Models, Guidelines and Trends for Process Quality Management: A Literature Review

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Abstract. Although process quality management is a mainstay for achieving success in business, it does not have a unique concept that helps its definition and application. This is due to a large amount of information that can be found in the existing bibliography, resulted from the countless diversity of opinions and theories that have emerged over time. Consequently, the difficulty to find a solid and valid pronouncement that serves as a basis to build a model of process quality management was one of the reasons to perform this work, intending to define which components or guidelines to be considered for management. With this goal in mind, a systematic literature review has been performed to cover most of the theories and models currently existing around the concept of quality management. This research covers a period of ten years, between 2009 and 2018, focusing on the industrial sector. Among the main results, it has been possible to establish the identification of the most used models of quality management, the most important guidelines, and the main benefits or challenges for the integration of a process quality approach within strategic management.

Keywords: Process quality management · Guidelines · Literature review · TQM · Strategic management

1 Introduction

Currently, competition between companies no longer occurs in a specific region. Today, it develops in a global environment, due to the so-called “economic globalization,” which is attributed to the global integration of markets, capital movements, migration and advances in Information and Communication Technologies (ICT) [1]. In this context, obtaining advantages to increase the capacities to confront competition is a must for enterprises. Some strategies for achieving this goal are the reduction of costs, the improvement of products and services delivery, and the management of process quality.
Quality management pursues customer satisfaction, improvements on public perception, and increasing incomes and profitability [2]. As a result, the concept of process quality has experienced some changes over time. At first, during the 1920–1930 decade, it was concerned to a simple inspection of production processes. Later, the quality concept has evolved to become a complex system that encompasses the entire organization and entails monitoring its internal activities, ensuring an adequate performance according to quality parameters. Nowadays, quality refers to a complete efficiency management system to maximize customer satisfaction by making continuous improvements to both processes and products [3].

There is a large amount of literature regarding process quality management, which can be divided into two large groups: (1) referring to quality management models [4, 5] and (2) referring to excellence models [6]. Their main difference is that excellence models are aimed to award quality management initiatives and innovations at a national or regional level [2]. Concerning to quality management models, there are works such as the conducted by Sampaio, Saraiva, and Guimaraes, and Fonseca, where quality management is studied, focusing on the main existing models and standards [7, 8]. These works employ the ISO 9001\(^1\) as the default model for quality management and also consider common features from other models or guides. About excellence models, the studies of Bohoriz, Chuan and Soon, and Sampaio, Saraiva, and Monteiro perform a comparison between excellence models with the purpose of showing a trend in the application quality criteria [9–11].

As mentioned above, the purpose of this work is to analyze process quality management within organizations from a global perspective with a focus on industrial applications. To this end, a systematic literature review regarding the topic of process quality management was performed. Thereby, the most commonly used models or standards were identified, such as ISO 9001, Six Sigma, Lean and the excellence awards (Deming Management Model, Malcolm Baldrige, and European Foundation Quality Management, EFQM model), in order to determine the level of application [2, 4, 5, 9]. This article is organized as follows. Section 2 describes the literature review methodology applied during the development of this work. Section 3 shows the results and discuss the main implications. Finally, Sect. 4 presents the conclusions with some recommendations.

## 2 Research Methodology

To develop this work, the literature review methodology proposed by Arlene Fink was used which allows identifying, evaluating, and synthesizing the information generated by different investigations [12]. The methodology applied consists of seven steps: (1) selection of research questions, (2) selection of bibliographic databases, web sites, and other sources, (3) choice of search terms, (4) application of practical screening criteria, (5) application of methodological screening criteria, (6) development of the review and (7) summary of the results.

The first step in the selection of the research questions corresponds to the determination of the research subjects to be addressed. In this case, the established research

\(^1\) https://www.iso.org/iso-9001-quality-management.html.
questions were: (a) What are the most used quality management models? (b) What are the perceived benefits and challenges from applying a quality management model? (c) What are the main guidelines on process quality management?

For the second step, the selection of bibliographic databases, digital multidisciplinary, and specialized repositories was considered, as shown in Table 1. The third step, corresponds to choosing search terms. Therefore, a basic set of keywords was defined, which includes “management” and “quality.” However, it wasn’t possible to use the same set in all search engines because some databases are more extensive and multidisciplinary; hence, more keywords were needed to reduce the results retrieved. While other more disciplinary databases required less words due to the existence of few or no results. Table 1 also shows the search terms used. Additionally, it is necessary to indicate that in the case of the Scielo\(^2\) database, the filters corresponding to the thematic areas were used for the search, which are: multidisciplinary engineering, management, industrial

| Table 1. Keywords and results obtained during the search on bibliographic databases. |
|---------------------------------|-------------------------------|---------------------------------|-------------------|--------|
| **Multidisciplinary/Specialized databases** | **Spanish query** | **English query** | **Number of results in Spanish** | **Number of results in English** |
| Scopus | “gestión”, “calidad”, “certificación” | “quality management”, “certification”, “modelling”, “excellence” | 41 | 29 |
| Scielo | “gestión”, “calidad” | “quality”, “management” | 166 | 213 |
| Dialnet | “modelo”, “gestión”, “calidad”, “certificación” | “Total quality management”, “model” | 68 | 30 |
| ScienceDirect | “gestión de calidad”, “estándar” | “TQM”, “excellence”, “standard”, “certification” | 69 | 153 |
| MDPI | – | “quality”, “management” | – | 100 |
| **Total** | – | – | 620 | 726 |

\(^2\) [https://www.scielo.org/](https://www.scielo.org/)
engineering. For the filter in the MDPI\textsuperscript{3} search engine, subjects such as business and economics, and engineering were employed; and, in the Dialnet\textsuperscript{4} database, there was no filter about the year of publication; thus, the results were ordered from the most recent to the oldest. As a result, a total of 1346 articles were found in the investigation.

The application of practical and methodological filters was performed in Steps 4 and 5. The former allows reducing the literature from a metadata perspective, while the latter serves to reduce the bibliography in terms of content. In order to apply the practical filter, four criteria were considered: date of publication, language, type of the resource, and sample. Regarding the date of publication, only the bibliographic sources published between the years 2009 and 2018 were considered, which ensured that the information is updated and those are the last trends used [12]. For the second criterion, the use of the Spanish language was a need, since it corresponds to the context where the authors would apply this investigation in subsequent studies, and the bibliographic material published in this language can provide guidelines that are closer to the local context. Also, the English language was considered, because it is a universal scientific language and it is essential for all types of research. The third criterion refers to the type of bibliographic resources to be considered for the review; it was determined that only papers published in scientific journals would be analyzed. The last criterion is the sample of the investigation, by means of which the number of relevant articles can be reduced to the next filter.

For the application of the methodological filter, a quick reading of the selected articles was made to determine which were specifically about quality management issues; for this purpose, a findings matrix was used. It was generated as a spreadsheet document and had the objective of constituting an initial database of the scientific articles found in the research. The findings matrix was composed of several fields, such as the title, authors and year of publication, and helped determine a reduced sample for the research. After applying both methodological and practical filters, of the total of 1346 articles obtained in Step 3, it was concluded that the most relevant for the research topic were 73, which were the documents used to carry out the research. A complete list of references can be found in Appendix A. Other documents were found during the review of the literature but were discarded because they did not address any quality management model or the field of application was not industrial. As a result, 50 articles in English (68.49\%) and 23 in Spanish were read, from which only 54 (73.97\%) mentioned an application of quality on a specific economic sector. For the analysis of the information, an academic licensed version of the Atlas.ti\textsuperscript{5} software was applied for classifying the information efficiently and for facilitating the analysis. In addition, the Zotero\textsuperscript{6} software tool was used for managing citations and bibliographic references.

Step 6 corresponds to performing the literature review, and it implied a deep reading of the selected articles in order to extract useful information. The analysis software was also employed during this step since it allows the use of labels or marks to organize and classify the information [12]. The last step focuses on the synthesis of the results from a

\textsuperscript{3} https://www.mdpi.com/
\textsuperscript{4} https://dialnet.unirioja.es/
\textsuperscript{5} https://atlasti.com
\textsuperscript{6} https://www.zotero.org/
metadata and content perspective and which must be described and interpreted through the experience of the researcher, as mentioned by Fink [12]. This step was performed using a code-document matrix generated in the Analysis software, which served as the basis for the content analysis whose results are presented later in this document.

3 Results and Discussion

3.1 Metadata Analysis

This section describes the results obtained from the literature bibliographic review. To perform the analysis, the creation of a labeling code structure was required. These labels marked and classified the relevant data from each article according to the groups: demographic data (year, author, country, journal, and title), guidelines, models for quality management, economic sector evaluated (primary, secondary and tertiary) [13–16], and an additional category called other data. The extra category was employed to register other aspects such as benefits and challenges for quality management, as well as, the methodological design applied and other management models or guidelines that are mentioned in the articles.

The demographic data and the filters for the year of publication allowed reviewing the publication trends on quality management research during the period from 2009 to 2018. Findings indicate that the most significant number was published in 2014 (12), as shown in Fig. 1. During 2017, there were nine publications, and, in 2018 and 2015, six articles were published. The years in which fewer researches were developed were 2016 and 2012 (3), while in 2010 only one article was found. The articles were classified according to the sector to which the analyzed company belongs. Thus, the primary sector or farmer sector was mentioned in only four documents. The secondary sector or industrial was the most representative since it was evaluated in more than half of the articles (28 or 51.85%). The tertiary or service sector appears on 22 investigations. The information was also grouped by years of publication, obtaining a higher frequency of mentions in studies from 2014 to present. This is evidence of the growing interest that quality management has created.

To evaluate the application trends by country, a preliminary classification regarding the methodological design applied to the selected articles was performed considering a qualitative and a quantitative content. The qualitative approach refers to works where a literature review or analysis of concepts is presented. The quantitative approach refers to the application of mathematical or statistical analysis within case studies, to evaluate the application of quality management. As a result of the classification, 58% (42 articles) were categorized as qualitative works, and the remaining 42% (31 articles) were quantitative research. Only the quantitative researches were used to evaluate the trends on implementation according to the place where they were conducted (Table 2). As a result of this analysis, it was obtained that the Lean, Six Sigma, and ISO 9001 standard are the most applied models for quality management in South Africa and Asia. In Europe, the EFQM is the most widely used, followed by the ISO 9001 standard and the Lean, Six Sigma, and Baldrige models. Finally, in the American continent, the most used is the ISO 9001 standard, followed by the EFQM model and finally the Malcolm Baldrige and Six Sigma models. Six articles do not identify the model.
Fig. 1. Economic sector mentioned in the investigations.

Table 2. Quantitative researches applied by countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Lean</th>
<th>Six Sigma</th>
<th>ISO 9001</th>
<th>Malcolm Baldrige</th>
<th>Deming</th>
<th>EFQM</th>
<th>Unspecified</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saudi Arabia</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brazil</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>China</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Colombia</td>
<td>2</td>
<td>2</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spain</td>
<td>1</td>
<td>3</td>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Greece</td>
<td></td>
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<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>India</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Iran</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Malaysia</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>South Africa</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Thailand</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>5</td>
<td>6</td>
<td>12</td>
<td>2</td>
<td>1</td>
<td>6</td>
<td>12</td>
</tr>
</tbody>
</table>
3.2 Content Analysis

For the content analysis perspective, the research questions established in Sect. 2 are answered. 1. **What are the most used quality management models?** Through this literature review, six basic models were identified, but also other four models were found as can be seen in Fig. 2. Among them, the ISO 9001 model has been the most mentioned in the selected literature. ISO 9001 is a standard, which can be applied worldwide and adapted to any company to focus on quality management [8, 17–19]. The fulfillment of the ISO 9001 standard leads to the attainment of certifications; therefore, more companies are deciding to apply it to obtain greater recognition within the market. Another quality model identified is the Six Sigma model [20–22], and it was the second quality management tool with most mentions. In the third and fourth place are the Lean [4, 5, 20] and EFQM [9, 11, 19, 23] management models. Finally, the two less mentioned models are Malcolm Baldrige [24, 25] and Deming’s management model [9, 11, 20]; these results may be because they are the least known and their application is uncommon.

![Table showing frequency of mention of quality management models.](image)

**Fig. 2.** Frequency of mention of quality management models.

In addition, the other four models that were found on the development of the review had a minimal frequency of application. But, it is considered necessary to present them because it is part of the investigation. On the contrary, they constitute evidence of a large number of options that exist when managing the quality of processes. Figure 2 presents the frequency of application for the quality models identified. In general terms, the most widely used model is the ISO 9001, mainly because it is the best known worldwide, moreover, since it is a standard, allows any company to implement it regardless of the type or sector to which it belongs. Furthermore, it is important to mention that by complying with the requirements proposed by ISO 9001, the company obtains an international certification. This improves internal processes and the image perceived by the stakeholders, because it ensures that the products or services offered are of quality and, in this way, an increase in sales, greater participation in the market and consequently an improvement of the financial results. The preference to use the ISO 9001 model can be verified in Table 2, which shows the application models according to their geographical location.
2. What are the perceived benefits and challenges from applying a quality management model? This review also identified the benefits and challenges for the implementation of quality management systems. Benefits were mentioned in 15 of the 73 articles reviewed. From the total benefits identified, a depuration was performed in order to eliminate duplications and similar benefits, obtaining a total of 19 benefits. Table 3 presents the main benefits mentioned. The remaining eight were not included, because their minimum number of mentions was 4 or less. These are the most perceived benefits when implementing a management model as they provide visible changes in the processes and the work environment. Likewise, the challenges were identified during the review, obtaining a total of 10. These are the main obstacles that companies have to face when they implement management. This fact occurs presumably due to the high costs that must be incurred to implement the system (machinery, infrastructure adjustments, equipment maintenance, hiring experts in quality issues, staff training, implementation of new processes, etc.). Table 3 shows a list of the benefits and challenges identified and their number of mentions in the literature reviewed.

Table 3. Summary of benefits and challenges of quality management mentioned in the articles.

<table>
<thead>
<tr>
<th>No. of mentions</th>
<th>Benefits</th>
<th>No. of mentions</th>
<th>Challenges</th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Improve productivity, competitiveness, and efficiency</td>
<td>20</td>
<td>Lack of knowledge, understanding, and trained personnel</td>
</tr>
<tr>
<td>11</td>
<td>Improvement in sales, profitability, and financial returns</td>
<td>12</td>
<td>Lack of leadership, support from senior management, commitment to implementation, and maintenance</td>
</tr>
<tr>
<td>10</td>
<td>Quality increase in products and services</td>
<td>10</td>
<td>Lack of participation and the total commitment of employees</td>
</tr>
<tr>
<td>10</td>
<td>Greater satisfaction of customers and employees</td>
<td>10</td>
<td>The complexity of the adoption process and difficulties in gathering information. Bureaucracy during implementation</td>
</tr>
<tr>
<td>8</td>
<td>Costs reduction</td>
<td>10</td>
<td>Resistance to culture change</td>
</tr>
<tr>
<td>7</td>
<td>Greater participation and expansion of market share</td>
<td>9</td>
<td>Inadequate selection of tools, approaches, and methodologies</td>
</tr>
<tr>
<td>7</td>
<td>Increase in employee motivation</td>
<td>9</td>
<td>Lack of time, planning, and coordination in the implementation of the quality management system</td>
</tr>
<tr>
<td>6</td>
<td>Reduction of errors, defects, and waste</td>
<td>7</td>
<td>High cost of implementation</td>
</tr>
<tr>
<td>6</td>
<td>Better company image</td>
<td>7</td>
<td>Limited human, material, technological, financial, and infrastructure resources</td>
</tr>
<tr>
<td>6</td>
<td>Reduction of times</td>
<td>6</td>
<td>Lack of links between the quality model and strategic planning of the organization</td>
</tr>
<tr>
<td>6</td>
<td>Improve the organization and internal planning of the company</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3. What are the main guidelines on process quality management? The main question to be answered in this study was regarding the guidelines that a management model should consider in order to establish a quality approach. Eight guidelines are considered because of the frequency of mention in the articles analyzed and, from highest to lowest: engagement of people, leadership, customer focus, process approach, relationship management, orientation to results, improvement and evidence-based decision making.

Engagement of People. The company must create the necessary conditions for its employees to commit to organizational objectives, providing them with knowledge, tools, technology, and adequate training, recognizing their capacities through their participation in decision-making, maximizing organizational performance [3, 26–32].

Leadership. Commitment of senior management in the implementation of mission, vision, policies and strategic planning in order to foster an environment of communication among all employees of the company, which contributes to the improvement of work performance [3, 26–35].

Customer Focus. Establishment of an open communication relationship between the company and its current and potential customers so products can be designed according to their needs, creating sustained value for the customer and greater competitiveness in the market [3, 26, 29, 30, 32, 36].

Process Approach. Design and systematically management of the internal processes will allow the company to achieve organizational objectives, determining those that are critical in order to minimize losses and maximize efficiency [3, 26–30, 32, 35, 36].

Relationship Management. Planning and management of external alliances, fostering an environment of communication and respect with suppliers, society, and the environment. In addition to that, monitor the physical, economic, and technological resources that the company has [3, 27, 29, 31, 32, 35, 36].

Orientation to Results. Focus on the fulfillment of proposed organizational objectives and evaluation of financial indicators, improvement of processes, products, services, and customer satisfaction [27, 30, 33, 36].

Improvement. Implementation of performance evaluation measures in order to determine the deficient activities and implement improvement plans, fostering an environment of problem-solving, learning, and communication [26, 29, 31, 32].

Evidence-Based Decision Making. Documentary management of relevant information that allows the measurement of processes, data analysis and control of activities, which will facilitate an evaluation of the organization for the subsequent decision making [3, 29, 32, 34].

Through the analysis of the results presented in this research, the guidelines to be considered have a more detailed level that can be defined as the components that allow them to be managed. When establishing quality management, these should be considered for their application, achieving the implementation of the guidelines mentioned above.
To facilitate its presentation, the components found in the literature review were grouped and summarized because they have differences between the articles; although they are minimal, the results can be noticed in Appendix B. It is necessary to indicate that, for its application or to develop future investigations, it is recommended to complement them with the components from the existing models and standards for quality management.

4 Conclusions

In the present article, a literature review has been carried out to analyze the topic of process quality management. This work is based on the methodology proposed by Fink, which commences with the search of information in bibliographic databases, applying the filters and the keywords that were considered necessary. A sample of 73 scientific articles was determined, and the corresponding analysis was performed with the support of an analysis software tool. It is important to indicate that this research focuses on the industrial sector, and it has not a geographical focus.

The main results of this investigation are those related to the questions defined initially. After the execution of the analysis, it was possible to identify that the ISO 9001 standard is the main reference for quality management. The management models derived from ISO 9001 are those that have the highest frequency of implementation within the scientific articles analyzed, demonstrating the applicability and recognition that this model has. Regarding the second research question: What benefits and challenges would companies obtain when applying a quality-based management model? The benefit most mentioned in the articles is the improvement in productivity, competitiveness, and efficiency.

On the other hand, the challenge that stands out is the lack of knowledge, understanding, and trained personnel. The last research question to be answered was: What are the guidelines on the management of quality processes that are currently used? In this case, eight guidelines were identified. The guidelines are in line with the most mentioned quality model (ISO 9001): (a) Engagement of people, (b) Leadership, (c) Customer focus, (d) Process approach, (e) Relationship management, (f) Orientation to results, (g) Improvement, (h) Evidence-based decision making.

This systematic literature review was aimed to analyze the process of quality management from a global perspective, i.e., it is not oriented towards a specific type of industry or management model. This was achieved by answering the main research questions determined, which allowed to obtain data such as the frequency of application of the base models, the region and country per model, years of publication, and the application of the guidelines on the different works. The collected information allows understanding of the topic of process quality management and is a basis for managing and implementing the quality approach. Thus, this research is intended to serve as a conceptual framework for the construction of a process management model based on quality variables.

Once the research is finished, it is necessary to generate recommendations that emerged during its development. The main one is about the results of the investigation. The determination of the guidelines for a management model based on quality aspects was one of the first questions, and, for this reason, it was necessary to get details
at a component level through the information found in the literature review. However, it is highly necessary to indicate that, for its application or in future research, these components should be complemented with elements from other models and standards for quality management.

For future work, this article is expected to serve as a theoretical basis for the conception of a management model based on quality process variables, which will be validated in a local context. Therefore, as the following work, it will be necessary to validate the results of this investigation on a local context, specifically in the industrial sector. The future work will commence by complementing the components of the guidelines found with elements from other standards and models for quality management may indicate.

5 Limitations

Since this research is of a completely theoretical nature, that is, state of the art, few limitations could be observed during its development. The most outstanding are related to the search for information and access. As mentioned earlier, quality management is constantly evolving, leading to a large number of theories, philosophies and models. This causes that there is not a single valid pronouncement. In other words, the main limitations are two, the lack of consensus in terms of quality management and, the access to the information, since it is not always open-ended.

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Appendix A: Full List of References Read in the Literature Review

The summary of the components of the guidelines can be found online at https://docs.google.com/document/d/107xJG45v5gC2pKVHQDS70zPe6zBCmzpqJmwl5sBbxQ/edit?usp=sharing.

Appendix B: Guidelines Components Found in the Literature Review

The full list of references used in the literature review can be found online at https://docs.google.com/document/d/1WJyKQRRWTq89ZstFBviNhp6MpiJdKZ0EymC50rK3P/edit.
References


