

A Literature Review on Quality Management in the Food Industry

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Abstract

The purpose of this paper is to analyze the quality management practices of the food industry in the past 30 years from 1993 to 2022 based on literature review. 102 articles from 53 journals were chosen for the detailed literature review. The focus of attention was solely on the articles related to quality management in the food industry. This study investigated the research time and journals distribution of quality management in the food industry and summarized the research streams. This review describes the application and progress of quality management practice in the food industry, including the global research in this field in recent years, which is mainly concentrated in Europe and Asia. The article is divided into three research streams, and a detailed overview is given. The research results include the determinants of implementing quality management practices, the reasons why researchers have proposed multiple models and frameworks in the food industry through the years, and the importance of tools and techniques used in the implementation of quality management.

Keywords

Quality management, Food industry, Models and frameworks, Determinants, Tools, and techniques.

1. Introduction

Quality runs through almost all human activities and the history of human development is also a history of quality development. For example, high-quality products such as delicate silk and ceramics created by the Chinese people travelled across Europe and Asia from the Silk Road to all parts of the globe. Until the middle of the 18th century, the industrial revolution broke out in Europe. The emergence of factories brought mass production of products, which brought a series of new technical problems, such as precision of components and measurement, etc. The emergence of these problems urged the emergence of quality management discipline. However, it was not until the 1920s that the quality management systems we know today began to surface. The statistical theory was first applied to product quality control, although the focus of quality management remained on the final product. This algorithm had been used for a long time. As time went on, however, the business began to develop and grow. More and more products were produced in a day. Companies began to go through difficulties in implementing quality control standards. Changes and developments were needed. In the 1960s, with the publication of Total Quality Management (TQM) by Feigenbaum, countries were gradually accepted this new concept and entered the stage of total quality management since then. Food industry is not only the cornerstone of social harmony and public safety, but also the economic lifeline of the country. As Jasti et al. (2021) mentioned, it was about the 1990s that TQM began to popularize and deepen, and gradually applied to the food industry. However, in general, there is a lack of summary on the application of quality management in the food industry. Thus, the aim of this paper is to explore the evolution of quality management models and

frameworks, benefits and constraints, and tools and techniques in the food industry over the last thirty years based on a literature review.

2. Literature Review

Quality management (QM) is an essential segment for food sectors as food quality violations are more significant than for other products. What's more, the contaminants cannot be easily observed and can only be detected in a laboratory environment (Schoenherr et al., 2015). The demand for quality products in the food sector is increasing due to the changes in lifestyles, demographics, health consciousness and consumer demand. Quality certification is a basic need and requirement for regional and domestic markets for trade and customer satisfaction, similarly in the food sector (Talib et al., 2014). With the invention of WTO and ISO, it is obligatory need and demand for global trade, even in multilateral and regional trade agreements.

In general, maximizing the effectiveness of quality management (such as ISO 9001, TQM, Lean, Six Sigma, etc.) can help food manufacturing SMEs consistently succeed in improving quality, preventing nonconformity, and satisfying their customers (Dora et al., 2013; Sui et al., 2018). The food sector benefits a lot from implementing QM, Psomas, Kafetzopoulos and Fotopoulos (2013) have demonstrated that maximizing ISO 9001 effectiveness can help food processing SMEs succeed in continuously improving quality, preventing nonconformity and satisfying their customers. Implementing QM in European food SMEs can reduce costs and customer complaints and increase productivity and profitability (Dora et al. 2013). Talib et al. (2014) claimed that TQM could improve the overall effectiveness, flexibility, and competitiveness of enterprises. ISO 9000 certified companies in the Greece's Food and Beverage industry gain a number of benefits, such as the increase of productivity and efficiency, improvement of image and penetration into new markets (Kakouris and Sfakianaki, 2018). But as mentioned by Dora et al. (2013), the company size is a significant factor in implementing QM. Medium ones are doing better than small and micro-ones. And Integrated Management System is seen as an effective means to overcome challenges and sustain in small food companies (Gianni, Gotzamani, and Vouzas, 2017a). Still, there is a significant gap in integration (Muñoz-Villamizar et al., 2019), and inadequate knowledge is the biggest challenge (Tutu and Anfu, 2019).

3. Methods

3.1 Selection of articles

There is various literature about QM in various publications. However, the focus of this paper was limited to the application of QM practices in the food industry and does not include the application in other industries. Article search was conducted in the following two online databases: Scopus and Web of science. The search criteria were a combination of quality management and the food industry. The year 1993 was chosen as the starting point, because it was during this period that quality management became familiar and gradually began to be applied to the food industry. The subject category was set as Business, Management and Accounting, Economics, and Social Sciences. Based on this combination, 135 articles (88 articles from Scopus and 47 articles from WOS) were initially collected, which were distributed in more than 60 publications. Among them, duplicate contents and non-English content were deleted, and only 102 articles were considered from 53 journal publications (including 21 Conference papers) by viewing the abstracts, which dealt with aspects of quality management related to the food industry.

4. Analysis and results

12 publications have published 2 or more articles on quality management, involving TQM, HACCP, ISO9001, lean, six sigma, traceability, best practices, and quality tools and technologies in the food industry, while the rest have only 1 article (Table 1). Since the focus of this study is to understand the development trend of quality management system, model and framework, benefits and constraints, tools and techniques in the food industry since 1993, even an article in a magazine will be considered if it is related to this study. Jasti et al. (2021) implemented the same strategy and reviewed TQM in higher education.

4.1 Time frame for the published articles

Table 1 shows the frequency of papers published in various journals over the past 30 years, thus giving the evolution of quality management in the food industry from 1993 to 2022. Compared to the first two five-years (1993–2002) in which only 4 papers were published in each five-year. The next two five-years saw an increasing publication with 14 and 10 papers. After that, it is worth noting that during 2013-2017, the number of publications increased steadily to

39, and remained a relatively high number in 2018-2022 which was 31. This shows that in the past few years, the importance of quality management in the food industry has been consistent on a global scale, and the fact that these papers have been published in various journals also shows that all kinds of researchers around the world have a wide range of influence and interest in the application of quality management in the food industry.

Table 1. List of journals with article publishing frequency related to QM

Journal name	1993-1997	1998-2002	2003-2007	2008-2012	2013-2017	2018-2022	Total
Agribusiness					1		1
Amftteatru Economic					1		1
Asian Social Science					1		1
Benchmarking					1	2	3
British Food Journal		1	1	1	1	1	5
Corporate Social Responsibility and Environmental Management					1		1
Dynamics in Chains and Networks			1				1
Economics and Sociology				1			1
Engineering Management Journal					1		1
European Journal of Innovation Management						1	1
Foods					1		1
International Journal of Business Performance and Supply Chain Modelling					1		1
International Journal of Health Care Quality Assurance			1				1
International Journal of Logistics Management						1	1
International Journal of Production Economics				1		1	2
International Journal of Production Research					1		1
International Journal of Productivity and Performance Management				1		1	2
International Journal of Productivity and Quality Management					1		2
International Journal of Quality and Reliability Management	1		2		1	2	6
International Journal of Services Operations and Informatics				1			1
International Journal of Services and Operations Management					1		1
International Journal of Supply Chain Management						1	1
International Journal of Technology Management and Sustainable Development						1	1
Journal of Agribusiness in Developing and Emerging Economies					1		1
Journal of Agricultural and Food Industrial Organization					1		1
Journal of Asia Business Studies			1				1
Journal of Commercial Biotechnology					1		1
Journal of Food Products Marketing	1						1
Journal of Industrial Engineering and Management						1	1

Journal of Information and Organizational Sciences					1		1
Journal of Manufacturing Technology Management					1		1
Journal of Operations Management		1					1
Journal of Security and Sustainability Issues					1		1
Journal of Small Business and Enterprise Development					1		1
Journal of the Knowledge Economy						1	1
Economic Policy in Transitional Economies		1					1
Wageningen Journal of Life Sciences			1				1
Prague Economic Papers					1		1
Production Engineering Archives						1	1
Quality - Access to Success					5	1	6
Quality and Reliability Engineering International					1		1
Research Journal of Business Management					1		1
Strategic Direction						1	1
Studies in Systems, Decision and Control						1	1
Supply Chain Forum					1		1
Supply Chain Management			1			1	2
Sustainability					2	2	4
TQM Magazine	1		3				4
Total Quality Management		1					1
Total Quality Management and Business Excellence				1	1		2
TQM Journal				2		1	3
Transportation Research Part E-logistics and Transportation Review						1	1
World Review of Entrepreneurship, Management and Sustainable Development					1		1
Conference paper	1	0	3	2	6	9	21
Total	4	4	14	10	39	31	102

4.2 Pattern of authorship (by continents)

To realize the maturity of a strategy or concept in a certain field, it requires global researchers to make significant contributions, because in any research field the progress is decided by the contributions of researchers from different continents, countries, regions, nationalities, or institutions (Guo, 2008). The study explored how papers from different continents of the world have been produced over the past three decades. Table 2 and Table 3 show the number of papers published from different continents each five-year and the main countries with more than five papers. It is worth noting that in the first three five-years (1993-2007), North America (9 numbers) and Europe (8 numbers) had the largest number of articles, and the USA and the UK were the main contributors. However, in the next three five-years, the number of publications from Europe and Asia increased significantly, but interestingly, although the number of papers from the UK gradually decreased, other European countries, such as Romania and Greece, contributed to publications in the meantime. On the other hand, although there were only 3 papers from Asian countries in the first three five-year, the number of papers increased five times to 19 in the second period of the 15 years. Among them, Malaysia has made major contributions, then came China and Thailand. It is noteworthy that only in the past 15 years have African countries and South American countries begun to have relevant research.

To sum up, the number of relevant papers in the USA and the UK is on the decline, because these countries have a very early understanding and implementation of quality management which has become more and more mature. However, the main driving force of research in the past five years still comes from the European countries, which shows that the other European countries still have room for improvement in this regard. In addition, Asian countries have made great progress in the past 10 years, which clearly shows that they are seriously implementing quality

management in the food industry. In addition, data shows that Africa and Brazil have only recently begun research in this area. Oceania, mainly Australia and New Zealand, has also increased its research in recent years.

Table 2. Continental distribution of research articles across time periods

Region	1993-1997	1998-2002	2003-2007	2008-2012	2013-2017	2018-2022	Total	%
Asia			3	2	9	8	22	21.57%
Europe		2	6	8	26	12	54	52.94%
North America	3	1	5		2	1	12	11.76%
South America					1	6	7	6.86%
Africa					1	1	2	1.96%
Oceania	1	1				3	5	4.90%
Total	4	4	14	10	39	31	102	100.00%
%	3.92%	3.92%	13.73%	9.80%	38.24%	30.39%	100.00%	

Table 3. Main countries with more than five papers

Country	Region	Year	Total
Romania	Europe	2009(1), 2014(2), 2015(2), 2016(2), 2019(1), 2020(3)	11
The USA	North America	1997(3), 1999(1), 2004(1), 2014(1), 2017(1), 2022(1)	8
Greece	Europe	2010(1), 2012(1), 2013(2), 2017(1), 2018(1), 2020(1), 2021(1)	8
The UK	Europe	1999(2), 2003(1), 2006(1), 2007(1), 2009(1)	6
China	Asia	2006(1), 2008(2), 2016(1), 2017(2)	6
Malaysia	Asia	2014(1), 2016(1), 2017(1), 2018(2), 2020(1)	6
Brazil	South America	2017(1), 2018(2), 2021(3)	6

4.3 Research stream

This study divided 102 articles related to quality management in the food industry into three research streams:

- (1) QM model and framework (MF)
- (2) Benefits and constraints of QM (BC)
- (3) QM tools and techniques (TT)

The reason for choosing these three research streams for classification is that this study focuses on the development of quality management in the food industry the model and framework of quality management in food sectors, the advantages, and constraints of quality management in the food industry, and the quality tools and technologies used in food enterprises are all the research focus. As Jasti and Kodali (2019) mentioned, the maturity of manufacturing strategy depends on whether its tools, technologies, practices, models, and frameworks were effectively implemented. To implement quality management systematically, a model/framework composed of quality management elements is needed. Therefore, articles on models/frameworks were separately classified as a research stream. In addition, to implement quality management models/frameworks in the food enterprises, the benefits they bring to the food enterprises and the obstacles in implementation them need to be clarified and understood. Therefore, they were regarded as a category of research flow. Similarly, to properly implement quality management and measure its performance, quality management tools and technologies need to be used; Therefore, they were selected as another research flow. Focusing on these three research areas helped to systematically review the development trends of these three areas in the past three decades. These three flows almost contain the support aspects related to the implementation of quality management in the food industry. Table 4 shows the number of papers of the main subjects of each research stream every five years. More than half (53.92%) of literature were focused on the models and frameworks (MF), then came with tools and techniques (TT 26.47%), while 19.61% of the papers were on benefits and constraints (BC).

Table 4. Distribution of research streams across time periods

Research streams		1993-1997	1998-2002	2003-2007	2008-2012	2013-2017	2018-2022	Total	%
MF	Modifying	1	2	4	3	6	4	20	19.61%
	Integration		1	3	4	6	8	22	21.57%
	Performance	1			1	6	5	13	12.75%
BC	Benefits and constraints	1		3	2	7	7	20	19.61%
TT	CSFs	1	1	1		7	3	13	12.75%
	Tools and techniques			3		7	4	14	13.73%

4.3.1 Focus on QM models/frameworks

It is obvious from the literature review that many models/frameworks have been developed over the years and the objectives to implement quality management vary from institution to institution, and the elements constituting the models/frameworks may be different. As Table 4 shows, 19.61% use the existing or modified models/frameworks. 21.57% by integrating other elements into the quality management system, 12.75% focus on the performance. It can be inferred that lots of models/frameworks studies were being studied in the last decade.

Using an industrial model as a reference and modifying it to suit the food industry

The socioeconomic system of each country has its own quality management and quality assurance model for production and sales. For example, the mandatory quality management systems of food enterprises in EU countries include good manufacturing practice (GMP) and hazard analysis and critical control points (HACCP) (Morkis, 2009). For other countries, they also include ISO 9000, TQM, traceability and so on. They can be used alone or modified to better adapt to the food enterprises.

Although HACCP may bring additional costs to food enterprises, it was mentioned by Rosak-Szyrocka and Abbase (2020) that in the production of ice cream, the quality and safety managers take the initiative to implement HACCP principles. As an enterprise management tool, HACCP has a positive impact on the company's performance. It was reported that the use of HACCP has improved the maturity of other food safety systems, while using ISO 9000 can improve the maturity of other quality systems (Pun, Wilcock, and Aung 2007). Dudin et al. (2017) proposed the main principles of ISO 9000 in agro-industry companies, which can be implemented as a separate model used in the national enterprise management system. Beardsell and Dale (1999) validated the applicability of TQM in the food supply and distribution industry and determined that the list of characteristics of total quality management is nearly the same as those in other industries.

Integrate other elements into the quality management system (QMS) in food industry

Sometimes using only one model or framework is not enough to achieve the desired purpose, and two or more systems need to be working together in one efficient system (Rebelo, Santos, and Silva, 2014). The benefits of integration lie in reducing costs, improving the company's external image, optimizing resources, improving internal communication, providing operational efficiency and improving customer satisfaction (Dahlin and Isaksson, 2017).

Mure et al. (2020) tried to integrate the preliminary plan into the quality management system (QMS) by monitoring biological hazards to improve the hazard analysis of HACCP in yogurt processing plants. Azucena Domínguez et al. (2021) proposed a lean 6S-HACCP model for food industrial production. Fuschi (2017) created an integrated quality management system (IQMs) for food enterprises based on ISO 9000 and HACCP principles, so that food enterprises can meet the requirements of today's market and ensure competitive product production.

Santos et al. (2021) proposed to integrate ISO 14001, ISO 9001 and ISO 22000 to show that the manufacturing industry of the food industry is maturing. While Gianni et al. (2017b) found integrated management systems can provide the necessary framework for the management of corporate sustainability. At the same time, integrate the traceability

system and supply chain management system, and use traceability data to manage business processes can improve competitive advantage and performance (Wang and Li, 2006).

Quality management and performance in the food industry

Research on quality management and organizational performance has always been a hot topic, while in the food industry, the research has mainly focused on the last decade.

Many models proposed by researchers were related to specific performance measurement. Partalidou et al. (2020) reported that TQM, Lean and Six Sigma positively affect the financial performance in food companies. Meanwhile, Zainal et al. (2018) showed that the TQM, Lean and HACCP significantly influenced the production performance. Danyen & Callychurn (2015) indicated that successful implementation of TQM in Mauritian food manufacturing companies had a significant and positive impact on operational performance and quality performance.

The standards, such as ISO 9000 and ISO 14000 are increasingly used in different industrial sectors for improving operational performance (Corbett and Yeung, 2008). The joint effective implementation of ISO 9001 and ISO 22000 has a positive and significant relationship with the competitive performance in the food companies who are certified.

Hong et al., (2020) mentioned that quality management has a significant positive effect on the quality safety performance and sales performance. Pipatprapa et al. (2016) indicated that quality management has a significantly positive effect on environmental performance of the enterprise, as well as green performance (Pipatprapa et al., 2017).

4.3.2 Focus on benefits and constraints of quality management systems adoption in the food sector

The goal of all quality management systems implemented by food manufacturing and processing enterprises, is to produce safe food products that meet the manufacturers' specifications, including the government established requirements (Ahmed, Ahmed, and Salman, 2005). The QM mainly includes TQM, ISO, quality control, food safety management system, the BRC and other standards or practices.

In general, food companies have benefited a lot from the implementation of quality management, the most important benefit is the access to the new markets (Barbancho-Maya and López-Toro, 2022). In addition, as Ruales Guzman and Castellanos Dominguez (2022) have revealed, after the implementation of quality management, all productivity indicators of the Colombian dairy industry have changed. According to research, all successful organizations have adopted one or another form of total quality management (TQM) (Yin et al. 2018). For example, TQM has become one of the cornerstones of quality management in Malaysia's food industry. Kristianto et al. (2012) found that through the adopting of TQM, customer satisfaction has steadily improved in three years.

Bobe and Toma (2019) emphasized the importance of food safety management systems in the production of high-quality food. Food producers can implement standardized production methods to ensure the production of high-quality products. By using the standard, the companies could formalize monitoring procedures and improve planning, procurement, manufacturing, and delivery efficiency, increase customer satisfaction, market share and inventory turnover, so as to promote a common method of safety and quality for food products. Casolani et al. (2018) found that the application of ISO 22000 could improve business opportunities and internal procedures of food enterprises, while ISO 9001 offers supply chain management benefits (Wilcock and Boys, 2017). Many managers believed that the implementation of more quality control procedures help improve quality, productivity and export capacity (Chaudhry, Tamimi, and Betton, 1997). The use and implementation of BRC and IFS were crucial to ensure the food quality and safety (Zrodlo-Loda, 2013).

The motivation for QM implementation is to comply with the law (Rendon-Benavides et al., 2022) Although the legislative requirements are the main driving force, there are still some constraints in the implementation. The most important obstacle is the high cost of adopting a quality system within the company, especially for small companies in a developing institutional environment. Casolani et al. (2018) mentioned that the main obstacles to implementation are related to changes in internal organization and the costs involved in certification. For companies that implement HACCP and ISO 9000 at the same time, two major obstacles are mentioned, namely, resistance to change and fear of documents (Nguyen, Wilcock, and Aung, 2004).

4.3.3 Focus on QM tools and techniques

The CSFs of quality management in the food industry

The conceptual framework for Critical Successful Factors (CSFs) was not recently conceived; it can be dating back to 1978. It was pioneered by John F. Rockart, who first introduced the concept of CSFs to the level of management tools (Reinaldo et al. 2020). CSFs support the achievement of the goals for the organization (G. Singh and Singh, 2020). CSFs can also be the variables that provide the greatest value to customers and the best variable to differentiate competitors in a particular industry.

Azalanazllay and Halim-Lim (2020) observed that Lean Six Sigma (LSS) in the food sector is still far behind other manufacturing and service sectors, so they focused on finding the CSFs of the LSS and identified the factors that influencing the readiness of LSS implementation in the food processing industry (Azalanazllay et al., 2020) .

Talib et al. (2014) explored the CSFs of quality management practices in the food processing SMEs in Malaysia, such as leadership, information management and customer focus etc. Psomas et al. (2010) indicated that market benefits come from customer satisfaction and internal quality improvement. Stanojeska et al. (2020) emphasized the role of the top management in quality management, on the other hand, employee participation is one of the main prerequisites. Krommuang and Suwunnamek (2015) showed that the improvement of employee participation has a positive impact on the application of quality management practice.

Implementation related usage of statistical tools/techniques

In order to evaluate the quality of products, it is best to use different quality management methods and tools (Dziuba, Ingaldi, and Kadlubek 2016), as quality management tools allow the collection and processing of data about events, situations and processes in the organization and its environment, which are related to all aspects of quality management. Using statistical methods and other quantitative methods of quality management can improve product quality, services, and process, as well as improve organizational performance and decision-making process (A. B. Santos and Antonelli, 2011).

Dudin et al. (2017) mentioned that Deming Cycle and the Balanced Scorecard tools can be used to monitor the effectiveness of the implementation of quality management under the given conditions. Strotmann et al. (2017) also adopted PDCA (Plan–Do–Check–Act) cycle in 15 food companies, a participatory approach was used and the employees were brought into the process of formulating and implementing measures to deal with food waste. Cotrim et al. (2018) believed that the use of quality management tools provides much-needed support for the implementation of cleaner production in an industry in the food sector. Control charts are a basis for process monitoring and improvement. Vicentin et al. (2018) developed a kind of control charts which would be an efficient tool for customers who continuously receive supplier product batches and need to statistically monitor the key quality parameters.

5. Discussion and implications

5.1 Significant findings

This is the first time to review in detail the three selected research flows, covering the quality management models, frameworks, benefits and constraints of implementation, and the evolution of quality tools and techniques in the food industry in the past three decades. This study shows that although the initial research on quality management in the food industry was mainly concentrated in the USA, UK and other developed countries, it is now implemented in all regions of the world, and the research interest has continued. Even today, papers on the application of quality management from different articles in the food industry are still published. Although literature on quality management in the food industry in developing countries was very few in the first 15 years (only 3 of the 22 articles), the research began to increase gradually in the next 15 years, accounting for 50% of the total research (40 of 80 articles). This study shows that the contribution of developing countries such as Asia and South America to the quality management literature of the food industry is about 42% (43 of 102 articles in the past 30 years), and it has continued to grow in the past decade.

5.2 Future research

In this literature review it mentioned a variety of models and frameworks, one or integrated models/frameworks can be used in food enterprises which will bring about the improvement of performance, and meanwhile the performance can be measured by statistical quality tools and techniques. However, for some small and medium-sized food

enterprises, there are still some difficulties in the implementation, such as the high cost, the complex files, etc., which cause the difficulties in the implementation. How to further integrate and simplify the models/ frameworks and tool/techniques in the field of quality management to make it more convenient to use in the food industry, make the most of the advantages in implementing quality management, and constantly overcome various constraints will be the focus of the future research.

5.3 Implications

The research on quality management in the field of food industry was systematically reviewed. This study is helpful for researchers to understand the current research situation and formulate appropriate research questions according to the gaps identified. This study analyzed the current situation of frameworks and models, which is beneficial for food practitioners to select appropriate framework or model to implement and improve food quality management in the food industry. The study is also helpful to understand the progress of food quality management practices in different regions across the time period. This study summarized the tools and techniques of quality management which helps to select and implement an appropriate set of quality management tool and techniques to solve problems. After understanding the benefits and obstacles in the implementation process, the study also provides food practitioners with confidence to implement quality management in the food industry and achieve substantial results.

6. Conclusion

In the past three decades, there have been an endless stream of articles on the application of quality management in the food industry around the world, which shows the importance and relevance of this field to the food industry even today. Although the selection of the article has based on the two most used databases, there are also limitations, and there could be articles from other sources that have not been reviewed. There could also be some mistakes in the classification of research methodologies. Nevertheless, it believes that there is enough information in the research findings for future researchers in this field. In general, the three research streams as part of this study and research results could provide useful references for researchers and users.

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