

Research trends in occupational health and social responsibility: A bibliometric analysis

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ABSTRACT

Occupational Health & Safety (OHS) and Corporate Social Responsibility (CSR) are domains of research characterised by a great complexity due to their interdisciplinary nature. Although the interest in Occupational Health & Safety issues in the context of Corporate Social Responsibility has recently increased, more effort is needed to address the complexity of both research areas and to understand the dynamic and implications of their relationship. This research describes and analyses the state of the art in the literature and potential areas for further research regarding OHS and CSR. In total, 289 articles published between 1995 and 2018 related to both CSR and OHS were identified in the most reliable database, Web of Science Core Collection. The publications cover 932 authors, 142 journals, 53 countries or territories and 489 institutions, which include 313 universities in the entire world. We employ bibliometric methods to describe the evolution of publication activity, the most relevant contributors, the methodologies applied as well as the content of the articles in order to examine the main topics and research trends. Moreover, we explore the mapping of bibliographic coupling, co-word analysis of keywords and clusters analysis, which provides maps of knowledge based on data of bibliographic nature. Our study allows us to identify potential avenues for future research that could be meaningful to advance in the consolidation of CSR as an integral framework to support OHS.

1. Introduction

In the last decades, multiple definitions concerning the Corporate Social Responsibility (CSR) concept have been adopted. The World Business Council for Sustainable Development defines it as “the continuing commitment by businesses to behave ethically and contribute to economic development while improving the quality of life of the workforce and their families as well as of the local community and society at large” (Holmes and Watts, 2000). The Guidance on Social Responsibility identifies CSR as “the responsibility of an organization for the impacts that its decisions and activities (products, services and processes) generate on society and the environment through ethical and transparent behaviour that contributes to sustainable development, guaranteeing the health and wellbeing of society, taking into account the expectations of the interested parties, complying with applicable legislation, is put into practice in its relations and is integrated throughout the organization” (ISO, 2010). Furthermore, the European Commission understands CSR as “the integration by companies of social

and environmental concerns in their business operations and in their interaction with their stakeholders on a voluntary basis” (Zwetsloot and Starren, 2004).

Moreover, the concept of sustainable development, strongly linked to the concept of sustainability, comprises economic, social and environmental dimensions (ISO, 2010). Sustainability, however, can be defined as the capacity to maintain a given situation over time without any changes to its condition, which is precisely what the term sustainable development is associated with (Gallopín, 2010). The United Nations defines the concept of sustainable development as the “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”. It constitutes undoubtedly a continuous process of improvement and should not be confused with the concept of sustainability.

In order to know the influence of CSR on firms, it is necessary to understand its evolution. Since the 1950's, CSR has been examined from different perspectives. An increased publication in this discipline can be observed since then (ISO, 2010). In recent years, different studies refer

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to the dynamic (Visagie et al., 2019) and interdisciplinary nature of CSR, consequently CSR has attracted the attention from researchers across distinct disciplines (Lim and Loosemore, 2017).

The discipline Occupational Health & Safety (OHS) takes into account labour practices and aspects related to social, mental and physical workers' wellbeing (Montero et al., 2009; Nagata et al., 2017). According to the International Labour Organization (ILO) and the World Health Organization (WHO), Occupational Health implies "the promotion and maintenance of the highest degree of physical, mental, and social wellbeing of workers in all occupations by preventing departures from health, controlling risks and the adaptation of work to people, and the people to their jobs" (ILO, 2019; WHO, 2019).

The interest in OHS in the context of CSR has increased in recent years. Reports such as the Green Paper of the European Commission "Promoting a European Framework for Corporate Social Responsibility" encourage organizations to fulfill voluntary initiatives to ensure compliance with OHS objectives beyond the legislation (European Commission, 2001). Among the seven main themes taken into consideration by ISO 26000:2010 (ISO, 2010), OHS is concerned with workers' wellbeing and injuries caused by working conditions. In this sense, OHS and CSR are interrelated (Koskela, 2014; Zanko and Dawson, 2012).

Currently, several legal instruments introduced by the ILO and other institutions, such as the European Agency for Safety and Health at work, seek to promote OHS in organizations. According to ILO, workplace accidents are one of the most important causes of death worldwide and every year around 2.8 million workers die from occupational accidents and work-related diseases (Azzi, 2019). One way to avoid accidents in a firm is to employ the principles of CSR. OHS is a key requirement as well as a key area of CSR, whose guidelines fall within the scope of the overall practices enshrined in labour law (Górny, 2017). The wellbeing of workers is one of the main aspects to take into account from a CSR perspective (Montero et al., 2009).

The future of a research field depends on an exhaustive analysis of the past and it must be built on the foundation of previous studies (Benavides Velasco et al., 2013). Consequently, the purpose of this work is to offer an in-depth and critical review and analysis of the literature on CSR and OHS. We examine the evolution, state of the art, trends and potential areas of future research in relation with CSR and OHS by using bibliometric methods and indicators. We analyse a large number of articles contained in the Science Citation Index Expanded and Social Sciences Citation Index compiled by the Institute for Scientific Information (ISI). This research covers the period from 1995 to 2018. VOSviewer software has been applied in order to create knowledge maps based on data of a bibliographic nature to be able to visualise scientific information on a specific research topic (van Eck and Waltman, 2010). These domains of research show great complexity due to their interdisciplinary character. A large number of areas are involved, such as legal, medical, social, environmental, technical or industrial, as well as labour and economic aspects.

One of the earliest bibliometric investigations specifically conducted in the field of occupational health was published in 1992 (McCunney and Harzbecker, 1992). It indicated that occupational medicine journals were 50 times more likely to cite the general medical literature than vice versa. In 1996, an article (Okubo et al., 1996) reported that epidemiology was assuming greater importance for occupational health literature, as the proportion of source items indexed under the term 'epidemiology' had increased over threefold between 1980 and 1990. There are some bibliometric studies related to epidemiology published in occupational health journals (Okubo et al., 1996; Sizaret and Kauffmann, 1997; Soteriades and Falagas, 2006).

At present, it is possible to find recently published bibliometric analysis that deal with occupational health in a global way (Liu et al., 2018; Lopez et al., 2008; Maqueda Blasco et al., 2014; Smith et al., 2008; Sweileh et al., 2015; Vicente-Herrero et al., 2016) and other studies that focus on a specific issue within occupational health such as ergonomics, cardiovascular diseases or psychosocial risks (Belinelli et al., 2017; Pinto

et al., 2018; Pulido Moreno et al., 2015; Smith, 2010; Zheng et al., 2016). When it comes to CSR, very few bibliometric studies have been published (de Bakker et al., 2005; de Sousa de Melo et al., 2017; da Silveira and Petri, 2017).

This work makes a contribution by analysing scientific publications addressing both domains of research CSR and OHS. This study is innovative as it uses a combination of bibliometric techniques and content analysis with an interdisciplinary approach that allows us to explore the integration of both research fields in depth. It is important to analyse this integration since part of the concept of CSR contemplates the safety conditions at work and the wellbeing and satisfaction of employees in their jobs. OHS is taken into account as an important aspect of CSR as it has a great impact on employees, one of the organisations' main stakeholders. It is also very useful in order to measure a company's overall progress in CSR (Segal et al., 2003).

This article is structured as follows. The first section presents the basis of methods used in the research. The second and third sections show the results related to publication activity and content analysis of the CSR and OHS literature. The fourth section performs a co-word analysis and offers an in-depth study of the main topics and potential future trends that have been identified in this literature. The findings are discussed in terms of a description of the evolution in the field. The last section includes the conclusions and proposes further research lines.

2. Methods

We carried out a bibliometric analysis of the journals included in the Web of Science (WoS) Core Collection database, particularly the Science Citation Index Expanded and the Social Sciences Citation Index. WoS was selected as the search engine since it is the most widely accepted and frequently employed database for analysis of scientific publications (van Nunen et al., 2018). Every publication in WoS contains many details, such as the year of publication, authors, authors' affiliations, title, abstract, source journal, subject categories and references.

Bibliometric indicators allow the analysis of scientific activity viewed from different perspectives. There are a wide variety of typologies, according to different aims of evaluation (Gálvez, 2018). A classification might be as follows: (1) indicators of production, visibility, impact and collaboration; and (2) relational indicators (Callon et al., 1995). An alternative classification proposes statistical techniques: (1) one-dimensional indicators, based on univariable statistics that measure just one characteristic of the document published, without taking into account any link between them; and (2) two-dimensional or multidimensional indicators, which simultaneously analyse different characteristics observed in the published documents (van Raan, 2005).

In our work, several bibliometric methods have been used: indicators of publication activity, a co-word technique as an advanced data-analytical method, mapping and clustering techniques as well as other complementary analyses of full-text content.

By applying these indicators, we analyse papers published in different categories of the WoS Core Collection during the period of time between 1995 and 2018. Our study begins in 1995 with the publication of the first article related to both CSR and OHS dimensions. This is the study by Baetz: "Evaluating technical alternatives on basis of sustainability" published in *Journal of Professional Issues in Engineering Education and Practice* (Baetz and Korol, 1995). It highlights the need for engineers to incorporate sustainable development concepts into all aspects of their professional activities.

We also explore the network of collaboration among different countries and institutions through the use of relational indicators. Additionally, we carry out a co-word analysis that allows us to identify the evolution of the literature and potential areas that deserve future research.

The bibliometric analysis presents two main phases. The first consists of general descriptive statistical data and the second one contains a mapping and cluster analysis using VOSviewer software.

The searches in the WoS database, were completed on January 15, 2019, attending to the following equations by topics: (1) “Safety Management AND Sustainability NOT Social Responsibility NOT Occupational Health”, (2) “Safety Management AND Social Responsibility NOT Sustainability NOT Occupational Health”, (3) “Sustainability AND Occupational Health NOT Safety Management NOT Social Responsibility” and (4) “Social Responsibility AND Occupational Health NOT Safety Management NOT Sustainability”. A last equation that included “Sustainability AND Social Responsibility AND Occupational Health AND Safety Management” was also incorporated. In these topic searches, the terms appear in the title, the abstract or in the keywords of the publications.

The documents were classified by the Institute of Scientific Information (ISI) as “Articles”. We only consider articles and not other types of documents because those are the ones which best reflect the production of the original research (Benavides Velasco et al., 2013). Only two of these articles were classified as proceeding papers: “Health and safety policies and work attitudes in Cypriot companies” (Hadjimanolis and Boustras, 2013) and “The policy program improving occupational safety in The Netherlands: An innovate view on occupational safety” (Oh and Sol, 2008).

Following these criteria, we obtained a total of 491 articles in 43 different categories of WoS. Out of this total, we selected those articles in relation with our research subject, rejecting those that were not relevant to the field of study, applying a refinement in order to erase duplicities and wrongs. As a result, we finally obtained 289 articles and 25 different areas of research (see Appendix A), proof of the multidisciplinary nature of the topics researched.

3. Publication activity on CSR and OHS literature: evolution, contributors and methodological issues

3.1. Publication output and growth trend. Evolution of CSR and OHS research

Publication activity is expressed by the number of papers published by a selected unit (journals, institutions, countries, etc.), in a given time (Callon et al., 1986). Indicators of publication activity give us a vision of

the quantitative evolution and the structure of the subject researched (Benavides Velasco et al., 2013) and they allow us to identify the most representative journals, institutions and countries publishing in a discipline. Additionally, we can recognize the topics covered during the study period. In this research, qualitative aspects have been examined such as activity sector, dimension of the study (cross-sectional or longitudinal) or methods applied in different researches (quantitative study, qualitative study, etc.), using worksheet Microsoft Excel®.

In order to study the evolution of literature on CSR and OHS, this section shows the most relevant results of the bibliometric analysis. During the period of study (1995–2018), a total of 142 different journals have published 289 articles. This paper examines the most relevant and productive countries, institutions and authors as well as the relationships between them.

According to the results obtained, the literature on both CSR and OHS has grown in an exponential way in the last several years.

As displayed in Fig. 1, during the 1990s, the publication activity was very low, producing among 1 to 3 articles per year. Nevertheless, there is an increase of publications from 2007 onwards. It could be observed that the evolution presents some peaks in 2009 ($n = 13$) after which a declining trend occurs ($n = 12$ in 2010, $n = 11$ in 2011). During 2012 and 2013 the number of publications is kept constant ($n = 20$), increasing progressively in the last five years with 28 publications in 2015, 29 in 2016, 33 in 2017 and 46 in 2018.

The growth of publications activity in the last few years might suggest the importance that companies attribute to social responsibility policies and to risk prevention at work in order to reduce accidents and professional illnesses. It would be interesting to follow the evolution of this trend.

The most common bibliometric indicator for analysing the activity of publications in a specific area is Price’s law. According to this law, which evaluates the overall growth of scientific publications in a specific field of research, the increase of a research goes through four different phases (Dabi et al., 2016). In the first precursors’ phase, a small body of scientist begins publishing on a new domain. The second phase explains the exponential growth produced due to the fact that a great number of scientists are attracted to the field, although many aspects still have to be explored. In the third phase, a consolidation of the body of knowledge

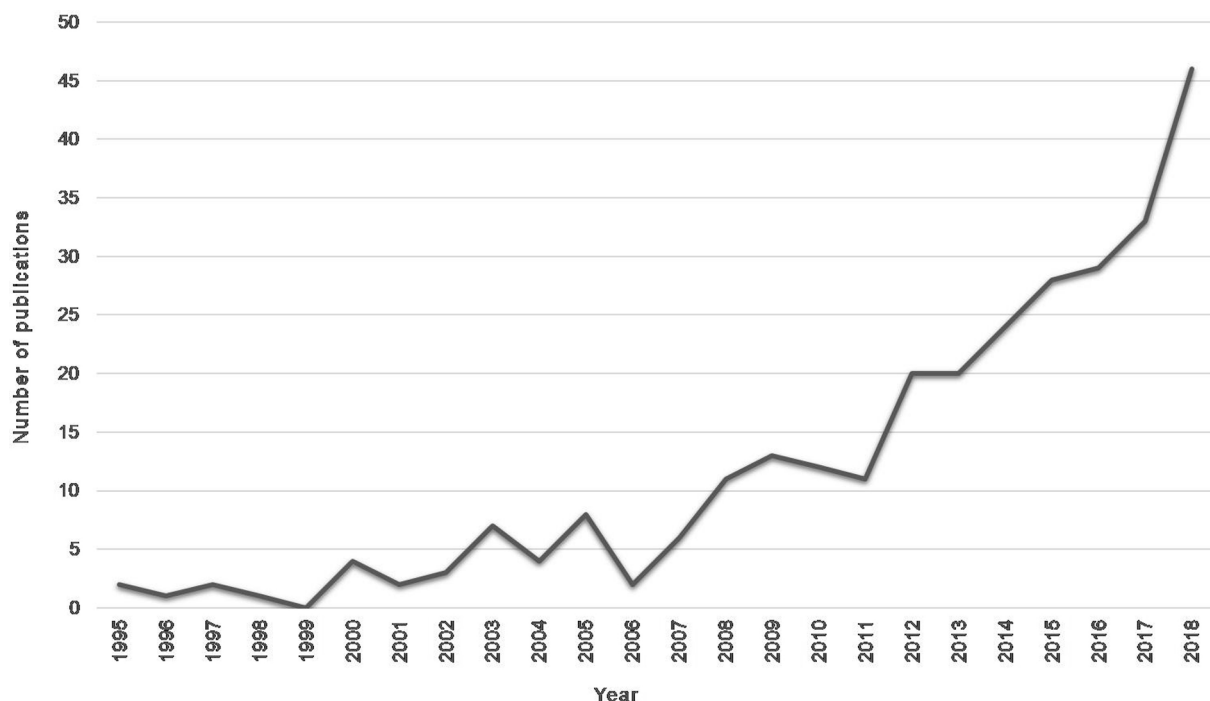


Fig. 1. Publication activity from 1995 to 2018.

is produced. It is followed by a decrease in the number of publications where the curve of scientific production is transformed from exponential to logistic. The last and fourth phase identifies the collapse of the domain and an important reduction of publications. Furthermore, Price suggests that scientific production presents a much faster development compared to other human activities, and duplicates its size every 10 to 15 years.

The publications analysed in our study are in the second phase as a result of the exponential growth produced in the number of publications per year, as shown in Fig. 1 and many issues are yet to be surveyed.

3.2. Journals publishing on CSR and OHS

Table 1 exhibits an apportionment of documents by those journals that have published at least four articles on CSR and OHS. The Impact Factor (IF) (from the 2018 Journal Citation Reports®), the categories of WoS and the quartile in JCR categories are also shown. In total, the 289 articles were published in 142 different journals.

Table 2 presents the most productive research areas of WoS on CSR and OHS. “Engineering” is the category with a major number of publications (18.40%). At least 9 out of these categories exceed 1.20% of the total production. The sum of areas of research per paper published may be greater than the total number of publications due to the fact that an article can belong to different categories or areas of research.

It is specially interesting to examine the evolution of the different areas of research, taking into account three periods of time: the first one from 1995 to 1999, the second one from 2000 to 2009 and the last one from 2010 to 2018.

Results regarding the first period of time reveal that the publications had a less technical character. Fig. 2 shows that approximately 45% of publications belong to the research areas focused on social aspects such as Psychology, Sociology, Social Work, Women Studies or Social Sciences and other topics. Whereas 11.11% of publications pertain to research areas with a more technical profile (Engineering, Operations Research and Management Science, Science Technology, Environmental Science Ecology).

In contrast, we can see in Fig. 2 that in the last period (from 2010 to 2018), those publications with a less technical profile (Psychology, Sociology, Social Sciences and other topics, Social Work or Women Studies) have declined to 8.59% whereas publications with a more technical nature (Engineering, Operations Research and Management Science, Science Technology, Environmental Science Ecology) have increased up to 57.82% with respect to the first period (45% and 11.11% respectively). Publications that belong to areas of research related to health issues (Public Environmental and Occupational Health, Medical Ethics, Legal Medicine and Health Care Sciences Services) and Business Economics have had an increase in publications between 2000 and 2009 from 22.22% up to 29.48% and from 11.11% up to 16.84% respectively (compared to the first period) and later the percentage of publications has decreased to 15.65% and 13.13% respectively, in the last period.

Therefore, the research areas have undergone some changes over time. In the first decade, “Public Environmental & Occupational Health”, “Psychology” and “Social Work” were the predominant areas whereas in the second decade, the most significant areas were “Public Environmental & Occupational Health”, “Business Economics” and “Engineering”. In the last decade, from 2010 to 2018, the publications have a more technical nature and a more environmental character, and “Engineering”, “Environmental Sciences Ecology”, “Public Environmental & Occupational Health”, “Science Technology & Other Topics” and “Business Economics” are the most relevant areas.

3.3. Geographical and institutional distribution and cooperation

A total of 489 institutions (mostly universities and research institutes) from 53 countries have produced at least one of the analysed articles, although only 13 of these countries exceed 2.16% of the total

Table 1
The most active journals publishing on CSR and OHS.

Journal title	Number of articles (1995 – 2018)	Impact Factor (IF)*	Subject category of the journal**	Quartile in JCR categories
Journal of Cleaner Production	32	6.395	Green & Sustainable Science & Technology; Engineering, Environmental; Environmental Sciences	Q1; Q1; Q1
Safety Science	27	3.619	Engineering, Industrial; Operations Research & Management Science	Q1; Q1
Journal of Business Ethics	13	3.796	Business; Ethics	Q1; Q1
International Journal of Environmental Research and Public Health	7	2.468	Public, Environmental & Occupational Health	Q1
Sustainability	7	2.592	Green & Sustainable Science & Technology - SSCI; Environmental Studies - SSCI; Green & Sustainable Science & Technology - SCIE; Environmental Sciences - SCIE	Q2; Q2; Q3; Q2
International Archives of Occupational and Environmental Health	6	2.025	Public, Environmental & Occupational Health	Q2
International Journal of Occupational and Environmental Health	6	0.973	Public, Environmental & Occupational Health (SSCI), (SCIE)	Q4; Q4
Ergonomics	4	2.181	Engineering, Industrial; Psychology; Ergonomics; Psychology, Applied	Q2; Q2; Q2; Q2
International Journal of Production Economics	4	4.998	Engineering, Industrial; Engineering, Manufacturing; Operations Research & Management Science	Q1; Q1; Q1
Journal of Occupational and Environmental Medicine	4	1.591	Public, Environmental & Occupational Health - SCIE	Q3
Total Quality Management & Business Excellence	4	2.181	Management - SSCI	Q3

*Impact factors and subject categories were retrieved from the 2018 Journal Citation Reports®.

**Categories of Web of Science.

Table 2
The most productive areas of research on CSR and OHS.

No.	Area of research	Number of publications	% of all articles
1	Engineering	92	18.40%
2	Environmental Sciences Ecology	82	16.40%
3	Public Environmental Occupational Health	79	15.80%
4	Business Economics	69	13.80%
5	Science Technology Other Topics	49	9.80%
6	Operations Research Management Science	40	8.00%
7	Social Sciences Other Topics	21	4.20%
8	Psychology	20	4.00%
9	Health Care Sciences Services	9	1.80%
10	Food Science Technology	6	1.20%

production. From the total number of institutions, approximately 64% corresponds to universities around world. As an article can be written by several authors from different institutions and countries, it is possible to find a greater number of articles published by countries than the total number of articles examined in the study.

3.3.1. Countries and territories

CSR and OHS publications have originated from 53 different countries or territories. Out of those 53, 24 are located in Europe, 10 in Asia, 10 in South America, 4 in Africa, 3 in North America and 2 in Oceania. [Table 3](#) gives information of the worldwide distribution of the contributing countries.

In [Table 3](#) and [Fig. 3](#), we observe that the largest contributor is the USA (14.82%), followed by the United Kingdom (9.16%), China (6.74%) and other countries in a smaller percentage. Approximately 46% of papers are published by European countries.

[Fig. 4](#) depicts the cooperation network that exists between countries and territories. Results are obtained by taken into account a threshold of at least one document and up to fifty of the most representative bibliographic connections are shown. Items are represented by a label and by default also by a circle. The size of the label and circle of an item represent its weight, so that the item with the largest label and circle is the most relevant. Lines between items represent links and the distance between different items indicates the relatedness of countries in this research field. The main advantage of the map is the possibility to observe those countries or territories with a similar character. In particular, countries belonging to the same continent tend to have a similar profile and they appear together in the map ([Merigó et al., 2019](#)).

As we can observe in [Fig. 4](#), the largest circle corresponds to the USA which is in close relation to other countries such as the United Kingdom, China, Australia, Brazil, Canada and Germany but mainly with The Netherlands. It is possible to observe that the USA name's label does not appear because The Netherlands label is superimposed on the USA label in the map.

Similarly to previous bibliometric studies, economic development seems to contribute to scientific and academic investment since the world's major industrialized countries are among the top contributors and attract major cooperation ([Nunen et al., 2017](#)).

[Fig. 5](#) shows the countries that cooperate with the USA, the territory with the major number of publications on OHS and CSR research. The thicker the lines between countries the more links among them. The United Kingdom, China, Australia and Canada are the countries with a stronger cooperation with the USA.

3.3.2. Institutions

The institution with the major number of papers is the Centers for Disease Control Prevention USA with five articles (see [Table 4](#)). The largest number of publications belongs to universities (313). From the total number of institutions participating in the research (489), approximately 64% belong to universities. The most prolific university

is the University of Kebangsaan of Malaysia (Asia) followed by Delft University of Technology in The Netherlands (Europe) with five publications each, and then, followed by the University of Alabama System in the USA with four published papers.

It could be of interest to subdivide all 489 institutions attending to different categories such as private organisations (e.g. industry or hospital), academic institutions (e.g. colleges or universities) or governmental organizations. However, Web of Science database does not provide this information and to do it manually would be very time consuming ([Nunen et al., 2017](#)).

From the 289 publications studied, a total of 932 authors published on CSR and OHS between 1995 and 2018. Among them, there are 47 authors with two or more papers published in 107 journals. Regarding productivity, Andersen, PA., Buller, DB., Scott, MD., Walkosz, BJ. and Zhang, DY., with 4 publications each are the most productive authors.

4. Trends and future research on CSR and OHS literature

The aim of this section is to describe the key trends on CSR and OHS disciplines and identify potential research areas. For this purpose, a co-word analysis is performed to recognise linkages between topics and emerging areas of study ([Bhattacharya and Basu, 1998](#); [Courtial, 1994](#)).

4.1. Research topics and co-word analysis

Co-word analysis is one of the most efficient methods for discovering trends and emerging research streams. It is a relational and multidimensional indicator ([Callon et al., 1995](#); [Leydesdorff and Hellsten, 2006](#)).

Co-word analysis is the study of co-occurrences, or joint appearances of two terms in a given text in order to identify the conceptual and thematic structure of a scientific domain. Once the terms to be analysed have been selected, matrices of co-occurrences are constructed and measures of similarity are calculated. These similarity measures serve as input in different kinds of multivariate analysis, such as clustering and Multidimensional Scaling analyses (MDS) ([Gálvez, 2018](#)).

Science maps might show relations among authors, documents, journals, or keywords ([van Eck, Nees Jan; Waltman, 2010](#)). The co-occurrence of keyword maps determinate the number of articles in which they have appeared together in titles, abstracts and keywords. Mapping and clustering techniques share the aim of providing insight into the structure of a network, and the two types of techniques are often used together in bibliometric and scientometric analysis ([Waltman et al., 2010](#)). Employing density and overlay visualizations allow us to identify the most developed keywords within the field and other words that might need more attention.

We have carried out a clustering analysis based on the co-occurrence of keywords. It consists of decomposing the analysis units in groups of similar related items. The associations of words obtained could be assimilated to the thematic lines of different scientific fields ([Gálvez, 2018](#)). Clustering analysis helps to identify research trends.

In order to perform the co-occurrence of keywords analysis, we have used the software VOSviewer to obtain the representation of a network of items with the total number of links and its link strengths. The size of the circles pertaining to each item is proportionate to the relevance of the words shown. The cluster analysis has been carried out in order to identify what areas are currently more developed and what the future trends on CSR and OHS research could be. The software allows bibliometric maps to be examined in full detail and can display a map in various different ways, each emphasising a different aspect of the map ([van Eck and Waltman, 2010](#)). This analysis contemplates all keywords and uses a full counting method. To obtain a representative sample of different clusters, and guarantee their consistency, keywords with a minimum number of five occurrences have been selected.

The [Fig. 6](#) represents co-occurrences of keywords network visualization on CSR and OHS research. Co-word maps allow us to reflect the

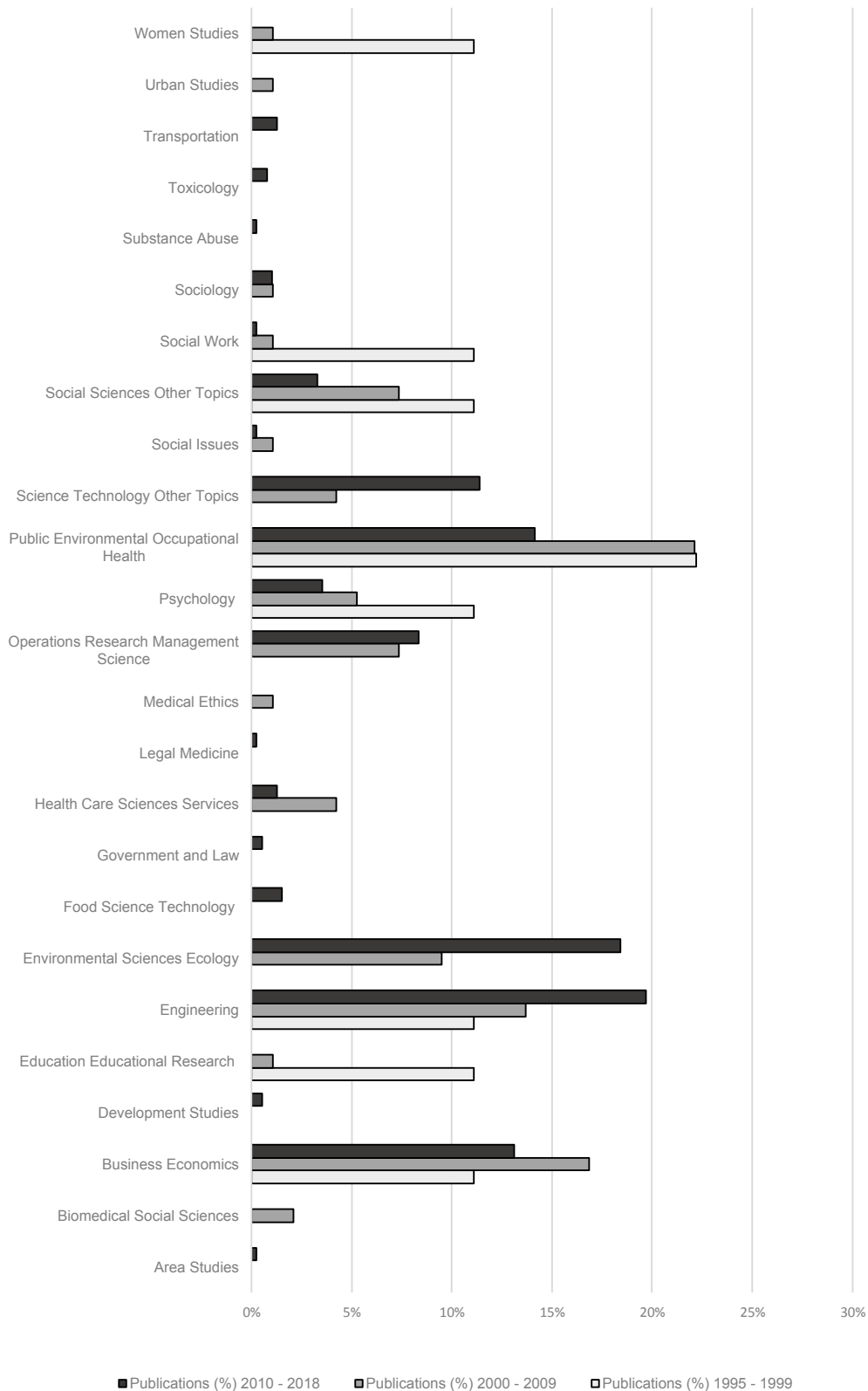


Fig. 2. Publication activity per area of research from 1995 to 2018.

semantic structure of a research domain. It is a very useful tool to measure the number of times a keyword is repeated, providing information about link strength between keywords. Circles represent the clusters of the keywords, and lines represent links between these keywords. A smaller distance generally indicates a stronger relation.

Based on the co-occurrence of keywords data, we perform a cluster

analysis. Five different clusters have been obtained that define the main research trends. These clusters were identified and classified according to the number of links, and their link strength. Finally, from 1783 keywords, 76 meet the threshold. Five different clusters have been obtained, 861 links and 1401 total link strengths.

Every cluster is related to each other. Clusters located in the middle

Table 3
Countries publishing on CSR and OHS.

Countries	(%) Publications	Countries	(%) Publications
USA	14.82%	Costa Rica	0.54%
UK	9.16%	Ireland	0.54%
China	6.74%	Lithuania	0.54%
Canada	6.20%	Venezuela	0.54%
Italy	5.93%	Portugal	0.54%
Australia	5.93%	Taiwan	0.54%
The Netherlands	5.12%	Argentina	0.27%
Brazil	4.31%	Belgium	0.27%
Germany	4.31%	Colombia	0.27%
France	3.23%	Cuba	0.27%
Denmark	2.70%	Dominican Rep	0.27%
Spain	2.70%	Ecuador	0.27%
Sweden	2.16%	Egypt	0.27%
Malaysia	1.89%	Indonesia	0.27%
Finland	1.89%	Mauritius	0.27%
Japan	1.89%	Nicaragua	0.27%
India	1.62%	Poland	0.27%
Switzerland	1.35%	Rwanda	0.27%
Romania	1.35%	Serbia	0.27%
Norway	1.08%	Slovenia	0.27%
South Korea	1.08%	South Africa	0.27%
Mexico	1.08%	Arab Emirates	0.27%
Greece	1.08%	Cyprus	0.27%
Chile	0.81%	Israel	0.27%
New Zealand	0.81%	Latvia	0.27%
Turkey	0.81%		
Austria	0.81%		
Iran	0.81%		

of the map (Fig. 6) represent a higher relation of keywords, while those on the edges of the map, indicate lower relations of keywords. In this study, cluster 1 has 27 items, cluster 2 15 items, cluster 3 15 items, cluster 4 11 items and, finally, cluster 5 7 items.

According to the map in Fig. 6, keywords such as health, performance, sustainability, safety, management, corporate social responsibility or industry are the top themes in the research field.

The five thematic clusters obtained which define the main trends in the domain of CSR and OHS research are:

Cluster 1: “Occupational Health” (35.52% of keywords)

Table 5 presents the keywords that belong to cluster 1 including the number of occurrences of these keywords, and the number of links they have. A total of 27 items form cluster “Occupational Health”. Keywords such as health, occupational health, work, workers or occupational stress are the top themes in this research field. A high number of occurrences of keywords and a high value of the total links strength mean they have a high influence on other topics in connection with this field of research.

Cluster 2: “Corporate Social Responsibility” (19.73% of keywords)

A total of 15 items form the cluster “Corporate Social Responsibility”. Keywords such as corporate social responsibility, occupational health, impact or responsibility are the top themes in this research field (see Table 6).

Cluster 3: “Performance and Sustainable Development” (19.73% of keywords)

A total of 15 items form the cluster “Performance and Sustainable Development”. Keywords such as performance, model or occupational health and safety are the top themes in this research field (Table 7).

Cluster 4: “Management and Sustainability” (14.47% of keywords)

A total of 11 items form the cluster “Management and Sustainability”. Keywords such as management, sustainability, framework or environment are the top themes in this research field (Table 8).

Cluster 5: “Industry and Safety” (10.52% of keywords)

Table 9 presents the total number of keywords, the number of occurrences, and the total number of links they have. A total of 8 items form this group. Keywords such as safety, industry and China are the top themes in this research field.

Table 10 indicates the most frequent keywords with a number of occurrences greater than 10 in the different clusters.

VOSviewer software also helps visualize the density of different clusters. By using density visualization, items are indicated by a label in a similar way as in the label view. Each location on the map depends on the density of items at that point.

That is, the location on a map depends on the number of items in the neighborhood of the point and on the importance of the neighboring items. The density view is particularly useful to get an overview of the

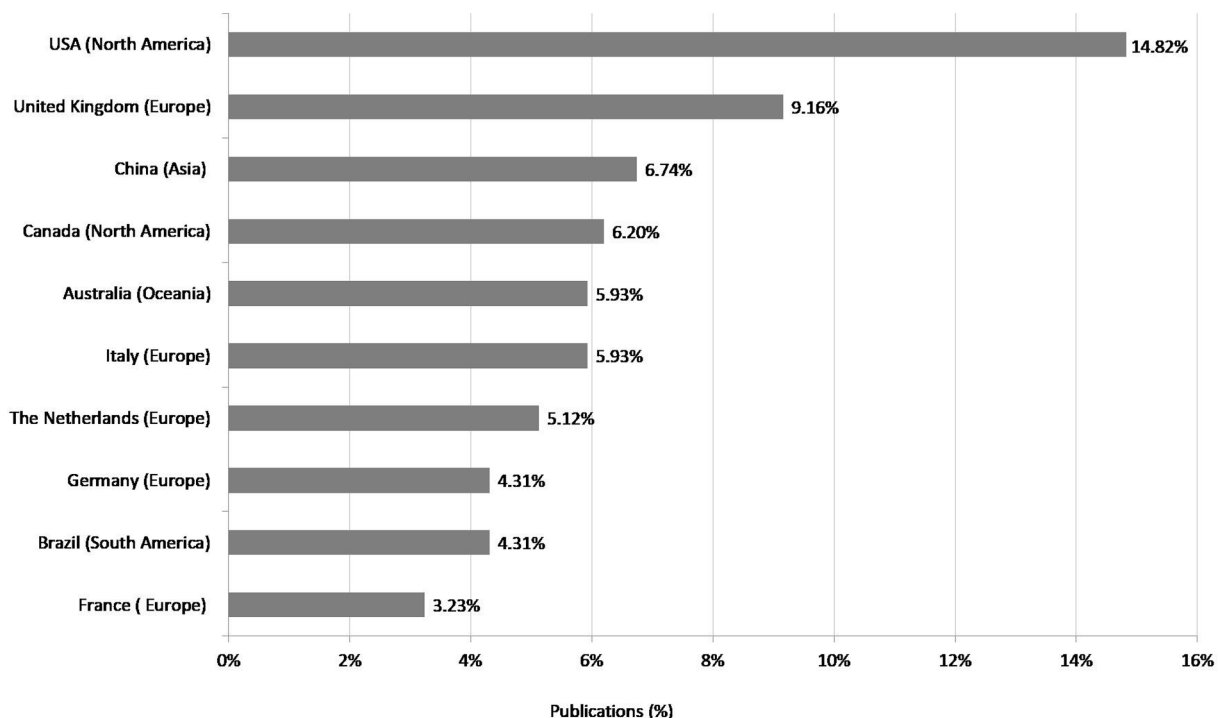


Fig. 3. Top 10 most productive countries or territories publishing on CSR and OHS (1995–2018).

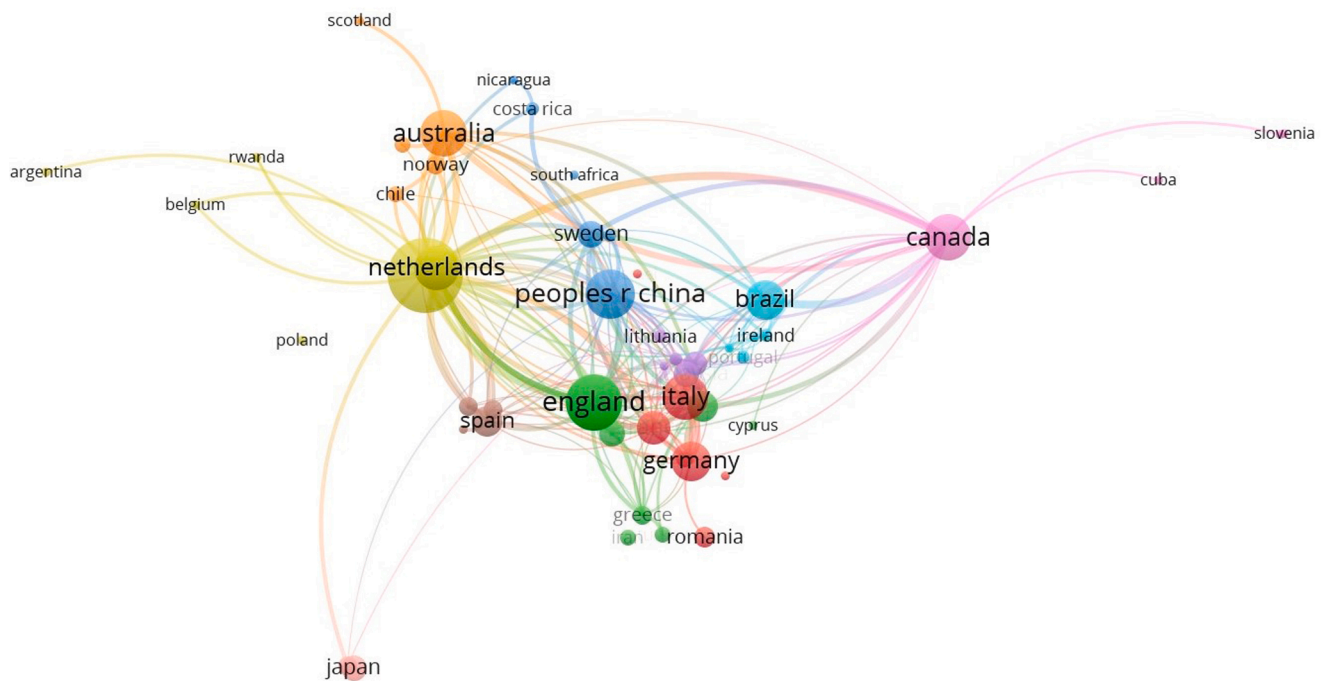


Fig. 4. Cooperation network between countries and territories in CSR and OHS research.

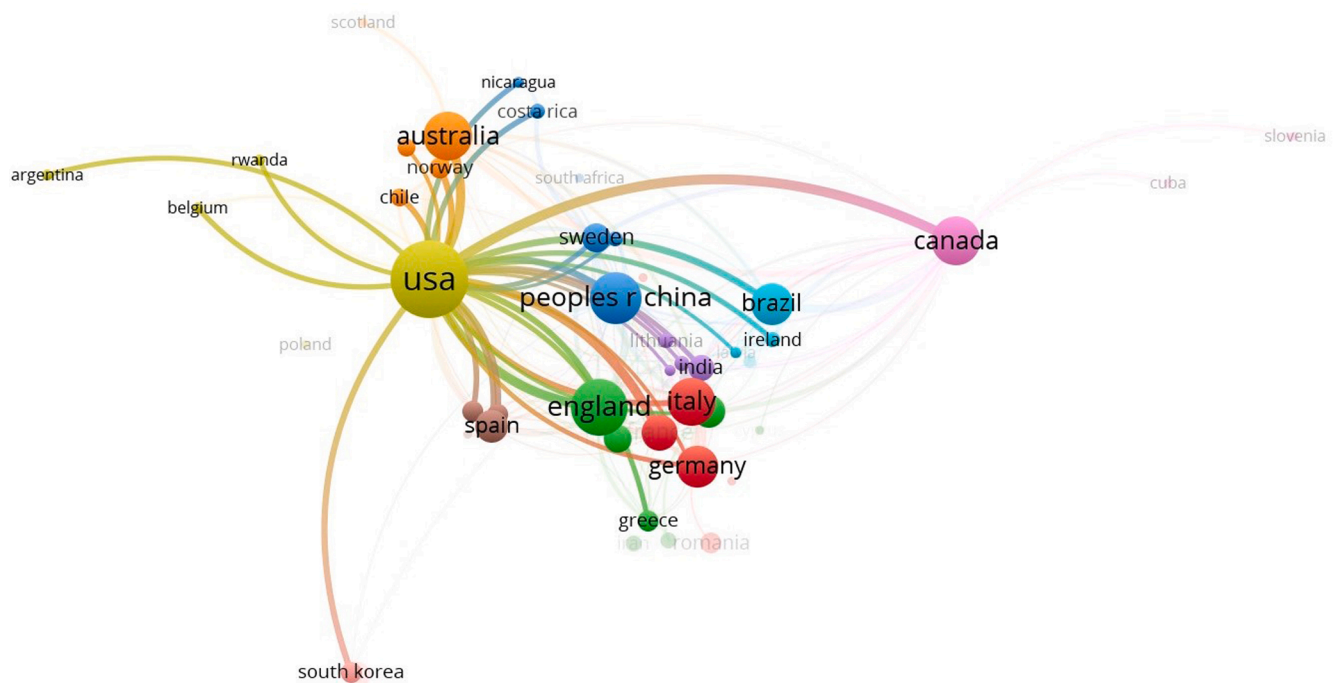


Fig. 5. Cooperation network between the USA and other territories in CSR and OHS research.

general structure of a map and to draw attention to the most important areas in a map (van Eck and Waltman, 2010).

The density view immediately reveals the general structure of the map. In particular, health, work, sustainability and safety areas turn out to be important. These areas are very dense, which indicates that overall the journals in these areas receive a lot of citations. Additionally, there is

a clear separation between the fields of performance, sustainability, corporate social responsibility, on the one hand, and the fields of work, health and occupational health research, on the other hand.

In Fig. 7, the central area corresponds to the highest density and the peripheral one to the lowest density. The greater the density, the greater the weight and therefore the co-occurrences are greater within a cluster.

Table 4
The most productive institutions publishing on CSR and OHS (1995 – 2018).

Institutions	Country / Region	Number of Publications
Centers for Disease Control Prevention USA	Georgia (USA)	5
University Kebangsaan Malaysia	Malaysia (Asia)	5
Delft University of Technology	The Netherlands (Europe)	5
California State University System	California (USA)	4
Henan Agricultural University	China (Asia)	4
Klein Buendel Inc	Colorado (USA)	4
National Institute for Occupational Safety Health NIOSH	Washington DC (USA)	4
San Diego State University	San Diego (USA)	4
University of Alabama System	Alabama (USA)	4
University of Florence	Italy (Europe)	4
University of Nottingham	UK (Europe)	4
University of Surrey	UK (Europe)	4
Polytechnic University of Milan	Italy (Europe)	4
Monash University	Melbourne (Australia)	4
National Research Centre for The Working Environment	Denmark (Europe)	4
Pennsylvania Commonwealth System of Higher Education PCSHE	Pennsylvania (USA)	4
University of British Columbia	Vancouver (Canada)	4

The size of the cluster indicates the level of relevance. The following areas have been highlighted:

- The central area of the map shows the most significant keywords belonging to consolidated research lines; OHS (health, safety occupational health and safety), management, performance, sustainability and corporate social responsibility.

- In the upper area, the left peripheral area of the map collects keywords related to environment sustainability (environmental management, supply chain) and financial performance (impact, costs, values). In the left peripheral lower area, keywords connected with industry and safety are shown (decision making, implementation, barriers, food safety).
- The upper right peripheral area, gathers keywords associated with working conditions (employment, working conditions, participations). In the lower right peripheral area, keywords are linked to occupational accident rates (workers, accidents, mortality, exposure) and to research lines that address psychosocial risks (stress, occupational stress, mental-health, social support, burnout).

4.2. Research trends on CSR and OHS

The subject studied has a multidisciplinary character, as demonstrated by the fact that the most relevant journals on CSR and OHS research are included in several research areas of WoS. We examine the articles comprised in each cluster in depth in order to analyse research trends on CSR and OHS.

Regarding the sectors of activity, the construction and metal sector is the focus of 10.38% of the articles, followed by the food sector (9.43%), agriculture, fishing or livestock sector (8.49%), service sector (8.49%), mining or coal industry (7.55%), energy sector (7.55%) and health sector (7.44%).

In Cluster 1: “Occupational Health”, the most important concerns are related to occupational health issues. It represents the highest percentage of the keywords in this research (35.52%). It consists of 105 publications. It is composed of texts on the subject of Occupational Health in all areas, but especially oriented towards exposure to risks of a psychosocial nature (satisfaction, stress, occupational stress or burnout). This documentary collection seems to be of special interest to authors from the United Kingdom, Canada, United States and Italy, thus

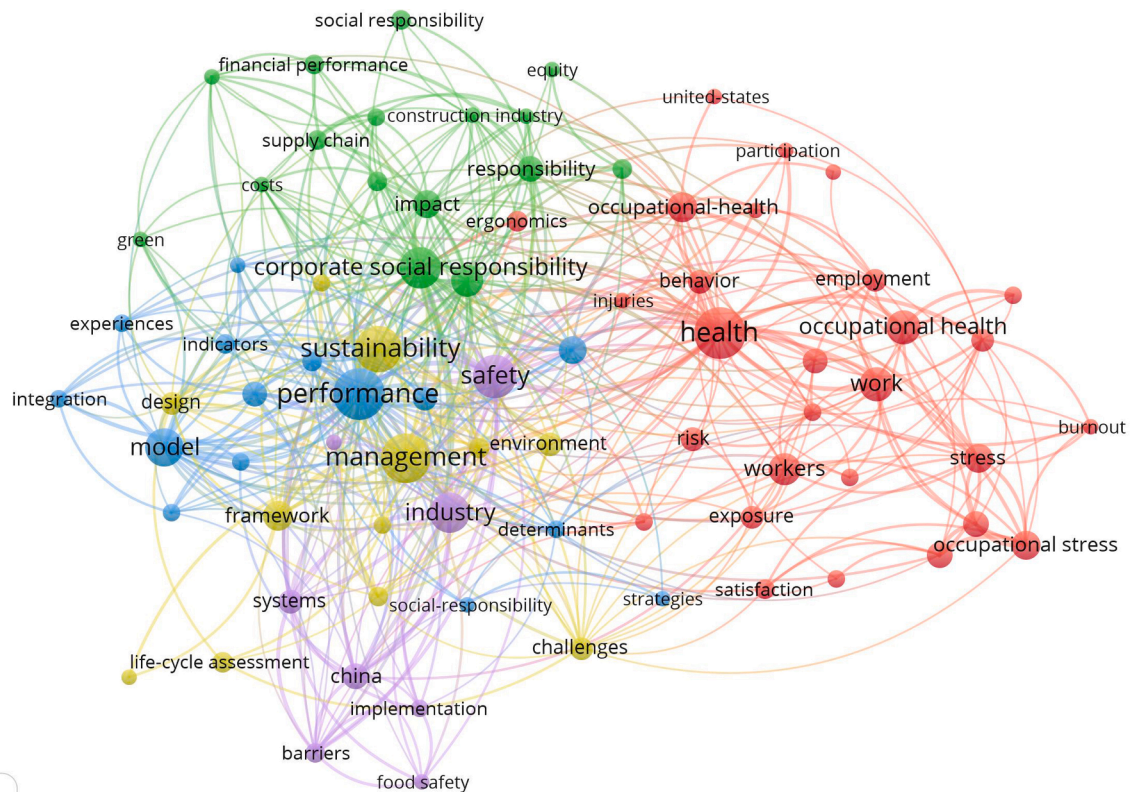


Fig. 6. Co-occurrence of keywords network visualization on CSR and OHS research.

Table 5
Keywords in cluster 1 on CSR and OHS research.

Keywords (Cluster 1) (Occupational Health)	Links	Total Links Strength	Occurrences
Health	55	120	40
Occupational health	60	91	34
Work	25	43	19
Workers	30	39	17
Occupational stress	16	38	14
Stress	21	41	14
Mental-health	19	35	12
Social support	14	29	12
Workplace	32	41	11
Behaviour	22	29	10
Risk	22	25	10
Employees	15	22	9
Employment	18	26	9
Exposure	17	22	9
Ergonomics	16	20	8
Satisfaction	18	22	7
Accidents	16	20	6
Mortality	17	19	6
Physical-activity	13	14	6
Prevention	23	25	6
Working conditions	9	13	6
Burnout	7	13	5
Injuries	21	23	5
Injury	15	20	5
Participation	12	17	5
Population	12	13	5
United States	8	9	5

Table 6
Keywords in cluster 2 on CSR and OHS research.

Keywords (Cluster 2) (Corporate Social Responsibility)	Links	Total Links Strength	Occurrences
Corporate social responsibility	81	162	44
Impact	35	52	13
Responsibility	27	40	12
Ethics	19	23	7
Financial performance	16	23	7
Globalization	17	22	7
Social responsibility	10	11	7
Supply chain	22	30	7
Environmental management	19	25	6
Competitive advantage	13	17	5
Construction industry	17	18	5
Costs	18	21	5
Equity	15	17	5
Green	19	22	5
Workplace safety	18	26	5

Table 7
Keywords in cluster 3 on CSR and OHS research.

Keywords (Cluster 3) (Performance and Sustainable Development)	Links	Total Links Strength	Occurrences
Performance	53	152	40
Model	42	87	24
Occupational health and safety	23	33	13
Quality	28	44	11
Sustainable development	21	25	10
CSR	20	24	7
Indicators	11	17	7
Determinants	16	20	6
Experiences	15	20	6
Integration	14	26	6
Perspective	16	22	6
Supply chain management	20	25	6
Social responsibility	13	15	5
Strategies	16	17	5
Values	15	19	5

Table 8
Keywords in cluster 4 on CSR and OHS research.

Keywords (Cluster 4) (Management and Sustainability)	Links	Total Links Strength	Occurrences
Management	52	115	38
Sustainability	40	78	34
Framework	28	44	15
Environment	31	40	10
Challenges	20	28	9
Design	24	37	9
Construction	21	29	8
Life-cycle assessment	16	22	13
Decision-making	14	19	7
Health and safety	21	27	6
System	19	25	6

Table 9
Keywords in cluster 5 on CSR and OHS research.

Keywords (Cluster 5) (Industry and Safety)	Links	Total Links Strength	Occurrences
Safety	50	131	30
Industry	49	100	26
China	18	46	12
Systems	28	61	10
Barriers	17	38	7
Implementation	20	31	6
Food Safety	14	24	5
Standards	18	23	5

Table 10
Main groups of co-words identified using VOS mapping technique clustering analysis of CSR and OHS literature, 1995–2018.

Name	Cluster	Keywords	Occurrences
Occupational Health	1	Health	40
		Occupational Health	19
		Work	19
Corporate Social Responsibility	2	Workers	17
		Corporate social responsibility	44
		Impact	13
Performance and Sustainable Development	3	Responsibility	12
		Performance	40
		Model	24
Occupational health and safety	3	Occupational health and safety	13
		Quality	11
		Management	38
Management and Sustainability	4	Sustainability	34
		Framework	15
		Environment	10
Industry and Safety	5	Safety	30
		Industry	26
		China	12
		Systems	10

coinciding with the most influential countries.

Some authors of reference and renowned researchers in the field of Occupational Health with publications belonging to this group are Georgios Boustras, Sari Mansour, David Walters or Sara Viotti. Themes refer mainly to psychosocial risks, ergonomics, chemical risks and musculoskeletal disorders. Studies in this cluster deal with aspects such as ergonomics (Barbalho Bezerra and de Carvalho, 2012), occupational stress (Goldenhar et al., 2003) or accidents at the workplace (Hasle et al., 2009). The need to create a healthy working climate, based on a good communication, support and conflict resolution, is one of the problems identified in this group (Ilic et al., 2017). Few studies have been found in relation with traffic accidents at work. Future research could aim to cover these needs. Within this cluster, there are a greater

(Petrovic-Lazarevic, 2008).

Cluster 2: “Corporate Social Responsibility” has a percentage of keywords of approximately 20%. Corporate Social Responsibility is a topic of special relevance in this research, having the highest coverage. This cluster is composed of 61 articles. Subjects such as CSR in the contexts of OHS, Food Risk Management (FRM), business ethic or ISO 26000 indicators are reviewed in this group. This documentary collection seems to be of particular interest to authors of United Kingdom, Spain, Greece, Japan or Finland such as Aditya Jain (Nottingham University Business School), Stavroula Leka (University of Nottingham), Gerard Zwetsloot (University of Nottingham), María José Montero (Universidad de Córdoba), Rafael A. Araque (Universidad Loyola Andalucía), Juan M. Rey (Universidad de Cádiz), Futoshi Kawashita, Yukari Taniyama, Song You Hwi, Takeshi Fujisaki, Takashi Kameda, Koji Mori (Occupational Health Training Center, University of Occupational and Environmental Health, Japan), Konstantinos Evangelinos (University of the Aegean) or Marileena Koskela (University of Turku). Taking into consideration the growing interest in the literature on OHS issues in the context of CSR, it could be particularly useful to initiate further research in these areas. Furthermore, the possibility of identifying ways of measuring sustainability indicators could be of great interest in helping companies to be socially responsible (Dura et al., 2018). In line with the discussion of cluster “Occupational Health” and, related to psychosocial risks, there is evidence that companies do not contemplate mental health in their CSR reports. Mental health requires attention since the second cause of occupational illness after musculoskeletal disorders is mental illness, constituting the main cause of disability and sick leave at work (Hunsley et al., 2014). There is a need for improving CSR reporting by considering the psychosocial risks affecting workers’ mental health and this could be applied in different geographical locations.

The production and presentation of occupational health reports brings added value to the company. OHS is considered one of the most important issues outlined in industry reports and many companies consider it a priority issue. However, it has been detected, through report analysis, that it has not been given the importance it deserves. More comprehensive environment, health and safety information could contribute to the better monitoring of risks, opportunities and communication between stakeholders. The need to design programmes in which employees can contribute with significant information has been detected. Better information and communication could favourably contribute to marketing strategies given the growing number of consumers who are willing to support and choose products/services from companies that provide credible information on their working conditions (Neumann et al., 2014).

Within this cluster we found works that analyse CSR within the building sector, pharmaceutical industry, safety, FRM and logistic sector. In this context, there are contributions that explore the impact of the implementation of CSR practices, especially focused on the food sector and chemical industry.

Some studies are concerned with business ethic and corporate social responsibility (Lamberti and Lettieri, 2009). Within the “Occupational Health” cluster, the use of pesticides is discussed in order to avoid the risk of exposure to these substances. Ethical codes are established to prohibit their use or withdraw them for health or environmental reasons not allowing them to be marketed by companies in other countries (Castleman and Sellers, 2008).

As for the relationship between work conditions and CSR practices, some researches study the influence of CSR at the workplace to reduce absenteeism, shirking and so on. They conclude that it can be useful to design CSR tools or practices in those firms with unmotivated regularly absent workers or employees with an adverse behaviour (Flammer and Luo, 2017). Therefore, CSR enables the implementation of friendly practices with employees that improve firms’ financial performance. A gap in the relevant literature to measure the influence of CSR on the overall performance of companies has been acknowledged (Petrovic-

Lazarevic, 2008).

Organizations that take into account the ISO 26000 (ISO 26000, 2010) indicators on occupational safety and health, significantly improve working conditions and the welfare of workers (Biquand and Zittel, 2012). Articles pertaining to this cluster have explored the effect of CSR on the workplace. Few contributions consider employees’ opinion regarding socially responsible firms (Nordlof et al., 2015; Staniskiene and Stankeviciute, 2018). Employees represent an important stakeholder group because of their specific characteristics such as their relationship with the firm, sentiment, and exposure, which cannot be underestimated by companies (Coutinho et al., 2018). Only through a better understanding of what is relevant for employees in terms of social responsibility in an organization, can an advancement towards sustainable development be achieved. Their perspective broadens a firms view on CSR as it provides more information than that which is mainly available from formal sustainability performance assessments. It would be interesting to analyse employees’ point of views in depth in order to identify other possible needs. Focus group or in-depth interview studies could be designed, as such needs could be further explored with more qualitative studies.

“Impact” is one of the topics linked to “corporate social responsibility”. There are articles that examine social and labour impacts (Hardadi and Pizzol, 2017). For instance, the impact of negative workplace safety announcements on the firm value are analysed. How to provide operations managers the support needed in order to mitigate exposure to working conditions are also examined (Kabir et al., 2018). Negative impacts of the petroleum industry (Tanielian, 2014) or accidents at work related to social responsibility are other issues explored (Hurjui and Hurjui, 2018; Wiengarten and Longoni, 2018). These studies draw attention to the negative consequences of safety events, helping to raise workplace safety as an important issue for the attainment of triple bottom line by firms. However, future research analysing positive effects may help managers to acquire a better understanding of the consequences and provide them with a framework to justify the expenses which are necessary to enhance workplace safety in their organizations.

In recent years (from 2014 to 2018) there is a growing concern in Food Risk Management (FRM) or food safety and its relation with CSR in China. Due to the diversity and magnitude of the food sector, there are some articles in this field that explore the connection between FRM and CSR and assure that the better the CSR, the better the FRM and that the larger the company, the less effective the food risk management preventive actions are (Zhang et al., 2017). Other studies explain that a higher level of engagement with CSR implies a lower number of incidents in food safety and provide recommendations for the implementation of CSR policies in the food sector. China is an important exporter of agricultural products, so there is an urgent need of improving food risks management. The recent worldwide coronavirus pandemic indicates the necessity of implementing these procedures in the short term. Governments must participate to promote CSR in the food sector and its supply chain (Zhang et al., 2015). A need for control, regulation and inspection is detected, so it would be necessary to introduce evaluation, inspection and support programs for all firms in China (Zhang et al., 2018). Future research could study this relationship between FRM and CSR in other western geographical locations with different cultural levels.

Cluster 3: “Performance and Sustainable Development” represents 19.73% of the keywords in the scientific production examined in this study. Contributions comprised in this cluster provide evidence of the positive influence of sustainability management practices on business performance. Factors associated with business performance include sustainable supply chain management, continuous improvement in OHS, and environmental improvement, among others. Nevertheless, transparency with stakeholders and community development were the factors which most correlated with business performance (Gomes et al., 2014).

When considering OHS as an integrating item of cluster 3, there are

works that explore how supply chain management can contribute to improving working conditions and firm performance (Kabir et al., 2018). In addition, methods of cleaner production have been found to help promote wellbeing of organizations focused on workers as well (di Fabio, 2017). From the cluster analysis, we can deduce that cluster “Performance and Sustainable Development” and cluster “Management and Sustainability” are closely linked to these two concepts. Climate change challenges currently faced by human beings can only be resolved by promoting a sustainable development. Cluster 3 contains 56 articles with topics mainly related to environmental impact, clean production processes that influence environmental sustainability and firm performance contributing to improve OHS (Severo et al., 2015). Other topics investigated are: greener supply chain, sustainable product development, sustainable life cycle assessment, green collar workforce, circular economy concept, sustainability reports or management systems to improve sustainability in organizations. Moreover, this cluster reveals that there is a connection with clusters “Occupational Health” in terms of OHS and with “Corporate Social Responsibility” in terms of supply chain management.

Some authors interested in this topic are Eliana Andréa Severo (University Potiguar, Brazil), Julio Cesar Ferro de Guimaraes (University Potiguar, Brazil), Eric Charles Henri Dorion (University of Caixas do Sul, Brazil), Cristine Hemann Nodari (University of Caixas do Sul, Brazil), Clandia Maffini (Santa Maria Federal University, Brazil), Jordana Marques Kneipp (Santa Maria Federal University, Brazil), Isak Kruglianskas (Sao Paulo University, Brazil), Luciana Paraecida Barbieri da Rosa or Roberto Schproni Bichueti (Santa Maria Federal University, Brazil).

Countries such as China, Italy or India are the most studied countries within cluster 3. Articles about these countries have been published in recent years, China (2015 to 2018), Italy (2012 to 2018) India (2017 to 2018), so these are geographical contexts of current concern. China is the world’s largest producer and consumer of carbon. This fact, together with the management of waste from coal production, brings serious problems and poses a threat to the environment. Some articles included in this cluster study the appraisal of environmental sustainability for solving the problems of contaminated land in China as well as its impact on human health (Song et al., 2018). There is also an interest on methods of machining dense solid waste derived from mining to improve safety and sustainability in the coal industry. As it is a complex method, it would be interesting for future research to explore how to automate the process and so decrease human exposure to the associated risks (Huang et al., 2017).

The studies focusing on Italy concern sustainable development topics such as sustainable product design, food supply chain sustainability or sustainable innovation in olive or sunflower farming systems.

In India, we found works related to production processes and social supply chain in the textile sector. Aspects such as social life cycle assessment methods, socio-economic costs, migration, child exploitation, extreme poverty, excessive working hours and OHS are taken into consideration. Other investigations in India analyse alternatives for green logistic in an automotive organization, the reduction of waste in the food supply chain, sustainable initiatives in the agri-food supply chain or sustainability reports.

In general, as for manufacturing facilities, there are several contributions that focus on the relocation of hazardous industries (e.g. chemical, automotive, metal, textile) to developing countries due to lack of health and occupational regulation or deficient laws among other reasons (Velázquez et al., 2008; Park et al., 2009). As a result, global occupational health risk levels are not reduced, but transferred from developed to developing countries. The OHS legislation in developing and low-income countries tends to ignore critical issues; it is necessary to widen its scope including dimensions such as workplace risk assessment, preventive OSH measures and setting safety and health committees, etc. (Ncube and Kanda, 2018). Additionally, manufacturing companies need to emphasize CSR and report more on a worker’s exposure to different risks.

An emerging research area identified in the co-word analysis concerns supply chain management. The climate change and the environmental impact produced by the pollution derived from industrial processes and labour activity has created awareness among workers who seek to promote sustainability, to reduce waste, to reduce the use of energy and pollution. The number of environmentally conscious workers is increasing in recent years and they are known as green-collar workers who serve in all industries and cover a variety of professions (more sustainable product design, more sustainable services, environmental educators or organic farmers). In addition to exposure to traditional risks, these workers are also exposed to new risks associated with tasks such as cleaning or removal of hazardous or polluting material, use of more complex construction elements, etc. Greening the supply chain, and the emergent so-called “green collar workers” are topics of current concern that in some cases also carry associated risks for workers’ health and safety. Green collar workforces are found to have better working conditions, better pay, health insurance and job satisfaction (McClure et al., 2017), and are considered very useful to take care of the environment. However, these workers are not protected against harmful exposures and practices in new tasks.

Very little research identifies links between “Green Economy” and OHS. Despite the importance currently attached to green economy and occupational safety and health, these issues have been jointly addressed in a very limited way (Valenti et al., 2016). Green collar workers constitute an emerging workforce worldwide and the general trend is a growing number of green jobs (Rademaekers et al., 2012). Extant research demonstrates that these workers have a unique socio-demographic profile (McClure et al., 2017) and indicates unique health conditions regarding: their chemical and physical exposures (Chen et al., 2017), occupational skin conditions (Moore et al., 2016) or occupational psychosocial hazards (Fernández et al., 2017) amongst others. Nonetheless, these studies are mainly focused on the U.S context and analyse green collar workers in various sectors. Future studies should extend these results to Europe and others context. They could also explore or create strategies aimed at how to maximize the safety and health of green-collar workers, comparing the exposures and health of these workers by sectors in order to identify gaps in OHS.

Moreover, the concept of CSR is closely linked to the new concept of “Circular Economy”. There is little evidence about a shift from a linear to a circular economy model. Very few studies focus on “Circular Economy”. Some of them identify opportunities for circular design in the health sector such as further investigation of the most effective ways of encouraging waste-segregation in medical contexts (Kane et al., 2018). Future studies should look into circular economy as an essential element of CSR.

Cluster 4: “Management and Sustainability”. This cluster represents 14.47% of keywords.

This group is composed of 42 publications that address issues such as sustainability, management systems or safety management. Authors such as Izaskun Larrieta-Rubín de Celis (University of the Basque Country, Spain), Sara Fernández de Bobadilla-Güemez (University of the Basque Country, Spain), María del Mar Alonso Almeida (Autonomous University of Madrid, Spain), Eva Velasco Balmaseda (University of Basque Country, Spain), Javier Esquer Peralta (University of Sonora, Mexico), Luis Velázquez, Nora Munguia (University of Sonora, Mexico), Iveta Mezinska, Inga Lapina, Janis Mazais (Institute for Quality Engineering, Latvia), Gopalakrishnan Muthu Samy (Kalaivani College of Technology, India), Candramohan Palani Samy (Professional group of Institutions, India) or Maheswari Ammasaiappan (Kalaivani College of Technology, India) are interested in this subjects. “Management and Sustainability” has a strong relationship with the rest of the clusters. Approximately 44% of the articles within this cluster, are studies that were published in the last two years, 2017 and 2018. This circumstance indicates that its relevance has increased in recent years.

Issues researched within the current cluster refer to CSR reports that take into account worker health and safety issues (Larrieta Rubín de

Celis et al., 2017; Koskela, 2014; Montero et al., 2009; Tsalis et al., 2009), reform in the health and safety systems in China (Wu and Chi, 2015) or OHS disclosures in sustainability reports (Evangelinos et al., 2018).

Standards or management systems, or Integrated Management Systems (IMS) are other topics dealt with in order to achieve better working conditions. Some studies examine the implementation of a Lean-Integrated Management System for Sustainability Improvement (LIMSSI). Organizations still face difficulties in integrating multiple management systems. The LIMSSI proposes an innovative explanation of correlations of the quality, environmental, occupational health and safety, and social responsibility requirements with the principles and tools of lean manufacturing. It is aimed at resolving difficulties in management systems by creating synergies and thus improving corporate responsibility in cleaner production (Estevam Souza and Alves, 2018). The term “Management” refers to those articles that study management systems issues but is also associated with safety management, which is discussed in more detail in the “Industry and Safety” cluster.

Managers should contemplate OHS and workers as relevant and valuable resources for firms (Darabont et al., 2018). Organizations are already familiar with the OHS management systems implemented according to OHSAS 18001 standard requirements, as a consequence, the transition to the standard ISO 45001 should be a smooth process. However, special attention should be paid to new and emerging risk issues such as psychosocial risks, ageing workforce, new technologies as well as other specific risks concerning production processes (Darabont et al., 2018). We have noted a lack of research on the standard ISO 45001 (ISO, 2018). This is an important gap for future studies to reduce. This could be due to the recent publication of this standard that substitutes the older OHSAS 18001 (BSI, 2007). Future studies could explore how the application of ISO 45001 improves occupational health and safety in firms.

The first article related to the concept of sustainability dates from 1995. In this cluster, technical alternatives for sustainability are evaluated, highlighting the relevance of synergy between engineering and sustainability (Baetz and Korol, 1995). There are works about a model for assisting firms to overcome barriers and implement industrial sustainability measures. These barriers are focused on areas such as OHS, eco efficiency, energy efficiency and sustainability, providing insight into the different perspectives for adopting measures in industrial sustainability. For further research, it would be interesting to study a new model based on how to overcome barriers in order to promote sustainability in general terms (Trianni et al., 2017). Some contributions within this area examine topics of sustainability and Social Life Cycle Assessment (S-LCA) in child labour or OHS (van der Velden and Vogtlander, 2017), dairy farms (Chen and Holden, 2017) or make a comparison between Life Cycle Assessment and Social Life Cycle Assessment (Foolmaun and Ramjeeawon, 2013). Others study Life Cycle Assessment in the construction industry (Moretti et al., 2017) or the Life Cycle Sustainability Assessment when evaluating sustainable innovations in olive growing systems (de Luca et al., 2018).

Cluster 5 is called “Industry and Safety” and represents 10.52% of keywords. The main reference journal of this group is Safety Science. Within the articles belonging to this group, 28% correspond to the aforementioned journal. Co-word analysis demonstrate that keywords belonging to this cluster such as safety, systems, implementation or standards are connected with keywords included in the cluster “Management and Sustainability” such as management or system. It is also related to the group “Corporate Social Responsibility” regarding safety in the food industry, mainly in China, issue that has been discussed in the previous clusters.

This cluster embraces contributions concerning industrial safety, workers perception of safe behavior at work, safety management in reactor plants, analysis and recommendations for reducing accidents at work, safety management at work environment and OHS perceptions of

workers among others. Particularly, several contributions have examined the level of risk acceptance by workers. Some studies have reported differences in risk perception and acceptance based on gender, race and ethnicity (e.g.; Gustafson, 1998; Henwood, Parkhill and Pidgeon, 2008). White men are usually found to judge risks as smaller and less problematic than the rest of the groups. This fact can be explained by power, status and other social and labour factors. Such socio-demographic differences are the result of complex effects of social, cultural and psychological sensibilities. It is necessary to carry out future research combining quantitative and qualitative methods that examine in depth the phenomenon of risk perception, the relationship among those sensibilities and how these can be shaped and managed by an adequate safety culture and CSR policies based on shared values, norms and attitudes of safety.

Contributions within this area examine topics such as the management of occupational safety in companies. This is an essential aspect for creating safer working environments. Inadequate safety management can be the cause of many accidents at work. Some studies divide safety management into two parts, the first dealing with legal aspects and the second with non-legal aspects, for instance, through The National Institute of Occupational Safety and Health (NIOSH). Many relevant public policies are aimed at reducing mortality. Evaluation of these policies is usually related to benefit-cost analyses and estimates the value society places on a life saved as a result of the policy (Mrozek and Taylor, 2002). Literature regarding this topic has focused on valuing fatality risk by estimating compensating differentials for labor risk exposure, which is useful in estimating the value of a statistical life (VSL) (Viscusi and Masterman, 2017). Although this research stream has received substantial attention, most of the contributions estimate the VSL for the United States and other developed countries (based on dimensions such as income, age, etc.), and extrapolate the estimations to lower- and middle-income countries adjusting only for income differences (Hammit, 2017). To identify accurate estimations of VSL, future studies should consider others factors that explain variations in different populations and countries such as life expectancy, access to medical care, age, etc. Improving the measurement of the value of human life helps to define more proper safety risk regulations.

Safety policies implemented should be taken into consideration as part of internal Corporate Social Responsibility in companies and training and support should be included to create a preventive culture focused on safety management (Hadjimanolis and Boustras, 2013). Particularly, in Spanish companies a scarcity of prevention practices and a lack of commitment and safety culture has been detected. This leads to workers suffering accidents and companies assuming associated costs (Fernández-Muñiz et al., 2009). A number of contributions underline the need to take urgent measures aimed at promoting the implementation of safety practices in this country. For further research, the study of CSR, OHS, safety management and firm performance together could be of special relevance due to the fact that they share concepts and approaches. The goal of zero accidents at work is not easy to achieve but measures can be implemented to ensure successful accident prevention through an effective causal analysis model (Gyekye, 2010), or audits to identify which areas in the organization are safe and which are not. The involvement of hierarchical levels in the organization that take into consideration the point of view of the workers is necessary (Arifin et al., 2013). In this sense, management has a relevant role in implementing measures to prioritise safety, demonstrating concern and awareness for a safer workplace and the workers’ wellbeing, or taking measures focused on educating workers to correct dangerous situations. Examples of practices that reduce accident rates, improve worker absenteeism, working conditions and organizational wellbeing are: safety policies that include and establish principles and commitment at all hierarchical levels of the organization, promotion, training, worker participation and adequate communication among the company members. These practices also have a very positive impact on firms’ reputation, innovation and productivity as well as profits (Fernández-Muñiz et al., 2009).

The attitude of workers, the organizational involvement or the safety and health policies implemented favorably affect the safety performance in the company (Hadjimanolis and Boustras, 2013), and it demonstrates that corporate competitiveness and the safety of workers is compatible (Fernández-Muñiz et al., 2009). This research brings to light the relationship between safety management and firm performance.

Very little research has been found regarding traffic safety from an occupational perspective. Future research could study these accidents in companies, emphasizing how the implementation of CSR policies have a potential impact on reducing them, for instance, through improved work schedules, work-life balance, etc.

There is little evidence from studies that explore what type of information technology (IT) can be most effective in managing and assessing risks in different types of companies (Koivupalo et al., 2015). Future research should explore the use of smartphones and other technological tools and devices for monitoring (Kim et al., 2013).

In general terms, very few contributions have been found in studies that relate OHS and CSR issues to such current and trendy aspects and other relevant dimensions such as gender diversity. Concerning this last issue, examples of areas that deserve further research are those relating to discrimination against young women in the labour market due to social issues (ethnicity, poor health, etc.) (Escott, 2012) or those that highlight the need to include in OHS aspects regarding the health of young women, including reproductive health (Wofford et al., 2016). A study conducted in Spain finds that compliance with regulations together with the application of CSR practices are the main drivers for promoting the gender perspective in the field of occupational health (Larrieta Rubín de Celis et al., 2017).

Future trends point to demographics, technology, sustainable development, psychosocial risks or occupational stress as emerging challenges (Azzi, 2019), coinciding with the results obtained in the analysis of the previous clusters.

5. Conclusions

In recent years, there is a growing interest in the literature that relates to the field of CSR with OHS. Research into CSR and OHS is considered to be in an evolutionary phase of exponential growth and still has to be explored more in depth (Arntz-Gray, 2016; Larrieta Rubín de Celis et al., 2017; Evangelinos et al., 2018; Nagata et al., 2017; Tsalis et al., 2018). The novelty of our study is the fact that we combine bibliometric techniques and content analysis using an interdisciplinary approach to explore the integration of both domains of research (CSR and OHS) in depth.

With this purpose, we have analysed the patterns and trends in CSR and OHS literature from 1995 to 2018 in order to identify potential research directions to consolidate the field. Our study comprises 289 publications on CSR and OHS covering 932 authors, 142 journals, 489 institutions and 53 countries worldwide. Diverse types of indicators have been used in order to describe the structure of the field and the evolution of the production. Based on the bibliographic data mapping we present a bibliometric analysis contemplating the scientific journal included in Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCI-Expanded) on diverse research areas. Complementary, we have employed a co-word analysis to obtain information about additional emergent research streams and the link to unite them.

The multidisciplinary nature of the CSR and OHS explains the diversity of categories in this area of research. The most relevant domains are related to health, occupational health, corporate social responsibility, sustainability, safety, performance, management and occupational stress. The most productive research areas of the journals examined are: Science & Technology – Other Topics, Engineering, Sciences & Ecology, Operations Research & Management Science, Business & Economics or Social Sciences – Other Topics.

The evolution in the number of publications towards a more technical profile is worth noting. During the first period of time identified,

approximately 45% of publications belong to research areas related to social aspects such as Psychology, Sociology, Social Work or Women Studies. Whereas in the last period, publications centered on Engineering, Operations Research and Management Science, Science Technology, Environmental Science Ecology have increased up to 57.82% with respect to the first period.

Within the potential areas for further research identified, the most notable fields refer to psychosocial risks especially in the health sector, Food Risk Management, sustainable development, supply chain management, Life Cycle Assessment or management systems in order to improve working conditions. Regarding the methodology applied, there are a greater number of cross-sectional studies than longitudinal studies, particularly in research addressing occupational health issues. Furthermore, there is a lack of research, which takes into consideration the employees' or workers perspective; this can be addressed in future research with more qualitative studies.

When it comes to research that analyses psychosocial risks, it can be said that these represent a significant problem particularly in the health sector. It is noteworthy however, that among the sectors examined in our study, the health sector is the one that has attracted the least attention. Few studies have been found that contemplate that CSR policies are helpful to reduce psychosocial risks, especially in this sector. More work is needed on the implementation of this type of initiatives to reduce psychosocial risks, applied at all hierarchical levels. It has become more necessary than ever to study these risks since health care workers worldwide are exposed to the coronavirus (COVID-19). Workers are experiencing high levels of risk of developing adverse mental health outcomes, affecting their decision-making and concentration capacity (Dhama et al., 2020).

Moreover, particular attention should be paid to the emergence of new risks associated with the development of new professions, which are more sustainable and affect the emerging green-collar workforce. The existing research examining socio-demographic profile and health conditions of such workforce uses the U.S as the main research setting and the findings are not disaggregated by sectors. Future studies should explore other geographical contexts and compare the exposure and health of these workers among sectors in order to identify gaps in OHS.

Continuing with the research setting of the articles analysed, countries such as China, India or Italy are the research settings most examined regarding sustainable development. There is also a growing concern on topics connected to food safety and risk management and their relationship with CSR policies, mainly in countries such as China. Future research could study the relationship between FRM and CSR in other western geographical locations with different cultural levels. Particular attention should be paid to a phenomenon related to the relocation of hazardous industries, such as the chemical or automotive industry. Due to lack of or deficient health and occupational regulations (Velázquez et al., 2008; Park et al., 2009), global occupational health risk levels are not reduced, but transferred from developed to developing countries. It is necessary to conduct more research regarding the OHS legislation in developing and low-income countries, focusing on their specific deficiencies and proposing lines of improvement.

We have also identified a lack of research on the standard ISO 45001 (ISO, 2018), which replaces the old OHSAS 18001. There is a need for further study to explore how the application of this recent standard improves occupational health and safety in firms, as well as its integration with other management systems implemented in the company.

Another future direction of interest refers to industrial safety. It is necessary to carry out future research combining quantitative and qualitative methods that examine in depth the risk perception, the relationship among those sensibilities and how these can be managed by an adequate safety culture and CSR policies founded on shared values, norms and attitudes of safety.

Additionally, the literature regarding the management of occupational safety has focused on valuing fatality risk by estimating the value of a statistical life (VSL) (Viscusi and Masterman, 2017). This research

stream has received substantial attention; nonetheless the majority of VSL estimations are made for the United States and other developed countries and extrapolated to lower- and middle-income countries adjusting only for income differences (Hammit, 2017). Future studies should contemplate others factors that explain variations in different populations and countries (e.g. life expectancy, access to medical care, age, etc.) to obtain more accurate VSL estimations.

Finally, we have identified that there is scant research about gender in the context of OHS and other aspects linked to traffic safety from an occupational perspective in companies that implement CSR policies. Future research could deal with these themes mainly because traffic accidents at work are a relevant part of OHS since they are considered labour accidents.

Our study presents some limitations. This research is limited to publications provided for only in The Core Collection of WoS database. Even though WoS is the most widely accepted, the most frequently used and largest international database for scientific publications analysis (Yang et al., 2012), there may be publications related to the subject matter that have not been contemplated in this study. Without any doubt, other important databases could be used to perform further bibliometric analysis. An interesting direction for future research would be to consider the use of practical guides, training and specialised books in order to obtain a more comprehensive perspective of the evolution of the integration of CSR and OHS fields.

Another limitation of the bibliometric analysis through WoS, is the omitted information such as the distinction between theoretical and

empirical papers and other details (Nunen et al., 2017). This research has analysed qualitative aspects such as the activity sector, the dimension of the study (cross-sectional or longitudinal) or the methodology used (quantitative study, qualitative study, etc.).

VOSviewer software presents a limitation in terms of visual maps. In particular, words in the co-word analysis map are displayed on screen whereas these words do not appear when the same map image is saved. It does not allow the image with the relationships between individual fields to be saved, making them only visible on the screen when pointed at with the mouse. VOSviewer software makers explain this aspect as a non-superposition question of words that are close to each other in maps (van Eck and Waltman, 2010).

As a continuation of this research, and in line with the limitations it presents, future research, with different bibliometric techniques (for instance a terms analysis or co-citation analysis), may complement our study. In addition, another software could be used that addresses research with qualitative and mixed methods, for example, NVivo Software for qualitative data analyses and the relation between data.

This research opens up new possibilities to uncover important research areas and provides suggestions concerning potential research areas related to the most relevant fields identified in the CSR and OHS literature, drawing attention to methodological and theoretical aspects. Our findings provide the motivation to continue the study of the unexplored issues mentioned above which constitute promising areas of inquiry.

Appendix A

Research areas (Web of Science)

No.	Area of research (WoS)	No.	Area of Research (WoS)
1	Area Studies	14	Psychology
2	Biomedical Social Sciences	15	Public Environmental Occupational Health
3	Business Economics	16	Science Technology Other Topics
4	Development Studies	17	Social Issues
5	Education Educational Research	18	Social Sciences Other Topics
6	Engineering	19	Social Work
7	Environmental Sciences Ecology	20	Sociology
8	Food Science Technology	21	Substance Abuse
9	Government And Law	22	Toxicology
10	Health Care Sciences Services	23	Transportation
11	Legal Medicine	24	Urban Studies
12	Medical Ethics	25	Women Studies
13	Operations Research Management Science		

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