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Emerging research trends of total quality management in the COVID-19 pandemic: a dynamic evolution analysis

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ABSTRACT

As the COVID-19 pandemic rages, the changing trends and emerging areas of total quality management (TQM) research before and after the COVID-19 pandemic are spotlighted, while the links between TQM and environmental social governance (ESG) are deeply discussed in this study. To explore the impact of the pandemic on TQM research, a comprehensive bibliometric analysis is conducted by collecting 1465 pre-pandemic and 76 post-pandemic publications from the WoS database. Further, the fundamental characteristics, conceptual structure and intellectual and social structure of TQM research are statistically analysed through bibliometric tools. Consequently, this article methodically sorts out the evolution, new research areas, primary sources, national collaboration networks and influential themes within an intricate and large TQM research system. The linkages between ESG and TQM are explored by focussing on some emerging topics after the outbreak such as sustainability and environmental management, which advances the innovative attempt towards the goal of cooperating sustainability. Finally, we offer some enlightening new perspectives on economic construction and social life during the pandemic to better cope with the negative effects of the pandemic.

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Total quality management; COVID-19 pandemic; bibliometric analysis; environmental social governance

JEL CODES
Z0; M0; Q0

1. Introduction

On 11 March 2020, the WHO declared that the outbreak of COVID-19 had become a global pandemic (Gong et al., 2020). As of 9 November 2021, there were 250,154,972 confirmed cases of COVID-19, including 5,054,267 deaths, reported to WHO (World Health Organisation, 2021). According to a report by McKinsey and Company (2020), between 1.4 million and 2.1 million US small businesses could close permanently in the first four months of the epidemic. SMEs face unpredictable challenges and severe crises caused by the COVID-19 pandemic. As the global economy is hit hard by COVID-19, the structure and management of organisations are reshaped (Grint, 2020; Kordestani et al., 2021), and this paradigm shift influences the processes and standards of fully implementing TQM (Singh & Arora, 2022). It is

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Table 1. Hard and soft factors of TQM.

Research	Hard factors	Soft factors
Powell (1995)	Advanced manufacturing systems, process management, SPC usage, benchmarking, zero-defect mentality	Committed leadership, closer customer and supplier relationships, Increased training, open organisation, Employee involvement, flexible manufacturing
Chin et al. (2002)	Systems, techniques and measurement and feedback	Top management commitment, leadership, education and training
Rahman (2004)	Process management tools and methods, benchmarking, JIT practices	Education, leadership, loyalty, empowerment and teamwork
Lewis et al. (2006)	Tools and techniques (e.g. seven tools, SPC, FMEA, QFD, etc.)	Involvement, commitment, teamwork, empowerment
Alkhaldi and Abdallah (2022)	Statistical process control, just-in-time (JIT) system, benchmarking, preventive maintenance, continuous improvement	Management leadership, customer focus, employee training, multifunctional teamwork.

Source: Authors' own summary.

critical to improve productivity, organisational execution, activity effectiveness and product quality in both manufacturing and service industries (Samsudin et al., 2021). Soft factors of TQM are the effective moderators for adapting and responding to these sudden shocks, such as organisational meaningfulness, work-related well-being (Palumbo et al., 2021), transformational leadership (Madi Odeh et al., 2021), staff training (Morales, 2021), customer satisfaction (Alshrbaji et al., 2022) and happiness management (Ravina-Ripoll et al., 2021). Organisations endeavours to establish a strategy focussed on TQM to overcome the vulnerability of the organisation and improve competitiveness during the crisis (Kaur et al., 2019). TQM activities have an essential role in an emergency plan to mitigate the damage of COVID-19 and increase productivity (Morales, 2021).

TQM, as a driver for improving business performance, not only is applied to address unforeseen and disruptive emergencies (Talib et al., 2011), but also contributes to maintaining high-quality products and services, meeting customer needs and promoting organisational competitiveness (Ooi et al., 2011). It is a management approach to improve organisational performance and incorporate both technical and behavioural topics (Rahman, 2004). Since the 1990s, TQM has been prevalent and widely applied in developed countries (Samson & Terziovski, 1999). Deming (1986) proposed 14 principles that translate and improve quality management practices. On this foundation, seven concepts of TQM were developed, including visionary leadership, internal and external cooperation, learning, process management, continuous improvement, employee fulfilment and customer satisfaction (Anderson et al., 1994). Those key TQM factors proposed by numerous researchers have been distilled out in Table 1, including 'hard' and 'soft' factors (Lewis et al., 2006). Hard factors include a range of tools and techniques, while soft factors are mainly about human factors (leadership, customer focus, employee training, education, empowerment; Nasim, 2018). During the period of the COVID-19 pandemic, the TQM leadership style 'transformational leadership' contributes to improving the organisation's adaptive culture and resilience in the face of survival crisis (Madi Odeh et al., 2021). Scholars argued that top management commitment and leadership are crucial TQM factors

that should be taken precedence by administrators (Zhang et al., 2021). With the research areas of TQM growing more intensive (Voon-Hsien & Jun-Jie, 2017), it becomes more popular in healthcare than others (Zhang et al., 2021). It is worth exploring more emerging areas and factors of TQM research, which advances towards the idea of a vision for sustainable development of society, environment and governance, even during the COVID-19 pandemic.

As epidemics, poverty, climate change and other destructive phenomena threaten humanity, the world is increasingly concerned about sustainable development (Sideri, 2021). While operating at a profit, companies are not only bound to inevitably provide a satisfactory quality of products and services but also address the need for economic, social and environmental sustainability (Abbas, 2020; Khurshid et al., 2022). In the environmental scope, climate change has become one of the most concerning investment risks for investors (Venturini, 2022), thus many market participants have taken environmental sustainability into account when making investment decisions (Senadheera et al., 2021). An increasing number of investors are moving away from traditional investment paradigms to increasingly popular ESG investments (Diaz et al., 2021; Zainullin & Zainullina, 2021). ESG factors are applied to assess the ESG risk of sustainable investments (Folque et al., 2021) and determine a portfolio (Wahab & Naim, 2021). The ESG concept embeds environmental (E), social (S) and governance (G) factors into fundamental investment analysis as metrics to evaluate investment and company performance (Caplan et al., 2013). The international system framework of ESG is shown in Figure 1. In addition, many central banks in OECD (Organisation for Economic Co-operation and Development) countries are also currently factoring ESG assessments into their investment guidelines (Boffo et al., 2020), applying them as a benchmark to assess sustainability risks and control the environment and society of organisations (Costa et al., 2022), which better aligns portfolios with the transition to a low-carbon, climate-resilient economy.

The strong convergence of the ISO 9000 quality assurance system with TQM practices promotes a well-structured quality management system (Hunt, 1995; Shahalizadeh & Mostabseri, 2008), which propels the full implementation of ESG activities (Curkovic, 2003; Tsou et al., 2021). In the environmental dimension, the zero-defect objective of quality management is inextricably bound up with the waste-free objective of environmental management (Molina-Azorín, Tarí, Claver-Cortés, & López-Gamero, 2009). TQM promotes ecological sustainability and improves the performance of the planet (Shrivastava, 1995; Zwetsloot, 2003). In the social and governance dimension, TQM and SCM practices are mutually reinforcing and create synergies (Kaur et al., 2019). Similarly, corporate social practice and TQM are regarded as two sides of the same coin (Holjevac, 2008; Parast et al., 2006). In turn, the effectiveness of the implementation of ESG factors affects the full implementation of TQM factors such as organisation learning (Carter, 2005), innovation (Reverte et al., 2016) and leadership (Akour et al., 2019). Moreover, the complementary management concepts of TQM and ESG have a positive impact on corporate performance (Benavides-Velasco et al., 2014; Chams et al., 2021). The complementarity and integration of ESG and TQM facilitate a company's commitment to implementing TQM and ESG for sustainable development (Jalilvand et al., 2018)

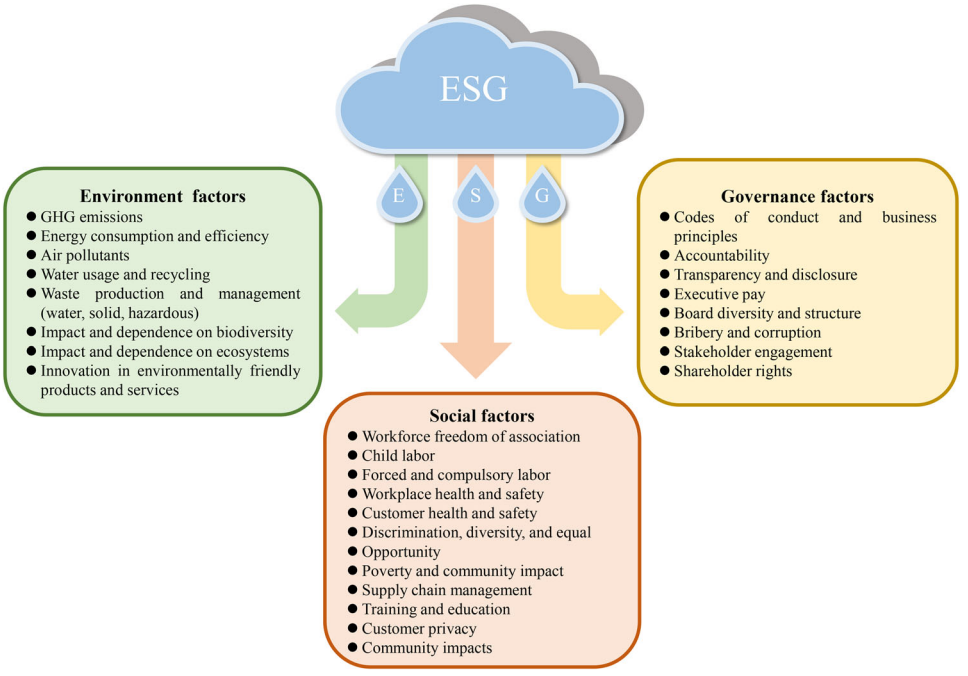


Figure 1. ESG framework (international framework).
Source: Author adapted from the report "EBA report on management and supervision of ESG risks for credit institutions and investment firms" Available online: https://www.eba.europa.eu/eba-publishes-its-report-management-and-supervision-esg-risks-credit-institutions-and-investment.

The COVID-19 pandemic has had a huge negative impact on national, corporate and social activities, while TQM with the goal of customer satisfaction has a vital role in coordinating the activities of machines, information and people in the complex environment. For better application of TQM during the pandemic, the visual bibliometric analysis provides scholars with a better understanding of the current state and limitations of TQM research, thus exploring valuable research directions and evolutionary pathways of TQM. In addition, the environmental, social and governance concerns of ESG are inextricably bound up with current hot topics such as dual carbon, sustainable development and corporate social responsibility (CSR). Researching the links between TQM and ESG facilitates the exploration of valuable mediating factors and coordination effects, which contributes efficient implementation of TQM and provides visionary and practical guidelines for better addressing the negative effects of the pandemic in actual combat. Therefore, we can divide the objective into two points: (1) New research areas and the evolution of scientific publications on TQM research before and after the outbreak of the COVID-19 pandemic. (2) Linkages between TQM research and ESG. The main insights of the article are as follows:

1. Finding new research areas and the most influential papers on TQM research to present the evolution and differences of publications pre and post the COVID-19 pandemic.

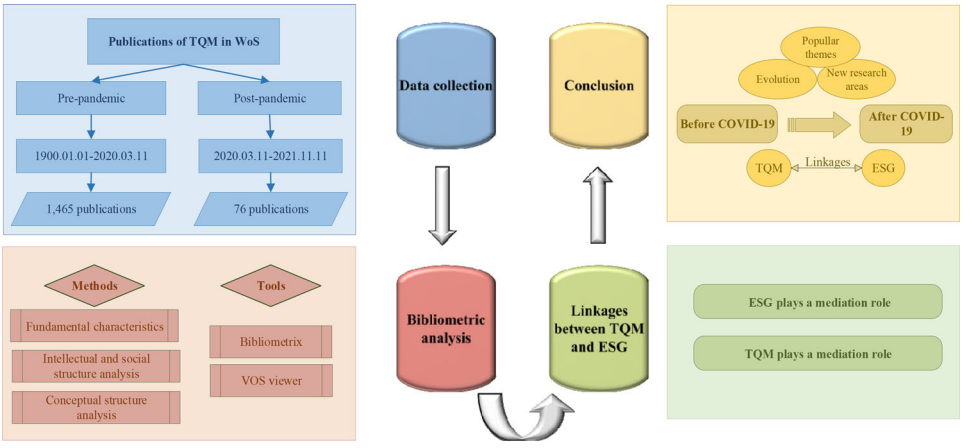


Figure 2. Research framework of the methodology used in this study.
Source: Authors' own research framework.

2. Showing the co-citation network of sources, collaboration map and transnational corporate for exploring the intellectual and social structure.
3. Presenting co-occurrence analysis and thematic analysis to show popular and emerging themes.
4. Discussing linkages between TQM and ESG.
5. Having further discussion from perspectives of avenues for future research, implications and limitation.

The rest of this article is developed as follows: Section 2 offers the data source and bibliometric methods. In Section 3, fundamental characteristics, intellectual structure, social structure and conceptual structure are analysed for the sake of delving into the content of TQM research and discovering emerging themes during the pandemic. Section 4 discusses the linkages between TQM and ESG. Section 5 provides a profound discussion. Section 6 ends the study with some conclusions.

2. Data and methodology

Section 2 focuses on the article's data sources, search strategies and bibliometric tools. Figure 2 illustrates the research framework of the methodology in this study, concisely presenting the research lineage of the article. As we can see, the article develops into four parts: (1) Data collection. (2) Bibliometric analysis. (3) Linkages between TQM and ESG. (4) Conclusion.

2.1. Data source and search strategy

In this article, the bibliometric method is applied to the TQM research, and our data are crawled from the Web of Sciences (WoS) core collection database which is one of the most credible indexes and databases in the social sciences (Farooq et al., 2021; Wang et al., 2021; Wang et al., 2021). The two data searches were carried out on 11 November 2021. We chose 11 March 2020, the profoundly significant date for the

global economic, political and social situation when WTO officially declared that the outbreak of COVID-19 has become a global pandemic (Gong et al., 2020), as the turning point for the search. Therefore, we selected the period from 1 January 1900 to 11 March 2020 as the pre-epidemic dataset and the period from 11 March 2020 to 11 November 2021 as the post-epidemic dataset. Ultimately, 1465 pre-pandemic and 76 post-pandemic publications were retrieved after removing the invalid data from the original dataset to provide informative and representative data. The specific details of the search strategy are summarised as follows:

1. For the first dataset,
   Title = Total quality management
   Timespan = From 1 January 1900 to 11 March 2020
   Databases = WoS Core Collection
2. For the second dataset,
   Title = Total quality management
   Timespan = From 11 March 2020 to 11 November 2021
   Databases = WoS Core Collection

2.2. Bibliometric methods

Bibliometrics is a powerful method of literature analysis to identify trends observed in topics, terms, or subfields of a particular scientific field (Qin et al., 2022). Specifically, bibliometric analysis is carried out in three main directions: fundamental characteristics, intellectual and social structure analysis and conceptual structure analysis, which analyzes the publication's performance, new areas of research, national/regional collaborations, important themes, etc. (Gao et al., 2021; Moral-Munoz et al., 2020). For a more comprehensive and effective bibliometric analysis, Bibliometrix and VOS viewer complement each other to enhance the visualisation and understandability of the research. Bibliometrix for RStudio (Aria & Cuccurullo, 2017) contributes to exploring the historical evolution and development prospects of the TQM field through co-citation network analysis, generation of collaborative networks and thematic maps (Wang et al., 2020). In addition, the co-citation and co-occurrence networks in TQM research are visualised by VOS viewer (Dahlawi et al., 2021; Qin et al., 2021), playing a predominant role in measuring the relevance of the term (Durana et al., 2020).

3. Bibliometric analysis

3.1. Fundamental characteristics

Based on the dataset in WoS and the analysis given by Bibliometrix, it is revealed that TQM research has lasted for 59 years, almost half a century since 1962. This section analyzes the fundamental characteristics of TQM research in terms of scientific production analysis, categories and types of publications, contributing to an understanding of the current state and emerging trends in TQM research. Specific information is presented in Table 2 including 1541 independent studies on defined topics, 2994 authors and 808 different keywords. Specifically, scientific production analysis

Table 2. The fundamental information of TQM research.

Description	Before 11 March 2020	After 11 March 2020	Total
Main information about data			
Timespan	1962:2020	2020:2021	1962:2021
Sources (Journals, Books, etc.)	827	45	856
Documents	1465	76	1541
Average citations per document	13.70	1.66	13.11
References	21,593	4205	24,692
Document contents			
Keywords Plus (ID)	738	193	808
Author's Keywords (DE)	1658	264	1669
Authors			
Authors	2977	213	2994
Author Appearances	3404	224	3421
Authors of single-authored documents	563	8	564
Authors of multi-authored documents	2414	205	2430

Source: Authors' own research.

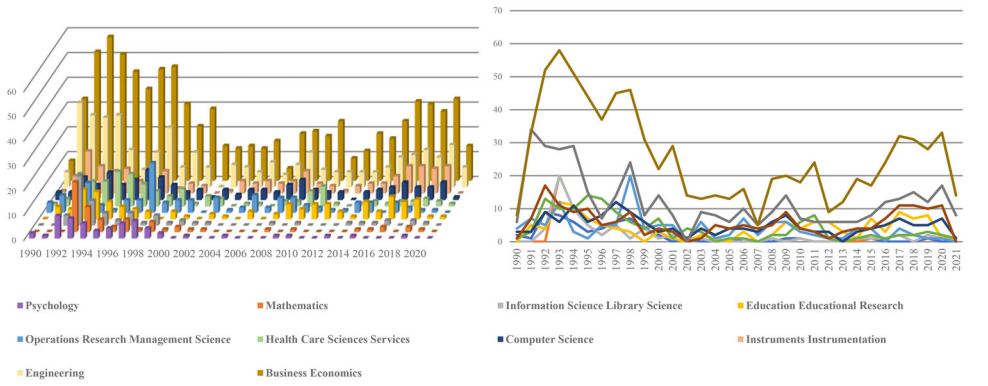
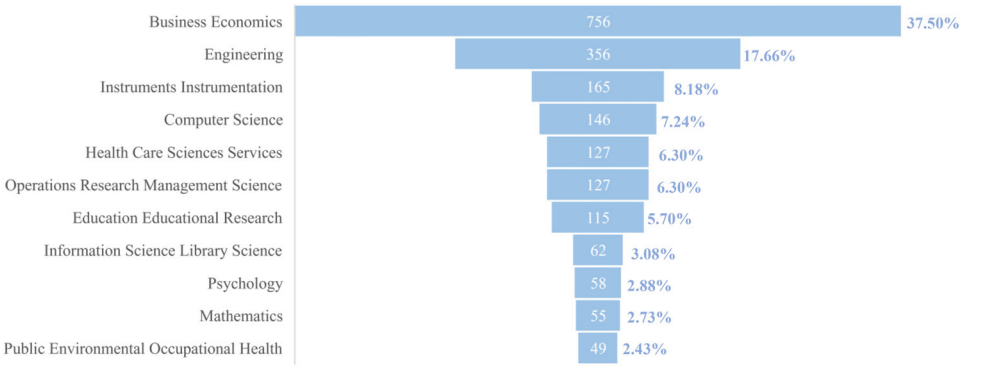


Figure 3. The tendency of top 10 research areas on TQM research.
Source: Authors' own research.

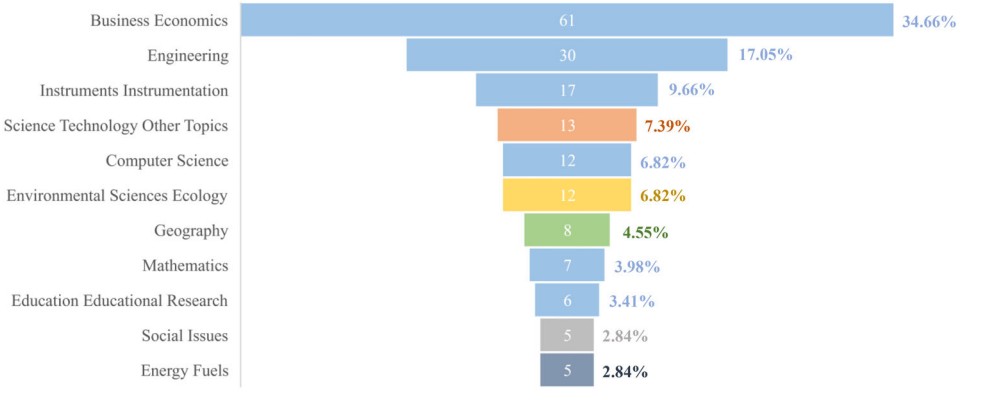
provides a comprehensive analysis of the current state of TQM research in terms of both publications and citations, which facilitates the observation of development trends.

3.1.1. Research areas of publications

Figure 3 indicates the changing trend of the number of publications in the top 10 research areas over time, which is instructive for observing the evolution of the diverse areas in TQM research over the last half-century. As can be seen from Figure 3, the top 10 research areas published fewer articles in the twentieth century than in the nineteenth century, with an upward trend in 2007 and 2012. Moreover, 'Business Economics' has a definite advantage over the other nine research areas, indicating the most mainstream and prevalent research area in TQM research. On the one hand, it is surprising that the number of articles in four research areas reached a ten-year peak in 2020, the year of the outbreak of COVID-19. Obviously, they are 'Business Economics', 'Engineering', 'Instruments Instrumentation' and 'Computer Science', indicating increasingly considerable scholarly interest is attracted by the four areas at a very special time. On the other hand, the number of 'Education Educational Research' experienced a



(a) Before the COVID-19 pandemic.



(b) After the COVID-19 pandemic.

Figure 4. Distribution of the top 10 research areas in TQM research.
Sources: Authors' own research.

steep decline in 2020, with a drop of 87.5%, implying that scholars' attention shifted to other research areas.

Furthermore, it is intriguing to pay particular attention to how the research areas changed before and after the outbreak of the pandemics of COVID-19. Figure 4 shows the top 10 research areas before and after the outbreak of COVID-19, colouring the emerging and prevailing research directions in the COVID-19 pandemic by comparing the divergences between (a) and (b) in Figure 4. It is worth noting that there are six research areas always in place both before and after the pandemic, suggesting that they are popular and common research areas in TQM research. Obviously, they are 'Business Economics', 'Engineering', 'Instruments Instrumentation', 'Computer Science', 'Education Educational Research' and 'Mathematics'. Among them, the top three positions are firmly and unshakeably occupied by 'Business Economics', 'Engineering' and 'Instrument Instrumentation', both in (a) and (b) of Figure 4. Then, five emerging research areas, 'Science Technology Other Topics' (13), 'Environmental Sciences Ecology' (12), 'Geography' (8), 'Social Issues' (5) and 'Energy Fuels' (5), are coloured for

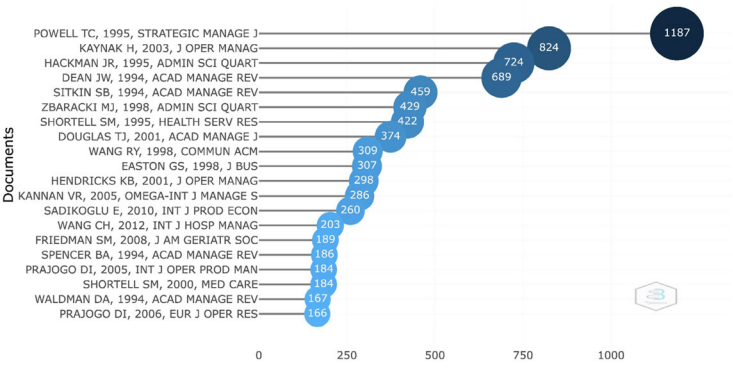


Figure 5. Top 20 cited documents on TQM research ordered by the TC.
Source: Authors' own research.

easy observation, revealing that environmental development and resource use issues have received widespread attention.

3.1.2. Most influential papers

Figure 5 presents the top 20 cited documents ordered by the total number of citations (TC). The first ranked document is named 'Total quality management as competitive advantage: A review and empirical study (Powell, 1995), which assessed the performance of TQM on strategic management research and made the appraisal of TQM from resource and other conceptual aspects. In addition, 'The relationship between total quality management practices and their effects on firm performance' (Kaynak, 2003) and 'Total quality management: empirical, conceptual and practical issues' (Hackman & Wageman, 1995) follow closely behind, giving an account of the direct and indirect effects of TQM practices on different levels of performance and alignment between TQM and behavioural science knowledge, respectively. The 20 sources of publications cover a total of 15 journals, with the journal 'The Academy of Management Review' appearing the most often, and 'Journal of Operations Management' and 'Administrative Science Quarterly' tied for second place, both appearing twice.

To enable a more objective assessment of a publication's influence, we introduce the number of citations per year (TC/Y) to eliminate the cumulative effect of time. Figure 6 indicates the top 10 documents ordered by TC/Y before the COVID-19 pandemic, in which the top three articles are the same as in Figure 5. In addition, Figure 7 presents the citation analysis of the top 10 documents ordered by the TC/Y after the COVID-19 pandemic. Notably, the top-ranked article in Figure 7 was published in 2020 during the COVID-19 pandemic with the title 'Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility' (Abbas, 2020). It highlights that TQM has a significant impact on both corporate green performance (CGP) and CSR, with the latter mediating the relationship between TQM and CGP. In summary, the top-ranked articles in the post-pandemic period focussed on research areas of sustainability, green development and CSR.

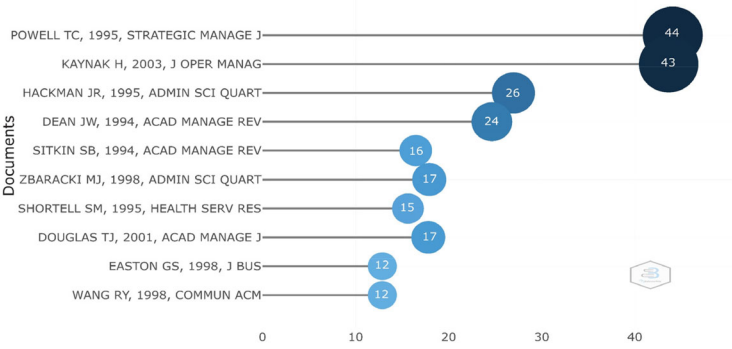


Figure 6. Citation analysis of the top 10 documents on TQM research ordered by the TC/Y before the COVID-19 pandemic.
Source: Authors' own research.

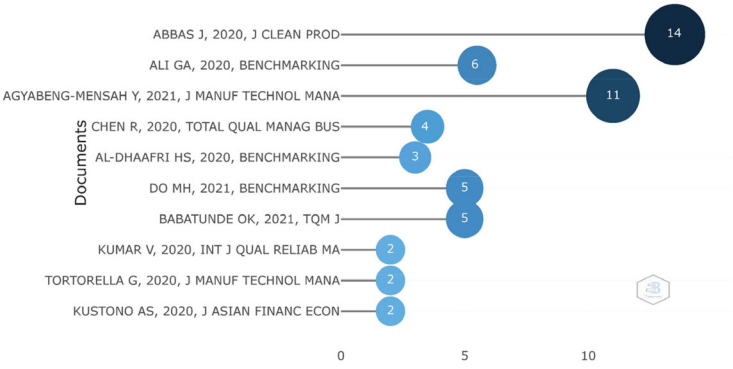


Figure 7. Citation analysis of the top 10 documents on TQM research ordered by the TC/Y after the COVID-19 pandemic.
Source: Authors' own research.

3.2. Intellectual and social structure analysis

3.2.1. Co-citation analysis

Figure 8 presents the source co-citation network of TQM publications before the COVID-19 pandemic, in which four coloured clusters are Cluster 1 (red) including 41 sources, Cluster 2 (green) including 33 sources, Cluster 3 (blue) including 14 sources, Cluster 4 (yellow) including 11 sources. According to Figure 8 and Table 3, the top three journals are *Management &Business Excellence* (577) in Cluster 4, *Journal of Operations Management* (429) in Cluster 2 and *Total Quality Management* (412) in Cluster 1 before the COVID-19 pandemic. Meanwhile, in Figure 9, there are four clusters: Cluster 1 (red) including 30 sources, Cluster 2 (green) including 24 sources, Cluster 3 (blue) including 21 sources, Cluster 4 (yellow) including 9 sources, presenting the source co-citation network of TQM publications after the COVID-19 pandemic. Moreover, combined with Table 4, the top three journals are *Total Quality Management & Business Excellence* (232) in Cluster 1, *International Journal Quality & Reliability Management* (189) in Cluster 1 and *Journal of Cleaner Production* (111)

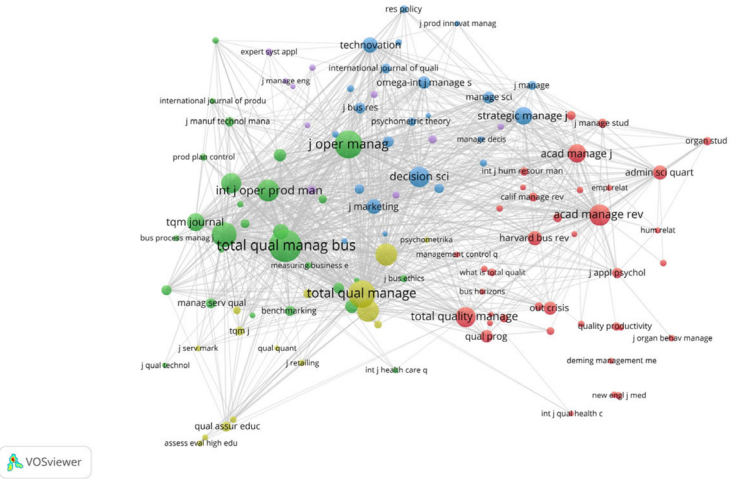


Figure 8. The source co-citation network of TQM publications before the COVID-19 pandemic.
Source: Authors' own research.

Table 3. The information of the pre-pandemic publications by co-citation analysis per cluster of cited sources.

Cluster	The number of cited sources	Source	Citation	Total link strength
1	38	Total Quality Management	412	12,599
		Academy of Management Review	263	9682
		Academy of Management Journal	197	8388
2	28	Journal of Operations Management	429	16,856
		International Journal Quality & Reliability Management	351	14,437
		International Journal of Operations & Production Management	277	11,356
3	23	Decision Science	248	9900
		Strategic Management Journal	185	7695
		Technovation	147	5959
4	15	Total Quality Management & Business Excellence	577	19,285
		The TQM Magazine	279	8512
		International Journal of Quality and Reliability	268	10,493

Source: Authors' own research.

in Cluster 2 after the COVID-19 pandemic. Both before and after the outbreak, *Total Quality Management & Business Excellence* consistently ranked first and was the most co-cited source, providing valuable references for scholars researching total quality management. In addition, the two sources *International Journal Quality & Reliability Management* and *Journal of Cleaner Production* are cited by more researchers and performed more outstanding in the post-pandemic period than in the pre-pandemic period.

3.2.2. Collaboration analysis

Figure 10 illustrates the countries/regions collaboration on TQM research before and after the pandemic, reflecting the characteristics of social structure in the area of TQM. Due to the cumulative effect over time, it is logical that the pre-pandemic

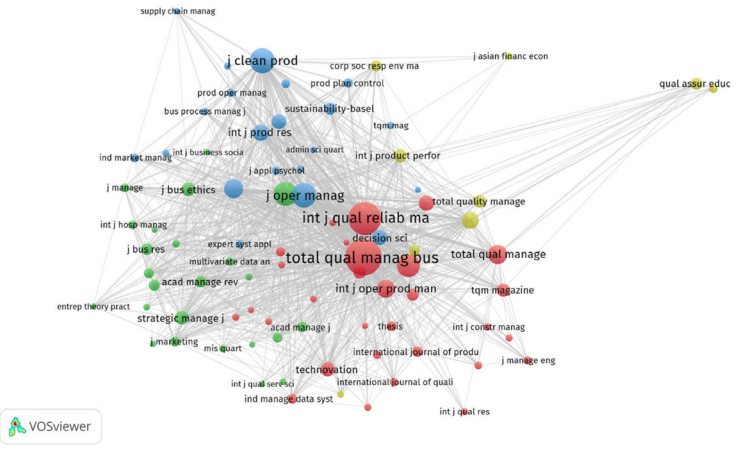


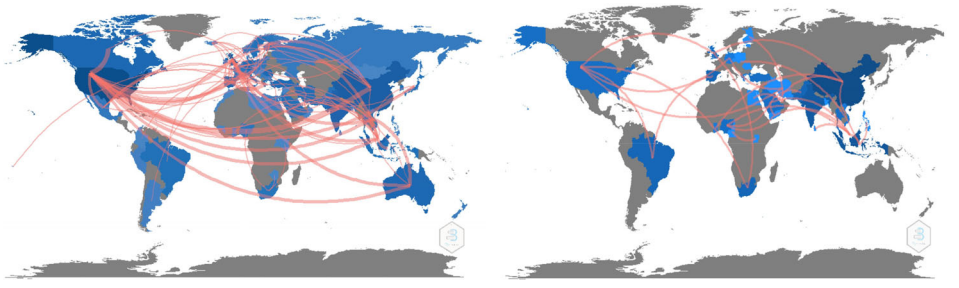
Figure 9. The source co-citation network of TQM publications after the COVID-19 pandemic.
Source: Authors' own research.

Table 4. The information of the post-pandemic publications by co-citation analysis per cluster of cited sources.

Cluster	The number of cited sources	Source	Citation	Total link strength
1	30	Total Quality Management & Business Excellence	232	8856
		International Journal Quality & Reliability management	189	8181
		The TQM Journal	95	4216
2	24	Academy of Management Journal	21	997
		Benchmarking: An International Journal	102	5415
		Journal of Business Ethic	36	1880
		Strategic Management Journal	36	2191
3	21	Journal of Cleaner Production	111	4869
		Journal of Operations management	106	5395
		International Journal of Production Economics	68	3299
4	9	International Journal of Quality and Reliability	53	2402
		International Journal of Productivity and Performance Management	32	1728
		Total Quality Management & Business Excellence	31	836

Source: Authors' own research.

studies on TQM had a broader coverage of 55 countries/regions than the 26 countries/regions after the COVID-19 pandemic. Figure 11 indicates the proportion of multiple country publications (MCP) and single country publications (SCP) in the top 20 countries/regions ordered by NP before and after the COVID-19 pandemic. At a glance, although the MCP is less than the SCP both before and after the pandemic in Figure 11, the proportion of MCP increased overall after the COVID-19 pandemic and even reached 100% in some countries/regions, such as Bahrain, Egypt and Finland. This phenomenon indicates the increasing attachment to international cooperation and external exchange among researcher scholars after the COVID-19 pandemic, advancing the development and dissemination of knowledge on TQM research. Before the COVID-19 pandemic, the top three countries in terms of the



(a) The distribution and collaboration of pre-pandemic literature (b) The distribution and collaboration of post-pandemic literature

Figure 10. The distribution and collaboration of TQM research in terms of country/region.
Source: Authors' own research.

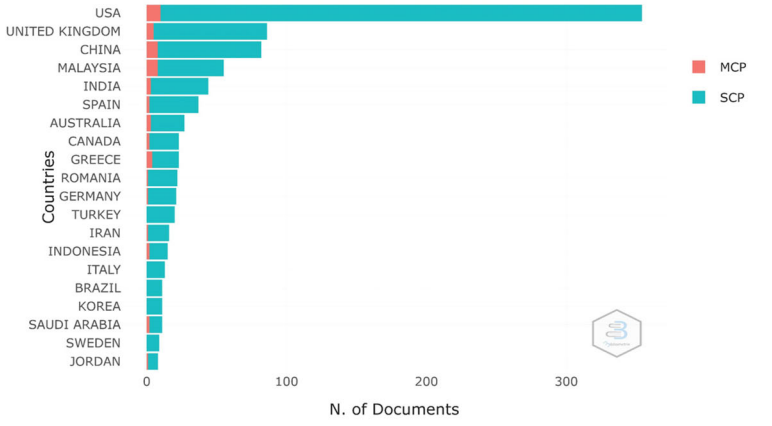
number of publications (NP) were the USA, the UK and China. However, after the COVID-19 pandemic, China became number one, while the USA and the UK published only one article and were pushed out of the top 10. It indicates that the US and UK downplayed TQM research after the outbreak. Surprisingly, some Southeast Asian countries/regions such as India, Indonesia and Malaysia performed well, occupying the top four positions. Likewise, the top five are all Asian countries/regions, which reveals that some Asian countries/regions scholars placed more emphasis on the significance of TQM research after the outbreak.

3.3. Conceptual structure analysis

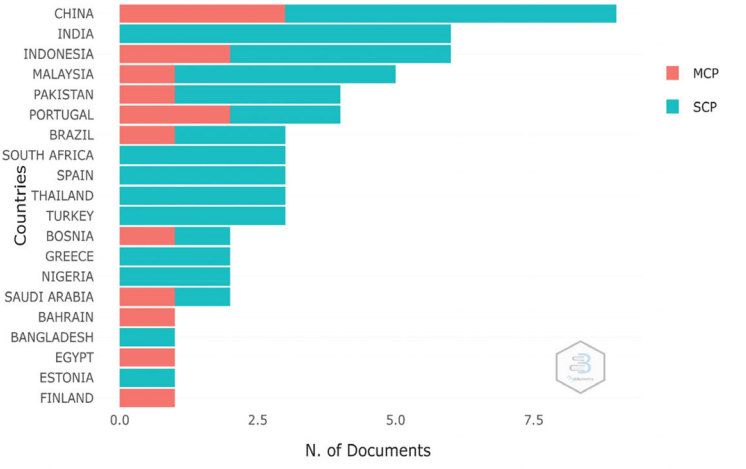
3.3.1. Co-occurrence analysis

Co-occurrence analysis is applied to establish the relationship among the themes in the literature, and it is generally accepted that the more occurrences of a word pair in the same document, the more intimately relevant the two topics are. We did the following setup in the VOS viewer: the unit of analysis is keywords plus and the minimum number of occurrences of a keyword is five. As a result, of the 802 keywords, 84 reach the threshold. Finally, Figure 12(a) presents a visualisation map of the keyword co-occurrence network concerning TQM research by VOS viewer. The figure clearly illustrates five different coloured clusters, with the red cluster containing the most keywords, in which 'tqm' and 'implementation' receive the most attention and are highly relevant, implying that the red cluster focuses on the implementation and methods of TQM in the organisation. The second cluster is green and consists of several words commonly associated with the TQM domain, namely 'competitive advantage', 'tqm practices' and 'knowledge management', suggesting that the role of TQM in business and financial performance is widely discussed. In the blue cluster, it is evident that 'performance' is the most high-frequency word, which is highly regarded and strongly associated with 'tqm implementation', 'information' and 'instrument'.

From the temporal dimension, Figure 12(b) overlays the temporal factor into the keyword co-occurrence network, implying that the previous topics are most concentrated on 'performance', 'system', 'service', 'model', etc. However, in recent years, scholars have shone a spotlight on several emerging research themes, such as 'financial performance', 'tqm practices', 'mediating role' and 'business performance'.



(a) The proportion of MCP and SCP before the COVID-19 pandemic.



(b) The proportion of MCP and SCP after the COVID-19 pandemic.

MCP: Multiple Country Publications.

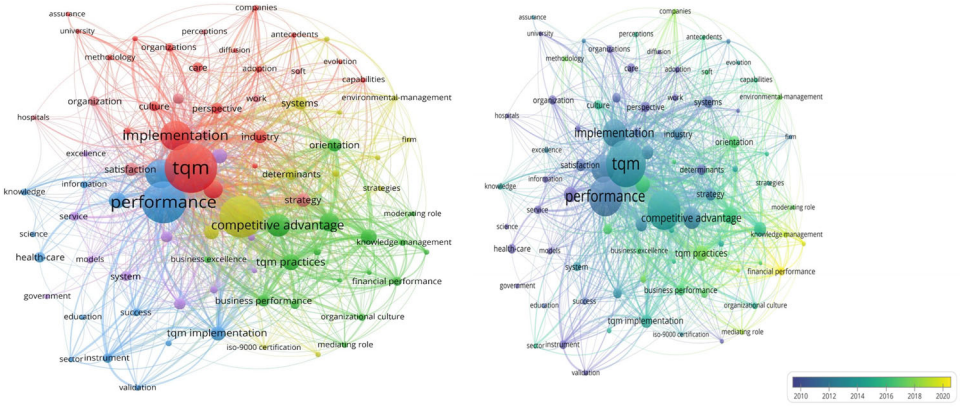
SCP: Single Country Publications.

Figure 11. The proportion of MCP and SCP in the top 20 countries/regions ordered by NP.
Source: Authors' own research.

Especially, 'financial performance' is an emerging stream during the pandemic in 2020. In summary, the focus of TQM research has shifted from performance and implementation topics in the past to practical and business-oriented topics in the present.

3.3.2. Thematic analysis

Figure 13 illustrates the trend topics of publications and the burst of keywords per year before the COVID-19 pandemic. As we can see, it is the keywords 'government' and 'health-care' that are earliest occurred burst in 1996, followed by 'team' in 1999. It suggests that these topics gained prevalence and prosperity at the end of the



(a) Co-occurrence network of keywords. (b) Overlay of co-occurrence network of keywords.

Figure 12. Visualisation map of the keyword co-occurrence network concerning TQM research.
Sources: Authors' own research.

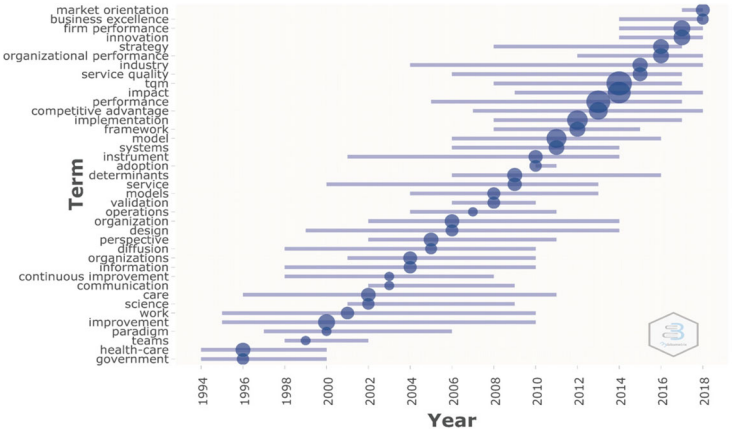


Figure 13. The trend topics of publications before the COVID-19 pandemic.
Source: Authors' own research.

twentieth century. At a glance, the term 'tqm' is the most high-frequency topic, which occurred topic burst with a frequency of 116 in 2014. In addition, most of the bursts of high-frequency topics occur from 2011 to 2014, with a frequency of 50–100 times, such as 'model' (51) in 2011, 'implementation' (57) in 2012, 'performance' (95) in 2013 and 'impact' (82) in 2014. Figure 14 presents the trend topics of publications after the COVID-19 pandemic, it is worth noting that new themes emerged and have gained the upper hand during the pandemic, such as 'financial performance' (2021), 'sustainability' (2021), 'environmental management' (2021) and 'culture organisation' (2020), reflecting the increased concern about the impact of TQM on financial performance, organisation culture, sustainable and green development. Specifically, scholars explore the correlation between lean practices driven by TQM and financial or

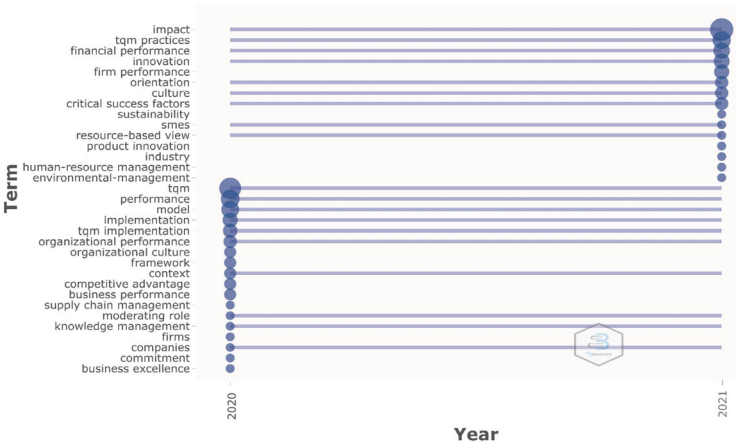


Figure 14. The trend topics of publications after the COVID-19 pandemic.
Source: Authors' own research.

operational performance, opening the way to better financial and operational performance (Dieste et al., 2021; Popescu, 2020). In addition, after the COVID-19 pandemic, TQM practices have had a positive impact on the green and sustainable performance of cooperation. It indicates that TQM research on ESG has gradually attracted widespread attention and TQM practices have significantly enhanced the ability of an organisation to achievement of environmental performance objectives (AlShehail et al., 2021; Khalil & Muneenam, 2021). Under the implementation of the sustainability strategy, financial performance is a prerequisite for ESG performances and TQM plays a moderation role (Chams et al., 2021).

In Figures 15 and 16, Bibliometrix provides a thematic map of TQM research to better explore the evolution and changes of TQM themes in pre-pandemic and post-pandemic periods. More to the point, centrality measures the level of interaction between clusters, while density measures the level of cohesion within clusters (Forliano et al., 2021). Hence, the thematic map is divided into four quadrants, that is, moter themes, niche themes, emerging and declining themes and basic themes, to depict the different features of the various themes. In addition, the size of the circle is proportional to the frequency of the keywords. According to Figure 15, it is the motor theme (quadrant 1) that is composed of the terms 'model', 'satisfaction' and 'service quality' and has a high centrality and density in the pre-pandemic period. It indicates a bright development prospect and a significant position in TQM research. However, this cluster disappears after the COVID-19 pandemic and is replaced by a green cluster with the terms 'impact', 'tqm practices' and 'firm performance' and a purple cluster with terms 'innovation', 'culture' and 'orientation', occupying the position of moter themes. It is worth mentioning that the orange cluster with the terms 'environmental-management', 'resource-based view' and 'supply chain management' sprang up only after the pandemic and became the base theme in Figure 16, which covers important future research directions but does not draw more attention at this stage (Lam-Gordillo et al., 2020). In summary, before the pandemic, there is a greater focus on issues such as service quality and model building; however, after the

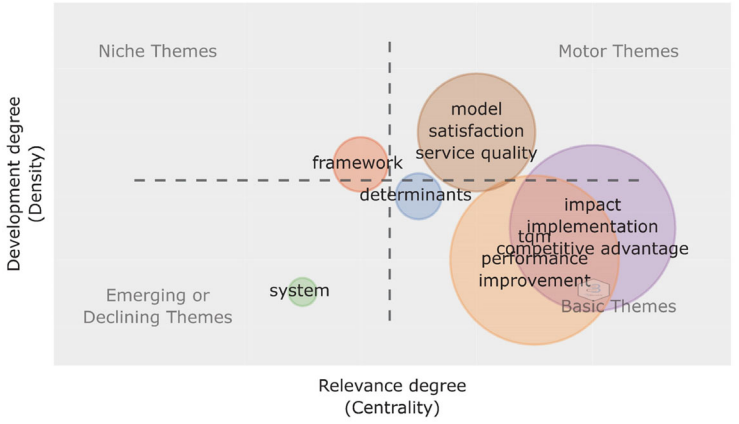


Figure 15. The thematic map of publications on TQM research before the COVID-19 pandemic. Sources: Authors' own research

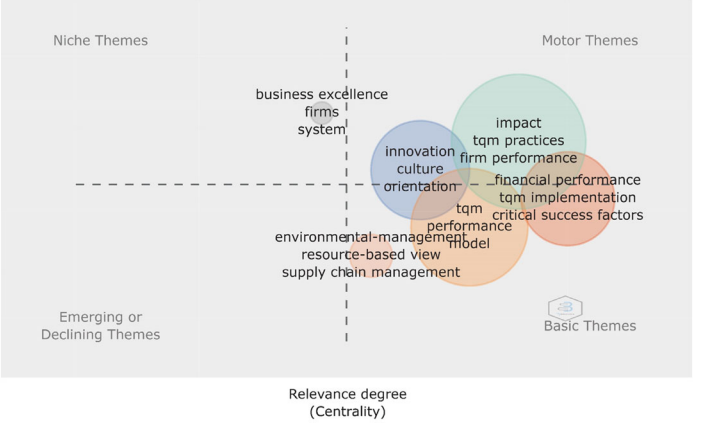


Figure 16. The thematic map of publications on TQM research after the COVID-19 pandemic. Sources: Authors' own research

pandemic, there is a greater focus on innovation development and social governance in TQM research.

4. Linkages between TQM and ESG

Through the bibliometric analysis above, several emerging keywords and themes are gradually occupying a dominant position in TQM research, such as 'sustainable', 'green development' and 'resource-based view' during the COVID-19 pandemic. Scholars shine a spotlight on the relationships among green, sustainable and social issues. In an ever-changing world, companies are bound to consider not only providing high-quality products and satisfactory services but also rooting in the environmental movement, assuming social responsibilities and improving corporate governance, which advances towards the idea of sustainability of social, environmental, economic and other stakeholders (Khurshid et al., 2022).

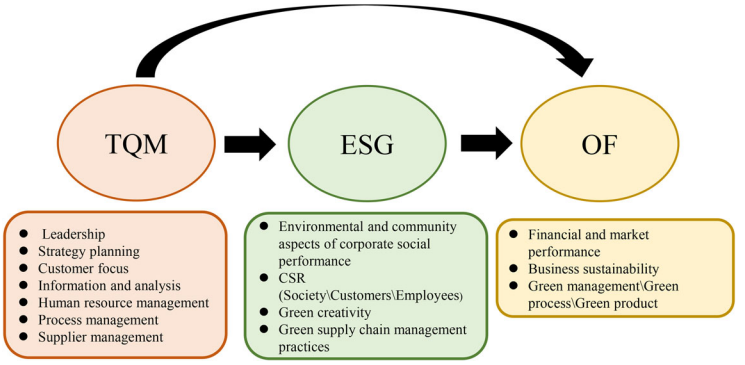


Figure 17. Impact pathway map with ESG playing a mediation role.
Source: Authors' own research.

The research on TQM and ESG is increasingly growing. Numerous studies about Spanish hotels (Benavides-Velasco et al., 2014), the Vietnam coffee industry (Tsou et al., 2021) and Bangladeshi organisations (Bhuiyan et al., 2020) all proposed a positive relationship between TQM and ESG. Integrating the idea of ESG into quality management can stimulate companies to invest in research green innovation and sustainable development (Li et al., 2018). That is to say, the linkages between TQM and ESG are worthy of in-depth study and exploration, to develop innovative and powerful collaborative forces, integrate social resources and achieve sustainability objectives. In the following section, the relationship among TQM, ESG and OF (other factors) is further discussed, and can be classified into three streams: (1) ESG plays a mediation role. (2) TQM plays a mediation role. (3) OF plays a mediation role. The three cases are discussed in turn in the following section.

4.1. Esg plays a mediation role (TQM ⇒ ESG ⇒ of)

Figure 17 shows the impact pathway map with ESG playing a mediation role. As can be seen from Figure 17, some of the main ESG factors, such as environmental and community aspects of corporate social performance (Sila, 2020), CSR (Abbas, 2020) and green supply chain management practices, play a coordinating role between TQM and OF. Specifically, ESG plays a mediation role between TQM and CGP (Abbas, 2020), and TQM has a significant impact on all three dimensions of the CGP, namely corporate green management, green processes and green product performance. Similarly, ESG plays a mediating role in achieving sustainable development goals (Shahzad et al., 2020). Meanwhile, ESG mediates between TQM (human and functional) and business performance (Manh-Hoang et al., 2021). The mediating effect of ESG on TQM and other factors draws the attention of companies to more fully implement TQM, and promote sustainable development of the economy, society and environment (Tsou et al., 2021). In summary, ESG as a mediator in TQM research is playing an increasingly influential role in corporate performance and green development issues.

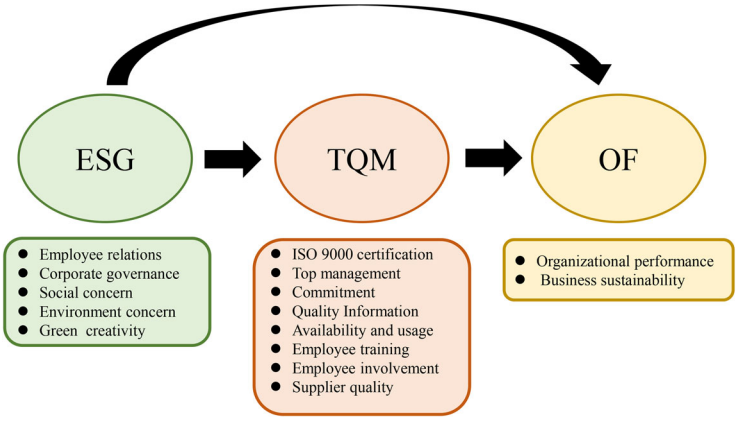


Figure 18. Impact pathway map with TQM playing a mediation role (ESG ⇒ TQM ⇒ OF).
Source: Authors' own research.

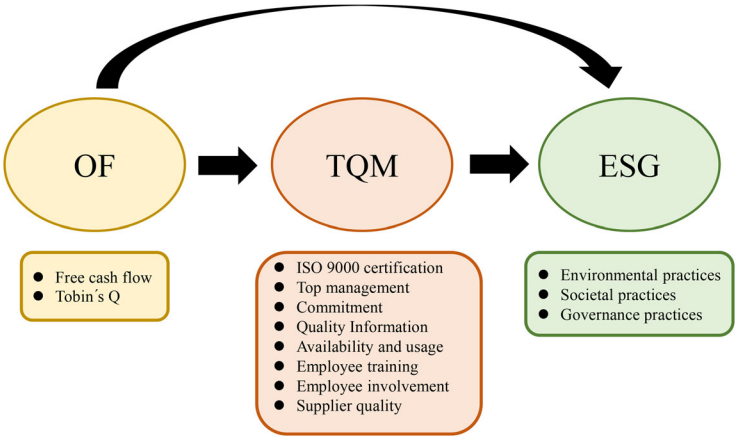


Figure 19. Impact pathway map with TQM playing a mediation role (OF ⇒ TQM ⇒ ESG).
Source: Authors' own research.

4.2. TQM plays a mediation role (ESG ⇒ TQM ⇒ of)/(of⇒ TQM ⇒ ESG)

The impact pathway map with TQM playing a mediation role is shown in Figures 18 and 19. Figure 18 shows the influence of some ESG factors on OF through the mediating role of TQM (AlQershi et al., 2022; Mehralian et al., 2016), while Figure 19 shows the influence of OF on ESG factors through the mediating role of TQM (Chams et al., 2021). Specifically, TQM has a moderating effect on corporate performance and ESG, as the implementation of TQM assists companies to be better equipped to implement ecological and social measures (McAdam & Leonard, 2003). Chams et al. (2021) asserted that the implementation of TQM diminishes the company's dependency on financial capital and fosters the overall execution of ESG programs. Similarly, in the pharmaceutical industry, TQM mediates between ESG and organisational performance, because the focus on social responsibility issues boosts the implementation of TQM and enhances the operational efficiency of the organisation (Mehralian et al., 2016). Unfortunately, which factors in TQM play a

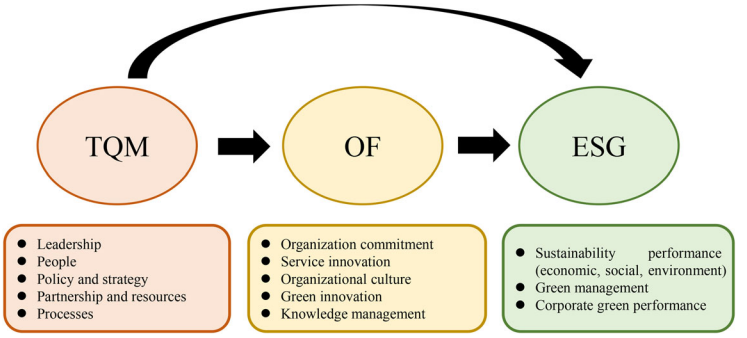


Figure 20. Impact pathway map with OF playing a mediation role (OF ⇒ TQM ⇒ ESG).
Source: Authors' own research.

coordinating role between ESG and OF need to be further explored. Therefore, in later studies, the various factors of TQM need to be identified to provide more practical and pertinent recommendations for the future outlook of the company.

4.3. Of plays a mediation role (TQM ⇒ of ⇒ ESG)

Figure 20 shows the impact pathway map with OF playing a mediation role, in which the OF factors (organisation commitment, service innovation, organisational culture, etc.) have a coordinating role between TQM and ESG (Abbas, 2020; Albloushi et al., 2022; Khalil & Muneenam, 2021; Makhdoom & Anjum, 2016). The TQM factors which positively influence ESG are deserving further exploration. Abbas (2020) and AlShehail et al. (2021) emphasised that TQM has a positive impact on corporate sustainability (CS) in three dimensions: environmental sustainability, social sustainability and economic sustainability. When implemented efficiently, TQM programs promote the enhancement of corporate knowledge management activities and service innovation, which not only has a positive impact on CS but also plays a coordinating role between TQM and CS. Besides, in line with these findings, organisational culture also has a significant positive mediating role in the relationship between TQM and corporate green performance. This is because effective total management activities enhance corporate culture and skills, motivate employees, improve work skills and competencies and reduce waste through efficient use of resources to achieve green performance goals (Khalil & Muneenam, 2021).

5. Discussions

This section further discusses avenues for future research, implications and limitations before and after the COVID-19 pandemic based on the preceding analysis.

5.1. Avenues for future research

According to the thematic maps on TQM research, several novelty themes are catching more eyes, such as supply chain management, resource-based view, environment, etc. Given this, two avenues for future TQM research are distilled by mulling the

existing and new research from perspectives of supply chain management and environmental sustainability.

The COVID-19 pandemic poses an extraordinary threat to supply chain disruption (Ivanov & Dolgui, 2020). It is crucial to focus on optimising and improving the performance of the supply chain regarding demand, production, procurement and transport to mitigate the jeopardy related to supply chain disruptions. TQM plays a crucial role in the supply chain links (Fan & Stevenson, 2018), and more superb TQM programs will involve more systematic formal mechanisms for interacting with suppliers, a more competitive focus, and a deeper understanding of customer needs (Carter et al., 1998). TQM tools are consolidated into sustainable supply chain settings to manage supply chain members, focus on customer needs (Siva et al., 2016), provide continuous improvement (Glover et al., 2015) and manage human resources (Vanichchinchai & Igel, 2011), which integrates sustainable development and supply chain management (Soltanmohammadi et al., 2021). TQM and SCM practices complement each other and generate synergies (Kaur et al., 2019), in particular, the advantages are significantly manifested in the following four areas: enhanced supply chain, improved customer satisfaction, enhanced firm performance and improved supply chain performance. For achieving sustainable and green development, it is prospective to explore the impact of integrating SCM and TQM resources on the green performance and initiatives of the supply chain.

With global warming, excessive consumption of natural resources, and the advent of industry 4.0, low-carbon living has become a strategic consensus for the future of humanity (Qin, Xu, Wang, Skare & Porada-Rochon, 2021; Roh et al., 2022). On the issue of climate change, numerous countries have taken actions. The USA returned to the Paris Agreement in 2021, China set an ambitious goal of becoming 'carbon neutral' by 2060, and the 2020 United Nations Climate Change Conference was held in Scotland. Energy production and consumption-related activities are the primary sources of carbon emissions, and reducing the green premium to improve the competitiveness of green products with fossil fuel products is an important initiative. Increasingly manufacturing firms implement sustainable and specifically green initiatives into their supply chains, and TQM practices assist green practices to meet customer needs for a cleaner environment (Liao & Tsai, 2019). In addition, high levels of waste occurred during the COVID-19 pandemic, and distribution systems for perishables and other products were severely affected. Not only does total quality and environmental management explicitly take into account environmental issues, product packaging and final disposal (Miles & Russell, 1997), but also TQM supports environmental management system implementation and integration of sustainability considerations (Siva et al., 2016). TQM practices will focus more on low-input, high-output, high-technology content enterprises that barely pollute the environment, forming a green, low-carbon and environmentally friendly industrial system. In the future, environment management and low carbon associated with TQM will become a significant focus area in line with international policy. We propose to explore how TQM about the circular economy industry or green practices can promote recycling and carbon neutrality to reduce environmental damage and waste of resources.

5.2. Implication and limitation

The COVID-19 pandemic rampage poses a huge crisis for businesses. The empirical study and theoretical framework of TQM can not only inspire scholars to further delve into the relevant research but also help managers and policymakers apply TQM to address the risks posed by the outbreak. The new research themes that emerged after the pandemic, such as 'financial performance', 'sustainability' and 'environmental management', indicate a shift and a gradual expansion of research themes in TQM. In addition, more discussions on TQM and ESG reveal that TQM should take into account multiple stakeholders including profits, humans and the planet and companies play a crucial role in assuming social responsibilities.

Although the method is comprehensive and integrated for visualisation and statistical analysis, there are still some limitations in two aspects: In terms of data source, we only collected data from the WoS database, resulting in the omission of some young publications, so the search results are incomplete. Therefore, more data sources should be added to future research, such as Google Scholar and Scopus. Another limitation is that there is a relatively large gap in the number of articles before and after the pandemic. The smaller number of articles after the pandemic limits more significant discoveries. Thus, further updates on the number of post-pandemic studies will follow to address this issue. Despite these limitations, this study provides a multi-dimensional perspective on TQM research before and after the COVID-19 pandemic, which may provide some important insights for relevant researchers, policymakers and managers.

6. Conclusion

The conclusions can be stated in four ways:

1. Fundamental characteristics. There are five emerging research areas 'Science Technology Other Topics', 'Environmental Sciences Ecology', 'Geography', 'Social Issues' and 'Energy Fuels' during the COVID-19 pandemic. The top-ranked articles in the post-pandemic period focus on research areas of sustainability, green development and CSR.
2. Intellectual and social structure. After the COVID-19 pandemic, China ranks first in the world in terms of NP, while the USA and the UK which ranked first and three in the pre-pandemic period are pushed out of the top 10. Surprisingly, some Southeast Asian countries/regions perform well, and the top five are all Asian countries/regions in the post-pandemic period.
3. Conceptual structure analysis. New themes emerge and gain the upper hand during the pandemic, such as 'financial performance', 'sustainability', 'environment management' and 'context', reflecting the increased focus on the impact of TQM on financial performance, sustainable and green development. According to the thematic map, innovation development, environmental management, etc., become the dominant themes of interest in TQM research after the pandemic.

4. Linkages between TQM and ESG. The linkages between TQM and ESG can be divided into three aspects, with TQM playing a mediating role, ESG playing a mediating role and OF playing a mediation role.

Nowadays, TQM is committed to providing higher quality products and services, faster delivery and competitive prices to satisfy higher customer expectations in the international context of green development. However, TQM faces huge roadblocks towards the idea of bi-carbon, as requiring a strong synergy between technology, policy and the market (Dong et al., 2021). In terms of technology, technological innovation in carbon capture, decarbonisation, storage and transportation of new energy sources, to achieve zero carbon emissions in the production process and logistics. With regard to policies, it is critical to spur green financing that favours technological innovation and the development of SMEs. In the market, improving the competitiveness of green products against fossil fuels can become a sharp blade breaking through green premiums and barriers in the present fuel market.

In addition, it is worth noting that digital technologies cover epidemic monitoring, temperature detection, virus detection and resumption of work and production in the prevention and control of epidemics. The rapid development of technologies such as blockchain, artificial intelligence, Internet of Things (IoT), big data analytics and robotics has an increasing impact on TQM, which contributes to the digitisation of quality management based on industrial IoT technologies. TQM faces the challenge of coordinating the activities of machines, information and people in a complex environment.

Based on the current study, our future research focuses on three areas: (1) Explore the innovation and contribution of TQM to environmental sustainability and green development. (2) Discuss the impact path and quantitative relationship between TQM and ESG in more detail. (3) Continue to track the future development of new areas on TQM research after the outbreak to uncover valuable research directions.

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