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Systematic Review

A Systematic Literature Review on Addressing Challenges in Operations Management Considering Industry 3.0–6.0 Based on PRISMA Framework

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Abstract

The cutting-edge era emphasizes developing key solutions to improve productivity and promote economic growth within limitations. To achieve this, the production management team employs various process improvement approaches to empower operations management. The aim of this article is to examine the recent trends in operations management scenarios in which industry professionals seek an ingenious path for selecting process improvement approaches through a systematic literature review. The study employed the PRISMA framework for a systematic literature review of 176 papers published from 2000 to 2026. The key finding shows the methodologies used for operations management scenarios, considering Industry 3.0–6.0. The methodologies include traditional approaches, concurrent approaches, data-driven assessment, real-life assessment for competent approaches, and sustainable approaches. The study focused on identifying obstacles to selecting and implementing a suitable decision-making process improvement approach to mitigate operations management issues in the Industry 3.0–6.0 work environment. These obstacles are recognized as several challenges and problems that arise on the shop floor and reduce the organization's sustainability. This study identifies an emerging research area: the development of innovative, AI-driven operations management platforms for flexible, emerging work settings.

Keywords: Industry 4.0; Industry 5.0; lean manufacturing; operations management; sustainability

Academic Editor: Koichi Murata

Received: 30 March 2026
Revised: 2 June 2026
Accepted: 3 June 2026
Published: 18 June 2026

1. Introduction

Emerging process improvement is a key principle in Industry 3.0–6.0, aimed at enhancing productivity levels on the production shop floor. Process improvement principle is primarily applied to production systems to address workflow issues [1,2]. Process improvement refers to approaches used for tackling the organization's performance-related issues on the shop floor. There are several approaches used in organizations including lean manufacturing (LM), kaizen, smart manufacturing, circular economy, digital kanban, radio-frequency identification systems, artificial neural networks (ANN), fuzzy logic, deep learning, digital twin, augmented reality, and machine learning (ML), which are implemented as process improvement approaches in Industry 3.0–6.0. The primary goal of the process improvement approach is described in Figure 1. A process improvement approach helps identify the source of issues, suggest a suitable path to address them, and enhance outcomes for the concerned organizations. The figure illustrates the aim of process improvement approaches in the organizational context, with a focus on the shop floor.

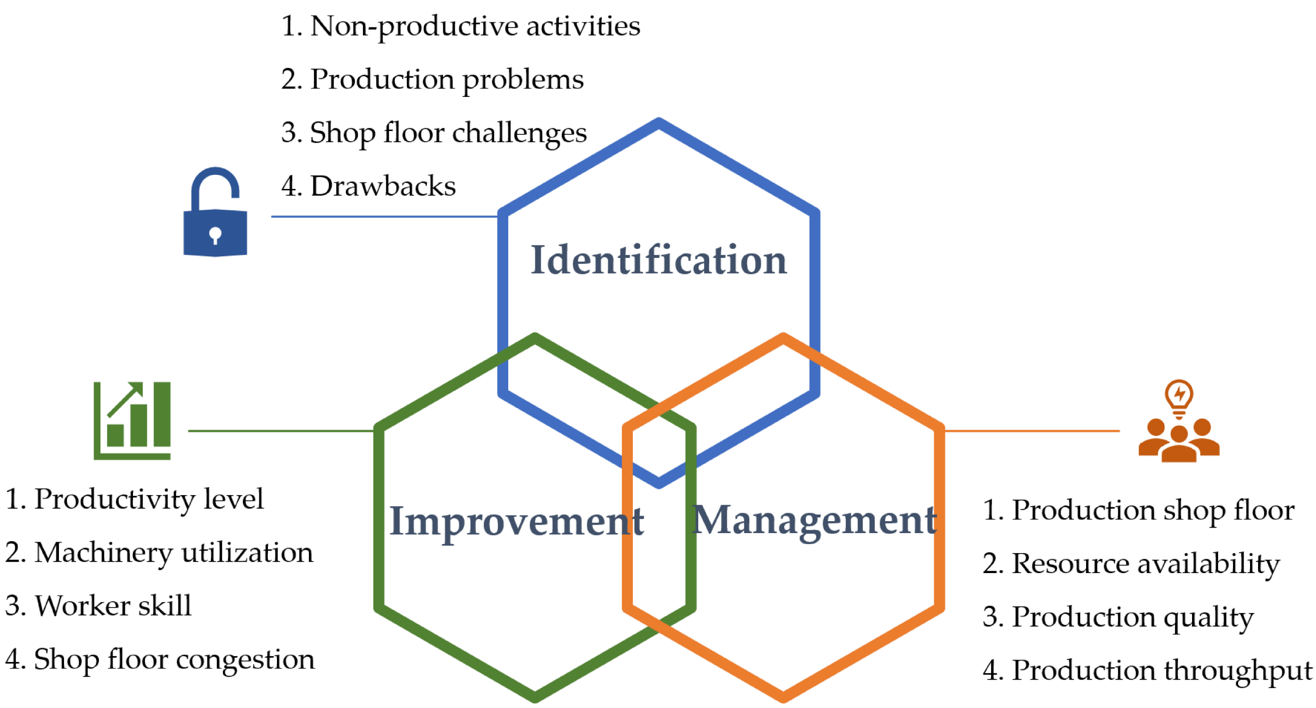


Figure 1. Objective of process improvement approach.

The process improvement approach enhances industry professionals' ability to manage the production operations system [3,4]. A thorough analysis of the production conditions determines a suitable process improvement approaches. The analysis is performed by organizational teams, who review operational scenarios, factors, problems, and challenges [5]. Several essential factors are analyzed to identify a suitable approach, including resource availability, machinery performance, financial conditions, environmental conditions, and ergonomic issues. Waste is primarily responsible for delays in product delivery, equipment malfunctions, manufacturing errors, workforce negligence, haphazard material flow, and financial deterioration in organizations. Figure 2 illustrates the causes and consequences of negligence of challenges in operations management. These reasons affect the organization's performance and are addressed through systematic tracking of its elements, including the workforce, machinery, methods, and materials.

The primary goal of the process improvement approach is to analyze existing data on both expected and unexpected shop-floor conditions at the start of production. Expected conditions indicate visible evidence of waste causes, while unexpected conditions reveal hidden demerits through thorough analysis. The expected conditions are analyzed through an extensive literature review, and unpredictable conditions are examined using various sources, including industry visits, shop-floor observations, discussions with workers, and interactions with professionals. The elaboration of both conditions is discussed through an analysis of previous research and illustrated in Table 1.

https://doi.org/10.3390/su18126286

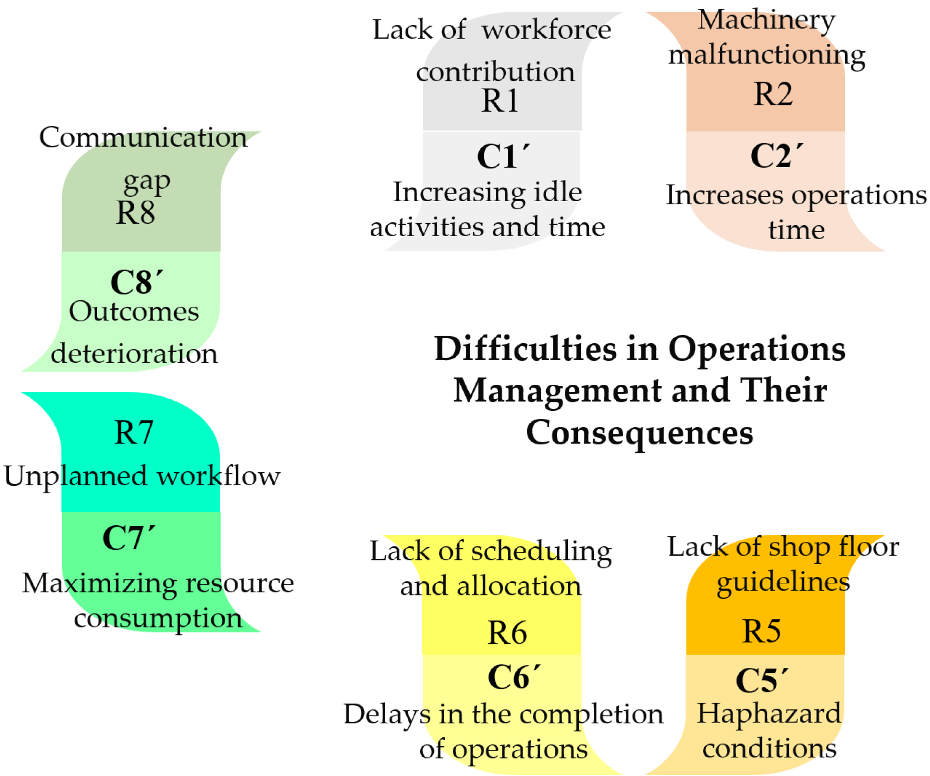


Figure 2. Reasons for waste reported in the previous studies (R refers to the reason, and C refers to the consequences).

Table 1. Analysis of shop-floor conditions.

Expected Condition	Author
Machinery malfunction	Mwanza et al. [6]; Chien et al. [7]
Lack of layout	Saqlain et al. [8]
Poor design	Das et al. [9]; Mittal et al. [10]
Higher inventory level	Masuti et al. [11]; Singh et al. [12]
Defect	Bertolini et al. [13]; Sahoo et al. [14]
Higher lead time	Liao et al. [15]
Lack of workers' skills	Jeyraj et al. [16]; Esa et al. [17]
Unexpected Condition	**Author**
Lack of worker contribution	Rahman et al. [18]
Poor material handling system	Frankó et al. [19]
Lack of workload distribution	Chen et al. [20]; Garee et al. [21]
Ergonomics issues	Santos et al. [22]
Error in production planning	Priya et al. [23]; Gaspar et al. [24]
Service outsourcing	Tripathi et al. [25]; Kenyon et al. [26]
Congestion on the shop floor	Das et al. [9]

To address the problems and challenges arising from these shop-floor conditions, process improvement approaches are implemented. Lean manufacturing is one of the predominant approaches in industry for improving shop-floor management [27,28]. The lean philosophy can enhance productivity in sectors with limited financial resources [29]. Nowadays, the management system emphasizes the development of a new sustainable approach for production control [30]. To fulfill this demand, new techniques are being used in shop-floor management to enhance productivity. Over the last five years, Artificial Intelligence (AI) has attracted the attention of researchers and industry professionals, as it has proven capable of influencing productivity [31,32]. AI is a robust approach that behaves in a manner consistent with human nature [33]. AI is primarily used on the production shop floor for predictive and analytical purposes. It receives information tasks and transmits them via electrochemical media. Machine learning is used as a process improvement approach to monitor the unexpected shop-floor environment [34]. The primary goal of machine learning is to align shop-floor scheduling, productivity, and quality [35]. Fuzzy helps the management team implement an efficient approach on the production shop floor, providing a systematic strategy to operate activities according to guidelines [36]. In addition, other emerging technologies were used to address issues across different work scenarios. It has been observed that the management scenario for Industry 3.0–6.0 requires a revolution in how process improvement is implemented. This can be achieved by making some changes to working practices and methodologies. Researchers and industry professionals are focusing on solving this problem and developing a suitable, sustainable approach to process improvement. In the current scenario, organizations seek to track the real-time operations management performance and trace the issues on the work floor. However, previous studies have highlighted contemporary methodologies and thematic strategies used in operations management revolution scenarios, where shop-floor settings are frequently revised to meet consumer and market needs. These were descriptive and generalized, lacking deeper conceptualizations and real-world analysis.

The present study reviewed the methodologies used by researchers and industry professionals to track and control operations management outcomes across different shop-floor scenarios. The methodology refers to selecting an appropriate path to track and tackle the performance of the process and activities in organizations. Industry professionals always prefer a competent methodology implementation tailored to challenges and real-world work-floor conditions, characteristics, and needs. In the current scenario, industry professionals operate in a hybrid work environment with a variety of operations management settings and process improvement approaches. The settings and approaches are adjusted to meet the needs of Industry 3.0 through 6.0. The challenges were implementing suitable methodologies to mitigate operations management issues in a flexible shop-floor environment where workstation settings changed dynamically. Industry professionals were seeking innovative problem-solving approaches to tackle hybrid, settings-driven operations management platforms. The review helps in understanding the methodologies adopted by operations management teams to address challenges, mitigate waste, and improve working conditions in Industry 3.0–6.0. Therefore, this study reviews methodologies for avoiding organizational obstacles across several shop-floor settings, including Industry 3.0–6.0. The investigation is crucial for identifying research gaps and the current state of barriers faced by organizations in adopting innovative operations management platforms. The following questions are designed to generate insights and advance current process improvement approaches in operations management.

RQ1. What are the trends in the articles, publishing years, country, publishers, and organizations?

RQ2. Which methodologies are primarily supported for addressing obstacles across different work settings, including Industry 3.0–6.0?

RQ3. Which integration of process improvement approaches strengthens operations management and is preferred in achieving sustainability in organizations?

There are four sections in the current study. Section 1 describes the background, process improvement approaches, operations management issues, shop-floor conditions, and research gaps. Section 2 outlines the research methodology and the sources of literature. In this section, the PRISMA method is used to conduct a systematic review of the challenges and process improvement approaches in operations management across Industry 3.0–6.0. Section 3 describes the summary and discussion. Finally, Section 4 presents the study's conclusion and contributions, along with implications for future research.

2. Materials and Methods

The materials and methods used in the current study comprise a systematic literature review using the PRISMA framework. The analysis explores process improvement approaches and trends in operations management across Industry 3.0–6.0 work platforms, and investigates the challenges and issues in maintaining excellence and sustainability across different shop-floor settings. The present study conducted a literature review in accordance with the PRISMA statement. PRISMA's preferred reporting items are a 27-item checklist used to improve the transparency of literature reviews [37] (Table S1).

2.1. Data Source

The study used SCOPUS and Google Scholar to review the literature in the same domain published from 2000 to 2026. The research selection process was based on different criteria and domains, including case studies, empirical studies, exploratory and descriptive studies, operations management, shop-floor management, Industry 3.0, Industry 4.0, Industry 5.0, Industry 6.0, and process improvement approaches. The research study focused on the implementation of process improvement approaches in different sectors and operational conditions. The literature search was conducted using research databases, including Scopus and Google Scholar. The literature search aimed to identify studies on process improvement approaches for addressing the challenges in Industry 3.0–6.0. The following Boolean strings were used: ("operations management" OR "industry 3.0"), AND ("Operations management" OR "industry 4.0") AND ("Operations management" OR "industry 5.0") AND ("Operations management" OR "industry 6.0"), AND ("Operations management" OR "process improvement approaches"). The study aims to provide a concise analysis of the approaches used by industry professionals and researchers in operations management. The search focused on English-language research articles in the engineering field published from 2000 to 2026. A total of 9194 articles were found in the Scopus and Google Scholar databases using keywords such as process improvement approaches, Industry 3.0, Industry 4.0, Industry 5.0, Industry 6.0, and process improvement approaches in operations management.

2.2. Data Screening and Exclusion Criteria

The selected studies were assessed using keywords, titles, and abstracts to identify potentially relevant research. The screening was conducted by more than one reviewer. The articles were evaluated against the criteria, as well as the domains and sectors in which process improvement approaches were used. The bibliography analysis helps analyze information from PRISMA-based articles [38]. The approach involves identifying research through a suitable assessment aligned with the present objectives, screening the appropriate studies, and including them. Table 2 lists the keywords used to retrieve articles. To maintain consistency and relevance in the literature selection process, inclusion and exclusion criteria were established. The inclusion criteria are: journal and conference articles published between 2000 and 2026; English-language publications; and research studies focused on process improvement approaches used in Industry 3.0–6.0. The exclusion criteria included: book reviews, book chapters, duplicate records, non-English publications, studies unrelated to the research objective, and articles lacking an appropriate methodology or sufficient empirical evidence. These criteria were used during title screening, abstract screening, and full-text review stages.

Table 2. Details of the keywords and the domains.

Keywords	Engineering	Journal	Conferences	English	Total
Operations management, Industry 3.0	310	199	80	256	922
Operations management, Industry 4.0	1581	696	585	1214	3136
Operations management, Industry 5.0	403	223	108	308	1096
Operations management, Industry 6.0	164	107	49	144	527
Operations management, process improvement approaches	1743	832	713	1461	4096

The study categorizes the methodologies used in identified related research articles to facilitate analysis and synthesis. The classification focused on key dimensions, including research objectives, methodological approach, technological status, and reported outcomes. There are six keywords used in the literature acquisition, including operations management, process improvement approaches, Industry 3.0, Industry 4.0, Industry 5.0, and Industry 6.0. The initial search on Scopus and Google Scholar, using the keywords mentioned without any filters, yielded 9194 articles. After that, some filters were applied, including engineering, articles, conferences, publication years, and the English language. The filters used were in accordance with the specific aim of the present study. After applying the filters discussed, 176 articles were found to be suitable and published between 2000 and 2026. Table 3 presents prior research according to the keywords used in the current study.

Table 3. Details of the keywords used in the literature.

Authors	Year	Keywords	Method/Tool/Technique
Braglia et al. [39]	2006	Process improvement	Value stream mapping
Hsu et al. [40]	2007	Process improvement	Shop-floor control strategies
Hodge et al. [41]	2011	Process improvement	Lean manufacturing-
Gurumurthy et al. [42]	2011	Process improvement	Value stream mapping
Jasti et al. [43]	2011	Process improvement	Value stream mapping
Lu et al. [44]	2015	Process improvement	Lean practices
Sharma et al. [45]	2015	Process improvement	Lean practices
Al-Refaie et al. [46]	2016	Process improvement	Fuzzy logic
Kesharwani et al. [47]	2016	Process improvement	Neural network
Askari et al. [48]	2016	Process improvement	Lean tool
Sagnak et al. [49]	2016	Process improvement	Green lean and lean six sigma
Méndez et al. [50]	2017	Process improvement	Total Productive Maintenance
Kumar et al. [51]	2018	Process improvement	Lean-kaizen, value stream mapping
Sreedharan et al. [52]	2018	Process improvement	Lean Six Sigma
Gijo et al. [53]	2018	Process improvement	Lean Six Sigma
Garza-Reyes et al. [54]	2018	Process improvement	Lean methods

Table 3. *Cont.*

Authors	Year	Keywords	Method/Tool/Technique
Kumar et al. [55]	2018	Process improvement	Kaizen, value stream mapping, and Fuzzy TOPSIS
Kumar et al. [56]	2018	Process improvement	Fuzzy Quality function deployment, Fuzzy failure mode and effect analysis
Buddala et al. [57]	2019	Process improvement	Teaching-learning-based optimization
Benda et al. [58]	2019	Process improvement	Machine learning
Dadashnejad et al. [59]	2019	Process improvement	Value stream mapping
Sana et al. [60]	2019	Process improvement, Industry 4.0	Genetic algorithm
Chiarini et al. [61]	2020	Process improvement	Lean Six Sigma and Industry 4.0 technologies
Chiarini et al. [62]	2020	Process improvement	Industry 4.0 strategies
Leong et al. [63]	2020	Process improvement	Lean and green manufacturing, Industry 4.0
Caiado et al. [64]	2021	Process improvement	Fuzzy logic-based Industry 4.0 maturity model
Shao et al. [65]	2021	Process improvement	Smart principle
Liao et al. [66]	2021	Process improvement	Lean manufacturing, digitization
Schoeman et al. [67]	2021	Process improvement	Value stream mapping
Buer et al. [68]	2021	Process improvement	Lean manufacturing, digitization
Tortorella et al. [69]	2021	Process improvement	Lean manufacturing
Logesh et al. [70]	2021	Process improvement	Lean and green manufacturing
Khanzode et al. [71]	2021	Process improvement	Industry 4.0 technologies
Benbarrad et al. [72]	2021	Process improvement	Machine learning
Salwin et al. [73]	2023	Process improvement	Value stream mapping
Mendes et al. [74]	2023	Process improvement, Industry 4.0	Lean principle, total productive management and real-time maintenance management
Hien et al. [75]	2024	Process improvement, Industry 4.0	Six sigma, Industry 4.0 technologies
Lorente-Leyva et al. [76]	2024	Process improvement	Smart and sustainable plan
Sagawa et al. [77]	2024	Process improvement	Simulation modeling, MATLAB
Komkowski et al. [78]	2025	Process improvement	Lean and Industry 4.0 technologies
Skalli et al. [79]	2025	Process improvement	Lean Six Sigma and Industry 4.0 technologies
Benitez et al. [80]	2025	Process improvement, Industry 4.0	Lean bundles, Industry 4.0 technologies

3. Summary and Discussion

The literature reports several operations management methodologies that employ suitable process improvement approaches. The review showed how the relevant department heads addressed the issues by implementing an appropriate strategy and roadmap to achieve the desired goal. The present review conducted a systematic literature review of prior studies and addressed issues related to shop-floor sources. The approach helps in selecting a suitable methodology and provides an ingenious path to achieving desired goals, considering the work platform, including Industry 3.0–6.0 environments. The research selection focuses on process improvement approaches used in Industry 3.0–6.0 work environments for operations and shop-floor management. The selection aims to retrieve research published between 2000 and 2026 in Scopus- and Web of Science-indexed journals and conference proceedings. The PRISMA framework was used for the study selection process. The initial database search showed a total of 9194 articles. After removing duplicate studies and those excluded for other reasons, 6436 articles remained for title and abstract screening. After that, studies that did not meet the inclusion criteria were excluded based on language and other criteria unrelated to the research objectives. Subsequently, a full-text assessment was conducted on the remaining studies to evaluate their eligibility. There were 176 articles retained for qualitative synthesis and detailed analysis.(see Supplementary Materials Table S2. Table of characteristics) The complete screening and screening process are shown by PRISMA flow diagram in Figure 3. Table 4 shows the sources of the articles retrieved using the keywords. Figure 4 illustrates the publishers whose articles were found using the discussed keywords.

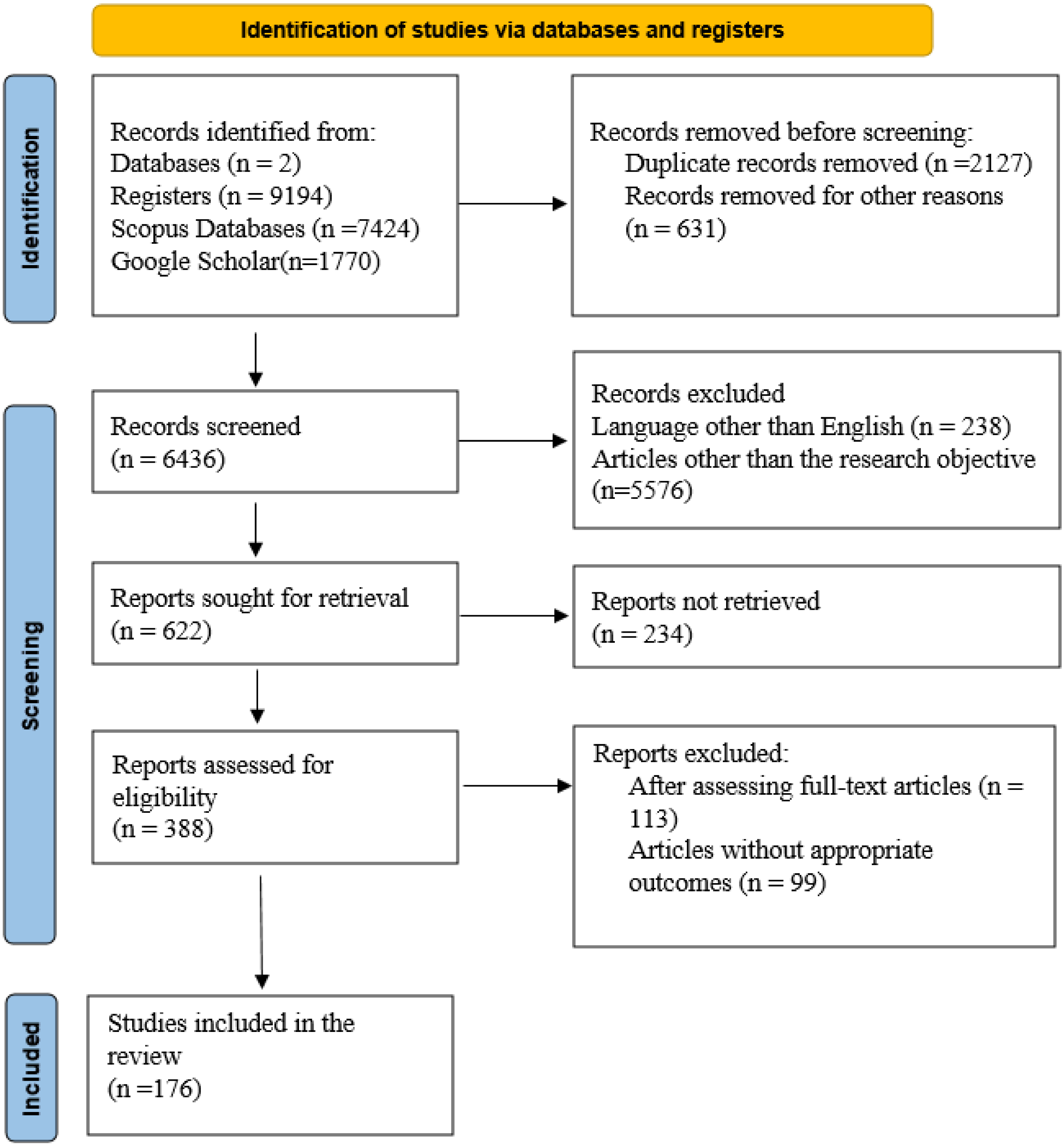


Figure 3. Prisma flow diagram.

Table 4. Details of the source database.

Source	Keywords	Number of Articles	Reference
SCOPUS	Operations Management, Industry 3.0	1	[30]
	Operations Management, Industry 4.0	26	[27,30,35,73,74,77–79,81–98]
	Operations Management, Industry 5.0	2	[35,99]
	Operations Management, Industry 6.0	1	[100]
	Operations Management, process improvement approaches	8	[82,97,101–106]
Google Scholar	Operations Management, Industry 3.0	53	[1,3,4,6,9,12–14,16–18,21–23,29,36,39–43,45,48–50,52,53,55,59,60,67–70,72,107–124]
	Operations Management, Industry 4.0	39	[2,7,8,10,15,19,20,24,31,33,40,46,47,58,61,63,64,80,85,89,99,110,125–141]
	Operations Management, Industry 5.0	4	[142–145]
	Operations Management, Industry 6.0	1	[34]
	Operations Management, process improvement approaches	2	[4,51]

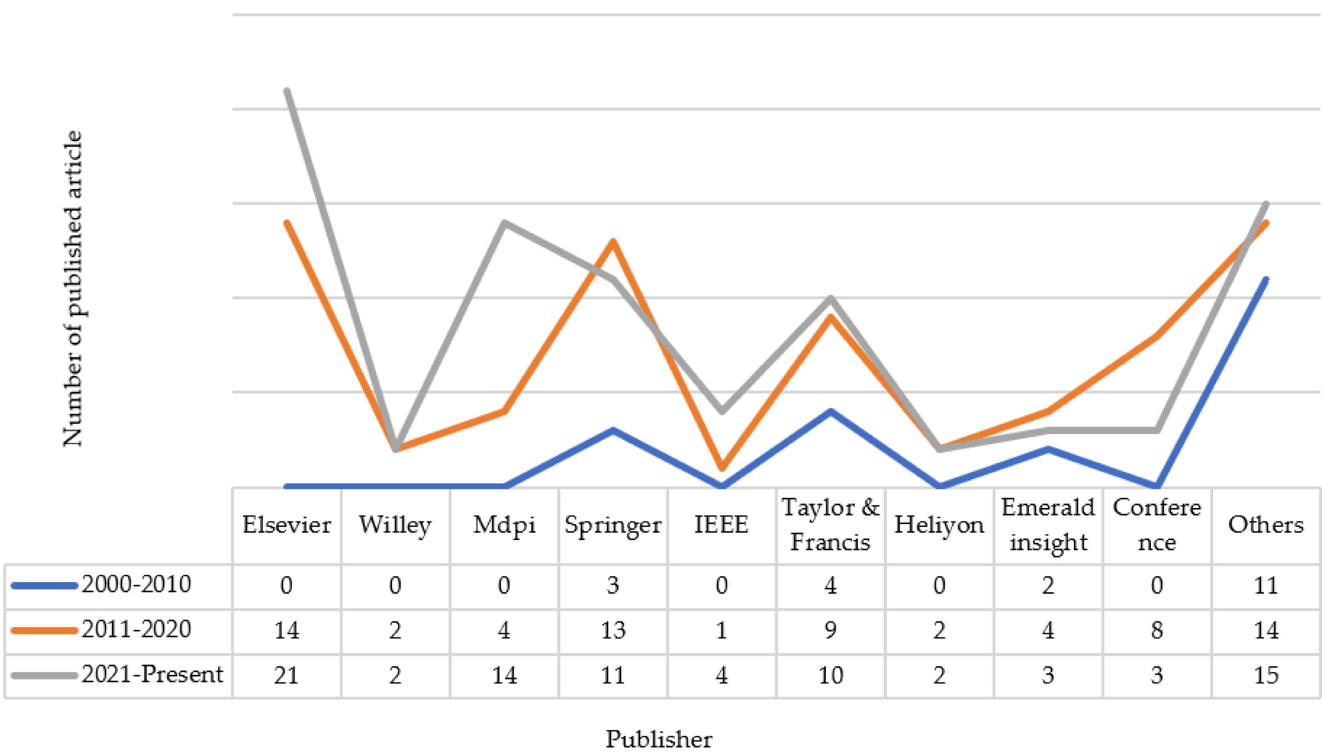


Figure 4. Details of publications.

The literature indicates that suitable methodologies have been used in previous decades according to different work scenarios. The primary objective of this article is to review the methodologies adopted by industry professionals to address and resolve problems in the relevant departments, considering Industry 3.0–6.0. The Industry personnel face several challenges on the shop floor. If a methodology is not used to address the identified challenges, the industry may incur financial losses. Therefore, it is necessary to identify and address the challenges before starting production work in Industry 3.0–6.0. The article aims to help understand the challenges faced in operations planning. To begin production processes, it is necessary to understand customers' product needs [146,147].

The management team must determine the actual need and clearly describe it, using a visual such as a picture or prototype. Recognizing need is a fundamental step across all industries, and it becomes challenging when members of the management team fail to identify consumer expectations [148]. There is always a need to establish more explicit goal-setting to ensure a smooth workflow [149,150]. The shop-floor settings play an essential role in the robust management system and help understand the actual production conditions [151]. In the literature, productivity has been evaluated by operations management parameters. The assessment showed the actual operations management conditions. It helps identify the bottleneck point through observation and comparative analysis. Absentees and apathy reported on the production shop-floor increase production time and prove to be a curse in industries. In the literature review, ergonomic issues have been identified as the primary factors contributing to absenteeism and workers' apathy on the production shop floor [152,153]. For this, several factors are analyzed at the beginning of production and at the time of the work plan.

The main objective of the management team is to achieve higher product quality in accordance with specified standards [154]. To do this, the management team makes a robust work plan to achieve the desired quality. The literature shows that industries focus on quality issues and, to this end, establish quality inspection sections at various stages on the shop floor. The various components have been analyzed in case of quality issues because they may cause defects and financial losses in the concerned industry. In order to start the production processes, it is necessary to analyze the constraints of the concerned industry. The restrictions vary by shop floor and depend on several factors. The constraint is a significant factor on the shop floor because it serves as a key control mechanism for production. To maintain a smooth workflow on the shop floor, the management team must survey and analyze the components of limitations at the beginning of production processes [155,156]. Previous studies have examined the factors contributing to operational challenges. In the present work, a brainstorming analysis has been conducted to identify the causes responsible for the challenges. This analysis will be beneficial to industry personnel in understanding which factors need to be addressed before production to meet the challenges in production management. Figure 5 illustrates the conceptual synthesis of the operations management in Industry 3.0–6.0 shop-floor settings.

The challenges result in negative consequences in operations management if organizations' performance is maintained by teams that fail to tackle them. However, several action plans and strategies were implemented to address them, and the organizations sought innovative methodologies to recognize challenges in real time and tackle them efficiently. Table 5 describes the challenges reported in prior research.

Table 5. Details of challenges, action plan, and solutions reported in the literature.

Challenges Reported	Action Plan	Activities	References
Recognition of need	Forecasting	Data integrity and implementing suitable process improvement approaches	[97,98,149]
Ergonomics issues	Eliminate non-utilized skill-related waste	Establishing a cleaner and more esthetic work environment	[86,87,89]
Quality-related issues	Adaptability of emerging technologies	Strategic assessment for trends, issues, and organizing awareness programs	[83,111,117,151]
Limitations	Assessment of operations management settings	Suitable process improvement approaches	[80,85,97,98,102]
Laggard thinking	Employee performance management	Organize training and awareness programs with the benefits of advancements achieved	[80,98,112]

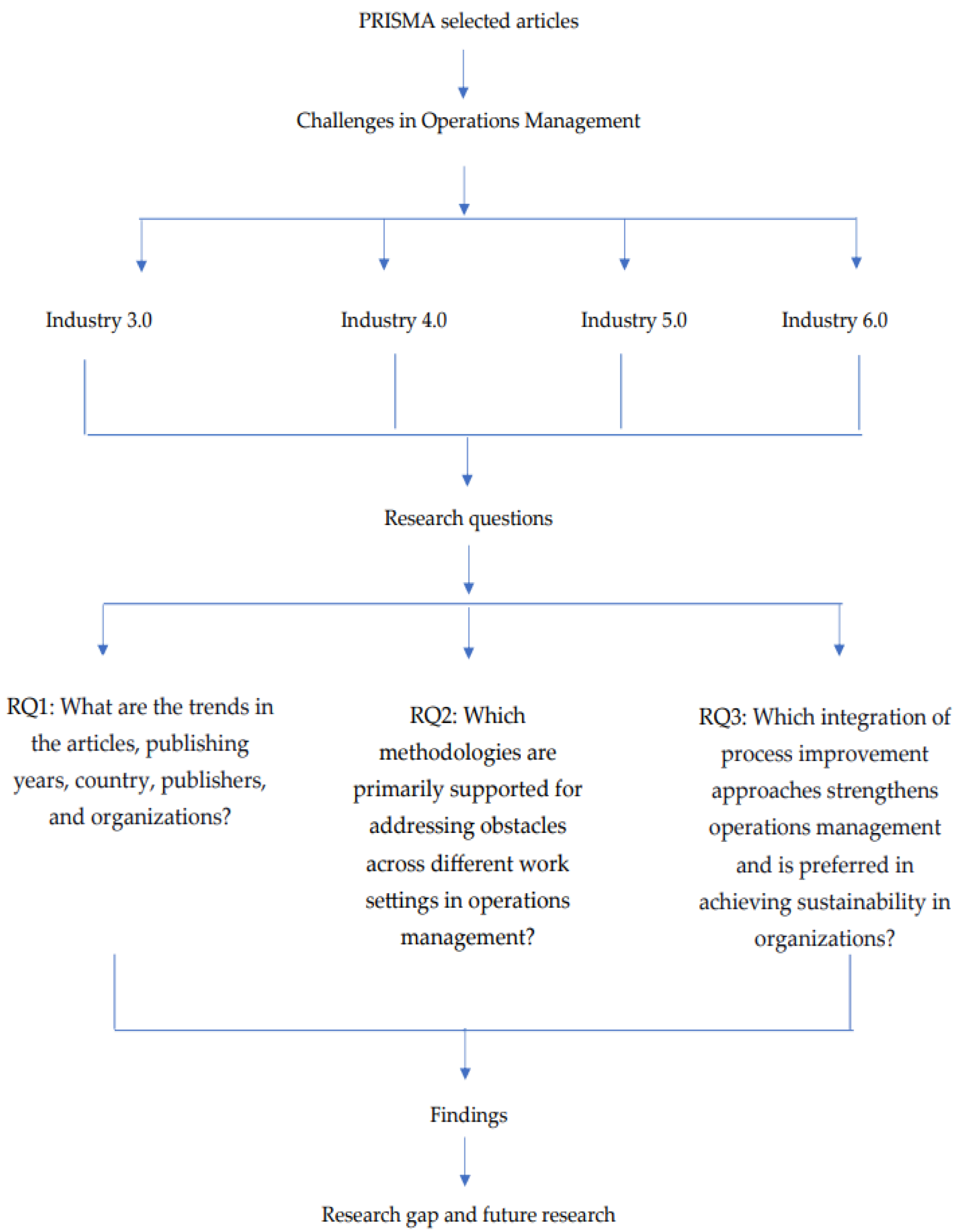


Figure 5. Conceptual synthesis.

The literature indicates that shop-floor performance management teams emphasize identifying problems on the shop floor, as they cause waste. To address the problems, various approaches have been used in previous research. It has been observed that several reasons and factors may cause problems on the shop floor. Problems were reported in the implementation of traditional maintenance systems [157]. For this, a condition-monitoring approach was needed to prevent malfunctions. Machinery malfunctions lead to increased downtime and production delays. Continuous working, unskilled workers, unplanned maintenance, and improper equipment handling were identified as the primary causes of machinery malfunctions. An efficient workforce was a basic need for any industry because all activities on the shop floor can be performed only under workers' supervision [158]. The workforce shortage creates a dire situation and affects the overall production system. The lack of workers at any workstation leads to lower productivity [159]. Defective products pose a significant challenge for any management system. To address this issue, industries are focusing on implementing an efficient approach on the shop floor [160]. Defective products are produced for several reasons. The present industries employ various methods to mitigate these potential causes, including improving the quality of inspection workstations, refining work processes, updating standards, expanding the workforce, and increasing the number of workstations. The literature review found that taking measures without careful consideration cannot eliminate defective products [161,162]. Therefore, it is necessary to analyze the possible causes, as any defect can be eliminated by identifying its underlying causes. The higher inventory level must be controlled in a specified manner, as it can significantly deteriorate the condition of the production shop floor [163,164]. The incontinence workflow is only one of the reasons for the higher inventory level, and it can be addressed by improving activities and the shop-floor layout, as identified through analysis and observation [165,166]. Some common factors affecting overall production on the shop floor are summarized in a literature review for controlling inventory levels on the shop floor. The communication gap between workers plays a crucial role in any industry, serving as a pillar of the management system. An unfriendly work environment leads to production losses [167]. The methods used to ensure every worker makes a superior contribution include group meetings, discussions, and training. In the current competitive industrial landscape, several key factors are analyzed at the outset of production processes, enabling management team members to allocate tasks efficiently and achieve optimal results [168,169]. This article thoroughly examines the problems encountered in shop-floor management and identifies their primary sources. The figure helps identify the sources of operational management inefficiency. The sources were identified by a thorough review of the literature. Figure 6 illustrates the co-occurrence overlay of keywords across operations management, process improvement approach, Industry 3.0, Industry 4.0, Industry 5.0, and Industry 6.0.

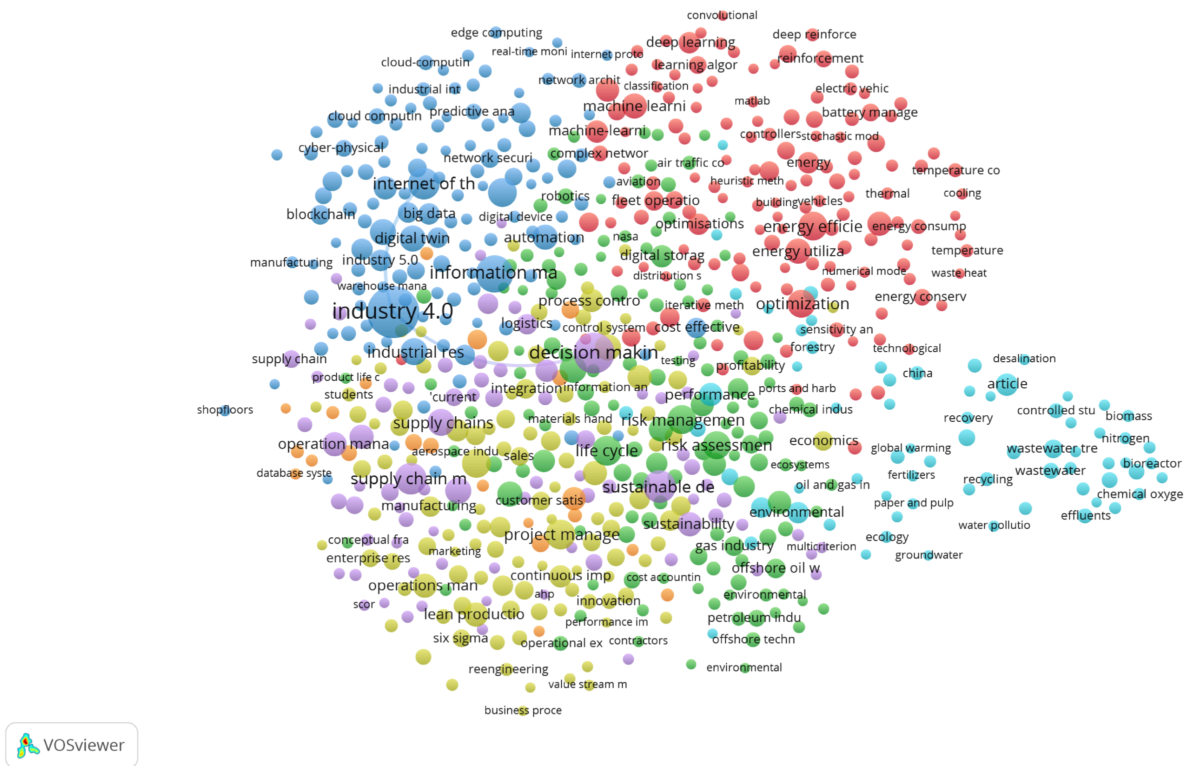
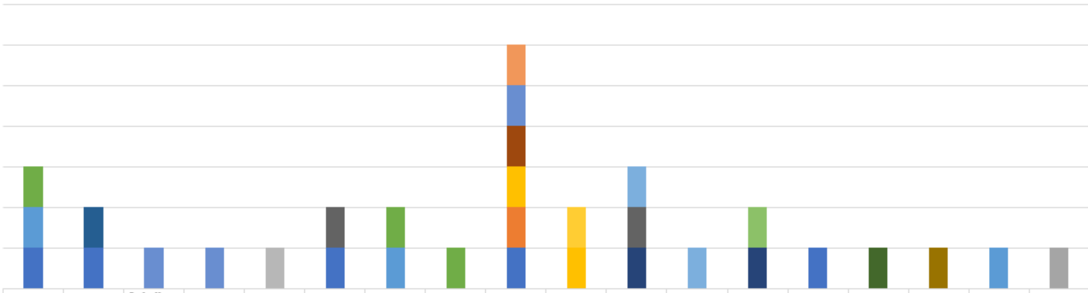


Figure 6. Keyword co-occurrence network.

The answer to RQ1 on current trends shows that research increased alongside Industry revolutions in organizations from 2000 to 2026. The study focused on the engineering sector, where operations management professionals needed excellence and sustainability. Figure 7 shows the details of the contribution of the country and organizations in the operations management in different work settings from Industry 3.0 to 6.0.



	Automobile	Aerospace	Labelling and Packaging	Cement	Oil and gas	Textile	Plastic	Food	Manufacturing	Pharmaceutical	Chemical	Semiconductor	Furniture	Foundry	Mining	Agro-Industry	Palm oil	Leather
Indonesia	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0
Taiwan	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0
Ireland	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Egypt	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
USA	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Bangladesh	0	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Ghana	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
France	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Portugal	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Spain	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0
Czeck Public	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
South Africa	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0
Brazil	1	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0
Malaysia	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0
Sweden	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0
Chaina	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Italy	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
India	1	1	0	0	0	1	0	0	1	0	0	0	0	1	0	0	0	0

Figure 7. Contribution of the country and organizations.

The answer to RQ2 reveals that previous researchers and professionals have appreciated both the traditional and concurrent methodologies. Some articles suggested that researchers are continually motivated to recognize new methodologies for tackling operational issues through appropriate process improvement approaches. However, data-driven validation was preferred for every operations scenario. An innovative path has been chosen primarily over the last ten years: organizations today need flexible, work-setting-driven platforms. Tables 6 and 7 present the details of the methodologies and their adoption by researchers and industry professionals across different work settings.

Table 6. Illustration of the methodologies and their adoption.

Methodology	Description	Outcomes
Traditional approach	Conventional process improvement approach	Mitigation of manual operations management-related issues
Concurrent approach	Integration of different process improvement approaches according to the department and sections present in the concerned organization.	Enhance operations management excellence in Flexible and dynamic operational settings
Data-driven assessment approach	Investigation of revised/modified/innovative platforms in a real-world scenario.	Improvement in the concerned operations management
Real-life assessment approach	Assessment of process improvement approaches, feasibility and awareness.	Providing a suitable and competent key for operations management.
Sustainable approach	Systematic path to minimize adverse consequences in operations management	Achieving operational, economic, and environmental sustainability

Table 7. Details of the study characteristics.

Reference	Year	Methodology	Operations Management	Outcomes
[42]	2011	Traditional approach, data-driven, and sustainable approaches	Industry 3.0	Developed a framework for significant improvement in organizations' performance, achieved improvements, and met increasing demand without additional resources.
[13,20]	2013	Traditional approach, concurrent approaches, data-driven approaches	Industry 3.0 and 4.0	Developed systems using hybrid and smart techniques for operations management and enhanced organizations outcomes.
[9]	2014	Traditional approach	Industry 3.0	Developed a system using lean manufacturing and enhanced the outcomes of the concerned manufacturing unit.
[6,17,22,36,44]	2015	Traditional approach, data-driven approaches, and real-life assessment	Industry 3.0 and 4.0	The developed frameworks were efficient at monitoring and tracking waste performance, reducing machinery malfunctions, work-in-progress buffer issues, ergonomics issues, and setup times.
[26,46–49]	2016	Data-driven approaches, Concurrent approaches, and real-life assessment	Industry 3.0	Integration of approaches enhanced operational performance, shop-floor quality, and environmental efficiency.
[21,27]	2017	Traditional approach, data-driven approaches	Industry 3.0	Improved the operational outcomes by mitigating waste activities.
[51,52]	2018	Traditional approach, data-driven approaches, and real-life assessment	Industry 3.0	Process improvement using suitable traditional approaches improved the concerned organizations' performance.
[8,11,15,60]	2019	Concurrent approaches, traditional approach, data-driven approaches, and sustainable approach	Industry 3.0 and 4.0	Improved the operational outcomes by improving data management and reducing shop- floor waste, time, and cost, and enhancing consumer satisfaction.
[7,19,61,63]	2020	Concurrent approaches, data-driven approaches, the traditional approach, and real-life assessment	Industry 3.0 and 4.0	Hybrid approaches have demonstrated their effectiveness in addressing issues across different operations management settings.
[24,29,33,64–68,70–72]	2021	Data-driven approaches, real-life assessment, traditional approach, sustainable approach, concurrent approaches, and data-driven approaches	Industry 3.0 and 4.0	Emerging technology-driven operations management effectively tracks waste and addresses the associated challenges.
[157]	2022	Concurrent approach and data-driven approaches	Industry 4.0	Improved the agility and quality of the concerned organizations' decision-making process in inventory management.
[93–95]	2023	Concurrent approach, real-life assessment, and sustainable approach	Industry 3.0 and 4.0	Revealed that the advanced and integrated approaches effectively control operations management efficiency.

Table 7. *Cont.*

Reference	Year	Methodology	Operations Management	Outcomes
[75,91,102]	2024	Concurrent, data-driven, and sustainable approaches	Industry 3.0, 4.0 and 5.0	Developed a smart system that promoted human–machine collaboration, including automation, robotics, and artificial intelligence systems. The integrated approach enhanced productivity by mitigating waste in the concerned small and medium enterprises.
[30,34,35,90,141]	2025	Concurrent approaches and the sustainable approach	Industry 3.0, 4.0, 5.0 and 6.0	Developed systems that effectively control operations management attributes and enhance excellence across different work environments.

The study categorizes studies according to the methodologies adopted by researchers and industry professionals to tackle challenges in operations management. There were five methodologies found in the literature. The study showed that the first, second, and fifth methodologies followed different concepts and approaches, with the second methodology verified by case examples, dynamic work settings, and real-life scenarios. The adoptability of these three methodologies was assessed by investigating their feasibility in real-world scenarios across traditional, integrated, advanced, and emerging work settings through the fourth methodology. The study reviewed these cases and provided the preferred keys for resolving the issues and tackling the challenges in Industry 3.0–6.0. The review showed that the researchers employed various methodologies to address operations management challenges. The methodologies were used in line with the organization's needs. Industry professionals have implemented multiple methodologies within the same operational area to mitigate problems. The methodologies were implemented simultaneously in some circumstances, as their aim is to resolve issues across different work platforms. The literature revealed that industry professionals and researchers preferred concurrent and data-driven approaches for tackling the challenges in Industry 3.0–6.0. A concurrent approach enhances the efficacy of the first and fifth methodologies, and a data-driven approach helps assess the competency of the first, second, and fifth methodologies for Industry 3.0 to 6.0. Figure 7 shows the network visualisation generated by the Vos viewer (version 1.6.20), which partitions the analysis into seven distinct colour-coded clusters based on keyword analysis. Cluster 1 (red, 141 items), cluster 2 (green, 135 items), cluster 3 (dark blue, 127 items), cluster 4 (olive, 115 items), cluster 5 (purple, 81 items), cluster 6 (light blue, 70 items), and cluster 7 (orange, 21 items).

The answer to RQ3 showed that integrating lean and smart concepts with other approaches, such as AI, machine learning, the Internet of Things, digital twins, fuzzy logic, Six Sigma, the circular economy, green, and kaizen, has proven to be efficient for shop-floor management. The comprehensive review of previous research revealed that the concurrent and data-driven approaches are emerging in production management, and their effectiveness increases when implemented alongside the lean concept [170–172].

The literature reports several process improvement approaches, including lean, green, smart, circular economy, kaizen, and digital twin, that are used in various operations management settings [173–175]. The studies showed how the relevant department heads addressed the issues by implementing an appropriate approach. The study investigates the adaptability and limitations of methodologies used in Industry 3.0–6.0. The study revealed that integrating process improvement approaches with emerging technologies enhances their effectiveness in real-world shop-floor scenarios. Figure 8 illustrates the approaches used in the literature considering different work settings.

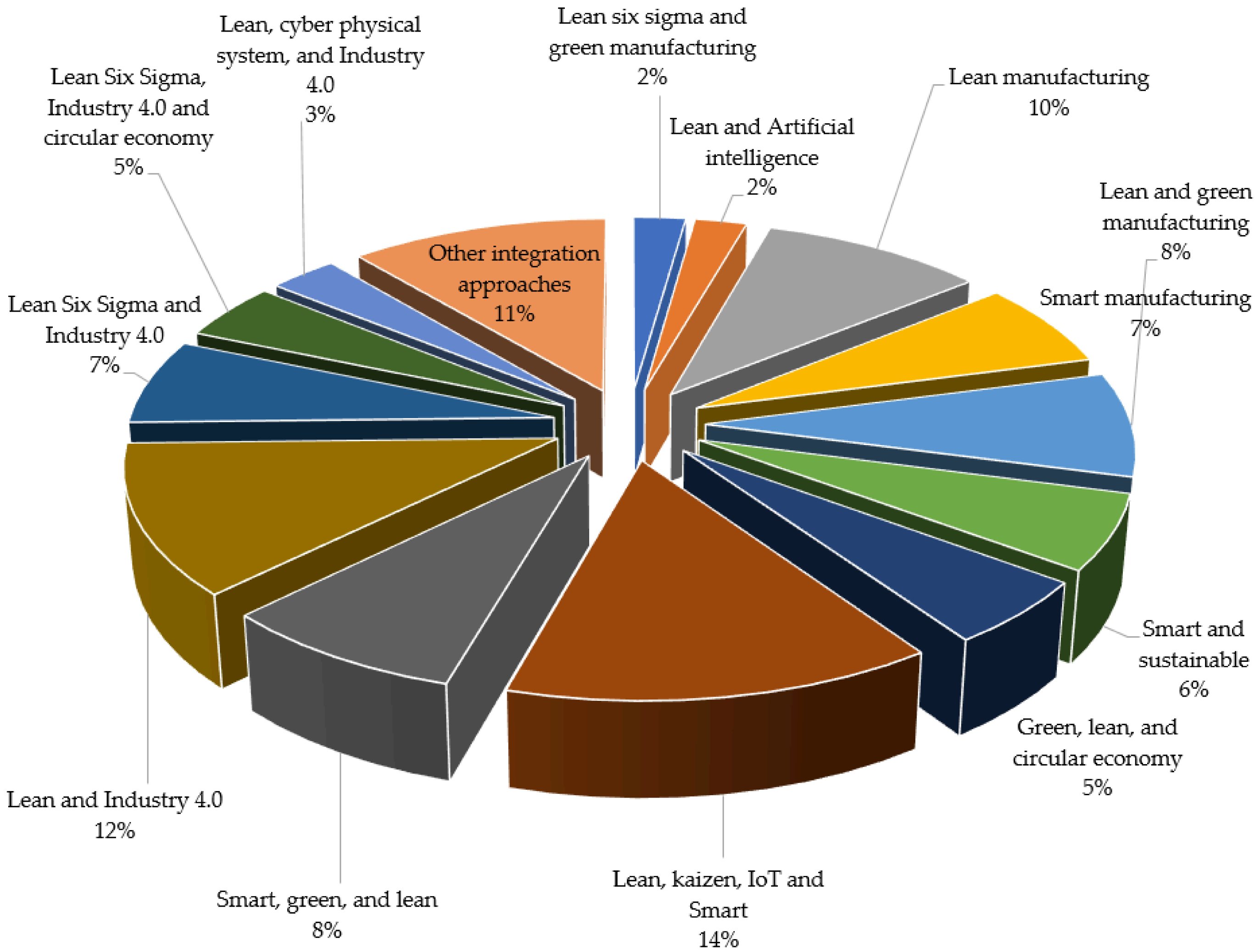


Figure 8. Approaches preferred in the literature.

The studies reported gradual upgradation in operational activities controlling platforms day by day. Industry professionals have emphasized this need and support for emerging technologies to tackle operational attributes in Industry 3.0–6.0. The studies reported that Human–AI collaboration is challenging and now necessary for controlling operational outcomes. The literature has identified several effective platforms and approaches for establishing human–AI collaboration in operations management. However, the reports indicated that the collaboration is challenging and has encountered numerous hurdles in real-world scenarios [176,177]. The methodologies discussed in the study help identify a suitable approach for the work setting and can directly leverage the efficacy of available resources to maintain a balance with artificial intelligence. The collaboration helped resolve the issues efficiently, but there remains a need to develop an innovative tool to bridge the gap between human thinking and AI commands. The collaboration can also resolve operations-floor-related issues within available limitations and deliver the desired outcomes in operations management. Human–AI collaboration can improve assessment precision and mitigate the risk of failure in tackling operational management challenges. The present article reviews the methodologies adopted for different operational scenarios and helps eliminate the root causes of operational management malfunctions. The articles provide an innovative direction for resilient operations, enhancing resource efficiency and establishing a socially sustainable system. The methodology enhances the efficacy of operations management by tracking and addressing challenges in flexible work settings, where industry professionals operate in dynamic workflows across Industry 3.0–6.0 environments. The study helps implement appropriate problem-solving approaches aligned with the organization's needs and enhances operational, economic, environmental, and social sustainability.

The study reviewed the literature dealing with challenges in operations management in Industry 3.0–6.0. However, the literature indicates that various studies have examined lean manufacturing, Industry 4.0, and Industry 5.0. The present study reviewed the process improvement approaches used for Industry 3.0–6.0. However, Industry 6.0 introduced the cognitive manufacturing paradigm, which refers to platforms controlled and monitored by integrated advanced technologies to establish a self-optimizing factory system. The present study examined the hidden issues arising from unexpected work conditions on the shop floor. The literature showed that if operations teams failed to identify these hidden issues, outcomes on the shop floor deteriorated drastically. The literature provided various platforms for tackling the challenges in Industry 3.0–6.0 and also in hybrid work settings. The present review provides insights into methodological approaches that mitigate the dilemma in selecting suitable process improvement methods. The study helps direct organizations in mitigating the chasm between adaptability and the feasibility of process improvement approaches for tracking and tackling operations management issues in work-floor settings, including Industry 3.0–6.0. The study focuses on providing guidance for organizations seeking transformation and change, operating in dynamic work settings, and facing a dilemma over which process improvement approaches to adopt. Figure 9 describes the key findings of the study in comparison with the previous studies.

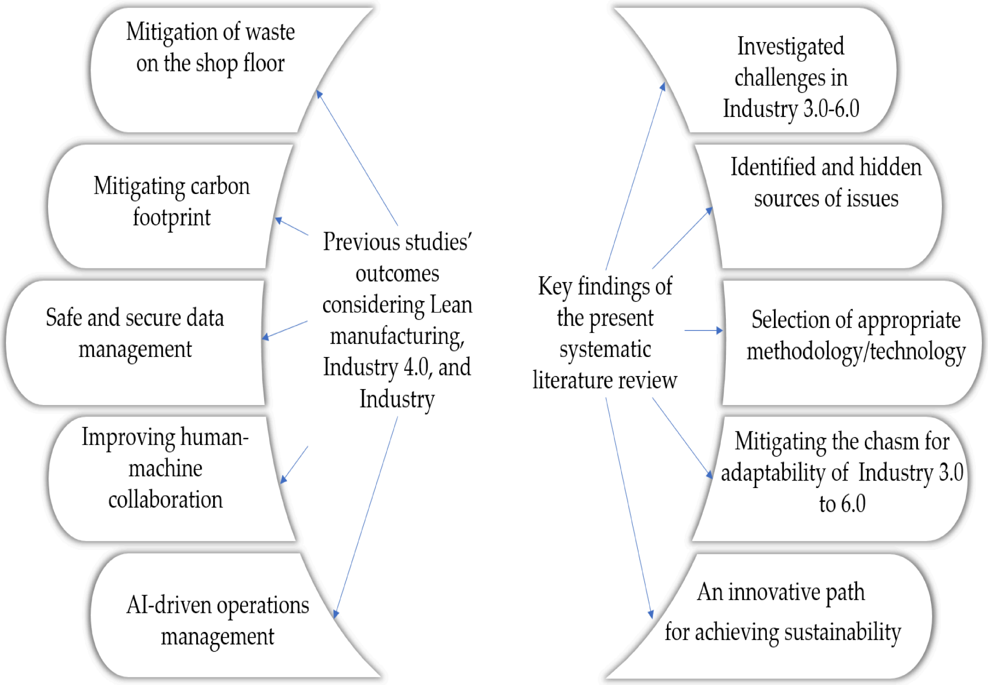


Figure 9. Key finding. [11,15,19,28,61,63,131].

4. Conclusions

The present study uses the Scopus and Google Scholar databases for a systematic literature review and a PRISMA-style review. The study used VOSviewer (Version 1.6.20) to analyze the literature published from 2000 to 2026. The conclusions drawn from the study are discussed as follows:

i. Operations management needs innovative ways for real-time tracking and tackling the operations management issues. The studies revealed that the integrated approaches worked efficiently in flexible shop-floor settings.
ii. It has been revealed that the suitable methodology enhances the competency of process improvement approaches in operations management. The analysis showed that concurrent and data-driven approaches were highly coveted for root causes encountered in operations management in Industry 3.0–6.0.
iii. The operations management professionals seek innovative and AI-driven shop-floor management, where the amendment can be implemented according to the operations management-related obstacles present in real-world scenarios.
iv. The integration of lean, smart, green, circular economy and emerging principles proved its competency in controlling operations management performance in hybrid industry revolutions-driven work environments.
v. There is a need to develop an innovative path to resolve the challenges in Industry 3.0–6.0. It empowers excellence in resources and operations management and enhances operational, environmental, economic, and social sustainability.
vi. There is a need to mitigate the chasm between Industry 3.0–6.0 feasibility and adaptability in the real-world scenario.

5. Future Research Direction

In the current Industry 3.0–6.0 scenario, the entire industry is focused on achieving sustainability within available resources and limitations. To meet this industry demand, there is a need to develop a novel methodology for tracking real-time performance across diverse work settings. There is a need to address real-time operational challenges on the floor using emerging technology-driven work platforms. The integration of Artificial Intelligence, Lean, and Smart principles is a foundational need for current organizations, where operations management teams tackle the dynamic shop-floor environment. The integration helps teams feel confident in tracking and mitigating issues on the work floor of the concerned operations. The integration of emerging and sustainable technologies promotes the power of operations management.

Supplementary Materials: The following supporting information can be downloaded at https://www.mdpi.com/article/10.3390/su18126286/s1, Table S1: PRISMA checklist; Table S2: Table of characteristics.

Author Contributions: Methodology, V.T.; Validation, G.D.B. and A.S.; Writing—original draft, V.T. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: No new data were created or analyzed in this study.

Conflicts of Interest: The authors declare no conflicts of interest.

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