Long Beach, California	Environmental and sustainable agenda.
W. Y. Yap, J. S. Lee Lam (2013)	Port of Shanghai	Sustainability and port development.
W. Cao, M. H. Wong (2015)	Port of Burnie in Tasmania	Regional development model.
X. Seguí et al. (2016)	Ports in general	Port conflicts and interests.
X. Le et al. (2014)	18 ports in North America, Asia, Africa and Northern Europe	Asset management related to damages and interaction between stakeholders.

Tab. 2. Main characteristics of the sample of selected papers. Research data.

It is possible to observe that these studies are closely connected to port sustainability management as well as the need to use sustainability performance indicators in ports. Moreover, there are several studies that address the influence of port authorities regarding sustainability management in ports.

Table 3 identifies the characteristics of sustainability indicators proposed by the researchers.

Authors	Characteristics of proposed indicators
D. Puente-Rodriguez et al. (2016)	Air quality; water quality; energy consumption; port noise.
M. Puig et al. (2015)	Water quality; air quality; soil quality; sediments quality; marine ecosystems; port noise; waste management; emission of greenhouse effect gases; energy consumption; water consumption.
N. Mat et al.(2016)	Socioeconomic and ecological indicators.
P. Antão et al. (2016)	Occupational health; safety indicators; sustainability indicators.
R. Bergqvist et al. (2015)	Qualitative and quantitative indicators; management indicators; operational indicators.

Tab. 3. Indicators of port sustainability management proposed by the authors in the research sample. Research data.

Performance indicators are informational tools so that decisions related to a given situation in an organization can be made (PUENTE-RODRIGUES et al. 2016). Within the same context, Puig, Wooldridge and Darbra (2014) state that European ports are encouraged to monitor and report their performance through sustainability indicators, addressing energy efficiency, social issues in local communities and port economic development.

European ports have progressively emphasized the utilization of sustainability performance indicators over the last few years aiming to guarantee their excellence at a global level (PUIG et al. 2015).

Antão et al. (2016) underline that the cost reduction and risks of environmental protection should be evaluated along with health, safety and environment. These are vital elements that should be thoroughly considered in port management.

According to Acciaro, Ghiara and Cusano (2014), the use of performance indicators related to the environmental management in ports has contributed to the reduction of emissions of greenhouse effect gases (e.g. Ports of Gothenburg, Genoa and Hamburg). These ports monitor the emission of pollutants through the utilization of renewable energy sources.

Mat et al. (2016) declares that a vital indicator to evaluate port sustainability is measuring energy efficiency, since it is possible to evaluate CO₂ emissions, using this indicator.

Recently, the need to use sustainability systems in companies has emerged; many maritime ports all around the world have started using sustainability management systems (PARK; YEO, 2012).

According to Peris-Mora et al. (2005), the Foundation European pour l'Education Environmental (FEEE) supported by the European Commission developed in 1987 the Blue Flag Project, which deals with the implementation of environmental and ecological management in marinas and beaches. In 1994, the Environmental Conduct Code for Industrial Ports was created and developed by the Sea Ports Organization. Within this same context, the port authorities of Amsterdam developed the Project Eco Information and the Port of Rotterdam initiated the Green Port Project, which is regarded as a complex system (PARK; YEO, 2012). Lange (2007) declares that the sustainability management in Rotterdam is deeply rooted in the Dutch Tradition of creating consensus among stakeholders. The same happens in the Port of Gothenburg in the West of Sweden. The collaboration among stakeholders is regarded as the key to the success of developing activities in a sustainable manner (O'KEEFFE, 2016).

In 1998, the Valencia Port Authority established a sustainability project in which the port industry should develop an Environmental Management System. Over the last decades, environmental disasters in the port industry have been regarded as the greatest causes behind environmental degradation. Because of these issues, the implementation of ISO 14001 has been considered as a prerequisite for the port industry (PERIS-MORA et al. 2005).

A study on the ranking of sustainability of the ports in the United Kingdom reports that they have made efforts to prevent environmental issues, improving the Environmental System Management through ISO 14001 certification (ASGARI et al. 2015). Haezendonck, Verbeke and Coek (2006) state that the port authority of New York in New Jersey approved a sustainability policy whose main goal is to minimize the risks in its facilities regarding climatic changes. Similarly, in the Port of Australia a sustainability project was developed, emphasizing climate change (O'KEEFFE 2016).

According to Langen (2007), the majority of ports uses some type of sustainability system. Gilman (2003) discusses the conflict of interests and port development of the United Kingdom, which is influenced by national policies of sustainability. These conflicts may lead to delays in the expansion of port projects regarding sustainability management.

Langen (2007) points out that the conflict of interests are: a) environmental protection versus port development; b) urban development versus port development; c) working conditions versus port development; d) the interests of residents in the region versus port development; and e) global economic development versus port development. The author argues that conflicts referring to environmental/sustainable protection are found in every port.

Iannone (2012) concludes that the lack of clear and effective policies regarding port sustainability management affects companies and threatens their development. This hurdle makes them inefficient and less competitive while facing a global market. The author underlines the importance of using adequate public policies to achieve economic, social and environmental benefits in the port industry.

Cerceau et al. (2014) state that ports constitute an area of high depletion of natural resources where the emission of pollutants are extremely high. Thus, the port industry faces a significant challenge regarding the utilization of sustainability management. Acciora, Ghiara and Cusano (2014) argues that the port industry is considered a sector that presents a high level of pollution. It requires the use of a proper sustainability management system to address environmental, economic and social concerns and optimize operations in terms of cost versus benefits.

According to O'Keeffe et al. (2016), ports are vital to the development of a country. Nonetheless, a few actions are being taken regarding climate change. Moreover, there is a need to develop global policies to be evaluated and implemented by port managers.

In spite of the growing importance of port sustainability management, the literature on eco-ports is still insufficient. The majority of studies is related to improvements in the port industry management and just a few studies are associated with a diagnosis on port conditions, evaluating the level of water and air pollution.

This issue is due to the lack of knowledge to be applied in the quantitative and qualitative calculations. In addition, there is no sufficient secondary data to allow this evaluation (PARK; YEO, 2012).

A relationship network between papers within the sample and their references was developed to identify their theoretical basis. The result of this first analysis is shown in Figure 2.

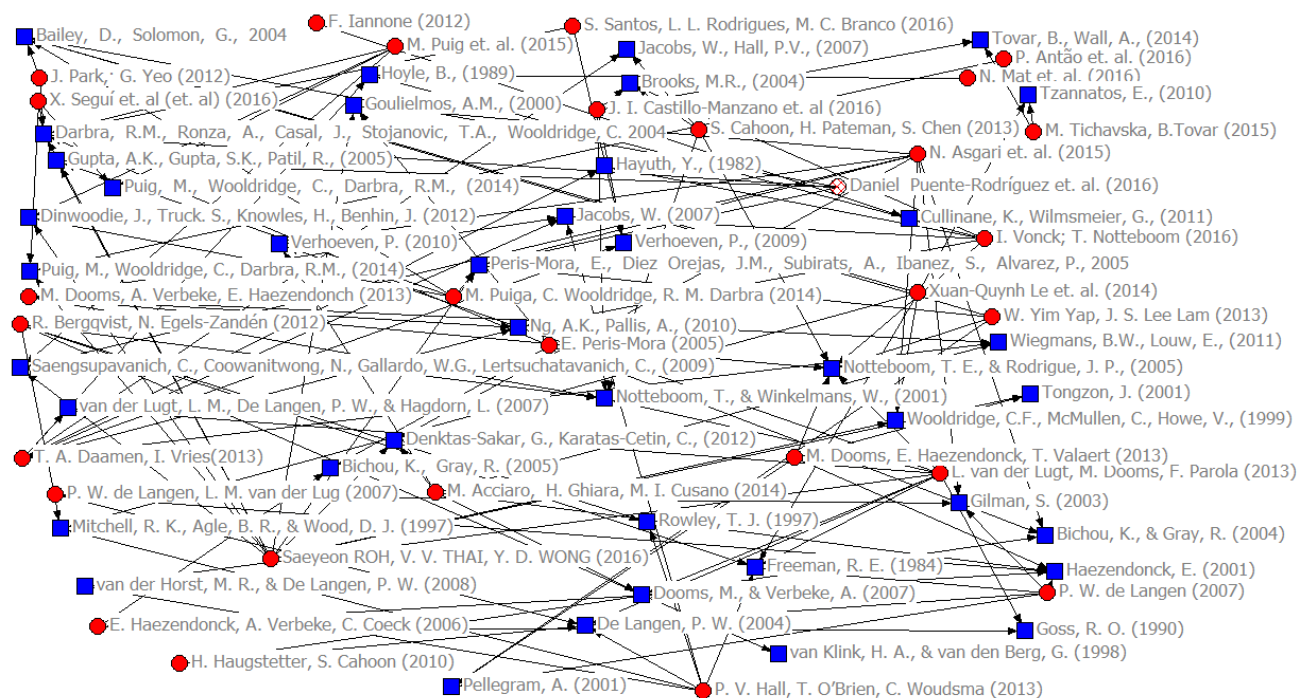


Fig. 2. Citation network among papers in the sample and their references. Research data.

Note: The circles represent papers from the initial sample and their references; they were cited at least twice.

There is a clear concentration around the reference of the study conducted by Darbra, which was referenced by seven papers. Darbra et al. (2004) state that maritime ports encompass very complex systems, which are related to the interference in the marine life, deforestation of coastline vegetation, waste generation, emissions of greenhouse effect gases, risks of accidents with ships and spilling of pollutants into the sea. Moreover, there are expansions in the sector, which imply the loss of environmental resources. These authors indicate that ports are in an environment of great changes, which highlight the continuous need to restructure and reevaluate their strategies. Within the same context, Verhoeven (2009) states that the main strategic changes in European ports are related to environmental, social and ecological issues. The author points out that environmental management in ports is an alternative to maximize port sustainability and minimize environmental risks.

Another reference to stand out in the citation network is Peris-Mora et al. (2005). The authors studied a set of indicators of environmental performance for ports, emphasizing the main environmental impacts through a multicriteria analysis and the ISO 14001 guidelines. The main indicators proposed by Peris-Mora et al. (2005) are: water consumption, waste management, environmental accidents, emissions of greenhouse effect gases, demand, cost and energy consumption, local ecosystem and noise.

Bailey and Solomon (2004) were referenced in five studies within the sample. The authors argue that the transshipment of merchandise and ports that count on a complex infrastructure, including cranes, equipment and trucks with diesel motors releasing Nitrogen and Sulphur Oxide significantly affect the air quality. That is reason why the authors claim that the port industry is a highly polluting sector.

5 Conclusion

After the literature bibliometric review of the 36 papers that deal with the sustainability management in ports, it is possible to infer that this field of knowledge still presents few practical studies, even though there is a prevalence of international publications in terms of volume. It is important to point out that Park and Yeo (2012) report that there is a lack of research on sustainability management in

ports. This issue is due to the lack of knowledge to be applied in quantitative and qualitative calculations. Moreover, there is no sufficient secondary data available to allow this evaluation. Acciuro, Ghiara and Cusano (2014) also indicate the scarcity of studies on the topic, especially when dealing with energy efficiency and reduction of CO₂ emissions.

European ports stand out in terms of using sustainability management. Ports in Spain use wave energy with the purpose to reduce costs and emissions of CO₂. The Ports of Gothenburg, Genoa and Hamburg monitor their emissions of pollutants through the use of renewable energy sources. The Port of Rotterdam aims to enhance both economic and environmental performance in its port activities.

The current study also showed that there are gaps and opportunities for future research. In this sense, the lack of research conducted in Brazil represents an opportunity, since just one study related to the topic and developed in Brazil was found. Europe is leading in terms of volume of publications on the subject. This feature can be explained by the privatization of ports according to Bird (2013).

Furthermore, some themes emerged and opportunities were identified:

- The impact of port authorities regarding the use of sustainability management in ports and current port legislation;
- The development, project mapping and application procedures for the implementation of sustainability management in ports;
- Analysis of investments versus costs versus benefits versus social impacts versus environmental impacts regarding the implementation of sustainability in ports.

Finally, it is possible to conclude that identifying recent empirical findings presented in research studies is related to creating an innovative forum for discussions based on concrete and real elements that have been developed, researched and evaluated. Based on this foundation, it is possible to come up with new research and create new study opportunities.

References

- ACCIOURO, M.; GHIARA, H.; CUSANO, M.I., 2014. Energy management in seaports: A new role for port authorities. *Energy Policy*. 71, 4–12.
- ANTÃO, P. et. al., 2016. Identification of Occupational Health, Safety, Security (OHSS) and Environmental Performance Indicators in port áreas. *Safety Science*. 85, 266–275.
- ASGARI, N. et. al., 2015. Sustainability ranking of the UK major ports: Methodology and case study. *Transportation Research*. 78, 19–39.
- ARAÚJO, C. A., 2006. Bibliometria: evolução história e questões atuais. *Em Questão, Porto Alegre*. 12, 11-32.
- BAILEY, D.; SOLOMON, G., 2004. Pollution prevention at ports: clearing the air. *Environ. Impact Assess*. 24, 749–774.
- BUFREM, L.; PRATES, Y., 2005. O saber científico registrado e as práticas de mensuração da informação. *Ciencia da Informação*. 34, 9-25.
- BAIRD, A. J., 2013. *Acquisition of UK ports by private equity funds*. *Research in Transportation Business & Management*. 8, 158–165.
- CARVALHO, S. D., 2008. Processo de licenciamento ambiental de pólos geradores de viagens: o caso portuário. Dissertação de mestrado do Instituto Militar de Engenharia – IME. Rio de Janeiro.

- CERCEAU, J. et. al., 2014. Implementing industrial ecology in port cities: international overview of case studies and cross-case analysis. *Journal of Cleaner Production*. 74, 1-16.
- CUNHA, M. V., 1985. Os periódicos em ciência da informação: uma análise bibliométrica. *Ciência e Informação*, Brasília. 14, 37-45.
- DARBRA, R.M. et.al., 2004. The Sef diagnosis method: a new methodology to assess environmental management in sea ports. *Mar. Pollut. Bull.* 48, 420-428.
- DOOMS, M.; HAEZENDONCK, E.; VALAERT, T., 2013. Dynamic green portfolio analysis for inland ports: An empirical analysis on Western Europe. *Research in Transportation Business & Management*. 8, 171-185.
- DOOMS, M.; VERBEKE, A.; HAEZENDONCK, E., 2013. Stakeholder management and path dependence in large-scale transport infrastructure development: the port of Antwerp case (1960-2010). *Journal of Transport Geography*. 27, 14-25.
- GILMAN, S., 2003. Sustainability and national policy in UK port development. *Maritime Policy and Management*. 30, 275-285.
- HALL, P.V.; O'BRIEN, T.; WOUDEMA, C., 2013. Environmental innovation and the role of stakeholder collaboration in West Coast. *Research in Transportation Economics*. 42, 87-96.
- HAEZENDONCK, E.; VERBEKE, A.; COECK, C., 2006. Strategic positioning analysis for seaports. *Research in Transportation Economics*. 16, 141-169, ISSN: 0739-8859, 2006.
- IANNONE, F., 2012. The private and social cost efficiency of port hinterland container distribution through a regional logistics system. *Transportation Research Part A*. 46, 1424-1448.
- KAISER, I.M.; BEZERRA, B.S.; CASTRO, L.I.S., 2013. Is the environmental policies procedures a barrier to development of inland navigation and port management? A case of study in Brazil. *Transportation Research Part A*. 47, 78-86. 2013.
- KITZMANN, D.; ASMUS, M., 2006. Gestão ambiental portuária: desafios e possibilidades. *Revista de Administração Pública*. 40, 1041-1060.
- LANGEN, P.W., 2007. Stakeholders, conflicting interests and governance in port cluster. *Research in Transportation Economics*. 17, 457-477. ISSN 0739-8859.
- LANGEN, P. W.. LUGT, L.M., 2007. Governance structures of port authorities in the Netherlands. *Research in Transportation Economics*. 17, 109-137. ISSN 0739-8859.
- LEI Nº 12.815, 2013 – Planalto. Disponível em: <http://www.planalto.gov.br/ccivil_03/_ato2011-2014/2013/Lei/L12815.htm.> Acessado em: 23 de agosto de 2016.
- LOURENÇO, A. V.; ASMUS, M., 2015. Gestão ambiental portuária: fragilidades, desafios e potencialidades no Rio Grande, RS, Brasil. *Revista de Gestão Costeira Integrada*. 15, 223-235
- LUNARDI, M. S.; CASTRO, J. M. F.; MONAT, A. S., 2008. Visualização dos resultados do Yahoo em nuvens de texto: uma aplicação construída a partir de web services. *Info Design Revista Brasileira de Design da Informação*. 5, 21-35.

- LUNKE, R. J. et. al., 2013. Estudo sobre a implantação do orçamento baseado em desempenho na autoridade portuária. *Revista da Administração Pública*. 47, 49-76.
- MARTÍN-SOBERÓN, A.M., 2014. Automation in port container terminals. XI Congreso de Ingeniería del Transporte. 160, 195-204.
- MAT, N.; et. al., 2016. Socio-ecological transitions toward low-carbon port cities: trends changes and adaptation processes in Asia and Europe. *Journal of Cleaner Production*. 114, 362-375.
- PARK, J.; YEO, O., 2012. An evaluation of greenness of major Korean ports: A fuzzy set approach. *The Asian Journal of Shipping and Logistics*. 28, 067-082.
- PATTERSON, M.G., 1996 What is energy efficiency?. *Energy Policy*. 24, 377-390.
- PERIS-MORA, E. et. al., 2015. Development of a system of indicators for sustainable port management. *Marine Pollution Bulletin*. 50, 1649-1660.
- PILKINGTON, A.; MEREDITH, J., 2009. The evolution of the intellectual structure of operation management - 1980 - 2006: a citation/co-citation analysis. *Journal of Operations Management*. 7, 185-202.
- PUENTE-RODRIGUEZ, D., 2016. Knowledge co-production in practice: Enabling environmental management systems for ports through participatory research in the Dutch Wadden Sea. *Environmental Science & Policy*. 55, 456-466.
- PUIG, M. et. al., 2015. Current status and trends of the environmental performance in European ports. *Environmental Science & Policy*. 4, 57-66.
- PUIG, M.; WOOLDRIDGE, C.; DARBRA, R.M., 2014. Identification and selection of Environmental Performance Indicators for sustainable port development. *Marine Pollution Bulletin*. 81, 124-130.
- O'KEEFFE, J. et. al., 2016. Stakeholder awareness of climate adaptation in the comercial seaport sector: A case study from Ireland. *Marine Policy*. <http://dx.doi.org/10.1016/j.marpol.2016.04.044>.
- RICHARDSON, R. J., 1999. *Pesquisa social: métodos e técnicas*. 3. ed. São Paulo: Atlas.
- SCIENCIDIRECT. Disponível em: <<https://www.elsevier.com/solutions/sciencedirect>> Acessado em: 30 de dezembro de 2016.
- SECCHI, B. *A cidade do século XX. Perspectiva*. São Paulo, 2009.
- SOARES, J. F. S.; et. al., 2007. O risco do uso de drogas no trabalho portuário: estudo no extremo sul do Brasil. *Revista de Enfermagem*. 11, 593-598. ISSN 1414-8145.
- TAYLOR, A.; TAYLOR, M., 2009. Operations Management Research : Contemporary Themes, Trends and Potential Future Directions. *International Journal of Operations and Production Management*. 29, 1316-1340.
- VENÇOZZI, T. A.; CARVALHO, A. C., 2013. O licenciamento ambiental nas operações portuárias: estudo de caso aplicado aos operadores do Terminal Portuário Porto Novo, no Porto Organizado de Rio Grande, RS, Brasil. *Revista de Gestão Costeira Integrada*. 13, 343-352.

VERHOEVEN, P., 2009. European ports policy: meeting contemporary governance challenges. *Maritime Policy Manage.* 36, 79–101.