Recibido: 12/12/2023 | **Aceptado:** 28/02/2024 | **Publicado:** 21/03/2024

Bibliometric and scientometric study on quality management
Estudio bibliométrico y cienciométrico sobre gestión de la calidad

https://doi.org/10.21803/adgnosis.13.13.706

Leslie Soraya Aguilar-Aguilar
https://orcid.org/0000-0003-1964-7149
Egresada del Doctorado en Dirección Empresarial, Máster en Economía y Desarrollo.
Profesor Titular Dirección del Sistema de Estudios de Posgrado de la Universidad Nacional Autónoma de Honduras, UNAH, Tegucigalpa (Honduras). leslie.aguilar@unah.edu.hn

How to cite this article:
Aguilar-Aguilar; L. (2024). Estudio bibliométrico y cienciométrico sobre gestión de la calidad. *Ad-gnosis, 13*(13). *e#706. https://doi.org/10.21803/adgnosis.13.13.706*

REVIEW ARTICLE

Abstract

Introduction: Quality management is of strategic importance for the competitiveness and sustainability of organizations. **Objective:** To analyze the behavior of scientific production in quality management for the period 2011–2022. **Methodology:** bibliometric and scientiometric study of 998 articles obtained from the Scopus database. Indicators of production, concentration, collaboration, impact, and relationships were used for the analysis. **Results:** Among the findings, it is highlighted that the scientific production reflects an exponential trend line with an adjustment value of $R^2 = 0.80$. The most productive authors of articles are Bäckström, I., Gremyr, I., and Tari, J.J. Fourteen journals were identified that make up the core, and the journal Total Quality Management and Business Excellence stands out for the number of published articles, number of quotes, and bibliographic matching. **Conclusions:** Contemporary and emerging research trends are Total Quality Management, the model of the European Foundation for Quality Management, competitive advantages, supply chain management, Six Sigma, enterprise excellence, and sustainability.

Keywords: *Quality Control; Higher Education; Factory; Interest groups; Organization; Public sector.*

Resumen

Introducción: La gestión de la calidad tiene importancia estratégica para la competitividad y sostenibilidad de las organizaciones. **Objetivo:** Analizar el comportamiento de la producción científica en gestión de la calidad para el período 2011-2022. **Metodología:** Estudio bibliométrico y cienciométrico de 998 artículos obtenidos de la base de datos Scopus. Para el análisis se utilizaron indicadores de producción, concentración, colaboración, impacto y relacionales. **Resultados:** Entre los hallazgos se destaca que la producción científica refleja una línea de tendencia exponencial con valor de ajuste de $R^2 = 0.80$. Los autores con mayor producción de artículos son Bäckström, I., Gremyr, I. y Tari J.J. Se identificaron 14 revistas que conforman el núcleo, sobresaliendo la revista Total Quality Management and Business Excellence por la cantidad de artículos publicados, número de citas y emparejamiento bibliográfico. **Conclusiones:** Las tendencias de investigación contemporáneas y emergentes de investigación son la Gestión de la Calidad Total, el modelo de la Fundación Europea para la Gestión de la Calidad, ventajas competitivas, gestión de la cadena de suministro, seis sigma, excelencia empresarial y sostenibilidad.

Palabras clave: *Control de Calidad; Enseñanza Superior; Fábrica; Grupos de interés; Organización; Sector público.*[1]

1 Los términos clave han sido recuperados a partir del Tesauro de la UNESCO.

Introduction

Organizations constantly face challenges that influence their survival and competitiveness. These challenges include globalization, technological progress, the entry of new competitors, the emergence of innovative business models, emerging markets and resource scarcity (Permana et al., 2021; Žitkienė & Deksnys, 2018). Given this reality, achieving stability and transformation requires achieving high levels of quality (Permana et al., 2021; Žitkienė & Deksnys, 2018).

According to Rey Sanchez et al. (2022), quality consists of subjective considerations about the expectations held about a product or service. It includes customer satisfaction and the implementation of organizational practices that contribute to providing an offer of excellence (Schiavo- ne et al., 2022). For its part, quality management is a strategy for cultural change, used by different organizations as a means of responding to the challenges that humanity faces in the social, economic and environmental dimensions (Carnerud & Bäckström, 2021). From this perspective, quality management is conceived as a fundamental aspect of the strategic management of organizations (Cebekhulu & Ozor, 2022). Which is conducive to high quality performance, while contributing to economic prosperity, social justice and a healthy ecological environment (Maletič et al., 2014).

Quality management has its roots in the 20th century and its development has been influenced by several movements and theories. The contributions of referents such as Walter Shewhart, Edward Deming, Armand Feigenbaum, Philip Crosby, Joseph Juran, Kaoru Ishikawa, Masaki Imai, Taiichi Ohno and Genichi Taguchi stand out (Carnerud & Bäckström, 2021; Hamid et al., 2019).

In this sense, in the first two decades of the 20th century, the first publications on quality management appeared, emphasizing corrective action and with a clear focus on the product. Between 1920 and 1950, the focus remained on the product and the use of statistical tools was incorporated for the corrective action of the problems detected (Camisón et al., 2006; Weckenmann et al., 2015; Sader et al., 2019; Carnerud & Bäckström, 2021). Between 1950 and 1980, the focus shifted to operating system process standards along the value chain. Subsequently, between 1960 and 1990, the focus on the system predominates, models such as Deming, British Standard (BS) 5750 and the International Standards Organization (ISO) 9000 series emerge (Camisón et al., 2006; Weckenmann et al., 2015; Sader et al., 2019; Carnerud & Bäckström, 2021).

Finally, from 1980 to the present, the focus is on people, collaborative networks, stakeholders and excellence (Camisón et al., 2006; Weckenmann et al., 2015; Sader et al., 2019; Carnerud & Bäckström, 2021). Quality systems such as the Malcolm Baldrige Model, Investor in People (IIP), EFQM Excellence Model, ISO 9001, ISO 31000, among others, stand out (Camisón et al., 2006; Weckenmann et al., 2015; Sader et al., 2019; Carnerud & Bäcks- tröm, 2021).

The objective of this research is to analyze the behavior of the scientific production in

quality management for the period 2011-2022. The structure of the article includes: theoretical framework, materials and methods, results, conclusions and bibliographical references.

2. THEORETICAL FRAMEWORK

For Basheer et al. (2019) and Hamid et al. (2019), quality management is a philosophy made up of a set of interacting principles supported by various practices or techniques. According to Seyfried et al. (2019), quality management "is defined quite broadly as the policies, systems, and processes designed to ensure the maintenance and improvement of quality within an institution" (p. 117). In this sense, "quality management implies a set of systematized and planned processes" (Rey Sanchez et al., 2022, p. 295), designed to promote good practices that have an impact on the improvement and transformation of organizations (Rey Sanchez et al., 2022).

Numerous authors point out that, over time, quality management has transitioned from a product-oriented approach, whose scope of application is the factory, to a more proactive and encompassing vision that includes services and public sector organizations (Gyllenhammar & Hammersberg, 2023; Fundin et al., 2020; Fundin et al., 2018; Bhuiyan & Baghel, 2005). Within this framework, "five specific areas have been identified (1) Quality Inspection (QI), (2) Quality Control (QC), (3) Quality Assurance (QA), (4) Total Quality Control (TC), and (5) Total Quality Management (TQM)" (Hamid et al., 2019, p. 165). In each era, there is a clear relationship between approach, principles, systems, tools and techniques; thus, if the approach changes, the other elements change as well (Hamid et al., 2019; Dahlgaard-Park et al., 2013; Camisón et al., 2006).

In this evolution, TQM represents a new systematic approach (Salem et al., 2019) to continuous improvement (Ramanathan & Isaksson, 2022; Abbas, 2020), which focuses on a set of management principles, tools and processes (Nguyen et al., 2023; Bahia et al., 2023; Alshourah, 2021; Zhang et al., 2021). In addition, TQM is a management philosophy aimed at driving excellence (Casprini et al., 2023; Ershadi et al., 2019), which orients its actions towards dimensions such as people, culture and preservation of the planet (Ramanathan & Isaksson, 2022).

Within this framework, TQM is a comprehensive management approach applicable at all levels and in various environments (Hussain et al., 2023; Permana et al., 2021; Algunmeeyn et al., 2021), which is premised on meeting the expectations of customers and all stakeholders (Maletič et al., 2014; Ramanathan & Isaksson, 2022). In this sense, TQM is characterized by the strategic vision that was absent in the early eras of quality management (Hussain et al., 2023; Permana et al., 2021; Algunmeeyn et al., 2021; Hamid et al., 2019; Camisón et al., 2006), enabling organizations to survive and compete in a globalized world (Fonseca et al., 2021).

Quality management research

Research over the past few decades has shown that quality management is a key element of quality management.

a current and growing area of study (Carnerud & Bacstrón, 2021; Zhang et al., 2021, Dahlgaard-Park et al., 2013). There is an increase in research related to fundamental values or key principles linked to building a quality culture, people and fact-based management, continuous improvement and customer focus (Dahlgaard-Park et al., 2013). For their part, Fundin et al. (2020) identify the concept of quality 5.0 as a new approach or paradigm of quality management with an emphasis on sustainability. Likewise, Carnerud & Bäckström (2021) found a predominance of research on quality certifications and models of excellence.

In the application of TQM in services, health care is the most studied industry, followed by studies addressing quality management in the field of higher education and in the public sector (Dahlgaard-Park et al., 2013; Zhang et al., 2021). According to Zhang et al. (2021), among the most commonly used words in the field of quality management are continuous improvement and organizational culture. The research also found that the journal Total Quality Management & Business Excellence ranks first in the number of publications (Zhang et al., 2021).

Bibliometrics and scientometrics

"Bibliometric analysis is a sophisticated technique for gaining effective knowledge and understanding of the thematic dynamics and structure of a field through the in-depth use of certain metrics and visualization tools" (Ghaith et al., 2023, p. 1660). This technique contributes to the quantification and description of scholarly literature (Iuga et al., 2023; Suclupe-Navarro et al., 2021). Because of its scope, some researchers point out that bibliometrics and scientometrics are intertwined and can be used together (Iuga et al., 2023; Suclupe-Navarro et al., 2021).

In this sense, "scientometrics is the study of the quantitative aspects of science and technology seen as a communication process" (Suclupe-Navarro et al., 2021, p. 2; Mingers & Leydesdorff, 2015, p. 1). In turn, it is a systemic work method whose main objective is to identify the evolution and scientific development of a given field (Bondanini et al., 2020). "It includes within its main topics the quantification of research and its impact, citations, mapping of scientific areas and the use of indicators for research policies and management" (Suclupe-Navarro et al., 2021, p. 2).

3. METHODOLOGY

A bibliometric and scientometric study was carried out based on meta-analysis and scientific mapping or visualization of bibliometric networks. According to Suclupe-Navarro (2021), this research was carried out in five stages: "1) data collection, 2) definition of analysis units, 3) definition of measurement units, 4) dimensionality reduction and distribution of visualizations, and 5) analysis and interpretation of visualizations" (p. 4).

In the first phase of data collection, the Scopus database was used as a source of information, which was selected for its various advantages in terms of access to research.

of recognized quality, the wealth of metadata, the facilities for downloading CSV files and their linkage with bibliographic reference managers (Cruz-Ramírez et al., 2020). The search was conducted in the month of December 2023, by applying Boolean operators from the inclusion of the construct "Quality Management", which initially gave access to 121,538 articles from which only those published in the period 2011-2022 were selected, in the subject area of business, management and accounting, type of document, articles, final publication status, type of source Journal and open access. The following search vector was used:

TITLE-ABS-KEY ("Quality Management") AND PUBYEAR > 2011 AND PUBYEAR < 2022 AND (LIMIT-TO (SUBJAREA, "busi")) AND (LIMIT-TO (DOCTYPE, "ar")) AND (LIMIT-TO (PUBSTAGE, "final")) AND (LIMIT-TO (SRCTYPE, "j")) AND (LIMIT-TO (OA, "all")).

As a result, a sample of 998 articles was obtained and exported in a CSV file by selecting the following options provided by Scopus: citation information, bibliographic information, abstract and keywords, and other information.

In the second phase, five units of analysis were defined: articles, journals, authors and keywords. In the third phase, the following units of measurement were established: indicators of production, concentration, collaboration, impact and relationship based on maps.

The fourth phase included systematization and visualization. Initially, the Ex- cel 2016 program was used to prepare tables and graphs. These show the unidimensional indicators of article production per year, per country, per institution, per journal; and impact indicators such as most cited articles and journals.

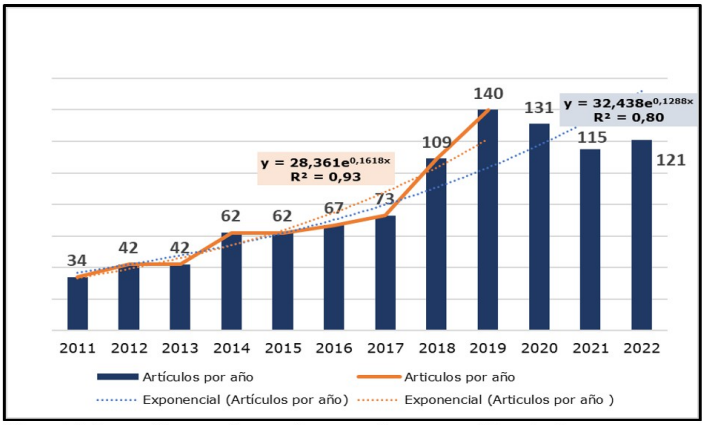
The database obtained from Scopus was then linked to the VOSviewer 1.6.13 software. This software is a mapping technique that, through the choice of different options that are selected in its dashboard, allows the visualization of similarities, the generation of relationship maps and the identification of association clusters, among others (Zhang et al., 2021). Among the analyses performed with this program are the multidimensional indicators of collaboration, bibliographic matching and research trends. Finally, in the fifth phase, the analysis and interpretation of the visualizations that were pointed out in the research results were carried out.

4. RESULTS

As shown in Figure 1, for the period 2011-2022, the scientific production in quality management in the area of business, administration and accounting reflects an ex- ponential trend line with an adjustment value of $R^2 = 0.80$. It is observed that the publication of articles experienced a sustained growth from 2011 to 2019, producing a decrease from 2020, the year in which the COVID-19 health emergency began. As shown in Figure 1, for the period 2011-2019, research on quality management achieved an exponential growth with an adjustment value of 0.93, a value higher than that of the entire period under study.

Figura 1

Artículos publicados por año, período 2011-2022 y período 2011-2019

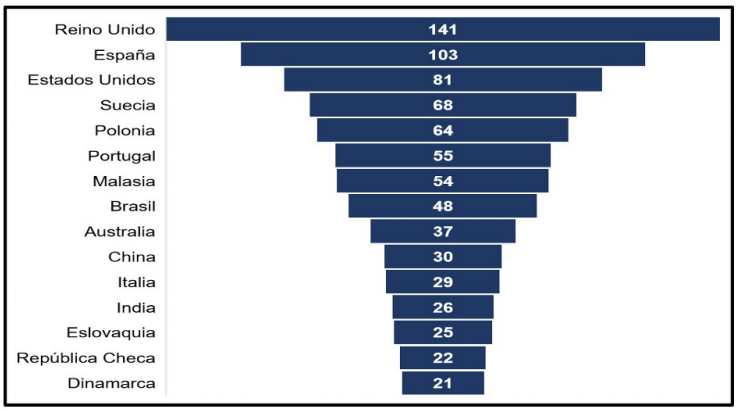


Nota: Elaboración propia con base en datos extraídos de Scopus.

According to the affiliation of the authors, the 998 articles are concentrated in 102 countries. Figure 2 shows the 15 countries in which 81% of the scientific articles are being published. The first, second and third places are occupied by the United Kingdom, Spain and the United States, respectively, which represent a concentration of 33% of published articles.

Figura 2

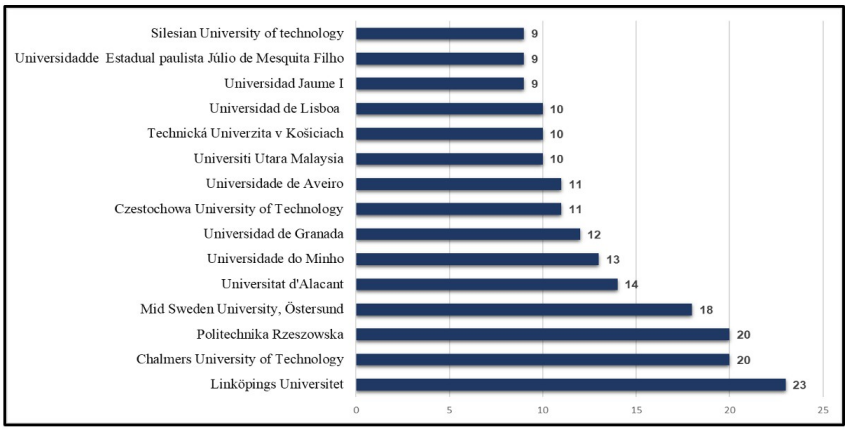
Artículos por país según la afiliación de los autores



Nota: Elaboración propia con base en datos extraídos de Scopus.

In addition to the above, 160 educational institutions were identified with which the authors of the articles included in the research are affiliated. Figure 3 shows the first 15 educational institutions with above-average publications, which account for 23% of the total number of articles. Linköpings Universitet, located in Sweden, stands out in first place with 23 articles. Second place is shared by Chalmers University of Technology, also located in Sweden, and Politechnika Rzeszowska, located in Poland, both with 20 articles, and in third place is Mid Sweden University Östersund, located in Sweden, with 18.

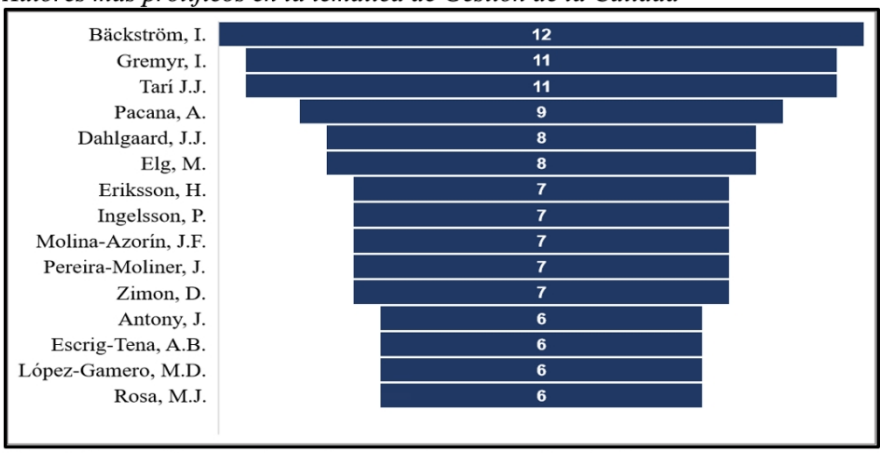
Figura 3
Artículos por instituciones según afiliación de autoría



Nota: Elaboración propia con base en datos extraídos de Scopus.

The three major producers are Bäckström, I., full professor at the Department of Communication, Quality Management and Information Systems at Mid Sweden University, Sweden, who has been involved in the authorship of 12 papers; Gremyr, I., professor at the Department of Technology Management and Economics at Chalmers University of Technology, Gothenburg, Sweden, who has been involved in the authorship of 11 papers; and Tarí J. J., professor at the Department of Business Organization at Chalmers University of Technology, Gothenburg, Sweden, who has been involved in the authorship of 11 papers, professor at the Department of Technology Management and Economics at Chalmers University of Technology, Gothenburg, Sweden, who has participated as author of 11 articles; and Tarí J. J., professor at the Department of Business Organization at the University of Alicante, Spain who is also author of 11 articles (see Figure 4).

Figura 4
Autores más prolíficos en la temática de Gestión de la Calidad



Nota: Elaboración propia con base en datos extraídos de Scopus.

According to Bradford's Law, of the 297 journals in which the 998 articles have been published, a core of 14 journals was identified, zone 1 is made up of 49 journals and zone 2 contains 234 journals (see Table 1).

Table 1

Bradford Zones in the field of quality management

Cluster	Magazines		Articles		Bradford Multiplier
	Quantity	%	Quantity	%	
Core	14	5	346	35	
Zone 1	49	16	315	32	3.5
Zone 2	234	79	337	34	4.8
Total	297	100	998	100	4.1

Note: Own elaboration based on data extracted from Scopus.

Table 2 includes the 14 journals with a high concentration of published articles that make up the core. At the top of the list are the journals Total Quality Management and Business Excellence, Quality Innovation Prosperity and the International Journal of Quality and Reliability Management. In addition, the journal Total Quality Management and Business Excellence constitutes the main focus around which different journals that have common references in the subject of quality management are paired.

Table 2

Journals that make up the core in the subject of Quality Management

Id	Magazine	Quartile	Number of items	SJR 2022 Index
284	Total Quality Management and Business Excellence	Q1	60	0.91
250	Quality Innovation Prosperity	Q2	30	0.48
138	International Journal of Quality and Reliability Management	Q2	29	0.61
113	International Journal of Health Care Quality Assurance	Q3	27	0.53
289	TQM Journal	Q2	26	0.73
178	Journal of Health Organization and Management	Q2	22	0.41
242	Proceedings on engineering sciences	Q2	22	0.13
244	Production Engineering Archives	Q2	22	0.35
82	Management and Production	Q3	21	0.20
49	Eastern European Journal of Enterprise Technologies	Q2	20	0.28
139	International Journal of Quality and Service Science	Q2	19	0.55
240	Polish Journal of Management Studies	Q3	18	0.33
130	International Journal of Production Economics	Q1	15	3.03
214	Management and production engineering review	Q2	15	0.38
	Total, articles published by the 12 journals		346	

Note: Own elaboration based on data extracted from Scopus and Scimago Journal & Country Rank.

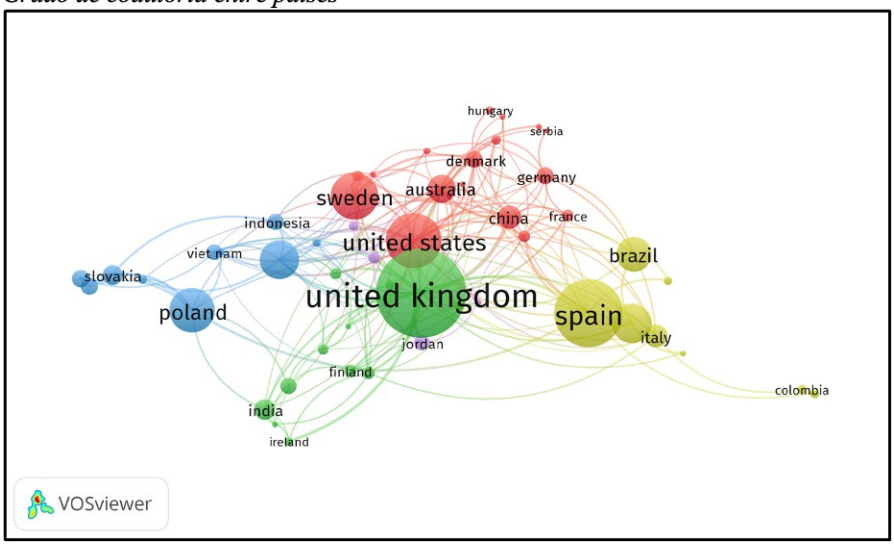
Figure 5 shows four clusters of co-authorship between countries. The proximity or remoteness of one country to another reflects the strength of co-authorship exercised by each country. In this sense, it can be seen that there are countries that, in addition to their proximity to countries in the same cluster, have a close and close relationship (co-authorship strength) with countries in other clusters. This is the case between the United States

The United States is located in cluster 1 (in red), and the United Kingdom in cluster 2 (in green).

The United Kingdom is the country with the highest number of collaborations, since it participated in co-authorship with 69 countries. In second place is the United States with a co-authorship with 33 countries, and in third place is Spain with a co-authorship with 27 countries.

In the Americas, only seven countries appear, namely the United States, Brazil, Canada, Colombia, Peru, Mexico and Ecuador: United States, Brazil, Canada, Colombia, Peru, Mexico and Ecuador.

Figura 5
Grado de coautoría entre países



Note: Own elaboration based on data extracted from Scopus. To elaborate Figure 5, the VOSviewer program was used and countries were selected to which at least five articles were associated and which have at least one citation. Of the 102 countries, 55 met this threshold, of which 53 are connected. Counting method: fractional counting and normalization method: association strenght.

On the other hand, the fifteen journals with the highest number of citations were identified (see Table 3). The first three places are occupied by Total Quality Management and Business Excellence of the United Kingdom with 1714 citations, the Journal of Cleaner Production of the United Kingdom with 1096 citations and the Inter- national Journal of Production Economics of the Netherlands with 679 citations. The journal Total Quality Management and Business Excellence has a higher impact measured by the number of citations and in the strength of its links to other journals. Table 4 summarizes the fifteen most cited articles.

Table 3
Fifteen most cited journals

Id	Magazine	Documents	Total appointments
284	Total Quality Management and Business Excellence	**60**	**1714**
164	Journal of Cleaner Production	14	1096
130	International Journal of Production Economics	15	679

Id	Magazine	Documents	Total appointments
138	International Journal of Quality and Reliability Management	29	618
276	Supply Chain Management	5	582
113	International Journal of Health Care Quality Assurance	27	561
128	International Journal of Operations and Production Management	13	549
289	TQM Journal	26	534
132	International Journal of Production Research	11	462
250	Quality Innovation Prosperity	30	447
218	Management Science Letters	12	357
178	Journal of Health Organization and Management	22	284
91	IEEE Transactions on Engineering Management	3	243
292	Uncertain Supply Chain Management	11	231
244	Production Engineering Archives	22	206

Note: Own elaboration based on data extracted from Scopus.

The number of citations ranges from 120 to 446 and marks trends in terms of contemporary topics researched in the area of quality management. In the most cited article, Cole et al. (2019) focus on identifying the benefits of blockchain technology, as a database system that contributes to quality management. In the second article, Siva et al. (2016) review "quality management methods, tools, or practices that have been employed in conjunction with sustainable development initiatives" (p. 148).

In the third most cited article, Maier et al. (2012) orient their research to the analysis of maturity charts as a way to manage, assess and improve organizational capabilities.

Table 4

Most cited articles on the subject of quality management

Authors	Year	Title	Magazine	Quotations
Cole, R., Stevenson, M., & Aitken, J.	2019	Blockchain technology: Implications for operations and supply chain management.	Supply Chain Management, 24(4), 469-483. Scopus. https://doi.org/10.1108/SCM-09-2018-0309.	446
Siva, V., Gremyr, I., Bergquist, B., Garvare, R., Zobel, T., & Isaksson, R.	2016	The support of Quality Management to sustainable development: A literature review.	Journal of Cleaner Production, 138, 148-, 148-. 157. Scopus. https://doi.org/10.1016/j.jclepro.2016.01.020.	201
Maier, A. M., Moultrie, J., & Clarkson, P. J.	2012	Assessing organizational capabilities: Reviewing and guiding the development of maturity grids.	IEEE Transactions on Engineering Management, 59(1), 138-159. Scopus. https://doi.org/10.1109/TEM.2010.2077289	185
Santos, G., Mendes, F., & Barbosa, J.	2011	Certification and integration of management systems: The experience of Portuguese small and medium enterprises.	Journal of Cleaner Production, 19(17-18), 1965-1974. Scopus. https://doi.org/10.1016/j.jclepro.2011.06.017.	177

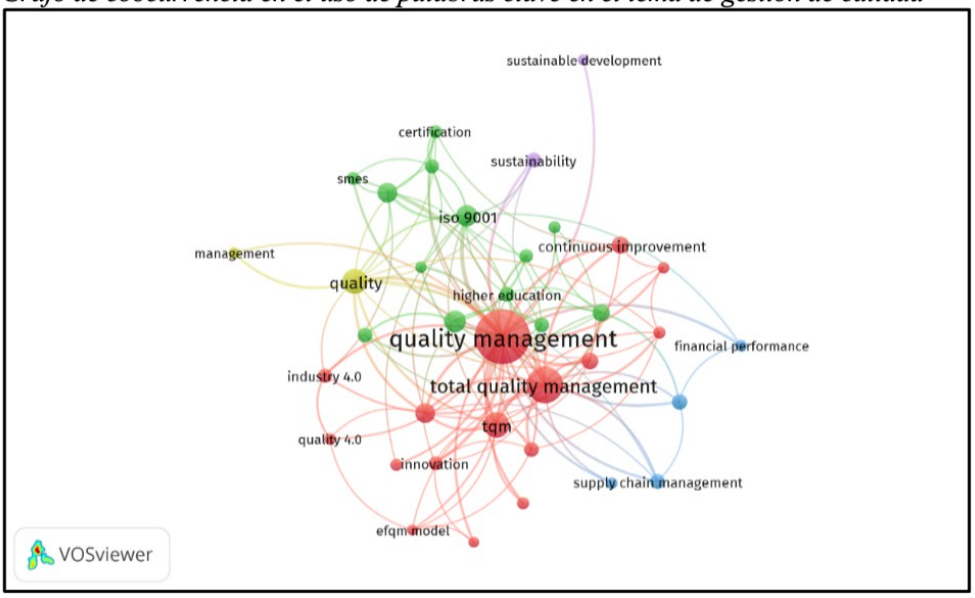
Burgess, N., & Radnor, Z.	2013	Evaluating Lean in healthcare.	International Journal of Health Care Quality Assurance, 26(3), 220-235. Scopus. https://doi.org/10.1108/09526861311311418.	175
Authors	**Year**	**Title**	**Magazine**	**Quotations**
Basheer, M. F., Siam, M. R. A., Awn, A. M., & Hussan, S. G.	2019	Exploring the role of TQM and supply chain practices for firm supply performance in the presence of information technology capabilities and supply chain technology adoption: A case of textile firms in Pakistan.	Uncertain Supply Chain Management, 275-288. https://doi.org/10.5267/j.uscm.2018.9.001.	171
Govindan, K., & Chaudhuri, A.	2016	Interrelationships of risks faced by third-party logistics service providers: A DEMATEL based approach.	Transportation Research Part E: Logistics and Transportation Review, 90, 177-195. https://doi.org/10.1016/j.tre.2015.11.010.	161
Drotz, E., & Poksinska, B.	2014	Lean in healthcare from employees' perspectives.	Journal of Health, Organization and Management, 28(2), 177-195. Scopus. https://doi.org/10.1108/JHOM-03-2013-0066	146
Urbinati, A., Bogers, M., Chiesa, V., & Frattini, F.	2019	Creating and capturing value from Big Data: A multiple-case study analysis of provider companies.	Technovation, 84-85, 21-36. Scopus. https://doi.org/10.1016/j.technovation.2018.07.004.	143
Zhang, M., Guo, H., Huo, B., Zhao, X., & Huang, J.	2019	Linking supply chain quality integration with mass customization and product modularity.	International Journal of Production Economics, 207, 227-235. Scopus. https://doi.org/10.1016/j.ijpe.2017.01.011	134
Gutierrez-Gutierrez, L. J., Barrales-Molina, V., & Kaynak, H.	2018	The role of human resource-related quality management practices in new product development: A dynamic capability perspective.	International Journal of Operations and Production Management, 38(1), 43-66. Scopus. https://doi.org/10.1108/IJOPM-07-2016-0387.	130
Yadav, G., Luthra, S., Huisingh, D., Mangla, S. K., Narkhede, B. E., & Liu, Y.	2020	Development of a lean manufacturing framework to enhance its adoption within manufacturing companies in developing economies	Journal of Cleaner Production, 245. Scopus. https://doi.org/10.1016/j.jclepro.2019.118726	127
Shafiq, M., Lasrado, F., & Hafeez, K.	2019	The effect of TQM on organizational performance: Empirical evidence from the textile sector of a developing country using SEM.	Total Quality Management and Business Excellence, 30(1-2), 31-52. Scopus. https://doi.org/10.1080/14783363.2017.1283211	121
Jira, C., & Toffel, M. W.	2013	Engaging supply chains in climate change.	Manufacturing and Service Operations Management, 15(4), 559-577. Scopus. https://doi.org/10.1287/msom.1120.0420	120
Dahlgaard, J. J., Chen, C.-K., Jang, J.-Y., Banegas, L. A., & Dahlgaard-Park, S. M.	2013	Business excellence models: Limitations, reflections, and further development.	Total Quality Management and Business Excellence, 24(5-6), 519-538. Scopus. https://doi.org/10.1080/14783363.2012.756745	120

Note: Own elaboration based on data extracted from Scopus.

Figure 6 shows the interconnections between the keywords most used by the authors of the selected articles. The size of the nodes shows that the two most used keywords in the articles published in Scopus are: Quality Management, which appears in 298 articles, and Total Quality Management, which appears in 125 articles. These words stand out for the strength of their links, which correspond to 211 and 100 respectively. Among the most cited keywords are the EFQM model, competitive advantages, supply chain management, six sigma, business excellence and sustainability.

Figura 6

Grafo de coocurrencia en el uso de palabras clave en el tema de gestión de calidad



Note: Own elaboration based on data extracted from Scopus. To elaborate Figure 6, the VOSviewer program was used and the keywords indicated by the authors and which have a minimum cooccurrence of 10 times in the selected articles were selected. Out of 2,795 keywords, 37 met this threshold. Counting method: Fractional counting and normalization method: association strenght.

Table 5 shows the keyword co-occurrence clusters. These represent the major areas of study or contemporary research fronts developed in the field of quality management. 5.

Table 5

Cooccurrence clusters in the use of keywords

Cluster	Items	Key words
1	16	competitive advantage, continuous improvement, efficiency, efqm model, industry 4.0, innovation, knowledge management, lean, organizational performance, organizational culture, performance, quality 4.0, quality management, six sigma, total quality management, tqm
2	13	Business excellence, certification, health care, higher education, iso 9001, leadership, process management, quality assurance, quality improvement, quality management system, quality management systems, quality management services, quality services, smes
3	4	customer satisfaction, financial performance, risk management, supply chain management
4	2	Management, quality
5	2	Sustainability, sustainable development

Note: Own elaboration based on data extracted from Scopus using the VOSviewer program.

DISCUSSION

This research includes a bibliometric and scientometric study at the level of five units of analysis: articles, journals, authors and keywords. For the analysis, production, concentration, collaboration, impact and relationship indicators were used. This made it possible to obtain

to provide a broad and rigorous overview of the scientific production on quality management published in the Scopus database during the period 2011-2022.

As a result of the production analysis, it was found that the publication of articles in quality management has grown exponentially, even considering the years 2019 and 2020, which were affected by the COVID-19 pandemic. These trends confirm that quality management is an area of research in force and of great relevance in the scientific field, which coincides with the findings of Carnerud & Bäckström (2021) pointed out in this article.

The countries whose researchers have published the greatest number of articles are the United Kingdom, Spain and the United States; however, among the educational institutions with which the different authors are affiliated, three universities located in Sweden stand out and play a leading role: Linköpings Universitet, in first place, Chalmers University of Techno- logy, which shares second place with Politechnika Rzeszowska, located in Poland, and Mid Sweden University Östersund, in third place, also in Sweden.

Three major producers of articles in quality management were also identified. These are: Professor Bäckström, I., who has collaborated as author of 12 articles, Professor Gre- myr, I., and Professor Tarí J. J., who have participated respectively in the authorship of 11 articles. In line with Bradford's Law, 14 journals were identified as part of the core. In first place is the UK journal Total Quality Management and Business Excellence, which stands out for the number of articles published, the number of citations and the bibliographic pairing. This result agrees with Zhang et al. (2021), who found that this journal ranked first in terms of the number of articles published in the period 1990-2017.

On the other hand, the United Kingdom tops the list of article coauthorship with 69 countries. The second place in co-authorship is held by the United States, whose authors collaborated with peers from 33 countries. In third place is Spain with 27 countries and, in fourth place, Sweden with 16 countries. These countries are also the most productive, which highlights the importance of collaborative work in research groups in the field of quality management.

The 37 keywords most used by the authors are organized in 5 clusters, which are identified in this study as contemporary research fronts in the area of quality management. The most frequently used words are quality management and total quality management. Among the words with the highest number of citations are EFQM, competitive advantage, supply chain management, six sigma, business excellence and sustainability. According to Fundin et al. (2020), sustainability is linked to the concept of Quality 5.0, which is seen as the emerging approach or paradigm of quality management.

The terms or words highlighted in the articles published in the period 2011-2022 coincide with the findings of Carnerud & Bacstrón (2021), related to the key areas around which research on quality has revolved during the period 1980-2017. Another aspect to highlight is that both health or medical care and higher education appear in the cluster.
2. This confirms the findings of Dahlgaard-Park et al. (2013) and Zhang et al.

The two sectors were highlighted as areas where quality management is being applied and researched.

6. CONCLUSIONS

For the period 2011-2022, the scientific production in Quality Management reflects an exponential trend line with a fit value of $R^2 = 0.80$, while when considering exclusively the years prior to the COVID-19 pandemic, the fit value is $R^2 = 0.93$. In the production of articles, the first places are occupied by Bäckström, I., Gremyr, I., both researchers at Swedish universities, and Tari J. J., professor at the University of Alicante, Spain.

We identified 102 countries, 160 educational institutions and 297 journals to which the authors of the 998 scientific articles selected in this research are affiliated. At the same time, 15 countries account for 80% of the publications, with the United Kingdom, Spain and the United States occupying the first places. The United Kingdom is the leader in the production of articles and for its collaboration with 69 countries. Sweden, in turn, is a leader in terms of the productivity of its educational institutions and the productivity, visibility and impact of its researchers. The journals with the highest number of citations and which are at the forefront of the scientific debate on quality management are: Total Quality Management and Business Excellence from the United Kingdom; Journal of Cleaner Production from the United Kingdom; and International Journal of Production Economics from the Netherlands.

With respect to network analysis, four clusters of co-authorship between countries and five clusters of co-occurrence of keywords were identified. These clusters show the systemic nature of the approach to quality management and mark the main research trends in this field. Among these trends are Total Quality Management (TQM), EFQM model, competitive advantage, supply chain management, six sigma, business excellence and sustainability.

One limitation of this study is that it was based exclusively on scientific articles from the Scopus database. Nevertheless, the methodology and findings of the present research can be the basis for future research involving other databases and other types of scientific publications. Finally, two lines of research are proposed. The first consists of identifying quality management frameworks that simultaneously enable stability and development in times of change and uncertainty. The second is aimed at establishing the relationship between quality management and the economic, environmental and social sustainability of organizations.

References

Abbas, J. (2020). Impact of total quality management on corporate green performance through the mediating role of corporate social responsibility. *Journal of Cleaner Production,* 242, 118458. https://doi.org/10.1016/j.jclepro.2019.118458

Algunmeeyn, A., El-Dahiyat, F., Alfayoumi, I. & Alrawashdeh, M. (2021). Exploring staff perspectives of the barriers to the implementation of accreditation in Jordanian hospitals: Case study. *International Journal of Healthcare Management, 14*(4), 1422-1428. https://doi.org/10.1080/20479700.2020.1763233

Alshourah, S. (2021). Assessing the influence of total quality management practices on innovation in Jordanian manufacturing organizations. *Uncertain Supply Chain Management, 9,* 57-68. https://doi.org/10.5267/j.uscm.2020.12.001

Bahia, T. H. A., Abbas, B. A. H. & Idan, A. R. (2023). Total Quality Management as a Philosophy to Improve the Performance of the Academic Organization. *International Journal of Professional Business Review, 8*(1), e01157. https://doi.org/10.26668/businessreview/2023.v8i1.1157

Basheer, M. F., Siam, M. R. A., Awn, A. M., & Hassan, S. G. (2019). Exploring the role of TQM and supply chain practices for firm supply performance in the presence of information technology capabilities and supply chain technology adoption: A case of textile firms in Pakistan. *Uncertain Supply Chain Management, 7*(2), 275-288. https://doi.org/10.5267/j.uscm.2018.9.001

Bhuiyan, N. & Baghel, A. (2005). An overview of continuous improvement: From the past to the present. *Management Decision, 43,* 761-771. https://doi.org/10.1108/00251740510597761

Bondanini, G., Giorgi, G., Ariza-Montes, A., Vega-Muñoz, A. & Andreucci-Annunziata, P. (2020). Technostress Dark Side of Technology in the Workplace: A Scientometric Analysis. *International Journal of Environmental Research and Public Health, 17*(21). https://doi.org/10.3390/ijerph17218013

Burgess, N. & Radnor, Z. (2013). Evaluating Lean in healthcare. *International Journal of Health Care Quality Assurance, 26*(3), 220-235. https://doi.org/10.1108/09526861311311418

Camisón, C., Cruz, S. & Gonzales, T. (2006). Gestión de la Calidad: Conceptos, enfoques, modelos y sistemas (1ª ed.). *Pearson Educación.* https://porquenotecallas19.files.wordpress.com/2015/08/gestion-de-la-calidad.pdf

Carnerud, D. & Bäckström, I. (2021). Four decades of research on quality: Summarising, Trendspotting and looking ahead. *Total Quality Management & Business Excellence, 32*(9-10), 1023-1045. https://doi.org/10.1080/14783363.2019.1655397

Casprini, E., Pucci, T., Fiorini, N. & Zanni, L. (2023). Blending "hard" and "soft" TQM for academic excellence: The University of Siena experience in the field of Life Sciences. *The TQM Journal, 35*(9), 231-255. https://doi.org/10.1108/TQM-07-2022-0213

Cebekhulu, B. & Ozor, P. (2022). The influence of quality management and ERP systems on organizational culture and performance. *Proceedings on Engineering Sciences, 4*(1), 41-50. https://doi.org/10.24874/PES04.01.007

Cole, R., Stevenson, M. & Aitken, J. (2019). Blockchain technology: Implications for operations and supply chain management. *Supply Chain Management, 24*(4), 469-483. Scopus. https://doi.org/10.1108/SCM-09-2018-0309

Cruz-Ramírez, M., Díaz-Ferrer, Y., Rúa-Vásquez, J. A. & Rojas-Velázquez, O. J. (2020). Estudio cienciométrico de una red de coautoría en educación matemática. Un análisis de sus campos de investigación basado en el método Delphi. *Revista Española de Documentación Científica,* 43(4). https://doi.org/10.3989/redc.2020.4.1727

Dahlgaard, J. J., Chen, C.-K., Jang, J.-Y., Banegas, L. A., & Dahlgaard-Park, S. M. (2013). Business excellence models: Limitations, reflections, and further development. *Total Quality Management and Business Excellence, 24*(5-6), 519-538. https://www.tandfonline.com/doi/abs/10.1080/14783363.2012.756745

Dahlgaard-Park, S. M., Chen, C.-K., Jang, J.-Y., & Dahlgaard, J. J. (2013). Diagnosing and prognosticating the quality movement—A review on the 25 years quality literature (1987-2011). *Total Quality Management and Business Excellence, 24*(1-2), 1-18. https://doi.org/10.1080/14783363.2012.756749

Drotz, E. & Poksinska, B. (2014). Lean in healthcare from employees' perspectives. *Journal of Health, Organization and Management, 28*(2), 177-195. https://doi.org/10.1108/JHOM-03-2013-0066

Ershadi, M. J., Najafi, N. & Soleimani, P. (2019). Measuring the impact of soft and hard total quality management factors on customer behavior based on the role of innovation and continuous improvement. *The TQM Journal, 31*(6), 1093-1115. https://doi.org/10.1108/TQM-11-2018-0182

Fonseca, L., Amaral, A. & Oliveira, J. (2021). Quality 4.0: The EFQM 2020 Model and Industry 4.0 Relationships and Implications. *Sustainability, 13*(6). https://doi.org/10.3390/su13063107

Fundin, A., Bergquist, B., Eriksson, H. & Gremyr, I. (2018). Challenges and propositions for research in quality management. *International Journal of Production Economics*, 199, 125-137. https://doi.org/10.1016/j.ijpe.2018.02.020

Fundin, A., Lilja, J., Lagrosen, Y. & Bergquist, B. (2020). Quality 2030: Quality management for the future. *Total Quality Management & Business Excellence, 0*(0), 1-17. https://doi.org/10.1080/14783363.2020.1863778

Ghaith, Y., Ghosh, U. K., Guerra, M. A., Hammouri, Q., Alkhuzaie, Y. A. & Ghaith, M. (2023). Quality management application and educational performance in higher education institutions: A bibliometric analysis. *Uncertain Supply Chain Management, 11*(4), 1657-1666. https://doi.org/10.5267/j.uscm.2023.7.003

Govindan, K. & Chaudhuri, A. (2016). Interrelationships of risks faced by third party logistics service providers: A DEMATEL based approach. Transportation Research Part E: Logistics and Transportation Review, 90, 177-195. https://doi.org/10.1016/j.tre.2015.11.010

Gutierrez-Gutierrez, L. J., Barrales-Molina, V. & Kaynak, H. (2018). The role of human resource-related quality management practices in new product development: A dynamic capability perspective. *International Journal of Operations and Production Management, 38*(1), 43-66. https://doi.org/10.1108/IJOPM-07-2016-0387

Gyllenhammar, D. & Hammersberg, P. (2023). How to facilitate improvements in public service systems: Propositions for action. *International Journal of Quality & Reliability Management, 40*(6), 1429-1448. https://doi.org/10.1108/IJQRM-09-2021-0314

Hamid, S. R., Isa, S., Chew, B. C. & Altun, A. (2019). Quality Management Evolution from the Past to Present: Challenges for Tomorrow. *Organizacija, 52*(3), 157-186. https://sciendo.com/es/article/10.2478/orga-2019-0011

Hussain, S., Alsmairat, M. A. K., Al-Ma'aitah, N. & Almrayat, S. (2023). Assessing quality performance through seven total quality management practices. *Uncertain Supply Chain Management, 11*(1), 41-52. https://doi.org/10.5267/j.uscm.2022.12.002

Iuga, M. M., Romero-Carazas, R., Espada-Salgado, F., Oprea, B., Stefanescu, S. V. & Lavado-García, M. (2023). Role of biodentine in endodontics: a bibliometric and scientometric analysis. *EAI Endorsed Transactions on Pervasive Health and Technology, 9*. https://doi.org/10.4108/eetpht.9.3849

Jira, C. & Toffel, M. W. (2013). Engaging supply chains in climate change. *Manufacturing and Service Operations Management, 15*(4), 559-577. https://doi.org/10.1287/msom.1120.0420

Maier, A. M., Moultrie, J. & Clarkson, P. J. (2012). Assessing Organizational Capabilities: Reviewing and Guiding the Development of Maturity Grids. *IEEE Transactions on Engineering Management, 59*(1), 138-159. https://doi.org/10.1109/TEM.2010.2077289

Maletič, M., Maletič, D., Dahlgaard, J. J., Dahlgaard-Park, S. M. & Gomišček, B. (2014). Sustainability exploration and sustainability exploitation: From a literature review towards a conceptual framework. *Journal of Cleaner Production, 79,* 182-194. https://doi.org/10.1016/j.jclepro.2014.05.045

Mingers, J. & Leydesdorff, L. (2015). A review of theory and practice in scientometrics. *European Journal of Operational Research, 246*(1), 1-19. https://doi.org/10.1016/j.ejor.2015.04.002

Nguyen, T., Nguyen, K. & Tucek, D. (2023). Total Quality Management 4.0 Framework: Present and Future. *Operations and Supply Chain Management: An International Journal, 16*(3), 311-322. https://doi.org/10.31387/oscm0540391

Permana, A., Purba, H. & Rizkiyah, N. (2021). A systematic literature review of Total Quality Management (TQM) implementation in the organization. *International Journal of Production Management and Engineering, 9*(1), 25–36. https://doi.org/10.4995/ijpme.2021.13765

Ramanathan, S. & Isaksson, R. (2022). Sustainability reporting as a 21st century problem statement: Using a quality lens to understand and analyse the challenges. *The TQM Journal, 35*(5), 1310-1328. https://doi.org/10.1108/TQM-01-2022-0035

Rey Sánchez, S. P., Garay, F., Jacha Rojas, J. & Malpartida Gutiérrez, J. (2022). Industria 4.0 y gestión de calidad empresarial. *Revista Venezolana de Gerencia, 27*(97), 287-298. https://doi.org/10.52080/rvgluz.27.97.20

Sader, S., Husti, I. & Daróczi, M. (2019). Industry 4.0 as a Key Enabler toward Successful Implementation of Total Quality Management Practices. *Periodica Polytechnica Social and Management Sciences, 27,* 131-140. https://doi.org/10.3311/PPso.12675

Salem M. A., Shawtari F., Shamsudin M. F., Manochehri N., Al Blooshi S. & Alyafei K. (2019). Structural Equation Modelling of the Relationship between TQM Practices and Organizational Commitment in Higher Educational Institutions. *Polish Journal of Management Studies, 19*, 331-342. https://pjms.zim.pcz.pl/resources/html/article/details?id=190208

Santos, G., Mendes, F. & Barbosa, J. (2011). Certification and integration of management systems: The experience of Portuguese small and medium enterprises. *Journal of Cleaner Production, 19*(17), 1965-1974. https://doi.org/10.1016/j.jclepro.2011.06.017

Schiavone, F., Pietronudo, M. C., Sabetta, A. & Ferretti, M. (2022). Total quality service in digital era. *The TQM Journal, 35*(5), 1170-1193. https://doi.

org/10.1108/TQM-12-2021-0377

SCImago. (2022). SJR. Scimago Journal & Country Rank. https://www.scimagojr.com/index.php

Seyfried, M., Ansmann, M. & Pohlenz, P. (2019). Institutional isomorphism, entrepreneurship, and effectiveness: The adoption and implementation of quality management in teaching and learning in Germany. *Tertiary Education and Management,* 25(2), 115-129. https://doi.org/10.1007/s11233-019-09022-3

Shafiq, M., Lasrado, F. & Hafeez, K. (2019). The effect of TQM on organizational performance: Empirical evidence from the textile sector of a developing country using SEM.*Total Quality Management and Business Excellence, 30*(1-2), 31-52. https://doi.org/10.1080/14783363.2017.1283211

Siva, V., Gremyr, I., Bergquist, B., Garvare, R., Zobel, T. & Isaksson, R. (2016). The support of Quality Management to sustainable development: A literature review. *Journal of Cleaner Production, 138,* 148-157. https://doi.org/10.1016/j.jclepro.2016.01.020

Suclupe-Navarro, P., Limaymanta, C. H., Ramírez, N. H. & Guillén, H. (2021). Producción científica sobre ansiedad bibliotecaria: Un análisis bibliométrico y cienciométrico desde Scopus. *Revista Española de Documentación Científica, 44*(2), e291. https://doi.org/10.3989/redc.2021.2.1753

Urbinati, A., Bogers, M., Chiesa, V. & Frattini, F. (2019). Creating and capturing value from Big Data: A multiple-case study analysis of provider companies. *Technovation,* 84-85, 21-36. https://doi.org/10.1016/j.technovation.2018.07.004

Weckenmann, A., Akkasoglu, G. & Werner, T. (2015). Quality management – history and trends. *The TQM Journal, 27*(3), 281-293. https://doi.org/10.1108/TQM-11-2013-0125

Yadav, G., Luthra, S., Huisingh, D., Mangla, S. K., Narkhede, B. E. & Liu, Y. (2020). Development of a lean manufacturing framework to enhance its adoption within manufacturing companies in developing economies. *Journal of Cleaner Production, 245,* 118726. https://doi.org/10.1016/j.jclepro.2019.118726

Zhang, C., Moreira, M. R. A. & Sousa, P. S. A. (2021). A bibliometric view on the use of total quality management in services. *Total Quality Management & Business Excellence, 32*(13-14), 1466-1493. https://doi.org/10.1080/14783363.2020.1732811

Zhang, M., Guo, H., Huo, B., Zhao, X. & Huang, J. (2019). Linking supply chain quality integration with mass customization and product modularity. *International Journal of Production Economics, 207,* 227-235. https://doi.org/10.1016/j.ijpe.2017.01.011

Žitkienė, R. & Deksnys, M. (2018). Organizational Agility Conceptual Model. *Montenegrin Journal of Economics, 14,* 115-129. https://doi.org/10.14254/1800-5845/2018.14-2.7