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Bibliometric Analysis of Occupational Health and Safety in Relation to Dynamic System

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Abstract. A popular analysis used to explore scientific data today is to use bibliometric analysis. bibliometric analysis will be carried out by exploring data taken from scopus indexed journals. in addition, visualizing the program is done using the help of the VOSviewer application. The purpose of bibliometric analysis in this study is to determine the development of research related to program coordination. Specifically, this article discusses the development of literature, publication trends, authors, keywords used in the span of the last 10 years (2012-2022). Data were collected from the Scopus database using the keywords "occupational health and safety" "system dynamic" and "system thinking". The results showed that the results of data exploration showed the number of publications per year from 2012 - 2022 as many as 67 citations. Salmon, P.M. is a researcher who has the greatest productivity in these keywords. Then, the country that publishes the most articles with related keywords is Australia.

Keywords. Bibliometric, occupational health and safety, dynamics system

1. Introduction

Technology is currently changing the way humans interact with their environment. The developing information technology forms a system that aims to improve the lives of workers [1]. Companies are required to make complex and continuous improvements. The work system is one of the important factors in the progress of a company and is the main key to success in order to increase productivity, minimize the occurrence of work accidents and occupational diseases, and company efficiency [2]. Ergonomic work systems can support the harmonious relationship between work components such as humans, machines/equipment, the physical work environment [3].

Occupational health and safety (OHS) is a crucial area of concern for workers and employers alike. Workplace injuries and illnesses can have significant human and economic costs, making it essential to understand the factors that contribute to OHS and how to prevent them [4]. In recent years, there has been growing interest in using bibliometric analysis and dynamic systems modeling to study OHS.

Bibliometric analysis involves analyzing the literature on OHS to identify trends and patterns, such as the most frequently cited authors, publications, or topics related to OHS. By examining citation data, bibliometric analysis can provide insights into the impact and influence of academic research, as well as the connections and relationships between different publications or authors. A dynamic systems approach, on the other hand, involves modeling the complex interactions between various factors that contribute to OHS, such as worker behavior, equipment design, and organizational culture. By understanding how these factors interact, researchers can gain insights into the root causes of workplace injuries and illnesses and develop more effective strategies for preventing them.

This paper will explore the potential of combining bibliometric analysis and dynamic systems modeling to study OHS. Specifically, that will be use bibliometric analysis to identify key trends and areas of focus in the literature on OHS, and then use a dynamic systems approach to model the complex interactions between various factors that contribute to workplace safety. By combining these two approaches, it gain insights into the factors that contribute to OHS and develop more effective strategies for preventing workplace injuries and illnesses.

2. Method

2.1. Study Design

A bibliometric study was conducted to analyse data on occupational health and safety implemented using systems thinking and dynamic systems. The data focused on publication year, country, affiliation, author id, citation, index keywords, and journal.

2.2. Stages of article exploration

This study uses bibliometric analysis, which is a procedure to present a clear summary of a large number of scientific studies [5]. The study began by exporting search data from Scopus and then analysing it with VOSviewer to identify the co-occurrence of keywords. Prior to the use of the research strategy and data analysis, exploratory research was conducted to select adequate databases for the proposed purpose and study. The exploratory research utilised data in Scopus on occupational safety and the use of systems thinking and dynamic systems. These databases were selected based on their relevance and global usage in the healthcare field. Database results were compared to determine database selection for the research strategy. The exclusion criteria were within the last 10 years i.e. the time period from 2012 to 2022.

Research strategy by entering the initial keywords in Scopus, namely occupational health, occupational safety, system dynamics, system thinking, resulting in the command (TITLE-ABS-KEY ("occupational health") OR TITLE-ABS-KEY ("occupational safety") AND TITLE-ABS-KEY ("system dynamics") OR TITLE-ABS-KEY ("system thinking")).

The explanation of the use of Boolean AND and OR is as follows :

- The Scopus data search is focused on the command occupational health OR (OR) occupational safety. The use of OR is intended to obtain broad keywords in relation to occupational health or safety.
- Scopus data searches are focused on occupational health or safety AND (AND) system dynamics or system thinking. The use of AND is intended to obtain occupational health and safety assessments that use problem solving tools with system dynamics or system thinking.
- Scopus data search is focused on the command system dynamics OR (OR) system thinking. The use of OR is intended to get broad keywords in relation to system dynamics or system thinking.

The stages in data collection can be described with the following flowchart :

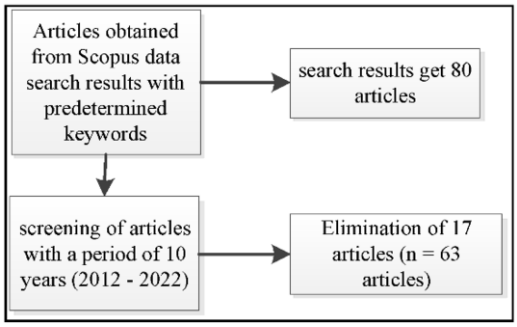

Figure 1. Stages data collection.

The boolean result obtained after eliminating some conditions is :

(TITLE-ABS-KEY ("occupational health") OR TITLE-ABS-KEY ("occupational safety") AND TITLE-ABS-KEY ("system dynamics") OR TITLE-ABS-KEY ("system thinking")) ANDNOT ((PUBYEAR = 2011 OR PUBYEAR = 2010 OR PUBYEAR = 2009 OR PUBYEAR = 2008 OR PUBYEAR = 2007 OR PUBYEAR = 1999 OR PUBYEAR = 1974)) AND (EXCLUDE (PUBYEAR , 1974) OR EXCLUDE (PUBYEAR , 1999) OR EXCLUDE (PUBYEAR , 2007) OR EXCLUDE (PUBYEAR , 2008) OR EXCLUDE (PUBYEAR , 2009) OR EXCLUDE (PUBYEAR , 2010) OR EXCLUDE (PUBYEAR , 2011) OR EXCLUDE (PUBYEAR , 2023))

2.3. Bibliometric

Bibliometric research will be used to look at the usage patterns and development of literature as a source of information on a topic. Bibliometric applications are then divided into two, namely: 1) calculation of bibliometric indicators (performance) at different behavioral levels; and 2) analysis and visualization of bibliometric networks [6].

Bibliometrics includes two types of research: descriptive research and evaluative research. Descriptive studies analyze the productivity of articles, books, and other formats by examining authorship patterns such as collaboration rates, author productivity, institutions where authors work, and author subjects. Evaluation studies are used to analyze literature usage by counting references or citations in research articles, books, or other formats.[7]

3. Result and Disscussion

3.1. Result

The data obtained from entering keywords in Scopus showed that there were 67 final articles that were then explored. Most documents were published by Australia (with 21 documents), followed by the United States (14 documents), China (13 documents), the United Kingdom (8 documents), Canada (3 documents), and other countries. As for Indonesia, only 1 relevant article was found.

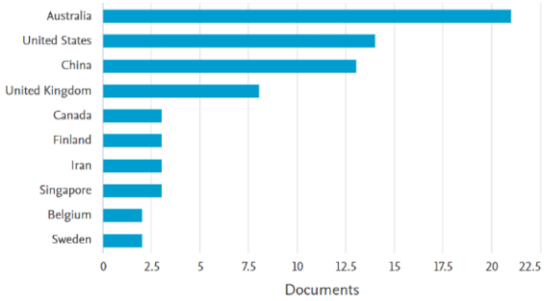

Figure 2. Literature data by country.

Journal titles obtained from the screening process in the past 10 years (2012 - 2022) experienced an increasing trend. The significant and fluctuating development is depicted in Figure 3

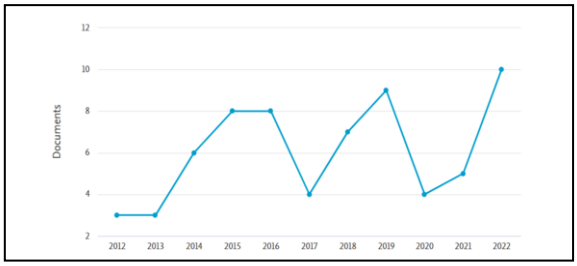

Figure 3. Literature data trend about OHS and dynamics system.

Based on the trend in the number of articles, it can be concluded that there is an increase, although not significant. A significant increase occurred between 2013 and 2016 with a total of 25 articles. However, from 2017 to 2021, this trend tends to decline. This is evidenced by the fact that in these 5 years there were only 25 articles. In 2022, there was a significant increase, namely there were 10 articles that studied it.

The subject area in the data search results is visualized in Figure 4, in this subject area it was found that the research area in engineering and social sciense has the same percentage of 26%. while for the next area medicine is with a total percentage of 25%. for other subject areas, namely the categories of health professionals, environmental, business, computer science.

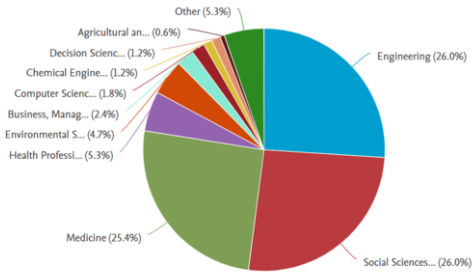

Figure 4. Subject area

Characteristics in a particular field and related documents will be represented by the author and related keywords. The author will create keywords in the journal system and the keywords become the Scopus database system. The most frequently occurring author in the selected articles and presented in the form are visualized in Figure 5.

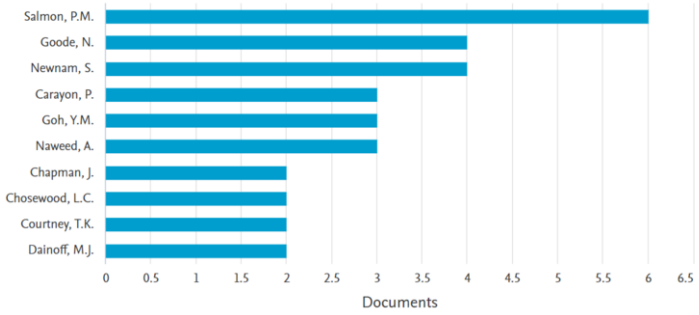

Figure 5. Author's most frequent keywords.

Author keywords are created by the author in the journal system and index keywords are created by the Scopus database system. The data shows that the 67 articles have many different keywords. Based on the 67 data that have been obtained from Scopus, keyword analysis is then carried out using VOS Viewer. Setting the minimum number of keyword occurrences is 2 which then produces 26 thresholds of 150 keywords. From the results of working with VOS Viewer, it is found that the keywords that are often used are system thinking, system dynamics, safety management, construction.

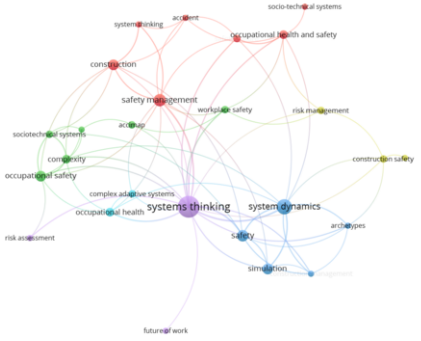

Figure 6. keyword clustering

Items that look the same indicate that there is a density of clusters. Each point of the label will have a different color. This identifies that the color of a point on the map depends on the number of items associated with other items. This section is very useful to get an idea of the general structure of the bibliometric map with respect to the items that are considered important to analyze. A visualization of the co-word density map of research progress from 2012 to 2022 can be seen in the following figure 6.

The keyword terms that appear frequently and are relatively close to each other on the map can be represented in the form of clusters. There are six clusters displayed as in table 1 below

Table 1. Clustering result

Cluster 1	Cluster 2	Cluster 3	Cluster 4	Cluster 5	Cluster 6
Accident	Accimap	Archetypes,	Construction	Future of	Complex
Construction	Complexity	construction	safety	work	adaptive
Occupational	Occupational	management	Risk	Risk	systems
health and	safety	Safety	management	assessment	Occupational
safety	Sociotechnical	Simulation	Safety	System	health
Safety culture	systems	System	behaviour	thinking	
Safety	Systems theory	dynamics			
management	Workplace				
Socio-technical	safety				
systems					
System					
thinking					

3.2. Disscussion

3.2.1. Occupational Health and Safety (OHS)

Occupational Health and Safety (OHS) is a discipline concerned with protecting the safety [8][9][10][11][12][13], health [5][14][9][12][15], and well-being of employees and others who may be affected by the work environment [16]. It involves identifying and controlling hazards [17][18][19][20][21][22][23] in the workplace to prevent accidents and injuries, as well as promoting a culture of safety and healthy work practices. There are many benefits of having strong occupational health and safety practices in place. For example, it can help to reduce workplace accidents and injuries [24][25][26][27][28][29][30], which can lead to a decrease in lost work time and increased productivity. It can also improve employee morale and job satisfaction, as workers feel that their employer cares about their well-being.

Effective OHS programs involve several key elements, including hazard identification and risk assessment, safety training and education [31][32], and ongoing monitoring and evaluation of safety performance. Employers also need to provide appropriate protective equipment and ensure that employees are using it properly.

There are many laws and regulations governing occupational health and safety [32][33][19], which vary depending on the country and industry. Employers have a legal and moral responsibility to ensure that their workers are safe and healthy while on the job. There are several potential areas for future research in occupational health and safety, including:

1. The impact of emerging technologies on workplace safety: With the rapid pace of technological change, there is a need to better understand how new technologies such as automation, artificial intelligence, and robotics are affecting workplace safety

2. The role of organizational culture and leadership in promoting safety: While many workplaces have established safety policies and procedures, the effectiveness of these measures can depend on the culture and leadership of the organization.
3. The impact of the changing nature of work on safety: The rise of the gig economy and flexible work arrangements are changing the nature of work, and may have implications for workplace safety.
4. The impact of occupational health and safety on worker well-being: While the primary goal of occupational health and safety is to prevent workplace accidents and injuries, there may also be broader impacts on worker well-being.
5. The role of data analytics in improving workplace safety: With the increasing availability of data on workplace accidents and injuries, there is potential to use data analytics to identify trends and patterns that can inform safety policies and procedures.

3.2.2. Dynamic system

A dynamic system is a system that changes over time, where the behavior of the system is determined by its past and present states. Dynamic systems can be found in a wide range of fields, including physics, engineering, biology, economics, and social sciences [34][21][29] [24][35][14][36][27][37][20][38][39][40][41][42][43][44][45]. The behavior of dynamic systems is typically described by differential equations or difference equations, which represent the rates of change of the system's state variables. The state variables of a dynamic system represent the system's current state, and their values change over time according to the system's behavior.

One key aspect of dynamic systems is that they can exhibit complex behaviors that are difficult to predict or understand. These behaviors can arise from feedback loops, nonlinearity, and sensitivity to initial conditions. As a result, dynamic systems are often studied using computational modeling, simulation, and analysis techniques. One important concept in the study of dynamic systems is stability, which refers to the tendency of the system to return to a certain state after being disturbed. A system is said to be stable if it returns to its original state over time, while an unstable system can exhibit chaotic or unpredictable behavior.

Dynamic systems are also often characterized by their attractors, which are states or patterns that the system tends to converge towards over time. Attractors can be fixed points, periodic orbits, or chaotic attractors, depending on the behavior of the system. The study of dynamic systems has many practical applications, such as in the design and control of complex engineering systems, the modeling of biological and ecological systems, and the analysis of economic and social phenomena. Overall, the analysis of dynamic systems is a powerful tool for understanding the behavior of complex systems over time, and has many important applications in science and engineering.

4. Conclusion

Bibliometric methodology has gained great popularity lately due to the omnipresence and usefulness of bibliometric software and databases that facilitate the acquisition and assessment of large volumes of scientific data. An important and relatively new application of bibliometrics is in program coordination.

In the context of occupational health and safety, workplaces can be thought of as dynamic systems, where the behavior of the system is influenced by various factors such as the physical environment, work processes, and the behavior of employees. The safety of a workplace can be analyzed using principles from the study of dynamic systems, such as feedback loops, stability, and attractors.

Similarly, the study of dynamic systems can also be applied to other aspects of occupational health and safety, such as the analysis of the spread of occupational diseases or the design of ergonomic workstations. By modeling and analyzing these dynamic systems, it may be possible to identify and control hazards more effectively, and create a safer and healthier work environment.

Overall, the study of dynamic systems can provide valuable insights into the behavior of complex systems, including workplaces, and can be used to improve occupational health and safety.

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