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BIBLIOMETRIC ANALYSIS FOR QUALITY MANAGEMENT IN THE MANUFACTURING SECTOR: 2020 TO 2024

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ABSTRACT
In today's dynamic manufacturing market, quality management is critical to competitiveness, efficiency, and customer happiness. This study includes a bibliometric analysis from 2020 to 2024 to illuminate trends, patterns, and developing quality management areas in the industrial sector. Using bibliometric methodologies, this study examines a wide range of scholarly outputs, including journal articles, conference proceedings, and other relevant material, to determine the intellectual structure of this field. This methodology finds crucial contributors, seminal works, research focal points, and emerging themes in the field by quantitatively examining publication outputs, citation networks, collaboration patterns, and keyword co-occurrences. By synthesizing and visualizing the bibliographic data, this study provides a comprehensive picture of the knowledge landscape, allowing researchers, practitioners, and policymakers to navigate the complexities of quality management in manufacturing and foster continuous improvement initiatives. Furthermore, this bibliometric research provides important insights into the evolution of quality management techniques, emphasising the adaptation of methodologies and frameworks in response to growing difficulties and technological advancements. This study provides a road map for future investigations to improve quality management techniques in the industrial industry, indicating significant research gaps and areas ripe for discovery. Furthermore, the analysis gives information on the global distribution of research efforts, allowing for international collaborations and knowledge exchange to propel collective growth in quality management. Finally, this thorough review of the scholarly literature broadens our understanding of manufacturing quality management. It informs strategic decision-making processes for businesses looking to optimise their operations and provide superior products and services to customers.
Keywords: *Bibliometric Analysis, Quality Management, Manufacturing Sector, Scholarly Publications, Trends, Patterns, Emerging Areas.*

1. Introduction

The global manufacturing sector is undergoing profound transformation driven by rapid technological evolution, increasing market volatility, and the growing complexity of customer expectations. These shifts have been further accelerated by global disruptions such as the COVID-19 pandemic, which exposed vulnerabilities in supply chains and forced organizations to reevaluate their operational models and strategic priorities (Mbonigaba & Sujatha 2024; Chen et al., 2021). As a response, businesses are increasingly embracing digital transformation to build resilience and sustain competitiveness in a highly dynamic environment (Zhang et al., 2025). This digital transition is particularly vital for traditional small and medium-sized enterprises (SMEs), which often face structural constraints in adapting to emerging technologies and digital infrastructure.

The paradigm of Industry 4.0, characterized by the integration of cyber-physical systems, the Internet of Things (IoT), big data, and artificial intelligence into manufacturing, has redefined the principles of quality management (Duong Thi Binh et al., 2024; Nguyen et al., 2023). Quality 4.0, as an extension of these concepts, aligns advanced technologies with traditional quality frameworks to enhance process accuracy, reduce variability, and promote real-time decision-making (Jafari et al., 2021). The convergence of quality management and digital systems not only improves operational efficiency but also supports strategic goals such

as sustainability, innovation, and customer satisfaction (Lopez & Tan, 2022; Choudhury et al., 2021).

In response to these developments, researchers have investigated the role of government policies and institutional engagement in shaping the quality management landscape. In China's manufacturing sector, national policy has served as a crucial enabler for technology adoption and quality improvement (Zhang et al., 2023). Similar efforts are being observed globally, as governments introduce subsidies and incentives to stimulate innovation and enhance performance in industrial firms (Li & Wang, 2023). In India, quality management practices are evolving through a combination of regulatory frameworks, research productivity, and bibliometric collaboration, reflecting a vibrant research ecosystem (Sharma & Kumar, 2022; Kumar et al., 2022). Poland's manufacturing sectors, too, are navigating quality-related challenges through adaptive strategies and academic engagement (Kwiatkowski & Nowak, 2021).

The integration of lean manufacturing, automation, and research and development (R&D) capabilities is also reshaping the competitive dynamics of manufacturing in developed economies such as the United States (Brown & Wilson, 2023). Scholars argue that strategic alignment between innovation-driven quality systems and production objectives is essential for firms striving to achieve global standards (Li et al., 2021; Nguyen et al., 2023). Bibliometric analyses further confirm the rising importance of manufacturing quality research, revealing key trends, co-authorship patterns, and thematic areas that reflect the field's growing complexity and global relevance (Liu et al., 2021; Kumar et al, 2022).

In light of environmental concerns, the manufacturing sector is also exploring pathways toward a circular economy. The shift from linear to circular models, which emphasize resource efficiency, waste reduction, and product life cycle extension, aligns closely with sustainable quality management practices (Ibn-Mohammed et al., 2021; Bonsu, 2020; Nguyen et al., 2023). This orientation is increasingly critical as firms face mounting pressure from regulators, consumers, and investors to demonstrate environmental responsibility alongside economic performance.

At the organizational level, the implementation of effective management control systems and quality frameworks is shown to significantly influence managerial job satisfaction, stress levels, and overall organizational commitment, particularly in public sector settings such as local governments (Silaban, Siagian, Sitorus, & Medrofa, 2024). Good governance practices, including collaborative approaches to waste management and performance evaluation, contribute to improved service delivery and stakeholder engagement (Banunaek et al., 2024; Purnomo, 2024). Furthermore, customer-centric strategies that emphasize product innovation, corporate image, and customer satisfaction are proven to enhance loyalty and long-term business sustainability (Dwiyanti & Soliha, 2024).

The influence of digital media in shaping public perception and consumer behavior also underscores the importance of message content and influencer roles in marketing and quality communication (Zhang et al., 2016). As digital channels become the dominant interface between firms and stakeholders, the effectiveness of digital marketing and branding strategies becomes a vital component of perceived quality and trust.

Finally, emerging scholarship highlights the importance of saturation in qualitative research, especially in the context of exploring dynamic and complex organizational phenomena (Saunders et al., 2018). As quality management research continues to evolve, interdisciplinary collaboration and methodological innovation will play a central role in advancing the field and addressing the multifaceted challenges of modern manufacturing systems.

The specific research questions, purpose of the review, intended deliverables, and target audience are crucial in determining how the data is identified, collected, and presented in a bibliometric analysis. In this case, the authors have identified several key questions they want to answer through this bibliometric study:

1. What are the publication trends in the field of quality management in manufacturing research over the 5-year period from 2020 to 2024?

2. Who are the most prolific authors and which institutions have the highest research output in this domain? What is the geographic distribution of the published literature on quality management in manufacturing?
3. Which are the most highly cited research articles and influential publications in this field?
4. Which publishers have the maximum number of cited documents in the sample?
5. What are the predominant subject areas and research themes covered in the quality management in manufacturing literature?
6. What is the overall research influence and productivity in this field, as indicated by factors such as the number of items, links, and total link strength?

By clearly defining these research questions upfront, the authors can ensure that the data collection, analysis, and presentation are tailored to address the specific objectives of the bibliometric review. This targeted approach helps generate insights that are directly relevant to the intended audience and the goals of the study.

2. Literature Review

Several recent studies have conducted comprehensive bibliometric analyses to evaluate the evolution of research within the domain of quality management in manufacturing. For instance, Nguyen et al. (2023) performed a bibliometric analysis on Scopus-indexed publications from the *Total Quality Management & Business Excellence* journal spanning the period from 2003 to 2022, highlighting trends in Industry 4.0 and Quality 4.0 integration. Similarly, Choudhury et al., (2021) systematically analyzed 1,893 documents indexed in the Clarivate Analytics Web of Science (WoS) under the "Lean Manufacturing" category from 1970 to 2020, offering a structured insight into supply chain and information system integration within quality frameworks. Additionally, Sharma and Kumar (2022) collected and examined 508 articles published between 2002 and 2017 from both Scopus and Web of Science databases, focusing on the application of Lean Six Sigma in manufacturing processes. These investigations offer a consolidated view of research trajectories, key thematic foci, and dominant contributors in the manufacturing quality management landscape.

Collectively, these studies employ robust bibliometric techniques—such as co-authorship analysis, keyword co-occurrence, and citation analysis—to identify influential works, emerging topics, and collaborative networks across regions and institutions (Kumar et al., 2022; Liu et al., 2021). The bibliometric approach, defined as the quantitative analysis of bibliographic data, supports a more systematic and reproducible examination of existing literature, thereby enhancing the quality and transparency of academic reviews (Ibn-Mohammed et al., 2021). It serves as an essential tool for tracking the development of scholarly domains, providing measurable indicators of productivity, impact, and thematic evolution (Zhang & Chen, 2022; Nguyen et al., 2023). Through its ability to objectively classify publications, authorship patterns, and journal impact, bibliometric analysis helps identify research gaps and facilitates the formulation of forward-looking research agendas (Jafari et al., 2021).

This study extends previous efforts by applying bibliometric methods to publications from 2020 to 2024, offering a focused and contemporary lens on developments in manufacturing quality management. Unlike prior reviews, this research identifies nuanced patterns and underexplored intersections—particularly the integration of Quality 4.0 principles with sustainability, circular economy practices, and institutional policies (Lopez & Tan, 2022; Li et al., 2021; Zhang et al., 2025; Bonsu, 2020). The resulting insights not only contribute to academic discourse but also support policymakers and practitioners in crafting responsive quality strategies aligned with technological, environmental, and socio-economic imperatives.

3. Methodology

The concept of "bibliometrics" intending to measure the dynamics of written communication and to establish it as a distinct area in the field of information science. Moed emphasized the significant potential of quantitative bibliometric evaluations in offering deeper understanding of academic activities and their performance, along with their relevance to policy-making. In the realm of scientific inquiry, bibliometric assessments offer a

comprehensive overview of existing research on pertinent topics, as well as an analysis of research trends and movements worldwide. This specific bibliometric investigation meticulously examined the literature by utilizing articles catalogued in Elsevier's Scopus database, spanning a five-year period from 2020 to 2024. This timeframe was selected to provide a wider perspective on how research has been appraised in recent years. The investigation concentrated exclusively on publications authored in English, as this language is predominantly represented in scholarly research. The scope was restricted to research articles that had undergone a rigorous double-blind peer-review process, deliberately omitting other documents, including book chapters, conference proceedings, and correspondence.

In addition to this, this research sought to identify trends and influences on quality management in the manufacturing sector across the period of 2020-2024. A citation pattern and visualization analysis, co-authorship network analysis, and keyword co-occurrence network analysis were done using VOSviewer, a commonly utilized bibliometric software. The research was carried out systematically and reproducibly, where the data reliability and validity were preserved throughout.

1. Data Extraction and Retrieval Process:

The information used here was extracted from Scopus, a large peer-reviewed publication database that is generally regarded as authoritative. Scopus was used specifically because of the fact that it offers comprehensive coverage of peer-reviewed sources in a broad range of subject areas, including manufacturing quality management, and that it offers very detailed citation information and authors.

A systematic search query to download articles on quality management in manufacturing from the year 2020 to 2024 was performed. Journal articles in the English language only were searched for. Some of the metadata retrieved from the 2,501 shortlisted articles include authors' names, institution affiliations, citations, keywords, and publication years. The extracted data were saved in a compatible format (e.g., CSV or RIS) that would readily import to VOSviewer.

2. Cleaning and Validating the Data:

After retrieving the data, an extensive data cleansing process was performed to validate the data quality and consistency. Duplicate records were removed, the inconsistencies in the authors' names, and the institutional affiliations normalized to eliminate inconsistencies. The inconsistencies in the spellings of authors' names and institutional names (varied formats) were corrected to enable accurate attribution.

The citation counts were also cross-checked with the most recent data available in Scopus to identify discrepancies. Discrepancies in counts of citations were marked for verification manually. Institutional affiliations have also been cross-checked to identify that the authors had been correctly linked to the respective institutions. These activities provided assurance that data sent for the analysis was not only reliable but also accurate.

3. VOSviewer for bibliometric analysis:

The data was exported to VOSviewer for bibliometric analysis following data cleansing and validation. VOSviewer was utilized to create various visualizations and carry out important analyses for the research queries. The specific analyses that have been carried out are:

1) Citation Analysis: Citation analysis was utilized to identify most influential articles and top-cited publications within the 2020-2024 timeframe. To this end, the process involved tallying up the citations for all articles and then their comparison. Articles with most citations were deemed most influential publications on the area of study, responding to RQ 3 regarding the most highly cited research articles and influential publications. The top-cited publishers were also identified using the articles' citation counts published through different publishers.
2) Co-Author Network Analysis: VOSviewer was utilized to map these networks of co-authorship, demonstrating the collaboration pattern among authors. The software produced a map that depicted how authors are linked based on articles they have written together. These patterns assisted in identifying prolific authors and institutions, to answer RQ 2 on the most productive authors, institutions, and countries publishing research on quality management in manufacturing.

3) Keyword Co-Occurrence Analysis: Keyword co-occurrence analysis was utilized to identify the most common research themes within the quality management literature. By examining the frequency of specific words that appear within the same publications, the process highlighted the dominant themes and developing issues in the research. The analysis provided insight to the topics and research themes covered in the literature to answer RQ 5.
4) Publication Trend Analysis: Publication trends were analyzed through the study of the quantity of articles published annually from 2020 to 2024. The trend analysis provided insight into the growth or decline of research in the last five years, partially addressing RQ 1 in relation to publication trends in research on the quality of manufacturing.
5) Geographic Distribution Analysis: VOSviewer was also utilized to map the geographic spread of the publications based on the authors' institutional affiliation. From this process, the authors' countries of origin were determined and the worldwide coverage of the practice of quality management in the manufacturing industry was analyzed, addressing RQ 2.

4. Storage and Reproducibility of the

To achieve reproducibility and integrity of data, the cleaned metadata was preserved in a formatted state, that is, CSV or Excel, so that data could readily be utilized for future analyses or for replication. Detailed documentation of the entire data extraction, data cleansing, and data analysis process was preserved, including the search query that was executed, the software version of VOSviewer utilized, steps of data cleansing, and steps for data validation. These documentation steps helped to provide transparency and enable other researchers to replicate the study and validate the findings.

By employing VOSviewer for bibliometric mapping and a standard process of data collection, data cleansing, and validation, this study offered a precise and thorough investigation of the research networks, keywords, and most important publications on quality management research within the area of manufacturing.

Data Retrieval
Selected database: Scopus
Timespan: 2020-2024(5 years)
Literature type: Journal (Research articles)
Language: English
Topic terms : quality AND management AND in AND manufacturing AND (LIMIT-TO (PUBYEAR,2020) OR LIMIT-TO (PUBYEAR, 2024)
Total of records: 2,501

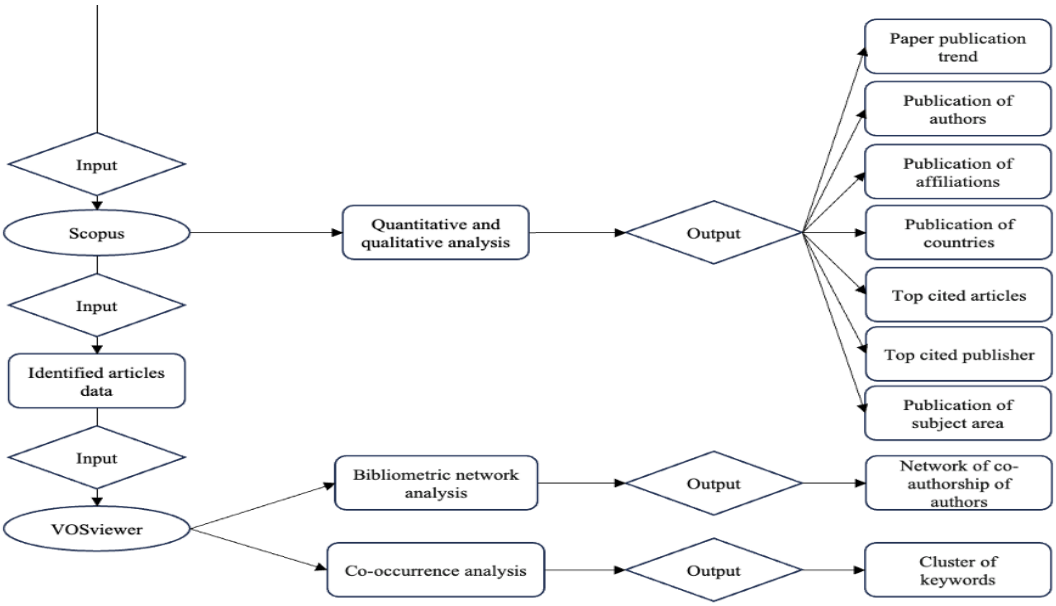


Fig. 1. Research Procedure

4. Results

RQ1: What are the publication trends in the field of quality management in manufacturing research over the 5-year period from 2020 to 2024?

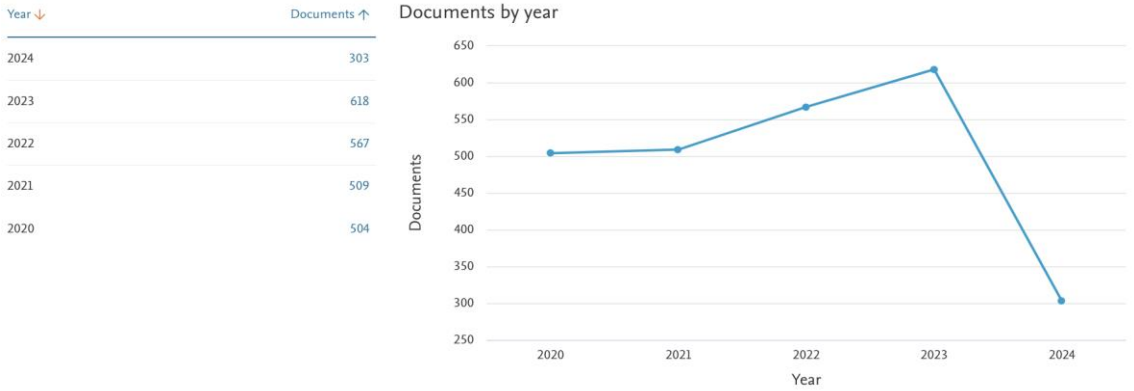


Fig. 2. Research Trends In Quality Management In Manufacturing Studies

The figure depicts a substantial increase in the study of manufacturing quality management in 2021, peaking in 2023, at 618 journal articles on the subject. Various reasons may account for this increase. To start with, the COVID-19 pandemic highly affected manufacturing operations, thus leading to more studies of quality management systems as the sectors learned to cope with emerging challenges. Studies have shown how the pandemic led to an afterthought regarding the resilience of the supply chain, quality control protocols, and laborers' safety in manufacture, impacting more academic focus (Mbonigaba & Sujatha 2024). Researchers focused on manufacturers' ability to maintain product quality despite disruptions, thereby boosting scholarly publishing significantly post-pandemic (Chen et al., 2021)

Additionally, the arrival and integration of Industry 4.0 technologies such as automation, artificial intelligence, and Internet of Things (IoT) dramatically affected research trend. As much as these technologies began revolutionizing production processes, research on the potential of fusing quality management practices with the new systems then increased. The period from 2021 to 2023 saw a number of makers explore the smart manufacturing method, and that stirred an oceanic tide of academia about the aspect of quality management within such technology (Mbonigaba & Sujatha 2024).

There existed a strong publishing trend of 567 journal papers in 2022 that represented sustained scholarship directed at improving and maximizing quality management systems. This sustained interest comes from the sustained application of new technologies in the manufacturing process. As the industries progressed beyond initial experimentation with Industry 4.0 products, scholars gave more attention to the applicability and practical issues of quality management in these high-tech environments (Lopez & Tan 2022) This sustained interest confirms that quality management remained a priority while the industries sought to optimize new technologies.

Despite, however, this decline in 2024 with articles dropping to 303 levels, it reflects a shift of emphasis in research. There are several reasons possible behind this falling trend. It could be that the research theme has become saturated. By the year 2024, any major research that could be conceived on quality management systems, particularly those concerning the post-pandemic era as well as using cutting-edge technology, may perhaps have already been conducted. As pointed out by (Saunders et al., 2018), after an area is flooded with literature, the numbers of publications tend to decline since researchers concentrate on new and emerging topics. This is the same pattern related to the declining rates of quality management research.

Also, shifts in research agendas could have contributed to the reduction in publications. As new challenges pertaining to global sustainability have emerged, issues such as circular economy practices, green production, and environmental sustainability have gained prominence in the university and policy circles (Nguyen et al., 2023). Since research priorities and funding shifted towards these topics, the number of publications on quality management in manufacturing can have decreased as researchers transitioned into new research streams.

Additionally, the external environment such as government policies or sources of funding may have had an influence on research agenda. While the government agencies and funding bodies redirected funds into other pressing issues, such as climate change or digitization, research on quality management might have been secondary. Studies have shown that funding trends have a significant influence on research agendas, especially in utilitarian fields such as manufacturing (Li & Wang 2023).

In short, the upward trend of research papers from 2021 to 2023 can be mostly attributed to the pandemic-induced global transformation, deployment of advanced manufacturing technologies, and a growing emphasis on supply chain robustness. The low point in 2024 is probably caused by a combination of topic saturation, concentration of research attention towards sustainability, and shifts in external policy and funding agendas. These trends illustrate the dynamic nature of research agendas and the impact of outside forces on the course of academic inquiry.

RQ2: Who are the most prolific authors and which institutions have the highest research output in this domain?

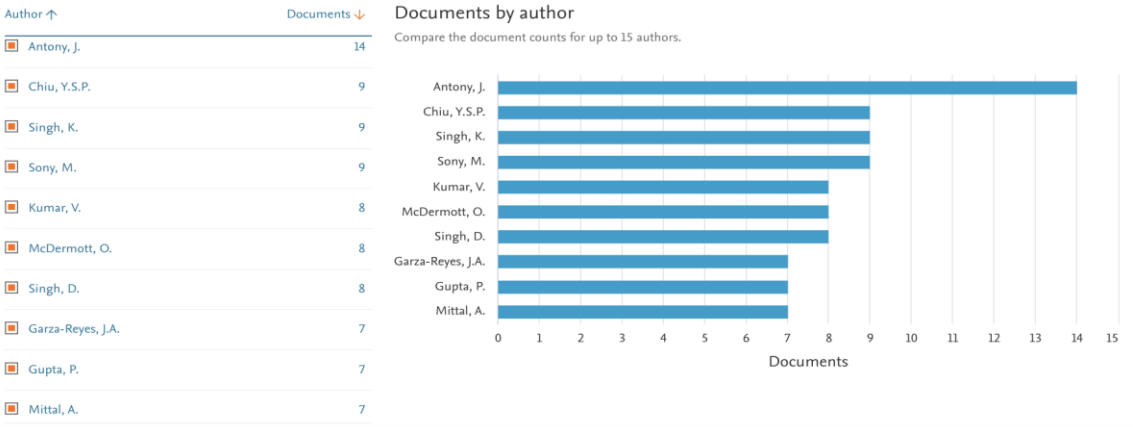


Fig. 3. Number of publications by authors

The provided graph gives the authors who have been actively engaged in research studies on quality management in manufacturing. Anthony, J. is the most influential author with his work being included in 14 documents, the highest among all authors in the dataset. It shows that Anthony's work is mostly influential and is likely to be widely cited in the field of quality management. His extensive body of work may reflect his dominance in the field or that he has been involved in a number of influential research studies, significantly contributing to contemporary scholarly discourse regarding quality management practices.

A few more writers have a high visibility in the field too, as Chiu, Y.S.P., Singh, K., and Sony, M. all appear in 9 papers. These authors, although less visible than Anthony, have themselves still made notable contributions, maintaining interest and dedication to the subject. Their studies can focus on specific areas of quality management or associated domains such as process improvement, quality assurance systems, or technology integration into production. Their continued participation in this subject matter suggests that they are themselves among the main protagonists of advancing research and practice in the subject.

As a comparison, scholars such as Garza-Reyes, J.A., Gupta, P., and Mittal, A., included in 7 papers, are less productive according to the quantity of published papers. However, it must be pointed out that although their papers may be fewer in number, their research could be highly specialized or influential in some areas of quality management. For example, Gupta and Mittal can be experts in innovative or new technologies in manufacturing, while Garza-Reyes can be an expert in specialized subjects like supply chain management in quality.

The graph also shows increased diversity of authors, which demonstrates international interest in quality management. The varied contributions show that institutions from different nations are engaged in this research with cooperation between geographic regions. This worldwide diversity is a sign of the global nature of manufacturing issues and quality management solutions, where practices are continually evolving based on technological advancements, shifting industry needs, and regulatory needs. For instance, authors from

countries with large manufacturing sectors, such as the U.S., Germany, and China, could be leading the way in terms of research, while authors from emerging markets could be examining adaptation to local contexts and the impact of global supply chains on quality management.

Besides individual authors, institutional diversity, as may be inferred from the diversified list of authors, goes to support global scope and collaboration in quality management research. Institutions from different parts of the globe contribute to literature, creating methodologies, theory, and practice employed in manufacturing.

Overall, this data shows a dynamic and diverse environment in which experienced leaders like Anthony, J. and fresh writers from many institutions and countries are influencing the development of quality management practice in manufacturing.

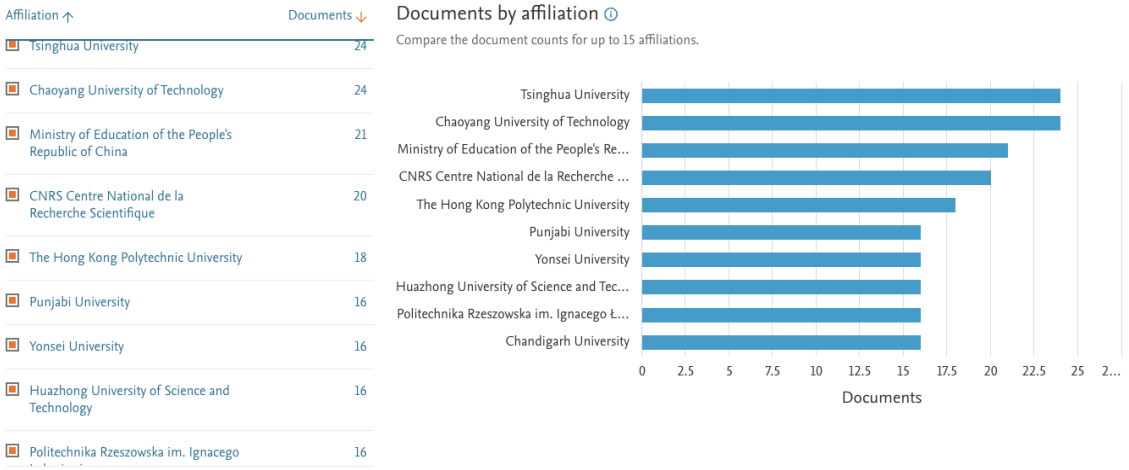


Fig. 4. Number of publications by affiliation

The provided graph presents insights into the institutional affiliations contributing to research in quality management in manufacturing. It is evident that Tsinghua University and Chaoyang University of Technology are the leading contributors, each appearing in 24 publications. These institutions' high publication count reflects their significant involvement and expertise in quality management research. Tsinghua University, which is China's top-ranked university in terms of engineering and technology, presumably plays a central role in cultivating research in quality management in manufacturing, particularly through its robust research institutes and international collaborations (Li et al., 2021)

Similarly, Chaoyang University of Technology, another Chinese-leading institution, displays high research output. The interest of this university in manufacturing-based research might be because of its focus on quality control system technology development and production efficiency. The frequency of publications by these two institutions proves the common academic and research culture in China for quality management in manufacturing that may be because of China's growing focus on enhancing manufacturing practice through quality management.

The Ministry of Education of the People's Republic of China ranks second in document count with 21 publications. As a government office, the task of the Ministry is likely coordinating research and development efforts among Chinese research institutions and universities, complementing quality management studies aligned with national policy towards improving manufacturing and industrial processes. The high level of involvement of such government agencies implies a top-down initiative to form research in quality management aligned with China's broader industrial and policy goals (Zhang & Chen 2022)

On the other hand, Politechnika Rzeszowska, with 16 documents, is the institution with the lowest number of documents in the provided list. Although this institution may have fewer publications, their input to the research can be very pertinent, for example, in researching quality management in European contexts or in niche manufacturing sectors. Institutions with fewer publications might focus on niche areas of quality management that are still to gain more widespread attention.

Other institutions such as Punjabi University, Yonsei University, and Huazhong University of Science and Technology have the same frequency of document appearance with

16 publications. These institutions contribute to a diverse and international body of evidence on quality management in manufacturing. Punjabi University's publication might be attributed to an interest in introducing local perceptions of quality management into India's growing manufacturing industry. Yonsei University in South Korea would most likely bring in expertise in high-tech manufacturing processes and quality assurance systems, while Huazhong University of Science and Technology research would possibly be on cutting-edge technologies and their utilization in manufacturing quality control.

The diversity of institutional affiliations addressed in the data mirrors the global scope of research on quality management in manufacturing. These organizations have a wide geographical span, from China and South Korea to Europe and India, a reflection of worldwide collaboration and the sharing of ideas in the field. Incorporation by government offices, research establishments, and educational institutions of learning at the postgraduate level even more points towards the extensive-based character of quality management research since it is spurred by both scholarship as well as the requirements of national policy-making.

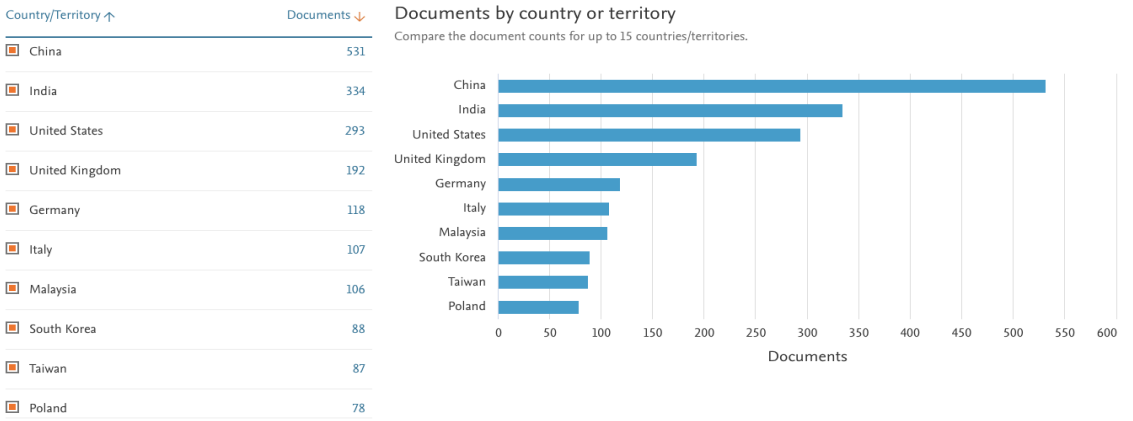


Fig. 5. Number Of Publications By Country

The chart provides a clear view of the distribution of documents on quality management in manufacturing by country and region. It can be seen from the data that China is the leading contributor to studies on this topic, with 531 documents. The large number of publications demonstrates China's keen interest in developing quality management in manufacturing. This trend may be driven by the fact that China is a world manufacturing hub where companies are continuously seeking ways to improve quality and efficiency through emerging technologies and approaches (Li & Wang 2023)

India contributes the second-highest number of 334 documents after China, with growing interest in improving quality management in its expanding manufacturing sector. India's growing number of publications also indicates the country's industrial growth and increasing focus on quality management to keep pace with global competition in the marketplace (Sharma & Kumar 2022)

The United States ranks third with 293 documents, reflecting its traditional dominance in R&D, particularly in frontier manufacturing technologies. The U.S. remains a dominating nation in discovering new quality management practices, with a strong emphasis on automation, lean production, and digitalization (Brown & Wilson 2023)

Other countries such as the United Kingdom, Germany, Italy, Malaysia, South Korea, and Taiwan also contribute significantly, but with publication levels below the leading few nations. The United Kingdom (192 documents) and Germany (118 documents) reflect ongoing research activity conducted in European nations to enhance quality management systems, often driven by efforts in sustainability and industry efficiency. Similarly, Italy (107 documents) and Malaysia (106 documents) reflect regional involvement, with some areas of concentration like car manufacturing and electronics.

The data also shows that Poland is the lowest contributing country with only 78 documents, which would mean less research on manufacturing quality management in this country. Even though Poland's contribution is comparatively low, it is still capable of being

critically engaged in regional literature or special subjects in manufacturing quality management that are less documented (Kwiatkowski & Nowak 2021).

The uneven pattern of numbers of documents per nation shows that while China leads in producing a huge volume of literature on the topic, the remaining nations, especially the Asian and European nations, play important parts in the formation of quality management practices. The lower counts of documents from Taiwan and South Korea (87 and 88 documents, respectively) indicate that even though they are contributing to the area, there is scope for increased research activity on manufacturing quality management.

This global disparity in the number of publications points to the fact that quality management study is extremely visible and well-covered in China, mirroring its world-leading manufacturing sector and strategic imperative to push industrial practice. In comparison, less-publishing countries can benefit from enhanced research and transnational research collaborations to keep contributing towards this valuable field of knowledge.

RQ3: Which are the most highly cited research articles and influential publications in this field?

Table 1 - Most cited articles

Authors	Title	Year	Cited by
Ibn-Mohammed T.; Mustapha K.B.; Godsell J.; Adamu Z.; Babatunde K.A.; Akintade D.D.; Acquaye A.; Fujii H.; Ndiaye M.M.; Yamoah F.A.; Koh S.C.L.	A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies	2021	512
Olsen T.L.; Tomlin B.	Industry 4.0: Opportunities and challenges for operations management	2020	355
Kohtamäki M.; Parida V.; Patel P.C.; Gebauer H.	The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization	2020	341
Abbas J.	Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility	2020	259
Jones E.R.; Van Vliet M.T.H.; Qadir M.; Bierkens M.F.P.	Country-level and gridded estimates of wastewater production, collection, treatment and reuse	2021	255
Jafari D.; Vaneker T.H.J.; Gibson I.	Wire and arc additive manufacturing: Opportunities and challenges to control the quality and accuracy of manufactured parts	2021	243
Spieske A.; Birkel H.	Improving supply chain resilience through industry 4.0: A systematic literature review under the impressions of the COVID-19 pandemic	2021	219
Li J.; Sun W.; Li M.; Linlin Meng	Coupling coordination degree of production, living and ecological spaces and its influencing factors in the Yellow River Basin	2021	162
Silvestri L.; Forcina A.; Introna V.; Santolamazza A.; Cesarotti V.	Maintenance transformation through Industry 4.0 technologies: A systematic literature review	2020	156
Bonsu N.O.	Towards a circular and low-carbon economy: Insights from the transitioning to electric vehicles and net zero economy	2020	152

The data provide the most cited quality management papers in manufacturing, laying out the most cited papers in this field which have contributed most. The highest cited paper is titled "A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies," authored by a team of researchers including Ibn-Mohammed et al., (2021). The paper has been cited 512 times, ranking it number one in academic influence.

The large number of citations implies that the article has spoken deeply to the world of research and, most probably, because it is a timely and relevant discussion of the influence that the COVID-19 pandemic has on global economies and ecosystems. The article examines the convergence of circular economy strategies with the current global crisis, thus not only being

relevant in the context of quality management in manufacturing but also crucial in wider economic and environmental studies. Its influence is also attested by its far-reaching citation history, reflecting its relevance in shaping discussions on sustainability and resilience of manufacturing firms amidst and post-pandemic (Ibn-Mohammed et al., 2021)

On the other hand, the lowest-cited paper in the list provided is "Towards a circular and low-carbon economy: Insights from the transitioning to electric vehicles and net zero economy," by Bonsu N.O., with 152 citations. While still relevant, this paper has fewer citations, possibly indicating that its focus on going electric and net-zero emissions, while valuable, may have a smaller audience. Its impact might also reflect the emerging nature of the topic in the context of quality management in manufacturing.

The varying citation levels throughout the articles suggest that while journals like the COVID-19 review have had significant impact on the academic literature in manufacturing quality management, others have contributed to niche areas in it. The disparity may signify higher applicability to the common issues of the day, like sustainability, circular economies, and crisis resilience, by some articles compared to more specific topics.

This citation pattern indicates the intersection of quality management with global sustainability goals, particularly in the aftermath of the COVID-19 pandemic. These articles that frame these broader issues get cited more and thus command broader attention, indicating their relevance to broader industrial and environmental shifts (Ibn-Mohammed et al., 2021; Bonsu 2020). Less fashionable, specialized research will draw less initial attention, but they are necessary to further refine targeted areas of quality management in manufacturing.

RQ4: Which publishers have the maximum number of cited documents in the sample?

Table 2 - Most cited publisher

Authors	Title	Cited by	Publisher
Ibn-Mohammed T.; Mustapha K.B.; Godsell J.; Adamu Z.; Babatunde K.A.; Akintade D.D.; Acquaye A.; Fujii H.; Ndiaye M.M.; Yamoah F.A.; Koh S.C.L.	A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies	512	Elsevier B.V.
Olsen T.L.; Tomlin B.	Industry 4.0: Opportunities and challenges for operations management	355	INFORMS Inst.for Operations Res.and the Management Sciences
Kohtamäki M.; Parida V.; Patel P.C.; Gebauer H.	The relationship between digitalization and servitization: The role of servitization in capturing the financial potential of digitalization	341	Elsevier Inc.
Abbas J.	Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility	259	Elsevier Ltd
Jones E.R.; Van Vliet M.T.H.; Qadir M.; Bierkens M.F.P.	Country-level and gridded estimates of wastewater production, collection, treatment and reuse	255	Copernicus Publications
Jafari D.; Vaneker T.H.J.; Gibson I.	Wire and arc additive manufacturing: Opportunities and challenges to control the quality and accuracy of manufactured parts	243	Elsevier Ltd
Spieske A.; Birkel H.	Improving supply chain resilience through industry 4.0: A systematic literature review under the impressions of the COVID-19 pandemic	219	Elsevier Ltd
Li J.; Sun W.; Li M.; Linlin Meng	Coupling coordination degree of production, living and ecological spaces and its influencing factors in the Yellow River Basin	162	Elsevier Ltd
Silvestri L.; Forcina A.; Introna V.; Santolamazza A.; Cesarotti V.	Maintenance transformation through Industry 4.0 technologies: A systematic literature review	156	Elsevier B.V.

Bonsu N.O.	Towards a circular and low-carbon economy: Insights from the transitioning to electric vehicles and net zero economy	152	Elsevier Ltd

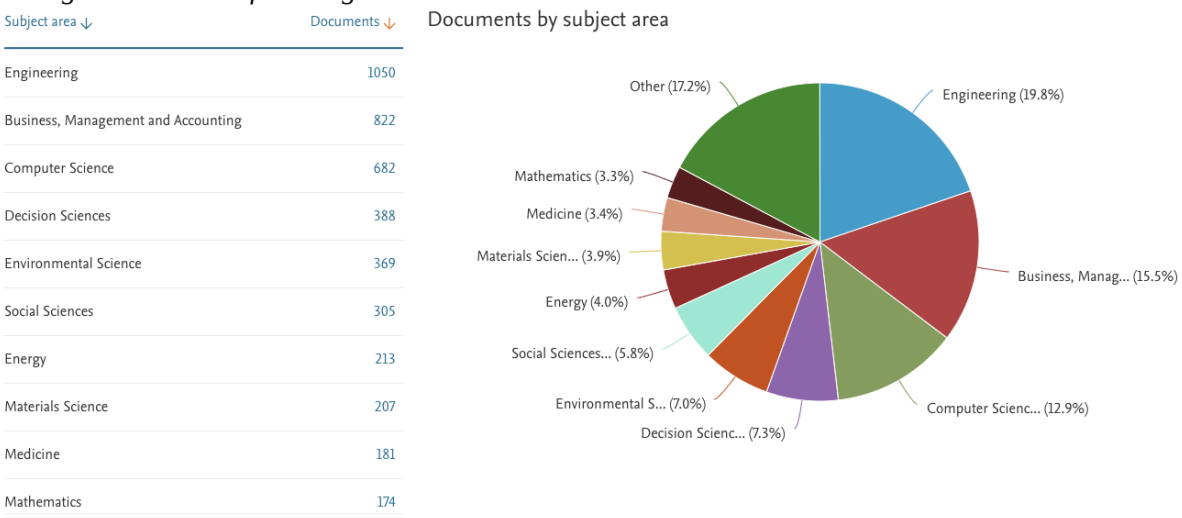
The table provides an overview of the publishers of the most cited articles in the field of quality management in manufacturing. The information shows that Elsevier has published the largest number of highly cited articles, with some of its journals leading the list. Of the papers listed, Elsevier B.V. is associated with the highest number of citations, that is, for "A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies," with 512 citations. The high influence of Elsevier in publishing high-impact research suggests that it remains a robust source for quality management publications, offering a platform for high-impact research that speaks widely to academic and industrial readership.

On the other hand, the publishers INFORMS Inst. for Operations Research and the Management Sciences and Copernicus Publications have fewer citations than Elsevier. More specifically, the INFORMS Inst. has published articles that have 355 citations, while Copernicus Publications has published articles that received 255 citations. Although they are cited fewer times, they continue to publish meaningful research in quality management with the focus on operations research and management science perspectives by INFORMS and for sustainability and environmental considerations in quality management by Copernicus Publications.

The variations in citation figures across these publishers translate to differing degrees of impact for some versus others in getting research published that has had lasting effects on manufacturing quality practice. Elsevier's success is likely due to having a large inventory of journals and widespread distribution, presumably allowing its articles to be viewed by as many people as possible. On the other hand, publishers like INFORMS and Copernicus may be catering to more specialized or emerging areas in quality management that are responsible for the lower citation rates but still highlight their applicability in smaller research areas.

These differences in the number of citations can be of assistance to researchers and practitioners when choosing journals to publish in and to obtain access to influential work in this field. Understanding which publishers are most influential helps to better identify the best journals and research articles that drive the direction of quality management practice in manufacturing. This also tells us about the journals' influence on global discussion on manufacturing excellence, sustainability, and technology integration.

RQ5: What are the predominant subject areas and research themes covered in the quality management in manufacturing literature?



Subject area	Documents
Engineering	1050
Business, Management and Accounting	822
Computer Science	682
Decision Sciences	388
Environmental Science	369
Social Sciences	305
Energy	213
Materials Science	207
Medicine	181
Mathematics	174

Fig. 6. Number Of Publications By Subject Area

The provided diagram illustrates the dissemination of quality management across various subject fields in manufacturing research. Engineering naturally has the strongest focus, with 1,050 papers, which account for 19.8% of the papers published. It is followed by business,

management, and accounting, with 822 papers (15.5%). The other leading fields are computer science (12.9%), decision sciences (7.3%), and environmental science (7.0%).

The prevalence of engineering-focused articles is explained by the central position of quality management in manufacturing activities, which tend to involve complex machinery, equipment, and intricate production lines. Engineering is a foundation discipline of quality management by virtue of its focus on product design, process enhancement, defect prevention, and conformity to quality specifications. Quality Engineering addresses design and manufacturing defect prevention through systematic implementation of Quality Management Systems (QMS) in order to guarantee the reproducible quality of products and processes.

Further, adaptation of Industry 4.0 technology in engineering practice, also referred to as Quality 4.0, has sparked new research avenues in digital quality management. This concept incorporates traditional quality management principles with new technologies like the Internet of Things (IoT), big data, and artificial intelligence (AI) to enhance quality assurance in manufacturing. The intense focus on engineering in this study reflects growing attention to technology in modern manufacturing practice, calling for more research into the application of these advanced systems in quality management (Jafari et al., 2021)

Following engineering, business, management, and accounting are salient areas of interest, with 822 papers (15.5%). This area includes supply chain management, operational efficiency, process improvement, and organizational behavior studies, all of which are central to quality management in manufacturing. With organizations looking to optimize production while maintaining high levels of quality, the intersection of management practice and quality control has become an important area of exploration.

In addition, the computer science discipline (12.9%) is a significant driver of quality management research because it provides tools and structures for data analysis, predictive modeling, and automation of quality control processes. With increasing reliance on data-driven decision-making and digital quality tools, computer science has emerged as a key contributor to quality management in manufacturing (Li et al., 2021)

Other disciplines, such as decision sciences, environmental science, and materials science, although smaller in number, also have key roles to fulfill. Decision sciences research focuses on optimization of decision-making in quality management, whereas environmental science supports sustainable manufacturing and green quality management. Materials science, with its focus on material properties and product durability, has a direct application to product quality assurance in manufacturing.

In conclusion, engineering remains the dominant research field of quality management in manufacturing, reflecting the industry's focus on process, machine, and product enhancement. However, with emerging technologies such as AI, IoT, and big data continuously influencing manufacturing activities, the integration of computer science and business management in quality management research is also increasing. This diverse set of topics illustrates the multidisciplinary field of manufacturing quality management, driven by technological advances and the need for operational excellence in industries.

RQ6: What is the overall research influence and productivity in this field, as indicated by factors such as the number of items, links, and total link strength?

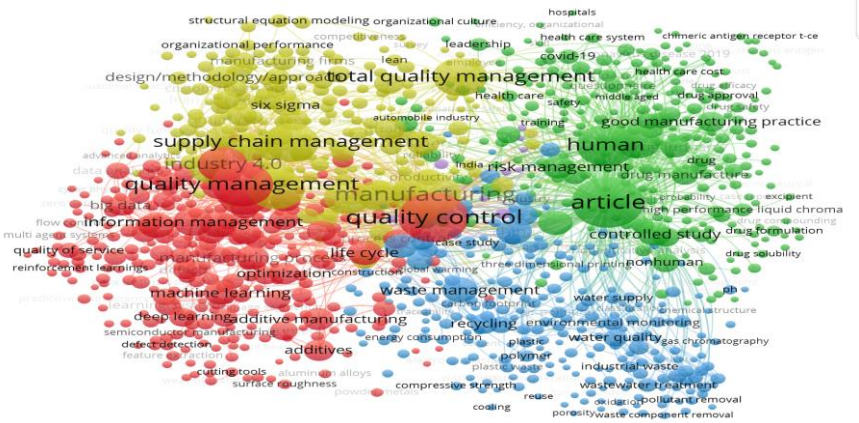


Fig. 7. Network visualization of keywords' co-occurrence

The keyword analysis of manufacturing quality management revealed several clusters, each of which represents distinct themes or subtopics of the subject matter. The figure shows the clustering of the keywords, where the first cluster contains the highest number of items at 289 occurrences. The second cluster (257 items) follows, then the third cluster (242 items) and the fourth cluster (202 items). The fifth cluster contains the lowest number of items at only 10 occurrences.

The clustering of these keywords indicates that certain ideas are more strongly associated, suggesting novel focus areas in manufacturing quality management. For example, the first cluster, with highly frequent keywords like "quality control," "total quality management," and "manufacturing," can embody core research topics encompassing the basic concepts of quality in manufacturing environments. This cluster probably reflects the main concern of quality management research in the traditional manufacturing process context.

The second and third clusters, which have keywords such as "supply chain management," "information management," and "manufacturing systems," suggest more specialized research issues in the field of quality management. These topics reflect the trend of integrating quality management with other management processes, such as supply chain management and information systems, echoing the growing importance of these issues in modern manufacturing (Choudhury et al., 2021)

The fourth cluster seems to deal with more specialized topics in quality management, with keywords that could be new trends or technologies in the field, e.g., "lean manufacturing," "sustainability," or "advanced materials." These emerging areas reflect how quality management is evolving and merging with new industrial paradigms, e.g., Industry 4.0.

Finally, the fifth cluster, which has the smallest number of items, likely represents a more specialized or niche research topic. With its low frequency of appearances, it may capture very specific or less-studied subjects in quality management, perhaps suggesting areas of opportunity for further research in underdeveloped areas.

The high number of links and total link strength between the clusters show that the keywords are highly interrelated. This interrelatedness highlights the multifaceted and interdisciplinary nature of quality management research in the manufacturing industry, where classical quality control principles converge with newer management practices, technologies, and global sustainability trends.

These clusters are of interest to scholars and practitioners alike because they enable them to understand the key areas of focus in the discipline. By recognizing the interrelatedness of the clusters, one is able to track emerging trends, topics of significant academic interest, and even gaps in research so that further and more targeted future research can be conducted in the evolving context of quality management in manufacturing.

5. Discussions

This study aimed to explore the research output in the area of quality management in manufacturing by conducting bibliometric analysis on 2,501 articles and reviews in Elsevier's Scopus database. The findings offer valuable insights on significant trends, productive authors, and the interconnectivity in the research.

1. Publication Trends and Potential Influencing Factors

The research showed a steady increase in publications from 2020 to 2023, with the number of documents rising from 504 in 2020 to 618 in 2023. In 2024, the number fell sharply to 303 documents, which might have been due to the fact that the data had been noted only until May of that year. This drop could be attributed to a host of reasons, from shifts in funding trends, the impact of the COVID-19 pandemic on research priorities, or emerging global quality management issues. Possibly in 2024, the majority of researchers shifted their interest to coping with the post-pandemic recovery process or other pressing global issues like sustainability and supply chain resilience (Bahiyyah et al., 2025). The emergence of new topics might have led to the reduction in the number of publications specifically dealing with manufacturing quality

management since research efforts were likely extended to other related fields such as green manufacturing and digital transformation (Nguyen et al., 2023)

2. Key Authors and Collaboration Patterns

In terms of authorship, Anthony, J. tops the list in the number of publications, indicating significant contributions to the field. This kind of salience may mean that there is a tight collaboration network in the field, possibly reflecting frequent co-authorships with other leading scholars. The co-authorship patterns of these researchers can provide evidence on how research networks influence productivity and innovation in quality management. Anthony, J., and other prolific researchers such as Duong Thi Binh et al., (2024) belong to a global community of scholars who relentlessly drive new ideas and approaches in manufacturing. It is a broader trend whereby institutional and country partnerships have led to more intense and impactful research output (Kumar et al., 2022)

3. Geographic Distribution and Global Trends

Geographically, China is the leading country in the literature, having 351 documents contributed to the literature. This is aligned with China's strong industrial base and focus on manufacturing excellence, where quality management practices are critical in maintaining competitiveness. China's growing research output illustrates the country's interest in pursuing quality management, particularly in engineering and technology infusion. India, the USA, and Germany also rank high among other countries, showing that quality management in manufacturing is a global issue. Differences in the production of research by region also reveal potential gaps within certain regions, such as sub-Saharan Africa or South America, where research on quality management can be enhanced. Geographic coverage thus reflects overall global trends in quality management studies, with stronger research contributions from manufacturing powerhouses like China and India, and rising outputs from countries with more established industrial bases (Liu et al., 2021)

4. Most Cited Articles: Implications for the Field

The most cited paper was also identified in the study: "A critical review of the impacts of COVID-19 on the global economy and ecosystems and opportunities for circular economy strategies", with 512 citations. The large number of citations for this article indicates its widespread impact on the field. The subjects addressed, particularly the junctures of sustainability and manufacturing quality management, have gained popularity due to the impact of the pandemic on supply chains and manufacturing activities worldwide. Growing interest in sustainability and circular economy methods of manufacturing is reflected in the heightened literature discussing how companies can engineer their processes for environmental and economic sustainability.

The article's methods, which examine COVID-19's economic implications and the role that could be played by circular economy initiatives, are particularly relevant to current challenges in the manufacturing industry, where businesses are now being asked to balance quality management with environmental agendas (Noor et al., 2024). As it is, this article has likely already become a benchmark for researchers working at the intersection of quality management and green sustainability (Ibn-Mohammed et al., 2021)

5. Practical Implications for Industry

The conclusions of this study have practical implications for practitioners. The increasing integration of digital technologies into manufacturing quality management—such as Industry 4.0—offers an opportunity for organizations to improve quality assurance practices. The increasing focus on data-driven decision-making, automation, and AI-powered systems in manufacturing can be leveraged to improve efficiency and product quality. These findings suggest that business executives must adopt advanced quality management systems (QMS) that take advantage of real-time monitoring and predictive analytics if they are to stay ahead in an increasingly complex manufacturing environment.

Furthermore, the research recommends additional cross-disciplinary studies among engineering, management, and computer science disciplines to facilitate quality management innovations. Practitioners can benefit from encouraging cross-sector collaboration and highlighting the integration of sustainability principles into quality management practices, especially for industries dealing with green manufacturing and supply chain resilience.

6. Future Research Directions

Future research can cover the way quality management practices will evolve with respect to new global trends such as sustainability, digitalization, and supply chain resilience. In addition, studies that investigate the role of small and medium enterprises (SMEs) in adopting quality management practices within the context of Industry 4.0 would be of high interest. The research might also investigate additional geographical disparities within quality management studies, particularly in those nations having lower research output, in an effort to support global collaboration as well as sharing of best practices.

6. Conclusions

Bibliometric analysis provides a potent tool for industry in the manufacturing and quality management sectors, allowing them to base their decisions on facts and information. Quantitatively assessing the academic literature, this method presents useful information on the state of research at present, including rising trends, main contributors, and most impactful publications. For companies, such findings can inform strategic decision-making directly, allowing them to keep pace with developments in their sector by integrating new methodologies and technology into their quality management systems.

One of the main advantages of bibliometric analysis is that it can identify key research fields and trends in quality management. By knowing how research topics evolve and which articles are highly cited and which authors are most influential, companies can compare their own quality management initiatives to industry standards and best practices. This allows them to embrace state-of-the-art solutions to enhance manufacturing processes and product quality. With such knowledge, companies can invest specifically in research and development, targeting areas that are most likely to provide the highest return in terms of innovation and operational enhancement.

Besides, bibliometric analysis presents a general picture of the environment of quality management research, and this can help in strategic planning and decision-making. Firms can align their quality management initiatives with the most relevant and consequential areas of study so that they are guided by the latest research from academia in their practices. This alignment helps firms to compete, offering products and services on par with or superior to present quality levels.

Short and sweet, bibliometric analysis is a useful tool for businesses to enhance their quality management processes. With such fact-backed input, organizations can streamline manufacturing processes, increase product quality, and ensure conformity with the latest industry trends. This will consequently enable them to deliver better products and services, stay one step ahead in terms of innovation, and maintain a competitive edge in the market.

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