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Review

Sustainable Development and Implementation of Quality Management Excellence Models in Public Organizations: A Systematic Literature Review

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Abstract: Purpose: The purpose of this study was to determine the effects of the European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma approaches in public organizations. Design/methodology/approach: A systematic literature review was conducted based on articles from three academic publishers (Emerald, Elsevier/Science Direct and Taylor & Francis). The 88 selected journal articles were published between 2004 and 2022 and documented the results of the quality tools. Findings: The effects of applying the models in the public sector are presented. From the literature review, specific findings were identified regarding the motivations of all areas of education and services and the challenges they face in applying the qualitative tool methodologies. The main topics discussed are the human factors involved in implementing quality tools. Research limitations/implications: An important limitation is that data were drawn from only three major journals and the authors did not always have access to all databases and peer-reviewed journals or to any review articles in languages other than English. Multiple keywords limited the article search, as qualitative tools have been widely used in the private sector but less so in the public sector. Practical implications: The results and limitations detailed in the study and presentation of the 88 articles will motivate academic researchers to further study the application of qualitative tools in the public sector and fill the knowledge gap caused by the limited publications on this topic. Originality/value: The European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma approaches have not been widely implemented in the public sector, and literature reviews are limited despite the increasing trend of their use in the sector in recent years. More future research in public administration is needed to determine the effects and limitations of implementing qualitative tools.

Keywords: European Foundation for Quality Management; Six Sigma; Lean Six Sigma; systematic literature review; public organizations and businesses; practical implications

Citation: Taraza, E.; Anastasiadou, S.; Masouras, A.; Papademetriou, C. Sustainable Development and Implementation of Quality Management Excellence Models in Public Organizations: A Systematic Literature Review. *Sustainability* **2023**, *15*, 7971. https://doi.org/10.3390/su15107971

Academic Editors: Udo Kannengiesser and Alois Zoitl

Received: 14 March 2023
Revised: 10 May 2023
Accepted: 11 May 2023
Published: 13 May 2023

1. Introduction

The ever-increasing rate of economic and social changes taking place on the national and global levels due to deep economic crises and the COVID-19 pandemic—characteristic features of the era—has prompted the goal of increasing the efficiency and proper functioning of organizations. The public sector in every country has been called upon to cope with limitations and restrictions [1,2]. As reported in the Quality Management Journal, total quality management and organizational and business excellence [3–6] are among the most researched topics [7] and play an important role in adapting to new data. Public organizations do not have the ability to spend money, especially when it is limited [8]. For this reason, various methodologies have been developed and established, such as Failure Mode and Effects Analysis, Six Sigma and Lean Six Sigma, to help to reduce and eliminate potential problems and failures to make it possible to deal with consumer expectations and limitations, while at the same time maintaining their competitive position in the domestic

and international markets [8–10]. This contributes to their evaluation and leads to better results [11]. Quality has been a relevant topic in management research [7] for a long time and some authors [12,13] claim it has been used for a century.

In the international literature, there has been an increasing use of advanced statistical methodologies to evaluate high quality statistical measures and evaluate the total quality management of organizations [14]. The conclusion in the literature is that total quality management and management have changed conceptually from their original focus and are now related to customer satisfaction and fulfillment of customer requirements [15–17]. The international literature contains numerous academic articles regarding the implementation of quality systems by public organizations [18–21]. The European Foundation for Quality Management Excellence Model and the Six Sigma methodology are modern statistical tools used in many studies to draw conclusions and must be harmonized with the specific environment of the organization [22]. The concept of excellence has evolved from a theoretical and conceptual base [23,24], supported by models that can assist organizations in a structured and integrated approach to developing excellence.

The European Foundation for Quality Management Excellence Model is based on the principles of Total Quality Management and is a self-assessment tool for organizations. The European Foundation for Quality Management Excellence Model has been used since 1991 and it is considered the most successful quality model for European organizations [25]. Conducted research has proven that the application of the Excellence Model has a positive effect on the efficiency and effectiveness of businesses [26,27] and subsequently on customer satisfaction [28–31]. In recent years, the European Foundation for Quality Management Excellence Model has been increasingly used by organizations to measure and evaluate their activities, while a number of universities in Europe have used the statistical tool as a basic measure for evaluating research activities [32–35]. Similar to the application of the European Foundation for Quality Management Excellence Model, the Six Sigma methodologies focuses primarily on improving the organizational processes. The aim of the model is to reduce defects, particularly the instability of products or services, in order to increase customer satisfaction [36]. The methodology can be used at every stage of the production and management process [37,38]. In addition, it aims to improve the performance and economic development of the organization, reduce costs and improve quality [39,40].

Despite the widespread use of the European Foundation for Quality Management Excellence Model and the Six Sigma quality management system by businesses and public organizations, few studies have performed a critical literature review [41,42]. The lack of a literature review regarding the implementation of European Foundation for Quality Management Excellence Model and the Six Sigma quality systems in public organizations motivates further research. Several examples of their application can be found in local governments of the United Kingdom [43] but also in Spanish local governments [44]. The lack of a literature review strongly creates the need for further investigations focusing on examples and highlighting their practical implications. This study sought to review the literature in order to identify and answer the questions:

Why is a bibliographic review of the implementation of quality assurance systems in public organizations necessary?

Should the European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma quality tools be adapted for public organizations?

What are the benefits and shortcomings of the implementation of the European Foundation for Quality Management Excellence Model and the Six Sigma quality systems in public organizations?

This study aimed to systematically review the literature regarding the European Foundation for Quality Management Excellence Model and Six Sigma quality management system in order to identify and record examples and highlight the benefits and limitations of their implementation in the public sectors of different countries. The implementation of a systematic literature review will help to create a database that can be consulted by

agencies and public organizations, which will contribute to decision making as a model for other organizations [45]. The present study contributes with a systematic literature review determining the effects of applying the European Foundation for Quality Management Excellence Model and Six Sigma methodologies in public enterprises and organizations. The results are grouped by country and the common benefits and limitations identified. With this categorization, managers and people in important positions in public sector companies, as well as researchers and academics, will be able to consult many examples of application of the methodologies compared to other studies that focus on specific cases of the application of quality management systems [46]. This constitutes the originality of this particular study and encourages further recording of cases of the application of the European Foundation Quality Management Excellence Model and Six Sigma methodology and their effects. At the same time, it should be emphasized that the findings of the present study were accepted by publications and journals after thorough study, approval and validation and have been checked for accuracy so academics, researchers and managers are able to make important decisions through their study. Furthermore, through the categorization of the impacts from the implementation of quality management systems by public organizations and businesses, academics and researchers can contribute to the development and improvement of the database. The structure of this paper includes a theoretical background related to the literature review followed by a detailed presentation and discussion of the findings of the effects of the implementation of European Foundation for Quality Management and the Six Sigma quality system, as well as suggestions for further literature review studies.

2. Theoretical Background

Quality management and quality improvement are two important quality concepts that every organization strives to implement for its development and the consolidation of its position on a global level [47]. Quality management, total quality management, and organizational and business excellence [4–6] are among the most researched topics [7]. This principle is deemed necessary to be adopted by all businesses, as well as public organizations, as it will contribute to the provision of continuously improving products and services at a lower cost, increasing their efficiency and effectiveness while simultaneously satisfying customers [48]. Quality has been a relevant topic for management research (Carnerud, 2018) for a long time, and some authors [12,13] claim it has been studied for a century. Many studies have shown that academic staffs consider the impact of teaching quality management to be limited or absent [49–52]. It is necessary managers and decision makers are informed about the implications of quality tools through the literature, so that they can take correct decisions to improve the processes of organizations.

The European Foundation for Quality Management Excellence Model and the Six Sigma methodologies were initially implemented by private companies. In particular, Klugt, the president of Philips, appointed Kees and Olivetti to bring together certain initiatives with the aim of providing total quality services, initiating the European Foundation for Quality Management Excellence Model. The success of the Japanese market that was based on quality and initial positive results led to the immediate action of the American market. Europe was lagging behind, and so Kees and Olivetti, after visiting large European companies that were active in the international arena and already had experienced tough competition, prepared a strategic plan called the "European Foundation for Quality Management" so that these companies could improve their efficiency and effectiveness [46]. As a continuation of total quality management, the Six Sigma methodologies are used to measure and evaluate quality. This is due to the organizations' remarkable records of effectiveness [39,40]. The roots of the Six Sigma methodology date back to 1809, when Gauss introduced normal distribution. Finally, in the 1980s, Bill Smith, a Motorola technician, developed the "6s" methodology. Motorola developed the 6s methodology in response to the competitive pressures from Japanese firms in the semiconductor industry [53–55].

From a business perspective, Six Sigma is a powerful strategy that improves the efficiency of business processes and significantly reduces product defects [56,57].

There are many connections between sustainability research and the core values of quality management [58–60]. Both academics and evaluators consider the contribution of a business model to be important in creating, maintaining and improving an organization's competitive advantage [61–66]. According to the literature, the European Foundation for Quality Management Excellence Model and the Six Sigma methodology have been used in the fields of manufacturing [67,68] and healthcare [69,70], showing excellent results. At the same time, the Six Sigma methodologies have been applied in the manufacturing and industrial sectors as well as in services [71]. The methodologies have also been applied with excellent results in public service organizations [47,72], reducing variability and resolving failures and weaknesses [73–75]. The adoption of Six Sigma enhances the ability to deal with ever-increasing innovations and directly affects the financial performance [76], demonstrating remarkable results and advantages compared to other methodologies [77]. The cost and time spent on the bureaucracy required for quality assurance in organizations has increased [78,79].

Total quality management standards are the most reliable measures of describing how a business or organization operates [61,80], as they continuously monitor all processes of design, production and distribution of products and services, ensuring the improvement in efficiency, effectiveness and customer satisfaction and addressing future problems [9,10]. The application of the European Foundation for Quality Management Excellence Model and the Six Sigma quality system in public services, organizations and enterprises has great potential [81–84].

3. Methodology

To evaluate this study and to identify and present the effects of the implementation of the European Foundation for Quality Management Excellence Model and the Lean Six Sigma and Six Sigma quality systems in enterprises and public organizations, an analysis of the existing literature was carried out. This was conducted to document examples of methodologies from a wide range of examples and to provide important information to academics, researchers and managers as well as people in key positions. This review contributes by gathering important publications and also motivates further research. Studies have proven that research through literature reviews brings many advantages [85,86].

A good literature review is not just a list that describes or summarizes many articles, but contributes to the understanding of the topic [18] and helps to guide academics and researchers to conduct thorough studies and come to detailed conclusions [86]. At the same time, the lack of literature reviews on the implementation of the European Foundation for Quality Management Excellence Model and Lean Six Sigma and Six Sigma methodologies in public organizations and companies indicates the strong need for their implementation [45]. This has been exemplified by recent systematic literature review studies on the implementation of these methodologies [2,87–89].

A systematic literature review is a combination of three factors [90], as shown in Figure 1.

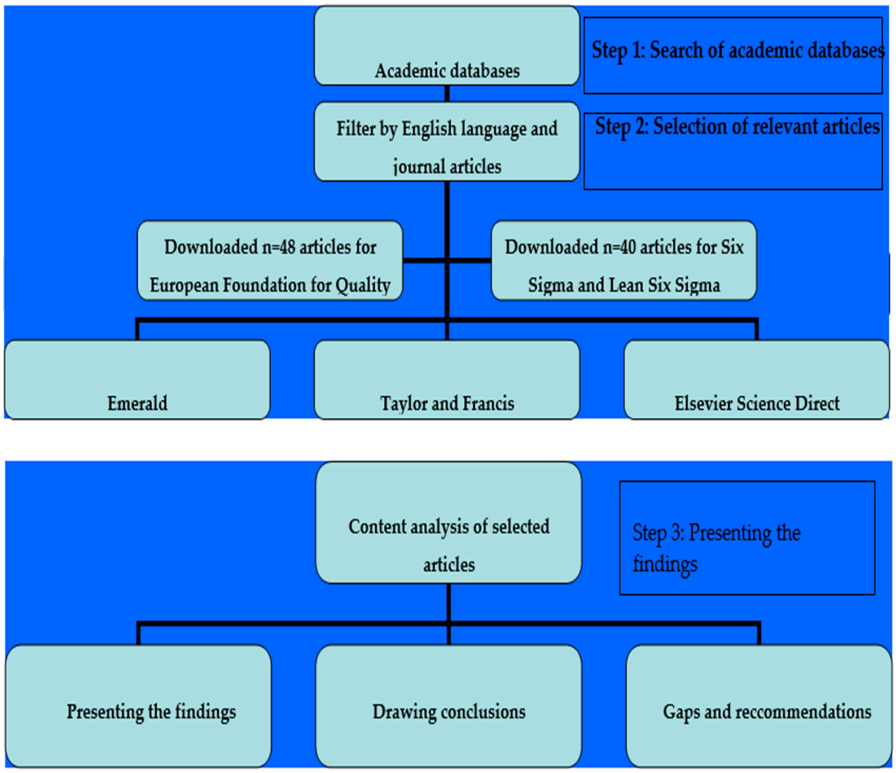

Figure 1. Overall research method map.

3.1. Search in Academic Databases

At this stage, following the selection of the research topic and the study of previous similar work regarding quality management in public organizations, the research question was formulated in accordance with the aims and objectives of the study. At the same time, the search strategy for similar studies and the evaluation method were determined [90]. This systematic literature review focuses on the European Foundation for Quality Management Excellence Model and the contribution of its application to the continuous improvement of public sector services [89], but also on the Six Sigma methodology and on how it contributes to the achievement of the above objective. In recent years, the academic interest in quality management has constantly increased and increasingly more research has been undertaken [91–93].

After identifying previous similar studies regarding the application of the European Foundation for Quality Management Excellence Model and the Six Sigma method in public organizations and services, the research question was formulated in accordance with the objectives of the study [90]. In addition, at this stage, relevant research studies that have been conducted in recent years were found and, based on the selection criteria, appropriate journal articles and publications were identified in terms of reliability and quality. The two quality models, European Foundation for Quality Management Excellence Model and Six Sigma, are the most suitable and most used methodologies by organizations and services to achieve the continuous improvement of services and operations [89,94]. The application of the two quality management systems for the development of organizations leads to many common results regarding the improvement in efficiency, as shown in the following research, increasing academic interest in further studies.

3.2. Selection of Relevant Articles

In order to conduct a search to gather and record the articles related to the present study, a search was conducted through several academic publishers and journals that are considered reliable [10], such as Emerald, Elsevier Science Direct, the *International Journal of Quality and Reliability Management*, the *International Journal of Operations and Production*

Management, *Total Quality Management and Business Excellence* and Taylor & Francis. It is worth emphasizing that in order to ensure the quality of the present systematic literature review, only journal articles published after critical selection were searched. The articles which are presented in the following tables were published from 2004 to 2022.

The public sector did not implement the European Foundation for Quality Management Excellence Model and Six Sigma methodology early on compared to private companies [2,87–89]; however, the literature review highlights the benefits of applying the models, as also highlighted in similar studies [21,72]. Figures 2 and 3 show the percentage of articles published in the respective journals. They include 48 articles that refer to the application of the European Foundation for Quality Management Excellence Model in organizations and have been published by three academic publishers (Emerald, Elsevier and Taylor & Francis). Forty published articles in the respective journals presented the benefits and weaknesses of the application of the Six Sigma and Lean Six Sigma models in organizations.

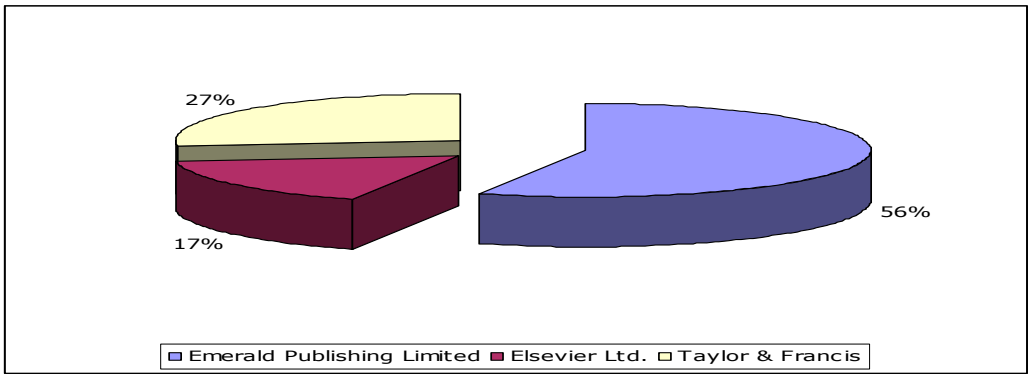

Figure 2. European Foundation Quality Management Excellence Model and its application in organizations.

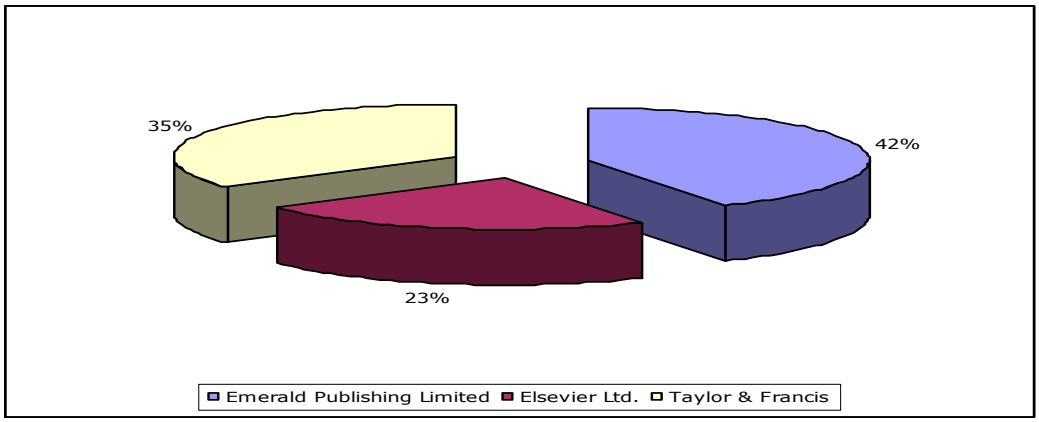

Figure 3. Six Sigma research model and its application in organizations.

This stage of the review process includes the selection of various studies based on their reliability, their evaluation and the extraction of data [90]. The literature search was based on the following terms: European Foundation for Quality Management Excellence Model, Six Sigma and Lean Six Sigma, public organizations and quality management. The investigation brought to the surface a number of studies and after thorough study, those relevant to the subject of this research were identified, taking into account the title, the summary and the conclusions of each research. However, in some of them it was deemed necessary to study the entire article in order to understand it and to include it in the specific study. The reliability of the articles was based, as mentioned above, on the fact that they had already been judged for their suitability by specialized staff in order to be approved

for publication in their respective journals, while their evaluation was also carried out by the members of the writing team.

The systematic bibliographic review is presented in detail, while all the effects of the use of the European Foundation for Quality Management Excellence Model and the Lean Six Sigma and Six Sigma models are recorded. The results are formulated specifically for academics and decision makers in public enterprises and organizations. The literature search for data collection and tabulation was based on the keywords European Foundation for Quality Management, Six Sigma, Lean Six Sigma, organizations and literature review. It is worth noting that because the term organizations is not widely used in the literature, not many publications were found in the specific years or earlier, which motivates further research. However, we focused on the most relevant articles which were reviewed based on the title, keywords and conclusions. In many cases, the entire article was read in order to be properly evaluated and included on the basis of its suitability. The evaluation and final selection of the articles was carried out by the authors; however, their validity and reliability were ensured as the published articles had already been evaluated by expert reviewers.

Of the 88 sample articles reviewed, a plethora of practical applications of the European Foundation for Quality Management Excellence Model and the Lean Six Sigma and Six Sigma models were found and are presented in Tables A1 and A2 in Appendix A in the "Impact on Results/Performance" column. The evaluation of the articles was carried out by each researcher, and after recording their personal conclusions, a meeting was held in order to discuss, compare, evaluate and record the results in the final tables. In the final column, where the conclusions of each survey were recorded, many similarities were observed in the results of the implementation of quality systems by organizations. On reviewing the articles, it was possible to find positive and negative similarities recorded by the organizations when using the quality systems, in addition to their limitations. Similar literature review surveys to record and classify similar findings in the implementation of Six Sigma and Lean Six Sigma quality tools by public organizations have been conducted by researchers in [2].

3.3. Presenting the Findings

At this stage of the bibliographic review, the recorded results are presented [90]. Specifically, in the fourth column of Tables A1 and A2, the findings of each research work are presented, with the aim of analyzing them and communicating them to academic researchers and executives of the organizations. Communicating results to academics, researchers and the executives of the organizations can lead to further research with greater depth and more specialized targeting, for example, of one type of organization. Thus, increasingly more research can be conducted and conclusions can be generalized, possibly for similar organizations, while at the same time identifying gaps and weaknesses.

4. Results

This particular systematic literature review focuses on the implementation of quality systems in public organizations following the research of several authors [6,44,87,89,94]. Despite the fact that public services and organizations in different parts of the world differ in how they operate, a study of published research highlights their significant benefits in various fields, such as education at all levels (primary, secondary, tertiary higher and professional education), the health care sector and municipalities, governments and public services, on which the present systematic literature review also focuses.

It is worth emphasizing that many statisticians argue that the tools used to carry out a systematic literature review are limited and less important compared to quantitative measurements with regards to extensively monitoring all factors that have a beneficial or even inhibitory effect on the orderly operation of organizations, ensuring the provision of services in line with consumer preferences and ensuring internal improvement. These factors are important in order to allow a thorough analysis of the impacts and find solutions to possible problems [95]. The European Foundation for Quality Management Excellence

Model and the Six Sigma approach have been applied with great success in the field of education at an organizational level [96,97]. In higher education in particular, the interest in the application of the above tools to facilitate their functions has increasingly intensified. Despite the fact that much research has been carried out in the field of education, interest from academia necessitates more studies. In the present systematic bibliographic review, an attempt is made to collect, record and present as many publications as possible to further facilitate research and to compare results [96,98–100].

Table A1 (in Appendix A) as it will be described below presents the selective articles related to European Foundation for Quality Management Excellence Model and results in organzations [101–146]. Table A2 (in Appendix A) as it will be described below presents the selective articles related to Six Sigma, Lean Six Sigma and results in organizations [147–186].

With the exception of the article [134] published in 1996, where the application of the European Foundation for Quality Management Excellence Model in the tourism sector demonstrated a serious discrepancy between the quality perceived by the customer and the quality recognized by management regarding staff and customer satisfaction due to high costs, after 2004 there was a growing interest in the implementation of quality systems in public organizations. Figure 4 shows the annual increase in publications on quality system implementation in public organizations from 2004 to present. From 2004 to 2013, there was little interest in the application of the tools in public organizations and businesses, and they were mainly applied in the private sector. After 2014, there was an increasing interest and the publications thus increased. The number of articles exponentially increased from 35 in the period of 2004–2013 to 52 in the period from 2014 to now according to our selection. This shows a 19.5 percent increase in publications.

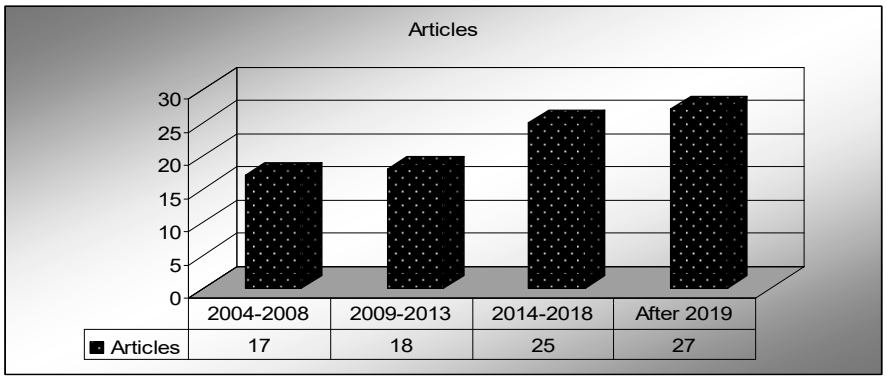

Figure 4. Number of relevant publications from 2004 to 2023.

Table A1 and in Appendix A show the number of selected articles after evaluation. The articles are initially classed based on the journal of publication and then in chronological order. Table A1 (showing the results of the application of the European Foundation for Quality Management Excellence Model) and Table A2 (showing the results of the application of the Six Sigma and Lean Six Sigma models) present all 88 articles that were deemed appropriate published by three academic publishers (Emerald, Elsevier and Taylor & Francis). In Tables A1 and A2, the title of the articles, the year of publication, the authors and the journal of publication are presented in detail, while the final conclusions are recorded in one column in order to compare them and facilitate further research [86].

The selected articles were read repeatedly by well-published and suitably experienced team members, who continuously took notes to document the research. All the above data were recorded in an Excel spreadsheet in order to construct Tables A1 and A2. At regular intervals, the team members met to reach an agreement on the recording of the final data. Many studies showed significant similarities, which indicate the usefulness of quality management tools and their positive effects on the smooth functioning of public enterprises and organizations. According to [90], the gathering of quantitative findings from empirical studies is deemed necessary to enhance the validity and reliability of qualitative research.

The main purpose of a thematic analysis is to create an analytical and systematic record of the findings and themes that emerge from the interviews with or observations of the participants. It is a time-consuming, laborious and complex method of analysis, which requires the researchers to have special experience and knowledge to reduce the error and draw valid conclusions [101].

Eighty-eight sample articles (Figure 5) evaluated and presented in this research refer to the application of the European Foundation for Quality Management Excellence Model. A total of 48 of them, at a rate of 54.5%, were implemented in public organizations and services, governments, primary and secondary education, higher education and pharmacies [102,104,105,111,131,137,147], while 40 of them, 45.5%, applied the Six Sigma (32%) and Lean Six Sigma (13.5%) quality tools [148,149,170,178,180,184].

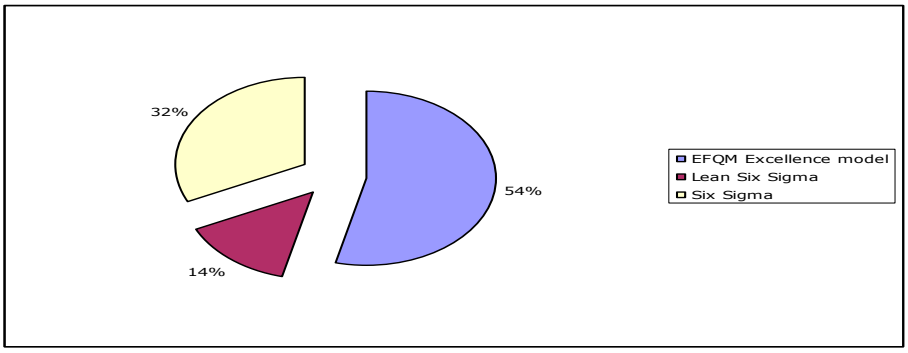

Figure 5. European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma methodologies in the public sector.

Figure 5 shows the percentage of examined quality models that were applied to the organizations from 2004 to 2022 in the selected presentation articles in hospitals, organizations, governments, pharmacies, primary and secondary education and universities. The published articles show a continuous growing interest among researchers, academics and professionals, as publications on the specific quality tools continuously increased over time. It is noticeable that from 2017 onwards, in all three publishers (Emerald, Elsevier and Taylor & Francis), there was increasing amount of public organizations implementing quality tools, aiming to satisfy the customer and increase company efficiency at the minimum cost. This also resulted in the growing interest of researchers to conduct further studies. Figure 6 shows that in terms of publishers, half of the sample articles (44 articles, 50%) were published by Emerald, followed by Taylor & Francis (27 articles, 30.7%) and Elsevier (17 articles, 19.3%).

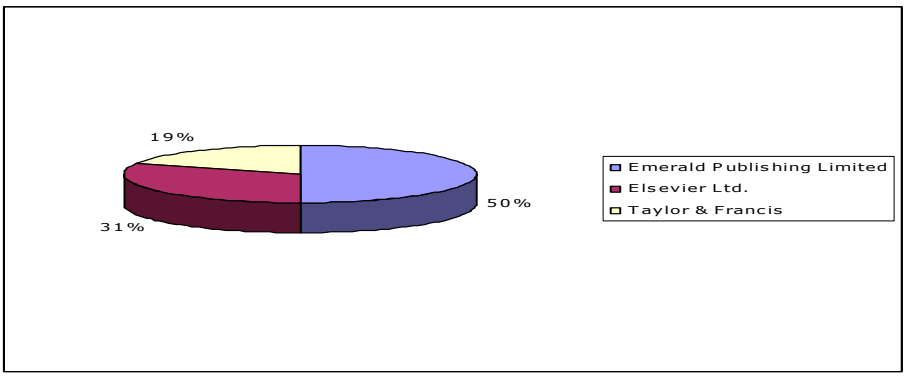

Figure 6. Percentage of journal articles.

The success that stems from an organization's infrastructure and management and administration systems is one that does not change over time and is difficult to replicate by rival companies. The European Foundation for Quality Management Excellence Model

and the Six Sigma and Lean Six Sigma quality tools can play an important role in achieving sustainable excellence. The creation of institutions that can evaluate quality management in higher education and the corresponding creation of internal groups in the Universities, together with the organization of internal and external evaluations, demonstrate the emphasis that is now placed on the quality of the provided education from higher education institutions. In addition to the above, the competition between Universities both domestically as well as abroad results in the search for various methods that demonstrate their aim to increase quality. From the literature review, some findings are identified concerning the motivations of the Universities, the readiness factors, the challenges they face when applying the methodologies and also the benefits of applying the European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma quality tools. As all research shows, the purpose of quality tools is to reduce defects and improve any kind of process, thereby increasing customer satisfaction and the profits of organizations.

Several authors stress the existence of preparedness factors to determine the overall readiness of an organization to apply the Lean Six Sigma continuous improvement methodology. In cases where these factors are not satisfied, then the university employees who are taught Lean Six Sigma will tend not to adapt to the new processes and go back to their old ways and methods of working. It has been noted that the inappropriate application of the fulfillment stage of preparedness factors has been described as one of the main factors of the failure of Lean Six Sigma [96,187–189]. A significant part of the literature [85–87] regards training in methodology as an important success factor. Specifically, training, to some extent, in statistics and quality tools is critical. The training should begin with the management team and end with the staff, and the Six Sigma methodology seems to have a great influence on the criterion mentioned in the processes, since Six Sigma is nothing but a method to continuously improve an organization's important processes. A more effective application of the European Foundation for Quality Management Excellence Model through the implementation of Six Sigma is visibly reflected in the organization's key performance results.

It is therefore clear that any standard model or methodology can help to implement the European Business Excellence Model more effectively, some more than others. What must be realized is that effective implementation of each of these tools must be treated with due care and commitment from management in order to deliver benefits to the organization that will enable and bring about the effective implementation of the European Foundation for Quality Management Excellence Model or Six Sigma and Lean Six Sigma approaches. Lean Six Sigma and Six Sigma tools may have originated in the private sector and this influenced their early application in public sector organizations. Their direct transfer to the public sector may not bring about the same beneficial results but may possibly identify and thus correct design errors [187].

5. Discussion

During the bibliographic systematic review, 88 articles were identified from three well-known academic publishers: Emerald, Elsevier and Taylor & Francis. These articles refer to the application of European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma quality tools in public organizations and services. During the literature review, the effects of the Lean Six Sigma and Six Sigma methodologies and the European Foundation for Quality Management Excellence Model in the field of public organizations were recorded, despite the limited availability of references in this area in the academic literature. This is due to the fact that quality tools were initially designed and implemented in private sector businesses, with the consequence that there is an extensive literature regarding this sector. The application of quality tools in public sector organizations has been limited, albeit with an increasing trend in recent years [72]. The consequence of all the above is the need for further and more studies of the application of the European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma quality tools in the public sector and a presentation of the positive

and negative effects. This will help administrative staff, as well as those specialized in decision making, in communicating the effects of the implementation of quality tools in the public sector. These effects include better decision making, which could lead to improved efficiency and effectiveness as well as customer satisfaction.

Through this research, it has become clear that a public organization has the ability to offer quality services to customers. With the continuous application of small improvements, and without deviating from the course or the goal, public organizations will be able to offer excellent services in the long term. A strong leadership plays an important role in this, as the leadership team can integrate the ideology of total quality into the rest of the organization and consequently the organization will improve and gain a competitive advantage.

Quality assurance models show that there is a link between strategic plans and how they will be achieved, proving that a public organization can continuously improve the way it is managed while simultaneously satisfying customers and minimizing costs. At the same time, models can provide a self-assessment process with a set of criteria, enabling benchmarking with other relevant public organizations and creating a framework through which the organization could stand out and improve. In the use of the Six Sigma and Lean Six Sigma methodologies, the necessity of establishing a system to measure the quality of the education provided by Universities globally has been demonstrated. This would have immediate positive effects on comparisons of the Universities amongst themselves but also of the departments within them, allowing them to establish appropriate goals. In addition, the universities can more easily benchmark themselves against others, leading to the establishment of best practices and therefore an increase in institutional quality.

Emerald is a collection of scientific e-journals and books that offers academic researchers, students, and the public access to a multitude of academic articles, such as the specific articles related to the application of the European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma quality tools. The information is in the public domain, enabling its easy access. The Emerald Business, Management and Economics and Emerald Social Sciences collections provide full texts for information retrieval, and the e-books in these collections complement the above project [10]. Accordingly, Science Direct, owned by Elsevier, is a service with the largest online collection of articles, covering health sciences, decision sciences, natural and social sciences, IT, fine arts, chemistry and its related disciplines and mechanical engineering. Elsevier is one of the four largest scientific publishing houses in the world, annually publishing about a quarter of all scientific journal articles. The present study reveals that systematic literature reviews are a widely used research method; however, literature review articles on the application of quality models in the public sector are limited [41].

In most of the articles presented, references are made to human factors involved in the European Foundation for Quality Management Excellence Model and Lean Sigma and Six Sigma quality tools and their important role in optimizing the efficiency and effectiveness of public services at the lowest cost while simultaneously satisfying customers. Many authors who have studied the European Foundation for Quality Management Excellence Model and Lean Six Sigma and Six Sigma quality models in the public sector [102,104,105,111,131,137,147,149,180] have demonstrated the benefits and impacts of and obstacles to their implementation. Despite the fact that the majority of the literature refers to the application of quality tools in private sector businesses, the corresponding literature in the public sector has exhibited a real increase in recent years, revealing significant benefits. As can be seen from the multitude of the 88 examined articles, the European Foundation for Quality Management Excellence Model and the Six Sigma method emphasize the importance of staff education and training, teamwork and the structure of the organization. The effective application of a model by an organization, both in the private and public sector, presupposes the creation of quality teams. These groups are created by specially trained people, i.e., quality management systems executives, with the principles of total quality management. These specially trained people can develop the appropriate techniques to promote innovation and excellence [190]. In the same direction, in the study in [147], the authors highlighted the importance of teamwork and training of human resources teams in

quality issues related to the application of the European Foundation for Quality Management and the Six Sigma models in the public sector.

The Six Sigma quality improvement method gives a special importance to teamwork and process improvement within an organization [191]. Many researchers support teamwork as an integral part of the methodology in the implementation of the Six Sigma method, which creates specialized jobs for personnel to train the employees of the organization in matters of quality. This promotes teamwork, with the aim of improving organizational processes. The role of trained workers and a high-quality team is particularly important for the successful outcome of the implementation of these models [192]. Employee training plays an important role in the successful outcome of the application of the Six Sigma method in an organization; thus, the organizational management should focus on implementing effective staff training to promote teamwork. As a result, staff training and teamwork must be emphasized to effectively implement the Six Sigma method and European Foundation for Quality Management Excellence Model. In addition, studies have reported that the European Foundation for Quality Management Excellence Model and the Six Sigma method, through their reinforcement of continuous improvement processes, better enhance the competitive advantage over other organizations.

6. Conclusions, Limitations, and Agenda for Future Studies

The application of the European Foundation for Quality Management Excellence Model and the Lean Six Sigma and Six Sigma quality tools in public services and organizations has not been widely studied; in fact, they have mainly been applied in private sector companies, resulting in insufficient research. In addition, there have been minimal systematic bibliographic reviews of the above quality models. However, the fact that the application of the European Foundation for Quality Management Excellence Model and Six Sigma and Lean Six Sigma models presents significant advantages for organizations; governments; primary, secondary and higher education institutes; and hospitals necessitates further investigation of their implementation in the public sector. In addition, future studies by researchers, academics and specialized staff are required to record more data and conclusions.

This research seeks to collect study and record the results of the application of the European Foundation for Quality Management Excellence Model, Six Sigma and Lean Six Sigma quality tools in public organizations and services, with the aim of reviewing and covering the existing literature. The authors wish to inform the public of the collective benefits of using these tools in public organizations and services and to urge for further research to record the results of these tools in public organizations, as the literature on them is minimal since quality systems have been mainly used in private sector businesses. This systematic literature review contributes to the literature by presenting the practical implications of the European Foundation for Quality Management Excellence Model and the Lean Six Sigma and Six Sigma quality systems in detail, with the intent to increase their use in organizations in order to reap the benefits, satisfy customers through the improvement of their processes and also achieve an increase in efficiency with as little cost as possible.

The findings of the present research can benefit researchers, academics and specialized executives of organizations by disclosing of the effects—positive and negative—and the difficulties of implementing the European Foundation for Quality Management Excellence Model, Six Sigma and Lean Six Sigma quality tools. Hence, the leaders and decision makers of public organizations and services will find it easier to integrate the models into their processes and apply them more effectively to achieve an improvement in efficiency, a stable service and the satisfaction of the customer as well as the consolidation of their trust. In addition, through a detailed presentation of the benefits and the difficulties of applying the European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma quality models, it is possible for the leading executives to compare the models according to the field of application and to choose the ideal one in order to

satisfy its goals. It is very important that managers, executives and decision makers are informed about the implications of quality tools through the literature, so that they can seek to fill theoretical and practical knowledge gaps and obtain key and correct decisions to improve the processes of organizations and provide services at the lowest possible cost while simultaneously improving their efficiency and effectiveness. This is especially important in such a difficult time due to worldwide economic crises.

The present systematic literature review study, as with any study, has certain limitations. An important limitation is that the data were drawn from only three major publishers (Emerald, Elsevier and Taylor & Francis) and are widely distributed despite the large number of journals, academic sources and databases. Although they are appropriate and recognized publishers, it is clear that there may be other relevant articles regarding quality tools in public organizations and services. This is reinforced by the fact that the authors do not always have access to all databases and to articles in recognized journals, and that we were not able to review articles in any language other than English. Another limitation is that for many studies in the health sector, i.e., in public hospitals and pharmacies, where there are several reports from the application of the Lean Six Sigma methodology [192], the specificity of the domain does not allow determining the times of certain processes, such as patient waiting times and other similar processes. At the same time, because the European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma quality models have mainly been used in private sector businesses, keywords such as public organization limited the search for articles. For this reason, the terms higher education, primary and secondary education, governments and health care sector were also used.

Future literature review studies can be conducted considering the above limitations. We suggest carrying out more systematic literature reviews regarding the European Foundation for Quality Management Excellence Model and the Six Sigma and Lean Six Sigma quality tools in public organizations and services or to compare the effects with their counterparts in private sector companies. We suggest that future studies consider academic databases, books and English language and non-English language journals for a systematic literature review on a larger scale to study quality models in more detail. In addition, more research ought to be conducted with the help of scientometrics, document analysis, text analysis, text classification and bibliometrics, as well as with big datasets using algorithms related to pipeline-based linear scheduling of big data streams in the cloud [193–201].

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

Conflicts of Interest: Not applicable.

Appendix A

Table A1. European Foundation for Quality Management Excellence Model and results in organizations.

Study	Title	Journal	Impact on Results/Performance	References
Menezes et al. (2022)	Sustainability and Quality Management has EFQM forested a Sustainability Orientation that delivers to stakeholders	International Journal of Operations & Production Management Vol. 42, No. 13, pp. 537–568 Emerald Publishing Limited	Direct and indirect positive associations between the Sustainability Orientation implied by EFQM and stakeholder performance are confirmed	[101]
Murthy et al. (2022)	Empirical classification of European Foundation for Quality Management model enabler sub-criteria using a quadrant matrix	International Journal of Quality & Reliability Management Vol. 39, No. 2, pp. 537–569 Emerald Publishing Limited	This paper identifies the co-relationships among sub-criteria of EFQM. While most of the earlier research papers have focused on the criteria level and analyzed the effect of assessment at the sub-criteria level	[102]
Gimenez et al. (2022)	Effects of the organizational culture and knowledge exploration and exploitation on results in the EFQM model framework	Journal of knowledge management Emerald Publishing Limited	Market culture develops learning ambidexterity. This finding highlights the importance for the implementation of the EFQM model and to promote excellent results, market orientation and process control	[103]

Table A1. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Zhang et al. (2021)	Internal relationships of market oriented EFQM enablers in the Chinese construction industry	Engineering Construction Engineering and Architectural Management Vol. 28, pp. 765–787 Emerald Publishing Limited	This study refines the strategy enabler of the original EFQM Excellence model. It also develops a market oriented EFQM Excellence model that is suitable for developing countries where cultural differences exist	[104]
Ashraf et al. (2021)	EFQM enablers and business performance relationship: examining mediating role of organizational learning culture in Pakistani textile sector	Research Journal of textile and apparel Vol. 25, No. 4, pp. 431–443 Emerald Publishing Limited	The results reveal the EFQM excellence enablers significantly influence financial, non-financial and market performance	[105]
Fonseca (2021)	The EFQM 2020 model. A theoretical and critical review.	Total Quality Management & Business Excellence pp. 1011–1038 Emerald Publishing Limited	The EFQM 2020 model is analyzed and compared with the 2013 version. The model adopts strategic management with remarkable results. The term excellence no longer exists explicitly being replaced by the term excellent.	[106]
Muhammad Din et al. (2021)	What makes excellence model excellent a comparison of the American, European and Japanese models	The TQM Journal Vol. 33, No. 6, pp. 1143–1162 Emerald Publishing Limited	The EFQM model provides an augmented focus on sustainability, stakeholder engagement and inclusivity. The findings can guide managers about what to expect from implementing the model and making better decisions	[107]
Calvo-Mora et al. (2020)	TQM factors and organizational results in the EFQM excellence model framework	Vol. 120, No. 12, pp. 2297–2317 Industrial Management & Data Systems Emerald Publishing Limited	The results confirm that the model can lead to an improvement in organizational performance, as the developed models enable managers to anticipate the effects of their management decisions	[108]
Medne et al. (2020)	Sustainability of a university's quality system adaption of the EFQM excellence model	International Journal of Quality and Service Sciences Vol. 12, No. 1 pp. 29–43 Emerald Publishing Limited	The EFQM excellence model can provide a management framework and a comprehensive overview of a university to identify the necessary improvements and promoting the implementation of promotional activities on the road to sustainable development	[109]
Laurett et al. (2019)	EFQM model's application in the context of higher education A systematic review of the literature and agenda for future research	International Journal of Quality & Reliability Management Vol. 36, No. 2, pp. 257–285 Emerald Publishing Limited	Using the model can lead to many potential benefits as well as increased knowledge about greater staff involvement and commitment in service improvement in sustainable and objective decision—making and cultural change	[88]
Kafetzopoulos et al. (2019)	The relationship between EFQM enablers and business performance. The mediating role of Innovation	Technology Management Vol. 30, No 4, pp. 684–706 Emerald Publishing Limited	The multidimensional structure of the EFQM model determines the contribution of quality management to firm performance by considering the role of innovation in firm performance	[110]
Kafetzopoulos et al. (2019)	Investigating the role of EFQM enablers in innovation performance	The TQM Journal Vol. 31, No 2, pp. 239–256 Emerald Publishing Limited	The results show that it is essential for a firm to manage all the facilitating enablers included in the EFQM model, since they cannot boost innovation when implemented in isolation	[111]
Escrig et al. (2016)	What is the effect of size in the use of EFQM Excellence model	International journal of Operations & Production Management Vol. 36, No 12, pp. 1800–1820 Emerald Publishing Limited	Empirical analyzes of the EFQM model show the necessity of adopting other criteria and the impact that outcomes can have on outcomes, thereby supporting a contingency perspective	[112]
Van Schoten, Steffie et al. (2016)	The EFQM Model as a framework for Total Quality Management in healthcare	International Journal of Operations & Production Management 2016 pp. 901–922 Emerald Publishing Limited	The results of the study show that applying the model in hospitals is related to improvement in organizational performance over time, a feedback to improve their process established	[113]
Zarraga-Rodriguez et al. (2016)	Efficient information related practices in companies committed to EFQM	The TQM Journal Vol. 28, No. 6, pp. 798–813 Emerald Publishing Limited	The analysis shows evidence that many information practices among companies committed to the model and reveals information practices that should be improved	[114]
Favaretti et al. (2015)	An EFQM excellence model for integrated healthcare governance	International Journal of Health Care Quality Assurance Vol. 28, No. 2, pp. 156–172 Emerald Publishing Limited	The EFQM model can act as an effective tool to meet governance demands and promote system level result	[115]

Table A1. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Moura e Sa et al. (2015)	Translating the EFQM model into the courts	International Journal of Quality and Service Sciences Vol. 7, No. 2/3, pp. 230–244 Emerald Publishing Limited	The EFQM model can act as an effective tool into the courts	[116]
Shanin et al. (2014)	EFQMQual evaluating the implementation of the European quality award based on the concepts of model of service quality gaps and Servqual approach	Measuring Business Excellence Vol. 18, No. 3, pp. 38–56 Emerald Publishing Limited	The EFQM model has a prominent social responsibility and stakeholder engagement focus. Moreover, it becomes apparent that the difference between his expectations assessment and assessment perceptions has a small gap	[117]
Al-Tabbaa et al. (2013)	Excellence models in the nonprofit context strategies for continuous improvement	International Journal of Quality & Reliability Management Vol. 30, No. 5, pp. 590–612 Emerald Publishing Limited	The EFQM model in relevant to NPOs and can be adopted both for self-assessment and also as tools for planning improvement	[118]
Valkani et al. (2010)	Three level quality assessment of a dental hospital using EFQM	International Journal of Health Care Quality Assurance Vol. 27, No. 6, pp. 684–701 Emerald Publishing Limited	Continuous learning, improvement, partnership development and corporate social responsibility were satisfactorily represented by the application of the quality model but the limitation of the findings to one hospital does not allow the generalization of the conclusions	[119]
Kim et al. (2010)	European Foundation for Quality Management Business Excellence Model An integrative review and research agenda	International Journal of Quality & Reliability Management Vol. 27, No 6, pp. 684–701 Emerald Publishing Limited	The results of the review show that the majority of work on the FEM quality model up to 2009 focuses on very few issues	[120]
Ignacio et al. (2008)	EFQM model knowledge governance and competitive advantage	Journal of Intellectual Capital Vol. 9, No 1, pp. 133–156 Emerald Publishing Limited	The EFQM Excellence model is considered as a suitable framework for the governance of organizational knowledge	[121]
Davies (2007)	Integration is it the key to effective implementation of the EFQM Excellence model	International Journal of Quality & Reliability Management Vol. 25, No. 4, pp. 383–399 Emerald Publishing Limited	The application of EFQM Excellence model in UK universities argues that the more the model is embedded in them, the more efficient is their operation	[122]
Daview et al. (2007)	The effect of academic culture on the implementation culture on the implementation of the EFQM Excellence Model in UK universities	Quality Assurance in Education Vol. 15, No 4, pp. 382–401 Emerald Publishing Limited	The EFQM Excellence model and its underpinning concepts and others acted as cultural barriers to the implementation of the model and define the academic culture in UK universities	[123]
Calco-Mora et al. (2006)	Using enablers of the EFQM model to manage institutions of higher education	Quality Assurance in Education Vol. 14, No 2, pp. 99–122 Emerald Publishing Limited	The results achieved indicate the establishment of the quality management model that leads universities to excellence	[124]
McCarthy et al. (2005)	Impact of EFQM Excellence model on leadership in German and UK organizations	International Journal of Quality & Reliability Management Vol. 23, No. 9 Emerald Publishing Limited	The results shows that there were more differences in perceptions of good practice between German organizations recognized for excellence and German organization not using the Excellence model than between German and UK organizations	[125]
Trevor et al. (2004)	Implementation of EFQM Q excellence model self-assessment in the UK higher education sector lessons learned from other sectors	The TQM Magazine Vol. 16, No. 3, pp. 194–201 Emerald Publishing Limited	The use of excellence model self-assessment in the public sector lagged because of the lag in pressures to respond to customers through continuous improvement in the public sector when compared with the private sector	[126]
Rodriguez Gonzalez et al. (2020)	Use the EFQM Excellence model to improve hospital pharmacy performance	Research in Social and Administrative Pharmacy 16 pp. 710–716 Elsevier Ltd.	The principles of the model are also applicable framework for periodically evaluating the performance of pharmacy operations helping it identify actions for continuous safety improvement and pharmacotherapy effectiveness client satisfaction and on the staff.	[127]
Rodriguez Mantilla et al. (2020)	Do ISO 9001 standards and EFQM model differ in their impact on the external relations and communication system at schools	Evaluation and Program Planning 80 (2020) Elsevier Ltd.	The implementation of the model in Spanish schools for the communication system and external relations in school revealed that it has a medium high level of impact on the communication system and a moderate level in the external relations dimension, while the size of schools plays an important role in their external relations	[128]

Table A1. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Suarez et al. (2017)	Quantitative research on the EFQM excellence model A systematic literature review(1991–2015)	European Research on Management and Business Economics 23 (2017) 147–156, Elsevier Ltd.	The widespread application of the EFQM model results in the presentation of more than a dozen proposals for future research.	[129]
Anastasiadou et al. (2015)	EFQM dimensions in Greek Primary Education System	Procedia Economics and Finance 33 (2015) 411–431, Elsevier Ltd.	Human Resource Management and Collaboration and Resources and Processes and related as it emerges from the research, while the same results confirmed by the results of Calvo-Mora et al. (2013)	[130]
Anastasiadou et al. (2014)	The European Foundation Quality Management evaluation of Greek Primary and Secondary Education	Procedia Social and Behavioral Sciences 143 (2014) 932–940, Elsevier Ltd.	The application of the model proves that the Greek education system has a lot to do to improve and meets the quality standards that Greek teachers can expect	[131]
Anastasiadou et al. (2014)	Reliability testing of EFQM scale: The case of Greek Secondary Teachers	Procedia, Social and Behavioral Sciences 143 (2014) 990–994, Elsevier Ltd.	The excellence model constitutes one of the most important options for the management and evaluation of the quality of institutions of education and the reliability of which has been verified by the implementation of five models such as the Model Alfa, the Model Spit Half, the Model Parallel and the Model Strict Parallel	[132]
Moreno Rodriguez et al. (2013)	A consensus support model based on linguistic information for the initial self-assessment of the EFQM in health care organizations	Expert Systems with Applications 40 (2013) 2792 2798, Elsevier Ltd.	For the highest patient care and safety with the available resources, the model pursues self-assessment to improve services and maintain global competitiveness	[133]
Camison (1996)	Total quality management in hospitality an application of the EFQM model	Tourism Management Vol. 17, No 3, pp. 191–201, 1996. Elsevier Ltd.	The application of the EFQM model in the tourism sector showed a serious discrepancy between of the quality perceived by the customer and the quality that recognized by management for staff and customer satisfaction due to high cost	[134]
Muhammad Yousaf (2022)	Evidence from certified firms from the EFQM excellence model	Total Quality Management Vol. 33, No. 13, 1471–1488 Taylor & Francis	The findings relieved that the quality certificate from the EFQM Excellence model haw a positive effect on the firm's performance	[107]
Gonzalez et al. (2022)	Does EFQM enhance learning and innovation?	Total Quality Management, 2022, Vol. 33, No 7, pp. 727–751 Taylor & Francis	The application of the EFQM quality model projects that development of learning capabilities an organization could lead to gradual and radical innovation. Organizations should improve existing products and develop new, making them more suitable for customers or adapt them to potential needs and requirements.	[135]
Fonseca et al. (2021)	Quality 4.0: The EFQM 2020 Model and Industry 4.0 Relationships and Implications	Sustainability 2021, 13, 3107.	The EFQM 2020 model it is indeed an integrated, holistic and updated business model that encompasses and supports Sustainability and Industry 4.0 principles without explicitly referring to quality or even excellence.	[136]
Perianez-Cristobal et al. (2021)	Organizational profiles: key factors and results from the EFQM model perspective.	Total Quality Management, 2021 Vol. 32, No. 16, 1850–1873 Taylor & Francis	Application of the EFQM Excellence Model. Model in self-evaluation and external evaluation processes in organizations and companies. Organizational profiles stand out for their strategic vision, for the effort they make to meet needs and expectations of their stakeholders, as well as the central role of human resources.	[137]
Calvo-Mora et al. (2018)	Assessment and improvement of organizational social impact through the EFQM Excellence model	Total Quality Management 2018, Vol. 29, No 11, 1259–1278, Taylor & Francis	The findings indicate that the model is a reliable and valid framework with which to measure and improve the organizational social impact.	[138]
Mesgari et al. (2017)	Causal structure of the EFQM Excellence model among healthcare sector: a case study in Iran.	Total Quality Management 2017, Vol. 28, No. 6, 663–677 Taylor & Francis.	By implementing this study in almost half of the total hospital beds in Iran, the application of the model for hospital process improvement has shown that the results can be extended to other health systems in the world. Especially those with a governmental structure.	[139]

Table A1. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Gomez et al. (2015)	EFQM Excellence Model and TQM: an empirical comparison.	Total Quality Management & Business Excellence pp. 88–103 Taylor & Francis.	Companies that implement the EFQM Excellence Model as a management tool will have high odds of being a Total Quality Management companies. In addition, provide a means for improving performance.	[140]
Araujo et al. (2014)	The path to excellence of the Portuguese organizations recognized by the EFQM model.	Total Quality Management, 2014, Vol. 25, No. 5, 427–438 Taylor & Francis	The main findings of this study are the fact that the internal motivations are the key factor for the implementation of the model. A new methodology haw designed where the self-assessment team has a remarkable mission in the implementation process of model.	[141]
Campatelli et al. (2011)	Development of a simplified approach based on the EFQM model and Six Sigma for the implementation of TQM principles in a university administration.	Total Quality Management Vol. 22, No. 7, 2011, 691–704 Taylor & Francis	The model for evaluating organizations shows significant advantages such a reduced training time for stakeholders, short involvement of external mediators and guiding workgroups easily and quickly on the process improvement path.	[142]
Alfaro Saiz et al. (2011)	Seeking organizational excellence by using the information coming from the EFQM Excellence Model as starting point: application to a real case.	Total Quality Management Vol. 22, No. 8, 2011, 853–868 Taylor & Francis	Application of the model highlights that organizations are able to reach excellence by jointly using an assessment method and later statistical data analysis techniques.	[143]
Nabitz et al. (2009)	Psychosocial work conditions and work stress in an innovating addiction treatment center. Consequences for the EFQM Excellence Model	Total Quality Management Vol. 20, No. 3, 2009, 267–281 Taylor & Francis.	Application of the model highlights positive findings regarding employee engagement in relation to patient satisfaction.	[144]
Tutuncu et al. (2007)	Relationship between Organizational Commitment and EFQM Business Excellence Model: A Study on Turkish Quality Award Winners	Total Quality Management Vol. 18, No. 10, 2007, 1083–1096, Taylor & Francis	The results of the research show that leadership, strategy, inclusive processes and human resources are decisive factors for achieving excellent results	[145]
Calvo-Mora et al. (2005)	Relationships between the EFQM model criteria: a study in Spanish universities	Total Quality Management Vol. 16, No. 6, 2005, 741–770 Taylor & Francis	The results from the analysis of the measurement and structural model support the reliability and validity of the European Excellence Model for the evaluation and improvement of quality in the area of higher education.	[146]

Table A2. Six Sigma, Lean Six Sigma and results in organizations.

Study	Title	Journal	Impact on Results/Performance	References
Akinwale et al. (2022)	Six Sigma Disruptive Technology and Performance of Nigerian Healthcare Systems during COVID-19 Pandemic	Entrepreneurship and Post Pandemic Future, 39–51, 2022, Emerald Publishing Limited	Six Sigma methodology has established how to reduce waste and flaws in health systems and has shown that innovative technology is the way to go top and achieve significant value propositions now and in the future.	[147]
Antony & Sony (2019)	An empirical study into the limitations and emerging trends of Six Sigma in manufacturing and service organizations.	Reliability Management Vol. 37,No.3, 2020, pp. 470–493 Emerald Publishing Limited	Applying the Six Sigma model to large manufacturing and service companies from more than 20 countries revealed the top 4 constraints for service companies on the integration of Six Sigma with Big Data. The use of Six Sigma in SMEs and very small business, Six Sigma's overemphasis on variability reduction and its poor implementation and negative impact on employee satisfaction.	[148]
Myszewski (2017)	Six Sigma model of transfer of development capability	Business Process Management Journal Vol. 23, No. 4, 2017, pp. 857–872, Emerald Publishing Limited	The model of Six Sigma includes all elements that are necessary for an effective transfer of capability: a managerial structure to support projects and transfer and a scheme to plan and control the growth in improvement capacity in a project team.	[149]

Table A2. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Partyal and Koilakuntla (2015)	Infrastructure and core quality practices in Indian manufacturing organizations Scale Development and validation	Journal of Advances in Management Research Vol. 12, No. 2, 2015, pp. 141–175 Emerald Publishing Limited	The higher order predictive validity assessment model Six Sigma suggested that core practices have a higher impact on quality performance than infrastructure practices.	[150]
Chakraborty et al. (2013)	An empirical analysis on Six Sigma implementation in service organizations	International Journal of Lean Six Sigma Vol. 4, No. 2, 2013, pp. 141–170 Emerald Publishing Limited	The findings confirm that the responses of not relevant and unknown to us as reasons for not implementing Six Sigma show the need for understanding specific requirements of service organizations	[151]
Malik & Blumenfeld (2012)	Six Sigma quality management systems and the development of organizational learning capability Evidence from four business process outsourcing organizations in India	International Journal of Quality & Reliability Management Vol. 29, No. 1, 2012, pp. 71–91 Emerald Publishing Limited	The study confirm the critical role that firms Six Sigma and quality management capabilities play in developing organizational learning capability	[152]
Chakraborty et al. (2012)	Case study analysis of Six Sigma implementation in service organizations	Business Process Management Journal Vol. 18, No. 6, 2012, pp. 992–1019 Emerald Publishing Limited	The study highlights the primary factors of successful implementation of the model which are the leadership and the satisfaction and participation of the human potential	[153]
Sony et al. (2012)	Six Sigma organizational learning and innovation. An integration and empirical examination	International Journal of Quality & Reliability Management Vol. 29, No. 8, 2012, pp. 915–936 Emerald Publishing Limited	This study proves the positive relationship between Six Sigma and organizational learning and confirms that Six Sigma role structure contributes positively to organizational innovation	[154]
Aboelmaged (2011)	Reconstructing Six Sigma barriers in manufacturing and service organizations. The effects of organizational parameters.	International Journal of Quality & Reliability Management Vol. 28, No. 5, 2011, pp. 519–541 Emerald Publishing Limited	A study highlights that only specific barriers such as professionals and finances exert in relation to dimensions of organizational factors	[155]
Lagrosen et al. (2011)	Organizational learning and Six Sigma deployment readiness evaluation: a case study	International Journal of Lean Six Sigma Vol. 2, No. 1, 2011, pp. 23–40 Emerald Publishing Limited	Six Sigma provides a structure for work and for defining, measuring, analysis, improvement and review of methodology required to address some current inefficiencies and problems	[156]
Chakraborty et al. (2009)	An exploratory qualitive and quantitative analysis of Six Sigma in service organizations in Singapore	Management Research News Vol. 32, No. 7, 2009, pp. 614–632 Emerald Publishing Limited	The study shows that the application of the Six Sigma model has a wider application in service organizations in projects that are not limited to solving simple problems but complex techniques for organizations.	[157]
Kumar et al. (2009)	Project selection and its impact on the successful deployment of Six Sigma	Business Process Management Journal Vol. 15, No. 5, 2009, pp. 669–686 Emerald Publishing Limited	The work demonstrates the effectiveness of the proposed methodology by applying it to small and medium sized enterprises that manufacture casting products and improve their efficiency	[158]
McAdam & Hazlett (2009)	An absorptive capacity interpretation of Six Sigma	Journal of Manufacturing Technology Management Vol. 21 No 5, 2010, pp. 624–645 Emerald Publishing Limited	The development of Six Sigma in practice is expanding mainly through more rigorous studies and applications in service based environments	[159]
Feng et al. (2008)	Under the knife: a national survey of Six Sigma programs in US healthcare organizations	International Journal of Health Care Quality Assurance Vol. 21, No. 6, 2008, pp. 535–547 Emerald Publishing Limited	The application of the Six Sigma model indicates the common projects implemented in healthcare organizations, typical implementation durations and significant cost benefits	[160]
Antony et al. (2007)	Six Sigma in service organizations. Benefits, challenges and difficulties, common myths, empirical observations and success factors.	International Journal of Quality & Reliability Management Vol. 24, No. 3, 2007, pp. 294–311 Emerald Publishing Limited	The study shows that the management's commitment and involvement, customer focus, linking Six Sigma to business strategy, organizational infrastructure are the most critical factors for the successful development of organizations	[161]
Black & Revere (2006)	Six Sigma arises from the ashes of TQM with a twist.	International Journal of Healthcare Quality Assurance Vol. 19, No. 3, 2006, pp. 259–266 Emerald Publishing Limited	Under the Six Sigma methodology, quality improvement projects carefully defined so that they can successfully completed within a relatively short period	[162]
Hensley et al. (2005)	Assessing readiness for Six Sigma in a service setting.	Managing Service Quality Vol. 15, No. 1, 2005, pp. 82–101 Emerald Publishing Limited	An application of the model to urban public transport to identify differences in perceptions between employees and customer services provide the basis for developing a process. Improvement that employees should be able to undertake	[163]

Table A2. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Vermaelen et al. (2022)	Driving meeting effectiveness through organizational process improvement. A Lean Six Sigma case study.	Organizational Dynamics (2022) 51, 1–9. Elsevier Ltd.	This case study uniquely demonstrated how the Lean Six Sigma methodology can be applied to implement change it aims to improve the factions of the meeting support service and to reduce the time for taking minutes.	[164]
Rathi et al. (2021)	Lean Six Sigma in the healthcare sector. A systematic literature review.	Materials Today Proceedings 50 (2022) 773–781. Elsevier Ltd.	During the pandemic due to COVID-19, that we need an operational excellence in healthcare business. Lean Six Sigma is a methodology which can reduce waste.	[165]
Lee et al. (2021)	U.S Hospital culture profiles for better performance in patient safety patient satisfaction Six Sigma and Lean implementation	International Journal Production Economics 234 (2021) 108047, Elsevier Ltd.	This study suggests based on the Competitive Values Framework the application of Six Sigma and reveals that hospitals improve their overall quality performance.	[166]
Galdino de Freitas et al. (2017)	Impacts of Lean Six Sigma over organizational sustainability. A survey study.	International Journal Production 156 (2017) 262–275. Elsevier Ltd.	The study verifies that the application of the model affects the organizational sustainability of organizations	[167]
Parmar & Desai (2017)	Evaluating Sustainable Lean Six Sigma enablers using fuzzy DEMATEL: A case of an Indian manufacturing organization.	Journal of Cleaner Production 265, (2020) 121802. Elsevier Ltd.	Lean Six Sigma is one of the key business strategies, which have employed by manufacturing organizations to improve their operational performance.	[168]
Sin et al. (2015)	Structural equation modeling on knowledge creation in Six Sigma DMAIC project and its impact on organizational performance.	International Journal Production Economics 168 (2015) 105–117. Elsevier Ltd.	Six Sigma helps organizations improve organizational effectiveness and customer satisfaction. Reduces operating costs and increases profits.	[169]
Sarby et al. (2014)	Factors critical to the success of Six Sigma quality program and their influence on performance indicators in some of Lebanese hospitals.	Procedia, Social and Behavioral Sciences 143 (2014) 990–994. Elsevier Ltd.	A medical literature states that Six Sigma has been applied to specific health care organizations and its critical points are influential in performance indicators.	[170]
Pavel & Sarbu (2014)	Integrating Six Sigma with Quality Management Systems for the Development and Continuous Improvement of Higher Education Institutions	Procedia, Social and Behavioral Sciences 143 (2014) 643-648. Elsevier Science Ltd	Higher education institutions should consider and refer to Six Sigma as a success strategy in maintaining academic quality at high standards	[171]
Mehrabi (2012)	Application of Six Sigma in educational quality management.	Procedia, Social and Behavioral Sciences 47 (2012) 1358–1362. Elsevier Science Ltd.	The successful implementation and growing organizational interest of the Six Sigma method allows organizations to better support the growing needs for coaching, mentoring and training.	[172]
Trakulsunti Yaifa et al. (2022)	Reducing pharmacy medication errors using Lean Six Sigma: A Thai hospital case study	Total Quality Management 2022, Vol. 33, No. 6, 664–682. Taylor & Francis	The implementation of the Lean Six Sigma model in hospital pharmacies improved the dispensing process, contributed to the reduction of administration errors and improved the patient security.	[173]
Antony et al. (2022)	Using Six Sigma DMAIC for Lean project management in education: a case study in a German kindergarten	Total Quality Management 2022, Vol. 33, No. 13, 1489–1509. Taylor & Francis	The implementation of Lean Six Sigma in primary education in a kindergarten improved staff preparation time and restructured the staff room showing significant results	[174]
Ng & Hempel (2020)	Organizational culture and the implementation of Six Sigma in Southern China	Total Quality Management & Business Excellence 2020, Vol. 32, No. 1, 82–98. Taylor & Francis	The application of the model indicates the necessary supportive organizational culture and management support of organizations to increase efficiency and meaningful results.	[175]
Cudney et al. (2020)	Systematic review of Lean and Six Sigma approaches in higher education	Total Quality Management & Business Excellence 2020, Vol. 31, No. 3, 231–244. Taylor & Francis	The application of Six Sigma and Lean models in higher education for development of academic programs improved quality of higher education without excessive cost.	[176]
Henrique et al. (2020)	A systematic literature review of empirical research in Lean and Six Sigma in healthcare	Total Quality Management & Business Excellence 2020, Vol. 31, No. 4, 429–449. Taylor & Francis	Through this study with the help of the Six Sigma model issues that have not been properly covered in the past such as untapped areas in healthcare are addressed	[177]
Laureani et al. (2017)	Leadership characteristics for Lean Six Sigma	Total Quality Management 2017, Vol.28, No. 4, 405–426. Taylor & Francis	The implementation of Six Sigma has highlighted that leadership plays an important role in continuous improvement with communication, employee motivation and training.	[178]

Table A2. *Cont.*

Study	Title	Journal	Impact on Results/Performance	References
Zhen et al. (2017)	An empirical investigation of the relationship between Six Sigma practices and organizational innovation	Total Quality Management 2017, Vol. 28, No. 5, 459–480. Taylor & Francis	The results support that Six Sigma practices are positive related to organizational innovation and can significantly enhancing organizational innovation performance	[179]
Uluskan et al. (2017)	Integration of Six Sigma to traditional quality management theory: an empirical study on organizational performance	Total Quality Management 2017, Vol. 28, No. 13, 1526–1543. Taylor & Francis	Six Sigma is a project oriented approach to process and product quality and helps increase organizational performance	[180]
Antony et al. (2016)	Lean Six Sigma and Innovation—an exploratory study among UL Organizations	Total Quality Management 2016, Vol. 27, No. 2, 124–140. Taylor & Francis	The results of research suggest that Lean Six Sigma does foster innovation process, incremental innovation or innovation capability.	[181]
Ericsson et al. (2015)	Implementing Design for Six Sigma in large Swedish product developing organizations. An interview study	Total Quality Management Vol. 26, No. 6, 2015, 648–660. Taylor & Francis	The application of the Six Sigma model promotes innovation and creativity in organizations.	[182]
Chen Cheng Yang et al. (2012)	Implementation of the Lean Six Sigma framework in nonprofit organizations: A case study	Total Quality Management 2012, Vol. 23, No. 4, 431–447. Taylor & Francis	The implementation of Six Sigma in government agencies and service oriented banks to improve their process resulted in improving efficiency and customer service.	[183]
Hilton et al. (2008)	Factors critical to the success of Six Sigma quality program in an Australian hospital	Total Quality Management 2008, Vol. 19, No. 9, 887–902. Taylor & Francis	The literature on Six Sigma in healthcare has managed to gain a deeper understanding of the effectiveness of the hospital's quality systems approach through the results of the study.	[184]
Furtener et al. (2005)	Implementation of TQM and Lean Six Sigma tools in local government: a framework and a case study	Total Quality Management & Business Excellence 2005, Vol.16, No. 10., 1179–1191 Taylor & Francis	Through the implementation of Lean Six Sigma, the finance department reduced the processing time of the organization's payroll, purchases and account.	[185]
Thawani Sunil (2004)	Six Sigma Strategy for Organizational Excellence	Total Quality Management 2004, Vol. 15, No. 5–6, 655–664. Taylor & Francis	Six Sigma is one of the strategies and tools which leading organizations have started using to achieve accuracy and speed and at the same time reduce cost and increase customer satisfaction and profits.	[186]

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