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Changes In The Short-Term Industrial Footprint Optimization Due To The Covid19 Pandemics

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ABSTRACT

Industries play a critical role in the growth of global economic development and transition. Footprint management is the process of systematically evaluating were to generate each of the references in a company's product catalogue. It achieved by examining the strategy's cost-effectiveness, benefit, and help, as well as its versatility in responding to emerging business changes and customer needs. The research in this area is immense as countless factors influence it. Nevertheless, this vast research becomes scarce when tackling industrial footprint optimization and events like the COVID19 appear. The article aims to present a literature review considering the critical issues and urgency for recovery from changes in short-term industrial footprint optimization caused due to the covid 19 pandemic.

Keywords: "Footprint", "Optimization", "Industry 4.0", "Supply Chain", "Covid 19 Pandemic".

1) Introduction

Industries play a vital role in the growth and transformation of global economic development. Footprint optimization can be defined as the systematic evaluation of reviewing were to produce each of the references of its product catalogue[1]. It is done by analyzing the cost-effectiveness, benefit, and support of its strategy, flexibility in adapting to the new market changes, and most importantly, customer's requirement[2][3]. The research in this domain is vast as various factors influence it e.g.: up-grading technology or implementing new technology, digitalization of industry and logistics - supply chain, carbon footprint, environmental and social responsibility, and international trades and contracts[4][5]. The fundamental question "what should be made, where?" helps expand its value and profitability. Due to the current economic downfall, various organizations seek ways to incline their growth. By examining these factors, industries can adopt the strategic approach to how, why, and where the resource can be implemented to improve operating flexibility and profitability. According to Didi [4], footprint optimization should be considered in following cases:

1. Expansion of the industry
2. Upgrading to the latest product mix
3. Deep market slumps
4. Merging or acquisitions of the industry
5. Upgradation of the industrial revolution

As major slump, industries and other business organizations have faced huge issues due to the outbreak of the covid-19. Widespread pandemic or epidemic has a substantial negative impact on the supply chain; in return has caused severe

disruption across the globe[6][7]. According to the world health organization, 1438 epidemic outbreaks have happened between years 2011 - 2018. However, the covid-19 pandemic has impacted worse, diversified, and dynamic outbreaks compared to any other epidemic. When compared to other previous outbreak, covid-19 has disrupted all the nodes and edges in the supply chain[8]–[10].Within this context, the novelty of this research is to analyze the model, or framework, or roadmap for change that's happened in the short and mid-term industrial footprint optimization due to the novel coronavirus (covid 19). The remaining article is organized as follows: Section 2 outlines the research framework for conducting the systematic literature review. Section 3 describes the steps involved in the article screening process. Section 4 summarizes the literature review and finally, section 5 discusses the consequences of these most important findings to propose how to tackle them.

2) RESEARCH FRAMEWORK

In this paper, a systematic literature review (SLR) has been followed in an attempt to answer the research question. SLR has been proved to be a meticulous method for literature review[8]. This method makes the research more consistent, transparent, and logical.

Figure 1 illustrates the search methodology adopted for the research.

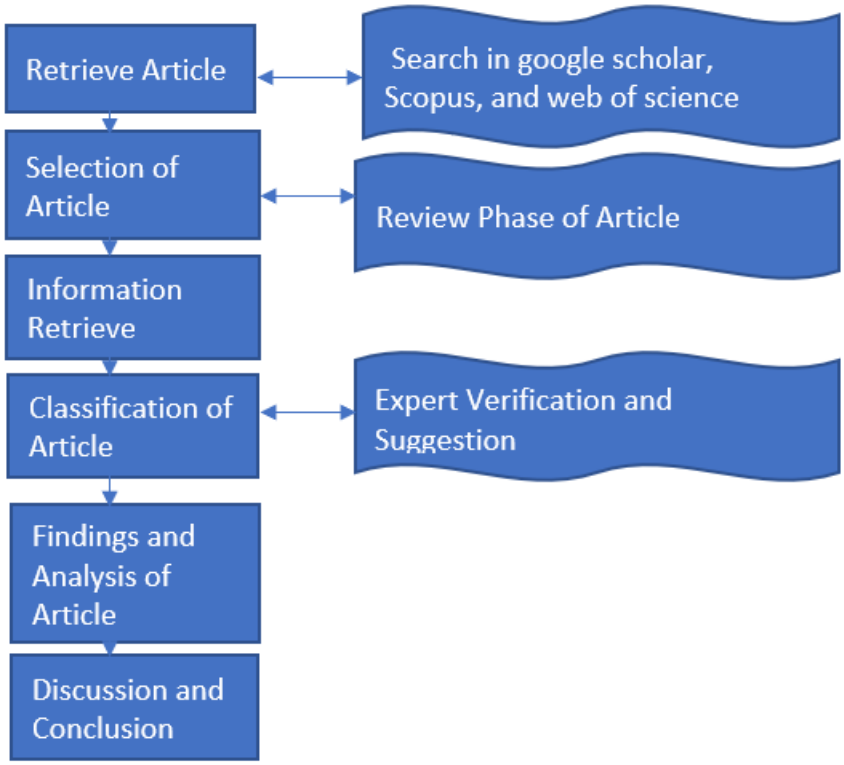

Figure 1 Search Methodology

The review process starts with collecting and preparing data from multiple research databases (Scopus, Google Scholar, and Web of Science). Articles published online, review articles, and short notes were also considered. Keywords used to search the article are "Footprint", "Optimization", "Industry 4.0", "Supply Chain", "Covid 19 Pandemic". This is followed by the article's inclusion and exclusion depending on one or more keywords. finally, articles selected were classified and analyzed for further related research questions. The entire review process of the article involved researchers and expert researchers to validate the classification process.

3) ARTICLE SCREENING METHOD

The article screening process illustrated in Figure 1 involves the following steps, retrieval of the

article and selection of article which are explained below.

Retrieval of Article

This section describes the process involved in the retrieval of the article. The initial phase involves the article retrieval process. To conduct the SLR, the first step involves the selection of databases. The most popular database in context to academics is Scopus, web of science, and google scholar. Mostly all the journals and conference proceedings are available in these databases.

The next step involves formulating the search string, which includes the synonyms related to footprint optimization and supply chain due to the covid 19 pandemic. The search string involved for databases is as follows.

Table 2 Search string: keywords and synonyms

Footprint Optimization	Supply Chain
Sustainability	Covid 19
Industry 4.0	Short-Term
Technology 4.0	
Carbon Footprint	
Manufacturing Footprint	

The section involves the search string on Scopus, the web of science, and google scholar to retrieve the total article. The research article is collected from recent years (2011-2021) in all the databases. This resulted in the following number of manuscripts found (see Table 3):

Table 3 Documents Extracted

Scopus	**Web of Science**	**Google Scholar**
Conference Paper	Conference Paper	Conference Paper
Articles	Articles	Articles
Article in Press	Article in Press	Article in Press
Note	Note	Note
Review	Review	Review

Selection of Article

This section involves a rigorous screening process of the article by the researchers to select relevant papers to address the research questions. The screening process involves different phases, as shown in figure 2.

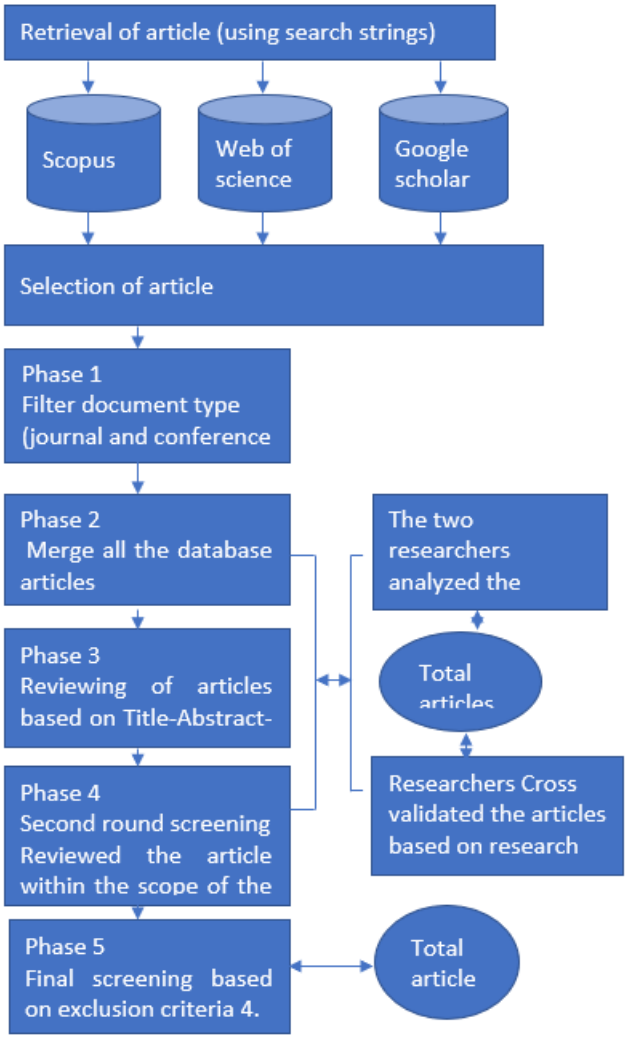

Figure 2 Screening Process

In phase 1, the articles are filtered according to the document type regarding certain inclusion and exclusion criteria in databases. These inclusion and exclusion criteria are respectively illustrated in Tables 4 and 5.

NUMBERS	CRITERIA	REASON FOR INCLUSION
1	No time constrain.	Understanding the impact of covid 19 on footprint optimization and supply chain to analyze the research questions.
2	Finding, journal, articles, and conference proceedings in all the databases. (Scopus, web of science, google scholar)	Most of the Research relevant articles are indexed in these databases.
3	All industries and countries.	To prevent any bias during the literature review.
4	Application of research in industrial footprint optimization.	To identify stages and changes due to the impact of covid 19 in footprint optimization.

5	Research conducted in context to overcome the changes in footprint optimization due to covid 19.	To understand and examine the issues that occurred and analyze the methods to overcome the change that occurred due to covid 19.

Table 4 Inclusion Criteria

Numbers	Criteria	Exclusion Reason
1	Grey literature.	To specify the scientific reliability of the literature review
2	Non-English articles.	To avoid any kind of barrier while filtering the articles
3	articles that are not relevant to the research area.	As the study concentrates on optimization of footprint, changes due to impact of covid 19.
4	Theoretical research discussion and frameworks.	To make sure methods are appliable in analyzing the changes that occurred in the short-term due to covid 19

Table 5 exclusion criteria

In phase 2, the articles from all the databases were merged into a single database. They then eliminated unessential articles, considering unessential, for example, articles containing the word Industry 4.0 but not developing anything related to that topic. In phase 3, analyzed articles according to the "title-abstract-keywords" following the inclusion and exclusion criteria. The initial phase was carried out in two sub-phases. Researchers analyzed articles in context to the research area and then cross-validated the total journal articles and conference findings.

In phase 4, similar method inclusion and execution criteria are considered. The researchers first studied and analyzed the articles within the research area's scope, then excluding irrelevant articles by reading titles, abstracts, full papers, and keywords. Inclusion criteria focused on articles related to industrial footprint optimization and recent changes in the short term due to the covid 19 pandemic. The researchers cross-validated the total journal articles and conference findings.

Lastly, phase 5 involves scanning the articles following the exclusion criteria in phase 4. The purpose is to include studies related to changes and issues faced in footprint optimization of industry and supply chain due to covid 19 pandemic and validate the changes that occurred.

4) Summary Of The Literature Review

This systematic literature review aims to define the short-term changes in industrial footprint optimization due to the covid 19 pandemic. According to the research framework, selected total articles 3434from both journals and conference proceedings. The article was classified based on recent short-term changes and issues in industrial footprint optimization due to covid 19. Most of the article findings discuss the impact of covid 19 and changes that occurred in the industry. The review conducted focuses on addressing the research questions in the form of findings of the related articles by presenting the overall trend in industrial footprint optimization. The study period was considered from the year (2011-2021). our study emphasizes the short-term changes and offers direction to advance the literature on the impact of covid 19 in industrial footprint optimization. The reviewed articles

shed light on challenges and strategies to overcome the impact of covid 19 in industry.

Retrieval of article process

Specifically, the search strings used to find articles in Scopus, web of science and google scholar were the following ones.

1) Search String for Scopus

KEYWORDS: "Footprint", "Optimization", "Industry 4.0", "Supply Chain", "Covid 19 Pandemic".
Language :(English)

2) Search string for the web of science

KEYWORDS: "Footprint", "Optimization", "Industry 4.0", "Supply Chain", "Covid 19 Pandemic".
Language :(English)

3) Search string for google scholar

KEYWORDS: "Footprint", "Optimization", "Industry 4.0", "Supply Chain", "Covid 19 Pandemic".
Language :(English)

Figure 3 Word Cloud for keyword Search

Figure 3 illustrates the word cloud for the keyword search for short term changes in industrial footprint optimization.
These searches collected the articles summarized in section 3.

Selection of articles

This section describes the classification of articles based on the research question RQ1. The articles were reviewed on recent research conducted in context to the impact of short-term changes in industrial footprint optimization due to the covid19 pandemic. The articles shed lights on the issues related to supply chain, industry 4.0, sustainability, the most affected area in industry and urgency to recovery.

RQ1) What are the area's most been affected and short-term changes due to covid 19 in industrial footprint optimization?

5) Analysis and findings

The paper describes the spread and impact of novel coronavirus (covid 19 pandemics) supply chain-related issues., the most article sheds light on the absence of the literature review regarding the problem related to supply chain due to covid 19. The findings reveal the impact of covid 19 pandemic on supply chain, resilience strategy for managing effects and recovery, the role of technology implementing resilience strategies, and supply chain sustainability in light of the pandemic[8], [11]–[13].

6) Discussion and future directions

Short-term changes in industrial footprint optimization were unexpected. Industries demand, workforce availability, and supply worldwide have been affected at the same time[14][15]. Most industries are experiencing disruption in the supply chain, raw materials, social distancing, and employee safety. Some of the industries lack the digital tool to work remotely. As soon as expected, some competencies will be needed, for instance, Digital Twins-VR-AR for remote training and actions, which would help the manufacturing industry overcome onsite workforce shortage[16][17]. Implementation of technologies like artificial intelligence, IoT, industry 4.0, Big data, cloud computing, supply chain resilience, human-robot collaboration, Technology 4.0 could play an important role in the industry by ensuring workability and recovery during a crisis like the covid19 pandemic and achieve the goal of the "smart industry" [14], [15], [18]–[33].

7) Conclusion

This paper presents the changes in the short-term industrial footprint optimization due to the Covid19 pandemics. For that, the manuscript presents systematic literature on the topic. The main changes related to the effects of the

pandemic regarding footprint optimization have been presented. The most important points discovered can be summarized in these:

The selected journal and conference proceeding articles discuss the impact of the covid 19 crisis. The journals focus on issues related to operation process, sustainability of the industry, workforce shortages in the industry, supply chain, logistics and focuses on what method or model or technologies could be implemented and provide future research opportunities.

The work developed in this research may be valid not only for the Covid case but for any of the short-term changes affecting Industrial Footprint Optimization, such as shortages in supplies for the industrial production (e.g., [34])

Further research will be oriented to develop a model to better prepare our organizations for tackling a redesign of the industrial footprint optimization for short-term changes.

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