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Publication performance and trends in Total Quality Management research: a bibliometric analysis

Yuh-Shan Ho, Ylenia Cavacece*, Andrea Moretta Tartaglione and Alex Douglas

Trend Research Centre, Asia University, Taichung, Taiwan; Department of Economics and Law, University of Cassino and Southern Lazio, Cassino, Italy; Management University of Africa, Nairobi, Kenya

Publications on Total Quality Management (TQM) over the last three decades are numerous; however, systematic quantitative reviews are scarce.

The aim of this paper is to provide scholars and practitioners with a comprehensive view of the extant literature on TQM. The method of bibliometric analysis is used to highlight the advances in research, the results achieved by previous studies, the gaps in the literature and the most current trends. The results show publication outputs of countries, institutes, journals, and research fields, the most cited authors and works, the most used keywords and the research trends. This work provides scholars with a systematization of the TQM research field and suggestions on how to contribute to the advancement of research on this topic. For practitioners, this paper offers an outline of the most important and current research results from which to obtain insights about techniques and strategies that best suit the implementation of TQM in their organisations.

Keywords: Total Quality Management; TQM; bibliometric analysis; research trends

Introduction

Quality has been of great interest in the business management field since the 1970s when, due to increasing competition and customers’ expectations, companies began to consider quality as crucial for their survival and success and so put great effort and investment into quality improvement (Aquilani et al., 2017). During the last thirty years of the twentieth century, the interest of scholars and practitioners for quality management practices and their implementation increased, shifting the focus from product quality to Total Quality Management (TQM) (Boaden, 1997; Talib & Rahman, 2015). TQM is a quality-centred management approach based on the participation of all members of an organisation with the aim of achieving long-term success through customer satisfaction and benefits for employees and society (Sadikoglu & Zehir, 2010). It can be considered as an evolution of the Total Quality Control (TQC) (Chiarini, 2011), defined by Feigenbaum (1961) as: ‘A network of the management/control and procedure that is required to produce and deliver a product with a specific quality standard’ (p. 6). TQM principles were introduced when the differences between the American and Japanese systems were emphasised and the belief that quality should not only be controlled but also managed spread among scholars (Martinez-Lorente et al., 1998). According to Chiarini (2011), TQM maintains the typical quality tools and techniques of TQC; however, to avoid confusion among the two systems, this work focuses only on TQM.

*Corresponding author. Email: ylenia.cavacece@unicas.it
There are numerous studies related to TQM but a widely accepted definition and a shared framework for its implementation do not yet exist (Aquilani et al., 2017). It is defined as a philosophy, as an approach or a concept; sometimes the focus is on the customer and other times on continuous improvement (Zhang et al., 2020). Several factors influencing the successful or unsuccessful implementation of TQM were investigated (Kaynak, 2003) as well as its influence on organisational effectiveness, but often the results were inconsistent (Yong & Wilkinson, 2002).

TQM has been studied for different types of organisations, from manufacturing to service companies. It has been applied to improve products, services, and business processes (Partlow, 1996).

Given the large number of studies on TQM and its complex and multidimensional nature, it is not easy for scholars to have a complete and comprehensive view of the developments of research in this field, the results achieved by previous studies, the gaps in the literature and the most current trends and, therefore, to understand how to contribute to the advancement of research on this topic. To facilitate the obtaining of this information, this work provides systematic data on the overall scientific output of TQM research. Traditionally, two methods have been used to achieve this goal: the qualitative method of literature review and the quantitative method of meta-analysis (Schmidt, 2008). Recently, bibliometric methods have gained acceptance thanks to the development of online databases with citation data (e.g. Web of Science) (Moretta Tartaglione et al., 2019) and have been widely applied to analyse the fields of strategic management (Zupic & Tomaz, 2015). These methods allow an objective analysis of the knowledge structure and research front of a research field (Okubo, 1997). Bibliometric analysis is often preferred by scholars to narrative literature reviews because it overcomes limitations such as lack of rigour and exposure to researcher bias by using a systematic, transparent, and reproducible quantitative method to describing and evaluating published research (Tranfield et al., 2003; Zhang et al., 2020). With this purpose, this paper offers a first attempt to conduct a systematic review on TQM by means of a bibliometric analysis in order to answer to the following research questions: (1) What are the quantitative aspects of relevant scientific production on TQM? (2) What are the weaknesses, foci, and trends in this field? (3) What are the possible research topics requiring further studies?

This work combines the conventional bibliometric methods, which offer a panorama of published research based on the citation analysis (Cole, 1989), and on the evaluation of publication outputs of countries, institutes, journals, and research fields (Braun et al., 1995; Colman et al., 1995; Ugolini et al., 1997), with an innovative method, which allows the identification of development trends and future orientation of the research field by analysing information as author keywords, source title, and KeyWords Plus (Li et al., 2008; Zhang et al., 2009). The method used differentiates this research from other bibliometric analyses in the field as: it uses the ‘front page’ as a filter to make the results more accurate; it uses three citation indicators to make the analysis checkable and repeatable; it uses different publication indicators to compare research performance of countries, institutes, and authors; it uses words distribution in different periods as information to find out research focuses and their trends; it presents citation history of the ten most cited articles and research trends of the four main topics in TQM research.

Recently, two bibliometric analyses on some specific aspects of TQM were published: Zhang et al. (2020) conducted a bibliometric analysis on the use of TQM in services; Marchiori and Mendes (2020) on the relations between knowledge management and TQM. Other studies are bibliometric analyses on quality-related topics but not on TQM. These include the work of Niñerola et al. (2019) on the Six Sigma literature; Hussain
et al. (2018) on the ISO 9000 standard series; Hussain et al. (2020) on the Knowledge-Based Intellectual Structure of Business Excellence Research; Gonzalez Aleu and Van Aken (2017) on the Continuous improvement projects; Lizarelli et al. (2016), and Veiga et al. (2016) on the statistical process and quality control. A quantitative and qualitative evaluation of the overall literature on TQM is therefore lacking.

The remainder of the paper is organised as follows. The next section presents an overview of the literature followed by the description of the method used, the discussion of results, conclusions, implications, and research limitations.

**Literature**

TQM can be defined as a management system aimed at customer satisfaction through the continuous improvement of products, services, people, processes, and the environment (Gapp et al., 2008; Goetsch & Davis, 2002).

The interest in quality management started in the 1970s when the entry of Japanese products into Western markets increased competition and consumer expectations (Yong & Wilkinson, 2002). The first contributions on TQM are traced back to Crosby (1979), Deming (1982) and Juran (1978); during the 1990s the scientific production on TQM grew at exponential rates. Despite the large amount of literature produced, TQM remains a complex and controversial topic. In fact, to date there is still no agreed definition of TQM (Sila & Ebrahimpour, 2003; Zhang et al., 2020), the results of different authors are sometimes contradictory (Knights & Wilmott, 2000), and there is confusion about management styles and their strategies (Chiariini, 2011). In the literature, TQM is sometimes classified as a philosophy, others as an approach or concept centred on customer focus as well as on continuous improvement, involving production but also administrative processes and affecting people, organisations or change processes (Zhang et al., 2020). TQM relates to different quality concepts like certifications, quality awards, standards, training, business excellence models, customer service, and many more (Dedhia, 1995). Several scholars analyse the factors that determine the success or failure of TQM reaching sometimes discordant results (Kaynak, 2003; Sila & Ebrahimpour, 2003; Zhang et al., 2020) and confirming that there is still no widely accepted model for its implementation (Aquilani et al., 2017).

For some authors the goal of TQM is customer satisfaction, for others it is to improve the quality of goods and services, increase productivity, reduce waste, costs, time, and inventory levels (Besterfield et al., 2003; Fuzi & Gibson, 2013; Goetsch & Davis, 2006; Oprescu, 2012; Pakdil, 2010; Valmohannadi, 2011).

Research on the relationship between TQM practices and firm performance has also produced mixed results (Chong & Rundus, 2004; Douglas & Judge, 2001; Fuentes-Fuentes et al., 2004; Kannan & Tan, 2005; Kaynak, 2003; Nair, 2006; Prajogo & Sohal, 2001, 2006; Rahman & Bullock, 2005; Sadikoglu, 2004; York & Miree, 2004) and some studies find a direct relationship between the two variables, others an indirect one (Kaynak, 2003; Rahman & Bullock, 2005). Different enablers of quality improvement have been identified, such as leadership, human resource management and process management (Paraschi et al., 2019), as well as different business results like customer, financial and people outcomes (Gómez-López et al., 2016; Sila & Ebrahimpour, 2005; Su et al., 2003), and the social and environmental impact of the firm (Eskildsen & Dahlgaard, 2000; Fotopoulos & Psomas, 2010; Mesgari et al., 2017).

TQM has been related to different tools, techniques and principles for quality improvement (Partlow, 1996), among which the focus on work processes, the analysis of
variability, the management by fact, learning and continuous improvement (Hackman & Wageman, 1995).

With reference to TQM implementation, Sharma and Mogdil (2019), after conducting a literature review, identified several tested practices: top management support, research and development management, product quality and total productive maintenance (Brah et al., 2000; McKone-Sweet et al., 2001; Prajogo & Sohal, 2006; Zu et al., 2008). For other authors, the basis of TQM is customer orientation (Mehra & Ranganathan, 2008; Singh & Smith, 2004; Ugboro & Kofi, 2000), continuous monitoring of customer expectations (Nguyen & Harrison, 2018; Sadikoglu & Olcay, 2014; Svendsen et al., 2011) and customer engagement in the internal improvement process (Baird et al., 2011; Carpinetti et al., 2003; Cua et al., 2001; Parast et al., 2006; Syamil et al., 2004). Finally, other key factors for TQM have been identified in leadership, people management (Corredor & Goñi-Legaz, 2011; Oakland, 2011; Salaheldin, 2009; Shah & Ward, 2003) and inter-functional coordination (Pattikawa et al., 2006; Rafiq & Saxon, 2000).

Although TQM was initially designed for manufacturing industries, it is increasingly being applied in service industries such as healthcare and education (Agus, 2004; Brah et al., 2000; Dahlgaard-Park et al., 2013; Prajogo, 2005).

In conclusion, given the multidimensionality of the subject, the different factors involved and the heterogeneity and huge number of publications, it is not easy for scholars to have a clear view of the scientific production on TQM and understand how to contribute to the advancement of research (Zhang et al., 2020). More efforts oriented toward a systematization of the TQM literature are therefore welcomed.

Methods
Data were retrieved on November 06, 2020, from the Science Citation Index Expanded (SCI-EXPANDED) and Social Science Citation Index (SSCI) of the Web of Science Core Collection by Clarivate Analytics. To have complete data on the publications per year and journals’ performance, the analysis was conducted until the end of 2019. The Science Citation Index (SCI) from the Web of Science databases of the Institute for Scientific Information (ISI) was used because it is the most important database source for a comprehensive review of scientific achievement in all fields of study (Bayer & Folger, 1966; Braun et al., 2000; Zhang et al., 2010). Moreover, it allows to evaluate the journals by their impact factor provided by the Journal Citation Reports. Search keywords (‘Total Quality Management’ or ‘TQM’) were used. By using advanced search with TI (title), AB (abstract), and AK (author keywords), 3,110 documents including 2,633 articles having the search keywords in their ‘front page’ (Fu et al., 2012) including article title, abstract, and author keywords from 1990 to 2019 were defined as Total Quality Management publications. These records were downloaded into spreadsheet software, and additional coding was manually performed using Microsoft Excel 2016 for analysis (Ho & Fu, 2016; Li & Ho, 2008). Besides, the journal impact factor (IF2019) of each journal was obtained from the JCR in 2019. The affiliation of England, Scotland, Northern Ireland, and Wales has been reclassified as from the United Kingdom (UK). Affiliations in Hong Kong before 1997 were included in the China category (Fu et al., 2012).

In this paper the term ‘reprint author’ used in the SCI-EXPANDED and SSCI databases, was replaced with the term ‘corresponding author’ (Ho, 2012). The institution of affiliation is classified as that of the first and corresponding author (Ho, 2014a). In the case of papers with multiple corresponding authors, only the last corresponding-author for the institution was considered and the country (Ho, 2019). In papers with a single
author, the latter is considered both the first and the corresponding author (Ho, 2014a). Note that in 2003 the journal Total Quality Management changed its name to Total Quality Management & Business Excellence, and thus these two journals were merged to be the Total Quality Management & Business Excellence.

The three citation indicators to investigate the citations received by the publications were:

- $C_{\text{year}}$: the number of citations from the Web of Science Core Collection in a particular year. $C_{2019}$: means the number of citations in 2019 (Ho, 2012).
- $TC_{\text{year}}$: means the total number of citations from the Web of Science Core Collection since publication year to the end of 2019 ($TC_{2019}$) (Chuang et al., 2011; Wang & Ho, 2011).
- $CPP_{\text{year}}$: means citations per publication ($CPP_{2019} = TC_{2019}/TP$), $TP$: total number of articles (Ho, 2012).

Results and discussion

**Document type and language of publication**

Comparing the total citations of documents in the Web of Science Core Collection, a better citation indicator, $TC_{\text{year}}$ is proposed as repeatable and checkable scientific data (Chuang et al., 2011; Wang & Ho, 2011), and it has been widely used in bibliometric research in the last decade (Ho, 2014b; Ho, 2018). The relationship among document types and their citations per publication, $CPP_{\text{year}}$, and the number of authors per publication, $APP$, has recently been proposed in a table (Monge-Nájera & Ho, 2017). Fourteen document types indexed by the Web of Science were found (Table 1). The document type of ‘articles’ was the most popular, with a total of 2,633 articles (85% of 3,110 documents), the $APP$ was 2.4. The largest number of authors was for the paper of Albert et al. (2009) published by 21 authors from 18 institutes in Germany. The document type of ‘reviews’ had the highest

<table>
<thead>
<tr>
<th>Document type</th>
<th>$TP$</th>
<th>%</th>
<th>$TP^*$</th>
<th>AU</th>
<th>APP</th>
<th>$TC_{2019}$</th>
<th>$CPP_{2019}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Article</td>
<td>2,633</td>
<td>85</td>
<td>2,626</td>
<td>6,199</td>
<td>2.4</td>
<td>62,347</td>
<td>24</td>
</tr>
<tr>
<td>Proceedings paper</td>
<td>241</td>
<td>7.7</td>
<td>241</td>
<td>521</td>
<td>2.2</td>
<td>4,063</td>
<td>17</td>
</tr>
<tr>
<td>Review</td>
<td>137</td>
<td>4.4</td>
<td>137</td>
<td>385</td>
<td>2.8</td>
<td>10,764</td>
<td>79</td>
</tr>
<tr>
<td>Book review</td>
<td>107</td>
<td>3.4</td>
<td>99</td>
<td>101</td>
<td>1.0</td>
<td>32</td>
<td>0.30</td>
</tr>
<tr>
<td>Editorial material</td>
<td>87</td>
<td>2.8</td>
<td>77</td>
<td>120</td>
<td>1.6</td>
<td>239</td>
<td>2.7</td>
</tr>
<tr>
<td>Letter</td>
<td>73</td>
<td>2.3</td>
<td>72</td>
<td>87</td>
<td>1.2</td>
<td>24</td>
<td>0.33</td>
</tr>
<tr>
<td>Meeting abstract</td>
<td>38</td>
<td>1.2</td>
<td>38</td>
<td>145</td>
<td>3.8</td>
<td>6</td>
<td>0.16</td>
</tr>
<tr>
<td>Note</td>
<td>13</td>
<td>0.42</td>
<td>13</td>
<td>16</td>
<td>1.2</td>
<td>49</td>
<td>3.8</td>
</tr>
<tr>
<td>News item</td>
<td>6</td>
<td>0.19</td>
<td>1</td>
<td>1</td>
<td>1.0</td>
<td>1</td>
<td>0.17</td>
</tr>
<tr>
<td>Discussion</td>
<td>4</td>
<td>0.13</td>
<td>4</td>
<td>5</td>
<td>1.3</td>
<td>4</td>
<td>1.0</td>
</tr>
<tr>
<td>Reprint</td>
<td>4</td>
<td>0.13</td>
<td>4</td>
<td>10</td>
<td>2.5</td>
<td>2</td>
<td>0.50</td>
</tr>
<tr>
<td>Bibliography</td>
<td>3</td>
<td>0.10</td>
<td>3</td>
<td>4</td>
<td>1.3</td>
<td>2</td>
<td>0.67</td>
</tr>
<tr>
<td>Correction</td>
<td>3</td>
<td>0.10</td>
<td>3</td>
<td>9</td>
<td>3.0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Addition correction</td>
<td>2</td>
<td>0.064</td>
<td>2</td>
<td>2</td>
<td>1.0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>

$TP$: total number of publications; $TP^*$: total number of publications with author names in Web of Science Core Collection; $AU$: number of authors; $APP$: number of authors per publication; $TC_{2019}$: the total number of citations from Web of Science Core Collection since publication year to the end of 2019; $CPP_{2019}$: number of citations ($TC_{2019}$) per publication ($TP$).
CPP\textsubscript{2019} of 79, which can be attributed to the only classic review with TC\textsubscript{2019} of 1,000 or more (Long et al., 2014) by Powell (1995) from Bryant College in the USA with TC\textsubscript{2019} of 1,093. Two other review CPP\textsubscript{2019} contributors, Ahire et al. (1996) with TC\textsubscript{2019} of 790 and Kaynak (2003) with TC\textsubscript{2019} of 699, were among the top ten cited publications in TQM research. The CPP\textsubscript{2019} of ‘reviews’ was 3.3 times that of the CPP\textsubscript{2019} of 24 ‘articles’. A total of 137 reviews were published widely in 84 journals, mainly in Total Quality Management & Business Excellence with 19 reviews (14% of 137 reviews) and CPP\textsubscript{2019} of 11. The sum of the percentages is higher than 100% because in the Web of Science Core Collection the same document can be considered in two different document types (Usman & Ho, 2020). For example, 241 documents were classified as document types of proceedings papers and articles.

Only document-type articles were used for further analysis because they contain complete research ideas such as introduction, methods, results, discussions, and conclusions. The publication language is one of the basic concerns in bibliometric studies as a big data analysis (Wang & Ho, 2011). Ninety-five percent of the articles were published in English. Other languages also appeared: German (63 articles; 2.4% of 2,633 articles), Spanish (25; 0.95%), French (13; 0.49%), Turkish (9; 0.34%), Polish (2; 0.076%), Portuguese (2; 0.076%), Slovene (2; 0.076%), and one each in Croatian, Korean, Russian, Serbo-Croatian, and Slovak. Articles published in English had a CPP\textsubscript{2019} of 25 which was much higher than articles published in non-English with a CPP\textsubscript{2019} of 2.3.

**Characteristics of publication outputs**

In order to understand publications and their impact trends within a research topic, a relationship between the annual number of articles (TP) and their citations per publication (CPP\textsubscript{year} = TC\textsubscript{year}/TP) by the years in a figure was proposed by Ho (2013). Figure 1 shows the relationship.

The number of articles on TQM grew sharply from 1990 to 1995; then decreased to 57 articles in 2007 (Figure 1). Average of 65 articles per year was found in the last 12 years. Articles published in 2003, 2005, 2001, 1994, and 2004 had higher CPP\textsubscript{2019} with 40, 38, 38, 37, and 36, respectively. The top three most frequently cited articles were published in 1994, 1996, and 1995 (Figure 2).

**Web of Science categories and journals**

Journal Citation Reports (JCR) indexed 9,381 journals classified in 178 Web of Science categories in SCI-EXPANDED and 3,492 journals classified in 58 Web of Science categories in SSCI in 2019. A total of 2,633 TQM articles in SCI-EXPANDED and SSCI were published in 769 journals which are classified among the 176 Web of Science categories. Altogether, 672 articles published in 170 journals were not in SCI-EXPANDED and SSCI in 2019 without IF\textsubscript{2019}. Table 2 shows the top 10 productive Web of Science categories including six in SCI-EXPANDED and four in SSCI.

A total of 1,434 articles (55% of 2,624 articles with category information) were published in the top three categories. ‘Management’ in SSCI contained 226 journals and published the most articles (1,119 articles; 43% of 2,624 articles), followed by ‘industrial engineering’ (399 articles; 15%) and ‘operations research and management science’ (328 articles; 13%). It should also be noted that journals could be classified in two or more categories in the Web of Science Core Collection, for instance, *International Journal of Technology Management* was classified in the SSCI category of ‘management’.
as well as SCI-EXPANDED categories of ‘multidisciplinary engineering’ and ‘operations research and management science’, and thus the sum of percentages was higher than 100% (Ho, 2014a). Comparing the top 10 productive categories, articles published in the category of ‘business’ (SSCI) had the highest CPP$_{2019}$ of 77 while articles published in the ‘multidisciplinary engineering’ (SCI-EXPANDED) had a CPP$_{2019}$ of 5.2. Six of the top ten most frequently cited articles by Day (1994), Porter (1996), Kotter (1995), Griffin and Hauser (1993), Westphal et al. (1997), and Hackman and Wageman (1995) were published in the category of ‘business’. Articles published in the category of ‘health care sciences and services’ had the highest APP of 3.6 while articles published in ‘multidisciplinary engineering’ and ‘information science and library science’ both had the same APP of 1.8.

The top 10 most productive journals are listed in Table 3 with journal impact factor (IF$_{2019}$), number of authors per publication (APP), number of citations per publication (CPP$_{2019}$), and Web of Science category. The top three productive journals were classified in the category of ‘management’.

However, seven of the 10 productive journals were classified in the category of ‘industrial engineering’. Total Quality Management & Business Excellence published the most articles (566 articles; 21% of 2,633 articles) followed by Quality Progress and International Journal of Operations & Production Management both had the same TP of 72 (2.7%). Total Quality Management & Business Excellence started from 2003 in SSCI, from 1995 to 2002 it was classified in SSCI as Total Quality Management. Similarly, Quality Progress was classified in SCI-EXPANDED from 1976 to 2003 and in SSCI from 1993 to 2003. Comparing the articles published in the top 10 journals, articles

Figure 1. Number of articles and citations per article by year.
published in the *International Journal of Production Research* had the highest *APP* of 2.9 while *Quality Progress* had an *APP* of 1.4. Articles published in the *International Journal of Production Research* and *International Journal of Operations & Production Management* had the highest *CPP* of 47, respectively which can be attributed to the highly cited articles with *TC* of 100 or more (Ho, 2014a) by Gunasekaran (1998) (*TC* = 289), Zsidisin et al. (2005) (*TC* = 188), Flynn and Flynn (2005) (*TC* = 134), and

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![Citation history of the top five articles.](image)

**Figure 2.** Citation history of the top five articles.

<table>
<thead>
<tr>
<th>Web of Science category</th>
<th><em>TP</em> (%)</th>
<th><em>APP</em></th>
<th><em>CPP</em></th>
<th>No. J</th>
</tr>
</thead>
<tbody>
<tr>
<td>management</td>
<td>1,119 (43)</td>
<td>2.2</td>
<td>31</td>
<td>226 (SSCI)</td>
</tr>
<tr>
<td>industrial engineering</td>
<td>399 (15)</td>
<td>2.1</td>
<td>20</td>
<td>48 (SCIE)</td>
</tr>
<tr>
<td>operations research and management science</td>
<td>328 (13)</td>
<td>2.2</td>
<td>37</td>
<td>83 (SCIE)</td>
</tr>
<tr>
<td>business</td>
<td>216 (8.2)</td>
<td>2.2</td>
<td>77</td>
<td>152 (SSCI)</td>
</tr>
<tr>
<td>manufacturing engineering</td>
<td>191 (7.3)</td>
<td>2.5</td>
<td>30</td>
<td>50 (SCIE)</td>
</tr>
<tr>
<td>interdisciplinary applications computer science</td>
<td>149 (5.7)</td>
<td>1.8</td>
<td>5.2</td>
<td>91 (SCIE)</td>
</tr>
<tr>
<td>health policy and services</td>
<td>95 (3.6)</td>
<td>2.9</td>
<td>25</td>
<td>87 (SSCI)</td>
</tr>
<tr>
<td>health care sciences and services</td>
<td>85 (3.2)</td>
<td>2.5</td>
<td>14</td>
<td>109 (SCIE)</td>
</tr>
<tr>
<td>information science and library science</td>
<td>73 (2.8)</td>
<td>3.6</td>
<td>26</td>
<td>102 (SCIE)</td>
</tr>
</tbody>
</table>

*TP*: number of publications; *APP*: number of authors per publication; *CPP*,: number of citations (*TC*) per publication (*TP*); No. *J*: number of journals in a Web of Science category; SCIE: Science Citation Index Expanded; SSCI: Social Science Citation Index

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Table 2. The top 10 productive Web of Science categories.
Table 3. The top 10 productive journals.

<table>
<thead>
<tr>
<th>Journal</th>
<th>TP (%)</th>
<th>IF&lt;sub&gt;2019&lt;/sub&gt;</th>
<th>APP</th>
<th>CPP&lt;sub&gt;2019&lt;/sub&gt;</th>
<th>Web of Science category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Quality Management &amp; Business Excellence</td>
<td>566 (21)</td>
<td>2.922</td>
<td>2.2</td>
<td>15</td>
<td>management</td>
</tr>
<tr>
<td>Quality Progress</td>
<td>72 (2.7)</td>
<td>N/A</td>
<td>1.4</td>
<td>3.9</td>
<td>multidisciplinary engineering</td>
</tr>
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<td></td>
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<td></td>
<td>industrial engineering</td>
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<td>management</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>operations research and management science</td>
</tr>
<tr>
<td>International Journal of Operations &amp; Production Management</td>
<td>72 (2.7)</td>
<td>4.619</td>
<td>2.4</td>
<td>47</td>
<td>management</td>
</tr>
<tr>
<td>International Journal of Production Economics</td>
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<td>5.134</td>
<td>2.2</td>
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<td>industrial engineering</td>
</tr>
<tr>
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<td></td>
<td>manufacturing engineering</td>
</tr>
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<td></td>
<td>operations research and management science</td>
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<td>management</td>
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<td>operations research and management science</td>
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<td>industrial engineering</td>
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<td>manufacturing engineering</td>
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<td>interdisciplinary applications computer science</td>
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<td>International Journal of Production Research</td>
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<td>manufacturing engineering</td>
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</tr>
<tr>
<td>Industrial Management &amp; Data Systems</td>
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<td>3.329</td>
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<td>1.348</td>
<td>2.3</td>
<td>5.0</td>
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<td>management</td>
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<td>operations research and management science</td>
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<td>industrial engineering</td>
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<tr>
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<td></td>
<td></td>
<td>manufacturing engineering</td>
</tr>
<tr>
<td>Production Planning &amp; Control</td>
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</tr>
<tr>
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<td>operations research and management science</td>
</tr>
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<td>12</td>
<td>operations research and management science</td>
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<td>civil engineering</td>
</tr>
<tr>
<td>Computers &amp; Industrial Engineering</td>
<td>22 (0.84)</td>
<td>4.135</td>
<td>2.1</td>
<td>10</td>
<td>interdisciplinary applications computer science</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>civil engineering</td>
</tr>
</tbody>
</table>

TP: number of publications; IF<sub>2019</sub>: journal impact factor in 2019; APP: number of authors per publication; CPP<sub>2019</sub>: number of citations (TC<sub>2019</sub>) per publication (TP); N/A: not available (IF<sub>2003</sub> = 0.146).
Curkovic et al. (2000) \( (TC_{2019} = 103) \) in the *International Journal of Production Research* and articles by Kitazawa and Sarkis (2000) \( (TC_{2019} = 181) \), Tan et al. (1999) \( (TC_{2019} = 176) \), Ghobadian and Gallear (1997) \( (TC_{2019} = 174) \), Prajogo and McDermott (2005) \( (TC_{2019} = 154) \), Sila and Ebrahimpour (2005) \( (TC_{2019} = 150) \), Theyel (2000) \( (TC_{2019} = 136) \), Baird et al. (2011) \( (TC_{2019} = 110) \), and Forza (1996) \( (TC_{2019} = 110) \) in the *International Journal of Operations & Production Management*. Besides, according to the journal impact factor, the *Journal of the American Medical Association* (JAMA) with one article, ranks first with the highest \( IF_{2019} = 45.540 \), followed by *Diabetes Care* with one article \( (IF_{2019} = 16.019) \), *IEEE Journal on Selected Areas in Communications* with one article \( (IF_{2019} = 11.420) \), *Trends in Food Science & Technology* with two articles \( (IF_{2019} = 11.077) \), and *IEEE Communications Magazine* with two articles \( (IF_{2019} = 11.052) \).

### Publication performance of countries, institutions, and authors

There were 2,539 TQM articles (96% of 2,633 articles) with author affiliation information in SCI-EXPANDED and SSCI from 78 countries. Altogether, 2,256 (89% of 2,539 articles) were single-country articles from 65 different countries and 283 (11%) were internationally collaborative articles from 65 countries. Six publication indicators \( (Ho & Kahn, 2014; Hsu & Ho, 2014) \): total articles \( (TP) \), single-country articles \( (IP) \), internationally collaborative articles \( (CP) \), first-author articles \( (FP) \), corresponding-author articles \( (RP) \), and single-author articles \( (SP) \) as well as citation indicators, \( CPP_{2019} \) of \( FP, RP, \) and \( SP \) were used to compare publication impact among the top 15 productive countries including the seven European countries, five Asian countries, two American countries, and one Oceania country were ranked on the top 15 of publications (Table 4).

South Africa with 10 articles ranked 38th was the most productive Africa country. The USA dominated in the six publication indicators with a \( TP \) of 993 articles (39% of 2,539 articles), \( IP \) of 887 articles (39% of 2,256 single-country articles), \( CP \) of 106 articles (37% of 283 internationally collaborative articles), \( FP \) of 930 articles (37% of 2,539 first-author articles), \( RP \) of 923 articles (37% of 2,506 corresponding-author articles), and \( SP \) of 353 articles (45% of 782 single-author articles). It has been noted that the USA also dominated in the six publication indicators in the social science topics \( (Ivanović & Ho, 2016; Ivanović & Ho, 2019) \), the science topics \( (Chen & Ho, 2015) \), and the medical topics \( (Yeung & Ho, 2019) \). Comparing the top 15 productive countries, articles by the first authors and the corresponding authors from Australia had the highest \( CPP_{2019} \) of 38 and 39, respectively. Single-author articles from the Netherlands had the highest \( CPP_{2019} \) of 35 while India had a \( CPP_{2019} \) of 3.5.

In total, 1,555 articles (61% of 2,539 articles) were single-institute articles and 984 (39%) were inter-institutionally collaborative articles. The top 12 productive institutions are listed in Table 5 with the six publication indicators \( (Hsu & Ho, 2014) \): total articles \( (TP) \), single-institute articles \( (IP) \), inter-institutionally collaborative articles \( (CP) \), first-author articles \( (FP) \), corresponding-author articles \( (RP) \), and single-author articles \( (SP) \) as well as citation indicator, \( CPP_{2019} \) of \( FP, RP, \) and \( SP \), respectively.

Five institutions in the UK, four in the USA, and one each in Australia, China, and India were ranked in the top 12 of publications. The University of Bradford in the UK dominated in the six publication indicators with \( TP \) of 39 articles (1.5% of 2,539 articles), \( IP \) of 22 articles (1.4% of 1,555 single-institute articles), \( CP \) of 17 articles (1.7% of 984 inter-institutionally collaborative articles), \( FP \) of 31 articles (1.2% of 2,539 first-author articles), \( RP \) of 30 articles (1.2% of 2,506 corresponding-author articles), and \( SP \) of
Table 4. Top 15 most collaborative countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>TP</th>
<th>TP R (%)</th>
<th>IP R (%)</th>
<th>CP R (%)</th>
<th>FP R (%)</th>
<th>FP CPP 2019</th>
<th>RP R (%)</th>
<th>RP CPP 2019</th>
<th>SP R (%)</th>
<th>SP CPP 2019</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>993</td>
<td>1 (39)</td>
<td>1 (39)</td>
<td>1 (37)</td>
<td>1 (37)</td>
<td>35</td>
<td>1 (37)</td>
<td>35</td>
<td>1 (45)</td>
<td>32</td>
</tr>
<tr>
<td>UK</td>
<td>406</td>
<td>2 (16)</td>
<td>2 (14)</td>
<td>2 (14)</td>
<td>2 (14)</td>
<td>26</td>
<td>2 (14)</td>
<td>26</td>
<td>2 (14)</td>
<td>22</td>
</tr>
<tr>
<td>Spain</td>
<td>120</td>
<td>3 (4.7)</td>
<td>3 (4.6)</td>
<td>8 (6.0)</td>
<td>3 (4.4)</td>
<td>19</td>
<td>3 (4.4)</td>
<td>19</td>
<td>14 (1.2)</td>
<td>17</td>
</tr>
<tr>
<td>Taiwan</td>
<td>118</td>
<td>4 (4.6)</td>
<td>5 (3.9)</td>
<td>4 (10)</td>
<td>4 (4.0)</td>
<td>16</td>
<td>4 (4.1)</td>
<td>15</td>
<td>5 (2.4)</td>
<td>18</td>
</tr>
<tr>
<td>Germany</td>
<td>103</td>
<td>5 (4.1)</td>
<td>4 (4.0)</td>
<td>11 (4.6)</td>
<td>5 (3.8)</td>
<td>5.9</td>
<td>5 (3.8)</td>
<td>5.9</td>
<td>3 (4.1)</td>
<td>4.2</td>
</tr>
<tr>
<td>Australia</td>
<td>81</td>
<td>6 (3.2)</td>
<td>7 (2.4)</td>
<td>6 (9.2)</td>
<td>7 (2.5)</td>
<td>38</td>
<td>8 (2.5)</td>
<td>39</td>
<td>6 (2.0)</td>
<td>34</td>
</tr>
<tr>
<td>China</td>
<td>81</td>
<td>6 (3.2)</td>
<td>9 (2.0)</td>
<td>3 (12)</td>
<td>7 (2.5)</td>
<td>21</td>
<td>7 (2.5)</td>
<td>21</td>
<td>8 (1.9)</td>
<td>16</td>
</tr>
<tr>
<td>India</td>
<td>80</td>
<td>8 (3.2)</td>
<td>6 (3.0)</td>
<td>13 (4.2)</td>
<td>6 (2.8)</td>
<td>13</td>
<td>6 (2.8)</td>
<td>11</td>
<td>9 (1.8)</td>
<td>3.5</td>
</tr>
<tr>
<td>Canada</td>
<td>77</td>
<td>9 (3.0)</td>
<td>8 (2.2)</td>
<td>5 (10)</td>
<td>9 (2.4)</td>
<td>18</td>
<td>9 (2.4)</td>
<td>18</td>
<td>4 (3.1)</td>
<td>13</td>
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<tr>
<td>Malaysia</td>
<td>63</td>
<td>10 (2.5)</td>
<td>12 (1.6)</td>
<td>6 (9.2)</td>
<td>10 (2.0)</td>
<td>15</td>
<td>10 (1.9)</td>
<td>15</td>
<td>18 (0.9)</td>
<td>12</td>
</tr>
<tr>
<td>Italy</td>
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<td>11 (1.9)</td>
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<td>11 (1.8)</td>
<td>31</td>
<td>11 (1.8)</td>
<td>31</td>
<td>12 (1.5)</td>
<td>21</td>
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<tr>
<td>Sweden</td>
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<td>11 (2.0)</td>
<td>13 (1.6)</td>
<td>8 (6.0)</td>
<td>13 (1.7)</td>
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<td>13 (1.6)</td>
<td>20</td>
<td>6 (2.0)</td>
<td>26</td>
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<tr>
<td>Turkey</td>
<td>49</td>
<td>13 (1.9)</td>
<td>10 (1.9)</td>
<td>26 (2.1)</td>
<td>12 (1.8)</td>
<td>13</td>
<td>12 (1.8)</td>
<td>13</td>
<td>9 (1.8)</td>
<td>5.9</td>
</tr>
<tr>
<td>Netherlands</td>
<td>47</td>
<td>14 (1.9)</td>
<td>14 (1.5)</td>
<td>11 (4.6)</td>
<td>14 (1.6)</td>
<td>25</td>
<td>13 (1.6)</td>
<td>26</td>
<td>9 (1.8)</td>
<td>35</td>
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<tr>
<td>France</td>
<td>36</td>
<td>15 (1.4)</td>
<td>15 (1.1)</td>
<td>13 (4.2)</td>
<td>15 (1.1)</td>
<td>8.0</td>
<td>15 (1.1)</td>
<td>7.9</td>
<td>14 (1.2)</td>
<td>12</td>
</tr>
</tbody>
</table>

TP: total number of articles; TPR (%): the rank and the percentage of total articles in the total number of articles; IPR (%): the rank and the percentage of single-country articles in the total single-country articles; CPR (%): the rank and the percentage of internationally collaborative articles in the total internationally collaborative articles; FPR (%): the rank and the percentage of first-author articles in the total first-author articles; RPR (%): the rank and the percentage of the corresponding-author articles in the total corresponding-author articles; SPR (%): the rank and the percentage of the single-author articles in the total single-author articles; CPP (CPP 2019): number of citations (TC 2019) per publication (TP); N/A: not available.
Table 5. Top 12 productive institutions.

<table>
<thead>
<tr>
<th>Institute</th>
<th>TP</th>
<th>TR (%)</th>
<th>IPR (%)</th>
<th>CPR (%)</th>
<th>FPR (%)</th>
<th>FCPP2019</th>
<th>RP</th>
<th>RPR (%)</th>
<th>RCPP2019</th>
<th>SPR (%)</th>
<th>SPRCPP2019</th>
</tr>
</thead>
<tbody>
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<td>University of Bradford, UK</td>
<td>39</td>
<td>1 (1.5)</td>
<td>1 (1.4)</td>
<td>1 (1.7)</td>
<td>1 (1.2)</td>
<td>33</td>
<td>1</td>
<td>1 (1.2)</td>
<td>34</td>
<td>1 (1.2)</td>
<td>9.1</td>
</tr>
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<td>University of Wisconsin, USA</td>
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<td>2 (1.0)</td>
<td>3 (0.84)</td>
<td>5 (1.3)</td>
<td>4 (0.67)</td>
<td>12</td>
<td>3</td>
<td>0.68</td>
<td>12</td>
<td>4 (0.64)</td>
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<td>24</td>
<td>3 (0.95)</td>
<td>2 (1.1)</td>
<td>26 (0.71)</td>
<td>2 (0.79)</td>
<td>44</td>
<td>2</td>
<td>0.80</td>
<td>44</td>
<td>2 (1.0)</td>
<td>48</td>
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<tr>
<td>Hong Kong Polytechnic University, China</td>
<td>22</td>
<td>4 (0.87)</td>
<td>11 (0.51)</td>
<td>3 (1.4)</td>
<td>6 (0.63)</td>
<td>22</td>
<td>6</td>
<td>0.60</td>
<td>22</td>
<td>28 (0.26)</td>
<td>8.5</td>
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<td>5 (0.71)</td>
<td>7 (1.1)</td>
<td>3 (0.71)</td>
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<td>3</td>
<td>0.68</td>
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<td>4 (0.67)</td>
<td>25</td>
<td>3</td>
<td>0.68</td>
<td>25</td>
<td>28 (0.26)</td>
<td>11</td>
</tr>
<tr>
<td>Harvard University, USA</td>
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<td>7 (0.58)</td>
<td>7 (1.1)</td>
<td>9 (0.47)</td>
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<td>9</td>
<td>0.48</td>
<td>396</td>
<td>3 (0.77)</td>
<td>597</td>
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<tr>
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<td>7 (0.79)</td>
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<td>9 (0.47)</td>
<td>29</td>
<td>11</td>
<td>0.44</td>
<td>32</td>
<td>15 (0.38)</td>
<td>4.7</td>
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<td>Sheffield Hallam University, UK</td>
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<td>11 (1.0)</td>
<td>7 (0.51)</td>
<td>36</td>
<td>7</td>
<td>0.52</td>
<td>36</td>
<td>28 (0.26)</td>
<td>46</td>
</tr>
<tr>
<td>Brunel University, UK</td>
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<td>7 (1.1)</td>
<td>30 (0.28)</td>
<td>69</td>
<td>42</td>
<td>0.24</td>
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<td>15 (0.38)</td>
<td>116</td>
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<tr>
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<td>59 (0.19)</td>
<td>5 (1.3)</td>
<td>22 (0.32)</td>
<td>26</td>
<td>22</td>
<td>0.32</td>
<td>26</td>
<td>N/A</td>
<td>N/A</td>
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<td>11 (1.0)</td>
<td>12 (0.43)</td>
<td>13</td>
<td>11</td>
<td>0.44</td>
<td>13</td>
<td>28 (0.26)</td>
<td>1.5</td>
</tr>
</tbody>
</table>

TP: total number of articles; TR (%): the rank and the percentage of total articles in the total number of articles; IPR (%): the rank and the percentage of single-institute articles in the total single-institute articles; CPR (%): the rank and the percentage of inter-institutionally collaborative articles in the total inter-institutionally collaborative articles; FPR (%): the rank and the percentage of first-author articles in the total first-author articles; RPR (%): the rank and the percentage of the corresponding-author articles in the total corresponding-author articles; SPR (%): the rank and the percentage of the single-author articles in the total single-author articles; CPP (CPP2019): number of citations (TC2019) per publication (TP); N/A: not available.
nine articles (1.2% of 782 single-author articles). The Indian Institutes of Technology in India had no single-author article. Harvard University in the USA had an extremely high $CPP_{2019}$ for their first-author, corresponding-author, and single-author articles with 396, 396, and 597, respectively. Three single-author classic articles were published by Day (1994) from University of Pennsylvania, Porter (1996) from Harvard University and Kotter (1995) from Harvard University with $TC_{2019}$ of 2,652, 2,012, and 1,109, respectively.

Seven of the 2,633 TQM articles were anonymous, and 2,626 articles were published by 5,011 authors. The top 11 most productive authors with 10 articles or more are listed in Table 6 with the four publication indicators (Chuang et al., 2011): total number of articles ($TP$), first-author articles ($FP$), corresponding-author articles ($RP$), single-author articles ($SP$) as well as citation indicator, $CPP_{2019}$ of $TP$, $FP$, $RP$, and $SP$, respectively.

B.G. Dale ranked the top in two publication indicators with a $TP$ of 23 articles (0.91% of 2,539 articles) and an $RP$ of 13 articles (0.52% of 2,506 corresponding-author articles) while G.K. Kanji ranked the top in first-author articles with an $FP$ of 11 articles (0.43% of 2,539 first-author articles). K.N. Dervitsiotis from University of Piraeus in Greece published the most (6) single-author articles. S.R. Devadasan from PSG College of Technology in India published 10 articles which were not first-author, corresponding-author, and single-author articles with a $CPP_{2019}$ of 6.4. S.M. Shortell from Northwestern University in the USA had the highest $CPP_{2019}$ for his total, first-author, and corresponding-author articles with 180, 215, and 215, respectively in all TQM articles. A. Gunasekaran published three single-author articles using Brunel University in the UK and University of Massachusetts in the USA as affiliations and had the highest $CPP_{2019}$ for single-author articles with a $CPP_{2019}$ of 117. The analysis of authorship may be subject to bias in the case of several authors with the same name, the same author using different names (e.g. maiden names) (Zhang et al., 2012), or when an author has changed affiliation (Fu & Ho, 2013).

### Top ten most frequently cited TQM articles

Ho’s team proposed the citation indicators $TC_{\text{year}}$ (Wang & Ho, 2011) and $C_{\text{year}}$ (Ho, 2012) with the advantage of being immutable and guaranteeing repeatability compared to the Web of Science Core Collection citation index which is instead updated from time to time (Fu et al., 2012). It should be noted that although citation frequency is an indicator of the impact of scientific publications, it does not necessarily indicate their quality (Brandt et al., 2010). The presence of articles in peer-reviewed journals that most researchers can read and cite classifies them as the best (Robinson & Callen, 2010). Table 7 lists the 10 most frequently cited articles with two citation indicators (Ho, 2012). Two of the 10 articles were published in Administrative Science Quarterly ($IF_{2019} = 8.391$) and Harvard Business Review ($IF_{2019} = 5.700$), respectively. All the top ten articles were published in the USA.

Harvard University published three of the top ten articles, followed by the University of Minnesota and Massachusetts Institute of Technology (MIT) with two each. Citation history of the top 10 articles is presented in Figures 3 and 4. An article impact might not be always high (Fu et al., 2012; Ho, 2014a). Highly cited article by Berenholtz et al. (2004) had $TC_{2019}$ of 584 ranked 10th but had lower impact in 2019 with $C_{2019}$ of 20 ranked 27th. Although some recently published articles in the past few years have great potential, their $TC_{2019}$ is not high. Therefore, articles having impact in 2019 were also considered. The article of Dubey et al. (2015) had $TC_{2019}$ of 160 ranked 55th and $C_{2019}$ of 53 ranked 5th.
Table 6. Top 11 productive authors with $TP \geq 10$.

<table>
<thead>
<tr>
<th>Author</th>
<th>$TP$</th>
<th>$TP$ R (%)</th>
<th>$TP$ CPP$_{2019}$</th>
<th>$FP$ R (%)</th>
<th>$FP$ CPP$_{2019}$</th>
<th>$RP$ R (%)</th>
<th>$RP$ CPP$_{2019}$</th>
<th>$SP$ R (%)</th>
<th>$SP$ CPP$_{2019}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>B.G. Dale</td>
<td>23</td>
<td>1 (0.91)</td>
<td>16</td>
<td>6 (0.28)</td>
<td>13</td>
<td>1 (0.52)</td>
<td>17</td>
<td>7 (0.38)</td>
<td>3.3</td>
</tr>
<tr>
<td>M. Zairi</td>
<td>19</td>
<td>2 (0.75)</td>
<td>14</td>
<td>10 (0.24)</td>
<td>13</td>
<td>2 (0.44)</td>
<td>14</td>
<td>7 (0.38)</td>
<td>13</td>
</tr>
<tr>
<td>K.B. Ooi</td>
<td>17</td>
<td>3 (0.67)</td>
<td>30</td>
<td>2 (0.35)</td>
<td>27</td>
<td>4 (0.36)</td>
<td>29</td>
<td>7 (0.38)</td>
<td>15</td>
</tr>
<tr>
<td>G.K. Kanji</td>
<td>16</td>
<td>4 (0.63)</td>
<td>34</td>
<td>1 (0.43)</td>
<td>44</td>
<td>2 (0.44)</td>
<td>44</td>
<td>7 (0.38)</td>
<td>42</td>
</tr>
<tr>
<td>A. Gunasekaran</td>
<td>13</td>
<td>5 (0.51)</td>
<td>58</td>
<td>6 (0.28)</td>
<td>64</td>
<td>4 (0.36)</td>
<td>68</td>
<td>7 (0.38)</td>
<td>117</td>
</tr>
<tr>
<td>B.S. Lin</td>
<td>11</td>
<td>6 (0.43)</td>
<td>33</td>
<td>74 (0.079)</td>
<td>19</td>
<td>4 (0.36)</td>
<td>32</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>S.R. Devadasan</td>
<td>10</td>
<td>7 (0.39)</td>
<td>6.4</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>R. Mcadam</td>
<td>10</td>
<td>7 (0.39)</td>
<td>29</td>
<td>6 (0.28)</td>
<td>36</td>
<td>7 (0.32)</td>
<td>32</td>
<td>64 (0.13)</td>
<td>55</td>
</tr>
<tr>
<td>D. Mccabe</td>
<td>10</td>
<td>7 (0.39)</td>
<td>34</td>
<td>13 (0.20)</td>
<td>15</td>
<td>16 (0.20)</td>
<td>15</td>
<td>2 (0.64)</td>
<td>15</td>
</tr>
<tr>
<td>S.M. Shortell</td>
<td>10</td>
<td>7 (0.39)</td>
<td>180</td>
<td>32 (0.12)</td>
<td>215</td>
<td>39 (0.12)</td>
<td>215</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>A.S. Sohal</td>
<td>10</td>
<td>7 (0.39)</td>
<td>39</td>
<td>74 (0.079)</td>
<td>13</td>
<td>9 (0.28)</td>
<td>50</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

$TP$: total number of articles; $TP$ R (%): the rank and the percentage of total articles in the total number of articles; $FP$ R (%): the rank and the percentage of first-author articles in the total first-author articles; $RP$ R (%): the rank and the percentage of the corresponding-author articles in the total corresponding-author articles; $SP$ R (%): the rank and the percentage of the single-author articles in the total single-author articles; CPP (CPP$_{2019}$): number of citations ($TC_{2019}$) per publication ($TP$); N/A: not available.
Six of the top ten most frequently cited articles with $TC_{2019} \geq 584$ still have a high impact in 2019 with $C_{2019} \geq 38$. They are summarised as follows:

1. The capabilities of market-driven organisations (Day, 1994). $C_{2019}$ of 164 ranked 1st and $TC_{2019}$ of 2,652 ranked 1st.

   Day (1994) investigates how market-driven businesses can be sustained and improved through the capabilities approach to strategic management and Total Quality Management. According to the author, the combination of these two approaches makes it possible to understand why some organisations are more market-oriented than others and, on this basis, he proposes a changed programme with the following elements: mapping and benchmarking to identify current capabilities; formulating a value creation strategy for customers to anticipate their future needs; building a team of managers of the continuous improvement for bottom-up planning; orienting leadership towards customer centricity; innovating the organisation through the use of information technology; monitoring progress with a view to continuous improvement.


   This paper analyses the impact of three contextual factors, plant size, plant age and unionisation status, on the implementation of lean production systems, and the effects of four practices, just-in-time, total quality management, total preventive maintenance, and human resource management on operational performance. The
results show that the implementation of lean production is more problematic in the presence of a unionised work force and older plants, even if they are less pervasive than conventional knowledge advises. With regard to the plant size, large plants were shown to possess more resources to implement lean practices than smaller plants. Moreover, all the practices under study, including TQM, were significantly related to a better performance of plants.

(3) What is strategy (Porter, 1996). C\textsubscript{2019} of 120 ranked 3rd and TC\textsubscript{2019} of 2,012 ranked 2nd.

In this paper, Porter analyses the strategic positioning and highlights how operational effectiveness can be achieved mainly through practices such as TQM and continuous improvement which, however, were not sufficient for a competitive advantage because they were easily emulated. According to the author, a strategy for a unique and valuable position must include other activities like serving few and broad needs of customers, making a ‘trade-off between competing and choosing what not to do’, and ‘creating ‘fit’ among a company’s activities’ (Porter, 1996, p. 1).

(4) Leading change: Why transformation efforts fail (Kotter, 1995). C\textsubscript{2019} of 71 ranked 4th and TC\textsubscript{2019} of 1,109 ranked 3rd.

Analysing more than 100 companies over a decade, the author found that the most frequently implemented strategies to become more competitive were: ‘Total Quality Management, re-engineering, right-sizing, restructuring, cultural change and turnaround’ (Kotter, 1995, p. 1). Some of these efforts had been successful while others had been total failures. The main reasons for the failure of these
strategies could be traced back to skipping certain stages of change, which in itself was a time-consuming process, to focusing on speed and making some critical mistakes at any stage generating a negative impact.


The paper explores the relationship between specific quality management practices, also considering the infrastructure supporting their use, and quality performance in terms of establishing and sustaining a competitive advantage. The results showed that the quality perceived by the market was related to the statistical control/feedback and the product design process, while the percentage of products passing the final examination without demanding rework was mainly related to process flow management. The most important infrastructure components for quality performance were found to be top management support and workforce management.


Griffin and Hauser (1993) introduced the concept of ‘the voice of the customer’ that is a product-development technique aimed at capturing customers’ needs into a hierarchical structure, their priorities, and satisfaction with current products. This process should be led by the product development core team and consist of both qualitative and quantitative market-research performed at the launch of new product, process, or service design initiatives in support of the innovation, quality deployment, or product specifications definition.

Research foci and their trends

Author keywords analysis allows the identification of the most relevant topics of the articles examined (Zhang et al., 2010). Distributions of author keywords in different periods as a table were presented to find research foci and roughly trends (Xie et al., 2008). A total of 3,746 author keywords were used in articles on TQM from 1990 to 2019. Table 8 shows the top 20 most frequently used author keywords and their distribution over the three decades considered.

The top 20 keywords show how TQM is a multidimensional framework, studied from various aspects, applied to different sectors and with various objectives. Clearly, the most frequent words are those used for the search on WOS (Total Quality Management, TQM and quality, present in 39, 20 and 6.6% of the articles, respectively). In the field of application of TQM within business management, the processes that attracted the most interest from scholars are those related to quality management (6.0%), quality assurance (3.2%), quality improvement (3.1%) with particular reference to the continuous improvement processes (2.4%), and quality control (2.6%) mainly through certifications like ISO 9000 (2.4%). Another investigated topic is Six Sigma (2.6%) and it is interesting to note how articles on Six Sigma increased significantly in number only during the last decade. With regard to the sectors in which TQM has been most investigated these are service industry (2.3%), and manufacturing (1.4%). The most studied objectives of TQM implementation (1.9%) are the development of innovation processes (2.1%), the improvement of performance (2.1%), and the increase of customer satisfaction (1.4%). In many articles, quality management is related to the implementation of business excellence models (1.4%), the importance of which has grown exponentially over the last decade, particularly with regard to the EFQM excellence model.
To identify the main search foci and trends, the method introduced by Ho and his group was used, based on the distribution of words in article titles, abstracts, authors keywords, and KeyWords Plus over different time periods (Wang & Ho, 2016; Zhang et al., 2010).

The results of our keyword analyses provide information about the four main and possible research foci shown in Figure 4:

- **Supply chain.** The conventional literature focuses on the influence of TQM and supply chain integration (SCI) practices on firm performance (Abdullah & Tari, 2012; Agus & Hassan, 2011; Chopra & Mendl, 2013; Huo, 2012). In recent years, studies have focused on the role of information and communication technologies in facilitating quality management in an integrated way with suppliers. Thai and Jie (2018) analysed these aspects in the container shipping industry showing how the appropriate implementation of TQM and SCI practices helps to overcome the latest challenges within the logistics/transportation sector.

Several works study the similarities between TQM and Supply Chain Management (SCM) (Prajogo & Hong, 2008; Talib et al., 2011; Vanichchinchai & Igel, 2009) demonstrating that they are positively related to each other, and TQM has a direct effect on SCM practices. Of particular interest is the study by Sharma and Mogdil (2019) showing the direct effect of TQM on SCM and their positive influence on operational performance in the pharmaceutical sector, defined as the ability to provide ‘quality products at the right time, right place and right price’ (Sharma & Mogdil, 2019, p. 1).

One of the most topical areas for the study of total quality in the supply chain is that of sustainable development and renewable energy. For example, McGover and

### Table 8. Top 20 mostly used author keywords in TQM articles in 1990–2019 periods.

<table>
<thead>
<tr>
<th>Author keywords</th>
<th>TP</th>
<th>1990–2019 Rank (%)</th>
<th>1990s Rank (%)</th>
<th>2000s Rank (%)</th>
<th>2010s Rank (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>total quality management</td>
<td>594</td>
<td>1 (39)</td>
<td>1 (38)</td>
<td>1 (38)</td>
<td>1 (40)</td>
</tr>
<tr>
<td>TQM</td>
<td>298</td>
<td>2 (20)</td>
<td>2 (24)</td>
<td>2 (20)</td>
<td>2 (17)</td>
</tr>
<tr>
<td>quality</td>
<td>101</td>
<td>3 (6.6)</td>
<td>3 (6.5)</td>
<td>3 (8.6)</td>
<td>5 (4.9)</td>
</tr>
<tr>
<td>quality management</td>
<td>91</td>
<td>4 (6.0)</td>
<td>5 (4.7)</td>
<td>4 (6.0)</td>
<td>3 (6.7)</td>
</tr>
<tr>
<td>total quality management (TQM)</td>
<td>71</td>
<td>5 (4.7)</td>
<td>5 (4.7)</td>
<td>6 (3.4)</td>
<td>4 (5.8)</td>
</tr>
<tr>
<td>quality assurance</td>
<td>49</td>
<td>6 (3.2)</td>
<td>4 (6.0)</td>
<td>9 (3.0)</td>
<td>19 (1.6)</td>
</tr>
<tr>
<td>quality improvement</td>
<td>47</td>
<td>7 (3.1)</td>
<td>12 (2.6)</td>
<td>8 (3.2)</td>
<td>7 (3.3)</td>
</tr>
<tr>
<td>quality control</td>
<td>39</td>
<td>8 (2.6)</td>
<td>9 (3.1)</td>
<td>5 (3.9)</td>
<td>37 (1.0)</td>
</tr>
<tr>
<td>six sigma</td>
<td>39</td>
<td>8 (2.6)</td>
<td>N/A</td>
<td>14 (2.3)</td>
<td>6 (4.4)</td>
</tr>
<tr>
<td>ISO 9000</td>
<td>37</td>
<td>10 (2.4)</td>
<td>11 (2.9)</td>
<td>6 (3.4)</td>
<td>24 (1.3)</td>
</tr>
<tr>
<td>continuous improvement</td>
<td>36</td>
<td>11 (2.4)</td>
<td>15 (2.1)</td>
<td>12 (2.6)</td>
<td>13 (2.3)</td>
</tr>
<tr>
<td>service quality</td>
<td>35</td>
<td>12 (2.3)</td>
<td>23 (1.3)</td>
<td>16 (1.9)</td>
<td>7 (3.3)</td>
</tr>
<tr>
<td>management</td>
<td>33</td>
<td>13 (2.2)</td>
<td>7 (3.6)</td>
<td>11 (2.8)</td>
<td>69 (0.66)</td>
</tr>
<tr>
<td>innovation</td>
<td>32</td>
<td>14 (2.1)</td>
<td>181 (0.26)</td>
<td>13 (2.4)</td>
<td>9 (3.0)</td>
</tr>
<tr>
<td>performance</td>
<td>32</td>
<td>14 (2.1)</td>
<td>45 (0.78)</td>
<td>9 (3.0)</td>
<td>14 (2.1)</td>
</tr>
<tr>
<td>implementation</td>
<td>29</td>
<td>16 (1.9)</td>
<td>7 (3.6)</td>
<td>18 (1.7)</td>
<td>37 (1.0)</td>
</tr>
<tr>
<td>leadership</td>
<td>25</td>
<td>17 (1.6)</td>
<td>33 (1.0)</td>
<td>18 (1.7)</td>
<td>16 (2.0)</td>
</tr>
<tr>
<td>business excellence</td>
<td>22</td>
<td>18 (1.4)</td>
<td>181 (0.26)</td>
<td>27 (1.1)</td>
<td>12 (2.5)</td>
</tr>
<tr>
<td>customer satisfaction</td>
<td>22</td>
<td>18 (1.4)</td>
<td>75 (0.52)</td>
<td>16 (1.9)</td>
<td>19 (1.6)</td>
</tr>
<tr>
<td>manufacturing</td>
<td>22</td>
<td>18 (1.4)</td>
<td>17 (1.8)</td>
<td>24 (1.3)</td>
<td>24 (1.3)</td>
</tr>
</tbody>
</table>

*TP*: total articles.
Klenke (2018) used the TQM approach to demonstrate how a reorganisation of bioenergy supply chain design based on continuous improvement can enable the achievement of energy transition goals.

Some authors stress the importance of risk analysis for Cost of Quality (CoQ) in the supply chain for strategic TQM. In fact, this aspect has not been sufficiently considered in the literature and Pattanayak et al. (2019) proposed the use of Monte Carlo simulation to analyse the risk involved in the estimation of CoQ elements in the supply chain. Another topic that emerged in the recent literature is the importance of integrating internal quality practices with those of external partners in the supply chain. Teoman and Ulengin (2018) analysed the role of top management leadership in this process providing evidence on how the level of transformational leadership of managers had a significant and positive impact on supply chain quality performance. Organisational culture is also a topic of current interest in research on quality management in the supply chain. Tomic et al. (2017) analysed how dimensions of organisational culture influenced the choice of quality improvement tools and their impacts on the performance of supply chain. The results showed that organisations with a high level of formalisation preferred TQM tools like Kaizen, while companies with a low level of formalisation used more lean manufacturing and internal audits. In any case, quality improvement tools positively influenced business performance in the supply chain.

- Business excellence. Scholarly interest is mainly focused on TQM and business excellence measurement. Metaxas and Koulouriotis (2019) conducted a literature

![Research Trends of the Four Main Topics](image.png)
analysis of business excellence measurement from 1990 to 2016 identifying 139 papers. The most widely investigated business excellence model is that of the European Foundation for Quality Management (EFQM) (Calvo-Mora et al., 2015; Calvo-Mora et al., 2018; Gómez Gómez et al., 2017; Gómez-López et al., 2017; 2016; Pop & Pelau, 2017; van Schoten et al., 2016; Vukomanovic et al., 2014). The work of Paraschi et al. (2019) proposed a specific version of the EFQM model for airports quality management revealing that employee results were the most critical success factor for airport excellence, followed by leadership and operational results.

The EFQM excellence model is often considered as a tool of Total Quality Management but only a few studies empirically demonstrate that organisations implementing EFQM indirectly use TQM. Among them, the work of Gómez Gómez et al. (2017) shows that EFQM and TQM, although not the same, follow a similar path and there is a high probability that a company implementing EFQM is a TQM company.

• **Six Sigma.** Several works study the similarities and differences between Six Sigma and TQM (Hammer, 2002; Harry & Schroeder, 2000; Hayler & Nichols, 2005). The literature shows as both may instil a proactive approach to process improvement through the deployment of specialised tools (Chountalas & Lagodimos, 2019; Kwak & Anbari, 2006). According to Chountalas and Lagodimos (2019), Six Sigma includes the same principles of TQM except for the extensive use of specialised statistical methods; customer focus, teamwork, incremental improvement, and decision-making based on objective data are the main fundamentals Six Sigma shares with TQM.

Several authors argue that Six Sigma is influenced by TQM principles mainly in its focus on identifying customer needs, with the difference that in the Six Sigma paradigm customer satisfaction is achieved by identifying critical quality parameters of each process within which defects can be confined (Harry, 1998; Raisinghani et al., 2005). Furthermore, the Six Sigma paradigm adopts the logic of small-scale change, which is a key to TQM, but attributes a specific beginning and end to the change instead of considering it as a continuous activity, as in TQM (Goh, 2002; Hammer, 2002; Schroeder et al., 2008).

Farrington et al. (2018) analyse TQM and Six Sigma as the continuous improvement methodologies to apply in the service industry. The authors emphasise how their implementation in sectors such as hospitality requires greater customer involvement to be successful. Moreover, they suggest the search for hybrid methodologies that combine the tools and techniques deemed most appropriate for improving the moment of interaction with the customer.

Chountalas and Lagodimos (2019) highlighted a lack of research about the relation of business process management (BPM) and the management paradigms within which it is implemented: Total Quality Management, standardised management systems, business process reengineering and Six Sigma. The authors claimed that Six Sigma is a good method for implementing the BPM lifecycle at individual process level and, in combination with Lean, also at systemic level. TQM principles, on the other hand, are automatically implemented on the entire system of processes throughout the organisation when BPM is applied.

• **Higher education.** Interest in TQM in the field of higher education was high in the first half of the 1990s and, after a decline, recovered since 2008. This was probably due to the growth of the number of higher education institutions in the last decade,
which also led to an increase in competition between public and private organisations. This phenomenon focused attention on quality in higher education and the centrality of customers (students) and their needs. One of the most relevant issues was the assessment of students’ perceptions of service quality. The HEdPERF (Higher Education PERFormance-only) proposed by Firdaus (2005) and the SERVPERF (Cronin & Taylor, 1992) are the most widely used scales (Abdullah, 2006; Randheer, 2015; Silva et al., 2017; Yavuz & Gulmez, 2016). The most frequent dimensions were R&D, innovation, human resources and knowledge management. However, in contrast to the previous literature, Chen et al. (2017) identify leadership, process management and information about the quality of operations as dimensions to be considered. Duzevic et al. (2018) called for more studies to further develop the framework introduced by Duque (2014) aimed at analysing higher education performance through the integration of service marketing approaches with the theories of student involvement and retention. More specifically, the framework examined relationships between students’ perceptions and their satisfaction, outcomes, and behavioural intentions. Hrnciar and Madzik (2017) identify a gap in the literature regarding empirical studies on the purposes and benefits of TQM in higher education that they attempted to fill through a methodology based on elements of the Common Assessment Framework of the European Commission’s system for measuring educational outcomes. Another frequent research topic was the relationship between TQM and organisational learning and innovation. Aminbeidokhti et al. (2016) analysed this relationship in the higher education sector showing that TQM had positive and significant effects on organisational learning but not on organisational innovation. However, organisational learning had a positive influence on organisational innovation and therefore could mediate the effect of TQM on this variable.

**Agenda for further research**

The results of the analysis suggest some interesting research areas for further studies on TQM.

With reference to supply chain management, the literature shows how a reorganisation of the supply chain according to TQM principles facilitates the achievement of environmental sustainability objectives (McGover & Klenke, 2018). These results suggest further studies on the implementation of TQM for the achievement of energy transition goals included in various international and European programmes (such as the United Nations Framework Convention on Climate Change, European Green Deal), with the aim of providing evidence and implications that could support organisations in accessing the relevant funds that will be allocated in the coming years. Other studies show a direct effect produced by the combination of TQM and SCM on operational performance of pharmaceutical companies (Sharma & Mogdil, 2019). It would be interesting to explore these results more in the current context of the Covid-19 pandemic where the operational performance of pharmaceutical companies has become critical to ensure the rapid supply of vaccines, medicines, and devices to all countries around the world.

Another topic that needs more investigation is that of business excellence models. Particularly, in this area more empirical studies are required. For example, the EFQM excellence model is often considered as a tool of Total Quality Management but only a few studies empirically demonstrate that organisations implementing EFQM indirectly use TQM. Scholars also claim for more empirical evidence about the correlations between the nine elements of the EFQM model and business performance (Pop & Pelau, 2017). Moreover, the work of Paraschi et al. (2019), which applies the EFQM model for airports
quality management, reveals that this model is interesting to apply for further studies on the tourism and air transport industries, which are experiencing great difficulties because of the coronavirus pandemic.

More empirical studies exploring the dimensions of TQM in higher education are needed to fulfil the gap in the literature regarding the purposes and benefits of TQM in this sector. Several authors highlighted the need for studying the implementation of quality management systems, ISO 9001 (Bakator & Cockalo, 2018; Gamboa & Melão, 2012), and 5-S kaizen principles (Nurcahyo et al., 2019) at higher education institutions. In the light of the reorganisation of education during the Covid-19 pandemic, it would also be interesting to investigate quality management systems for distance learning.

The analysis shows the increasing interest for TQM in the services industries. However, TQM is generally adopted directly from the manufacturing industries without adaptation. Further studies should be conducted on how TQM should be adapted to fit the characteristics of service companies with particular focus on the engagement of customers and the management of the interactions with them. In this line, the integration of the TQM theory with most recent service paradigms like Service-Dominant logic (Vargo & Lusch, 2004, 2008) would be appreciated (Farrington et al., 2018).

Finally, the literature shows such confusion about the relations and differences between TQM and other management paradigms like business process management, standardised management systems, business process reengineering and Six Sigma; hence further efforts in this line are required.

Another research area in which studies on quality management are still scarce is the hospitality industry. Increasing knowledge on quality improvement in hotels is particularly important in this period of severe crisis for the sector.

Conclusions
The attention devoted by the scientific literature to TQM over the last three decades, demonstrated by the large number of publications, citations and journals on the subject, justifies a bibliometric analysis to support scholars in identifying the most productive journals and authors, the most relevant publications in terms of citations, the most salient topics, trends, gaps and weaknesses in this field of research.

This paper analyses the scientific production on TQM from 1990 to 2019 containing 2,633 articles extracted from SCI-EXPANDED and SSCI, using rigorous and innovative bibliometric analysis methods based on the search for keywords in the ‘front page’, the use of three citation indicators, and the identification of research trends through the analysis of the distribution of words in article titles, abstracts, authors keywords, and KeyWords Plus, over different time periods.

The results show that after a peak of publications in the first four years, the average number of publications has remained stable since 2002, indicating that TQM is a topic that is constantly present in the academic world even though the number of citations has been decreasing over the last few years. The research fields most concerned with TQM are management, industrial engineering and operations research, although the most cited articles are in the business category.

Total Quality Management & Business Excellence is the most productive journal but the journals that have published the most cited articles are International Journal of Production Research and International Journal of Operations & Production Management.
The scientific production on TQM is distributed all over the world and covers 78 countries with USA, the UK, and Spain at the podium. The most productive authors are B.G. Dale, M. Zairi, and K.B. Ooi, while the most cited author is S.M. Shortell.

Our analysis shows a ranking of the most cited articles based on two citation indicators that guarantee immutability and repeatability over time. This analysis is complemented by the ranking of the six most cited articles that still have a high impact in 2019, allowing the identification not only of the most relevant articles for the scientific community but also the most current ones. According to this ranking, topics that still arouse great interest are: the role of TQM for the success of market-driven businesses (Day, 1994); the combined impacts of contextual factors and quality management systems on operational performance (Shah & Ward, 2003); how TQM and continuous improvement can support strategic positioning (Porter, 1996); the main strategies to become more competitive, including TQM, and the reasons for their failure (Kotter, 1995); the relationship between quality management practices and quality performance in terms of competitive advantage (Flynn et al., 1995); and the introduction of a product-development technique aimed at capturing customers’ needs in a hierarchical structure (Griffin & Hauser, 1993).

The analysis also identifies the top 20 authors keywords showing that the most investigated aspects of quality management are quality improvement, assurance and control. The most studied sectors, in addition to manufacturing, are those belonging to the service industries. Regarding quality management practices, six sigma, certifications and continuous improvement are the most studied ones. Inside organisations attention is focused on innovation processes, performance improvement and customer satisfaction increasing. During the last years, business excellence models, such as the EFQM, have captured great attention.

From the analysis of the distribution of words in article titles, abstracts, authors keywords, and KeyWords Plus over different time periods, it emerged that the main trends in research are quality management in the supply chain, business excellence measurement and models, the Six Sigma methodology, and the implementation of TQM in the higher education context.

**Implications and limitations**

It is clear from the data that TQM is very much a current and relevant management intervention. This has implications for researchers, for organisations’ management, and for university courses (content and teaching).

First, researchers, students or professionals approaching TQM can use this work to identify the most productive and cited authors, the journals publishing the most relevant work, the institutes most active in research, and the most important works on the topic. This information, which is difficult to find in the literature of a research field as broad and varied as TQM, helps guide knowledge acquisition on the subject.

For scholars, this paper provides advices on how to contribute to the advancement of research. Research areas in which academics’ interest has grown over the years are related to the integration of TQM and SCM practices, the links between the application of business excellence models and TQM methods, the similarities and differences between TQM and other quality improvement paradigms, and the adaptation of TQM to the service industries with particular reference to the higher education institutions. Each of this research areas presents gaps that need to be fulfil. In general, there is a strong demand for more empirical investigations and studies that are contextualised to
specific sectors or types of businesses. In addition, the analysis shows that some results achieved by previous research should be further explored in the current context of the Covid-19 pandemic to make a difference to organisations and society. For example, based on the evidence shown, the implementation of TQM should be further investigated in the following areas:

- Healthcare – with an emphasis on mass production of high quality vaccines and other medicines by pharmaceutical companies and Personal Protective Equipment (PPE) by manufacturing companies. During the coronavirus pandemic there were a number of instances of deliveries of PPE that had to be scrapped or returned because they were not fit for purpose and failed to meet safety standards, for example face masks (Good Law Project, 2020) and Gowns (BBC News, 2020) or batches of vaccines that were delayed because they were awaiting quality checks vaccines retested for stability (Morgan, 2021).
- Supply chain – with a focus on getting the right quality of product to the right place at the right time and at the right price. The speed of flow down the supply chain has never been more important. It is a case of only right first time is good enough.
- Sustainability - deepening how the implementation of TQM to business processes can allow a post-pandemic economic recovery in line with the objectives of environmental and social sustainability set by various governments at global level.
- Tourism/hospitality - analyzing how TQM can help companies in this sector recover losses in this time of severe crisis by identifying and meeting consumer needs that have changed profoundly in the last two years.
- Service - Providing more studies on how to adapt the application of TQM to service businesses. Indeed, the pandemic has highlighted the importance of the delivery and quality of several services that have proven to be critical in times of crisis.
- Higher education - the sector of higher education experienced profound changes during the pandemic. New teaching and learning methods were introduced, but their level of quality is still not satisfactory. More efforts are needed to understand how to improve quality in this field.

TQM is a relevant and ever evolving branch of management science and its theory and practice needs to become a core part of business and management degree programmes at both undergraduate and post graduate levels. As this paper has demonstrated, it is a very broad field of study and covers such areas as Quality Management and Improvement, Supply Chain Management, Operations Management, Human Resources Management, Information Systems Management, Lean Production, Six Sigma, Quality Systems and Excellence. It should be an integral part of degree programmes in sector specific management degrees such as Healthcare, Education, Construction, IT, Logistics, Supply Chain Management and many more.

The main limitation of this work is that it uses only the SCI-EXPANDED and SSCI databases as they provide the most complete citation data and allow to classify the journals on the bases of the impact factor provided by the Journal Citation Reports. However, there are some important journals in the field of quality management that are not indexed in SCI-EXPANDED and SSCI, thus leading to an important omission of data in the analysis. For example, The TQM Journal, named TQM Magazine before 2008, is only indexed in Scopus, which shows 782 articles published by this journal from 1990 to 2019 with the keywords ‘Total Quality Management’ or ‘TQM’ in article title, abstract and keywords.
TQM Journal has been just selected for inclusion in the Web of Science and articles published since January 2019 will be included in the Emerging Sources Citation Index. Moreover, as higher education emerged from our analysis as an important topic in TQM research, it has to be pointed out that Quality Assurance in Education, an important journal for quality studies in education, is not indexed in SCI-EXPANDED and SSCI but only in Scopus.

Since the Journal of Citation Reports takes several months in publishing the data on the outputs of journals for a specific year, it is possible to carry out an analysis considering the journals’ performance and their Impact Factor in the second half of the year following that under review. For this reason, as a suggestion for future research, it would be important to update the analysis at the end of each year to have a systematic and always up-to-date overview on TQM research.

**Disclosure statement**

No potential conflict of interest was reported by the author(s).

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