Weaponizing Cost of Quality of Food Manufacturers: Implications for Organizational Performance

Ayham A.M. Jaaron
Senior Lecturer in Business and Management
Department of Management and Entrepreneurship
The Centre for Enterprise and Innovation, Leicester Castle Business School
De Montfort University, Leicester, LE2 7BY
United Kingdom
Ayham.jaaron@dmu.ac.uk

Niveen Mohammed Ghunaim
Quality Management Program, Faculty of Graduate Studies,
Arab American University, West Bank, Palestine
niveen87@hotmail.com

Abstract

Owing to the current business environment, food manufacturers must provide high-quality products while simultaneously providing competitive prices for their customers. Cost of quality (COQ) can play a crucial role in fostering organizational competitive performance through reduced costs. The aim of this paper is to analyze the interrelationship between the application of COQ and organizational performance in the context of Palestinian Food Manufacturing Organizations (PFMO). The study employs a questionnaire through which data is collected from 119 PFMO. The collected data is analyzed using the partial least square structural equation modeling (PLS-SEM) technique. The results of this study suggest that application of COQ practices has a strong effect on the organizational performance of PFMO. External, internal, and prevention costs were all found to have a positive impact on organizational performance of PFMO. However, appraisal cost has no impact on organizational performance. The study provides significant value to quality management literature on the role of COQ practices in enhancing performance of food manufacturers in a developing country context and responds to calls for enhancing organizational efficiency in today's complex business environments.

Keywords
Total Quality Management, Cost of Quality, Food Manufacturing, Developing Countries and Organizational Performance.

1. Introduction
It is widely supported that Total Quality Management (TQM) boost companies' capabilities to produce reliable products and services based on continuous improvement techniques (Herzallah et al. 2017). Therefore, TQM is viewed by an increasing number of manufacturing organizations as a management philosophy for enhancing internal and external customer satisfaction, while improving financial performance of organizations through better management of resources (Hung and Sung 2011; Saleh et al. 2018). It is as posited by Elyazid (2016), organizational commitment or non-commitment for TQM practices entail costs that are known as cost of quality (COQ). In fact, COQ is composed of four main types: internal and external failure costs, prevention costs, and appraisal costs. This classification is essential for identifying the extent to which companies' resources are utilized by practices that foster the quality of products and services (Kefari et al. 2016; Ghanem 2018).

According to Chatzipetrou and Moschidis (2017), there is lack of understanding of the role of COQ practices in supporting food manufacturing organizations strategic goals, and that further analysis of their impact on food manufacturing organizations performance is much needed. Similarly, Kefari et al. (2016) argued that studies on the application of COQ practices in the Tunisian food manufacturing industry is quite at its infancy, and that there is noticeable lack of empirical studies around their contributions to performance of food manufacturing organizations in literature. Thus, there is a need for more studies that can explore the impact of COQ systems on the financial returns of food manufacturing organizations' quality initiatives (Omar and Murgan 2014). At a more subtle level, Rahmat et al. (2016) explained that very little is accomplished in literature on investigating the impact of COQ practices on food manufacturing organizations in the context of developing countries. In fact, food manufacturing organizations operating in both developing and developed countries are required to accommodate ever increasing customer expectations for improved food safety measures, better prices, more innovative packaging, and quicker delivery times. These are considered global challenges that exert more pressure on food manufacturing firms to keep renovating their quality management systems to meet such customer expectations and remain highly competitive (Costa et al. 2018).

Based on this, the current study investigates the interrelationships between the application of COQ practices and organizational performance in PFMO. The value of this paper is prominent as there is absence of previous studies that explores the role of quality costing systems on PFMO. In addition, this study is among the first studies to investigate the relationship between COQ application and food manufacturers organizational performance in a developing country context. The next section presents the literature review conducted around concepts of COQ and organizational performance. Next, research methodology will be explained including data collection processes and analysis techniques. This will be followed by a presentation of results of analysis and discussion. Finally, conclusions and research limitations will be provided.

2. The Cost of Quality: Concept and Categorization

According to Farooq et al. (2017), the concept of COQ was first coined in 1950 because of the work of quality gurus Juran and Feigenbaum. They were the first authors to develop the concept of estimating the COQ. They defined COQ as all the costs that would be saved by organizations if no defects were produced in the manufacturing process (Khozein et al. 2013, Farooq et al. 2017). The concept was further developed to classify COQ into four main types, namely, internal failure cost (IFC), external failure cost (EFC), prevention cost (PC), and appraisal cost (AC) (Alglawe et al. 2017). However, it is evident in literature that there is no sigle definition for the concept of COQ; therefore, literature is rife of several definitions (Elyazid 2016).

Based on the work of Chatzipetrou and Moschidis (2017), COQ can be defined as the cost of all practices and activities that will ensure that a product will meet the required specifications and customer needs.

Djekic et al. (2014) defined COQ as a measure of required level of quality or lack of quality and has demonstrated that it is useful as a method through which organizations can assess their overall performance. In addition to these, Ghanem (2018) explained that COQ is composed of all costs required to bring products into conformance to specification and costs that are associated with actions resulting in products non-conforming to specification. Generally speaking, COQ is the total costs incurred by investing in preventing non-compliance with requirements, evaluating a product or service to meet the requirements, and failing to meet the requirements (Ayah et al., 2019). Furthermore, Glogovac and Filipovic (2018) pointed out that quality cost management is one of the most important features of quality management system and its application has proven to provide scope for organizational improvement. Based on the work of Kerfai et al. (2016), COQ can be explained through its four main types mentioned earlier. Table 1 presents the costs belonging to each category, and these are discussed in more details below.

- **PC:** this category includes all costs associated with activities aimed at preventing non-conformity from occurring (Psomas et al. 2018). In other words, the cost required to ensure that quality requirements will be met (Ayach et al. 2019). PC practices include planning costs, applying quality control system, and implementing quality improvement initiatives (Farooq et al. 2017). Other costs included in this type of COQ are activities related to quality planning, product design improvement projects, purchasing of quality control devices or tools for quality assurance laboratories, customer feedback and satisfaction analysis, staff training and development programs, and quality software developments (Lari and Asllani 2013). These costs arise because of efforts and activities aimed at doing what is right for the first time. In short, it aims to prevent the production of poor-quality products (Plewa et al. 2016).

- **AC:** this includes the costs of conducting testing of devices and tools, costs of sample measurements and evaluation, and other measurements related to consistency of quality. This type of COQ also involves inspection of materials delivered by suppliers, checking quantities and dimensions, process, or service audits, testing lab equipment for accuracy, and supplier facilities surveillance and monitoring (Khozein et al. 2013). They include also costs of purchasing of devices and equipment used in quality inspection in general (Ghanem 2018). Other costs such as tests conducted by outsourced laboratories to evaluate the quality of purchased raw materials are included in this type (Farooq et al. 2017). In addition, other costs associated with stationary requirement incurred in the recording of measurement or laboratory tests are also part of AC. Furthermore, they include the cost of time that personnel spend on maintenance activities and equipment depreciation costs (Dujaili 2013; Alglawe et al. 2017).

Table 1. Categories of COQ. Source: Farooq et al. (2017)

Prevention	**Appraisal**	**Internal Failure**	**External Failure**
Design and development of equipment	Cost of testing equipment	Scrap	Lost revenue/sales
Quality review and supplier quality audits	Laboratory testing and Inspection	Rework and renovate	Loss of goodwill
Maintenance and calibration of production and inspection equipment	In-process inspection	Rescheduling due to Downtime	Warranty costs
Quality training (Seminars and workshops)	Field testing (Performance tests)	Downgrading	Cost of complaints
Quality improvement Programs	Final inspection (100%/sampling inspections)	Overtime to cover up production losses	Product recalls

- **IFC:** In this type of COQ, all costs of activities related with products that do not match quality requirements are calculated (Pattanayak et al. 2019). Internal failure costs are costs associated with replacing and repairing defective products before they are delivered to a customer. Therefore, IFC is extremely importance to prevent products not matching quality requirement from reaching customers. Also, labor, extra materials, scrap, and other resources consumed in repairing the defective products represent an essential part of IFC (Ahmad et al. 2015).

- **EFC:** this type of costs occurs when defects existed is delivered to the customer by mistake (Ahmad et al. 2015). EFC increases as the number of defective units delivered to markets increase (Chopra and Singh 2015). As it would be expected, these costs include complaints costs in warranty resulting from failed products replaced, or services re-performed under certain forms of guarantee. The cost of a complaint in the warranty is associated with investigation, repair, and replacement. These costs are resulting from resources consumed in the process of resolving customer complaints (Al-Dujaili 2013). In addition, product liability costs are part of the EFC as some customers may sue the company if the products they buy are of low quality (Diefenbach et al. 2018). Therefore, the company's future sales are likely to decline due to its poor reputation. These costs are hidden costs because it is extremely difficult to estimate (Chatzipetro and Moschidis 2017).

3. Impact of COQ on Organizational Performance

According to Lari and Asllani (2013), COQ systems are crucial for organizational performance as they allow an organization to develop a measurement system through which process monitoring and controlling can be achieved. Similarly, Diefenbach et al. (2018) explained that COQ system can be used as a tool to reduce organizational overall operational costs and, thus, COQ can contribute to organizational financial performance targets. In fact, Guinot et al. (2016) found that COQ offered automobile manufacturers an opportunity to increase their new products present value due to enhanced quality of their products. Their study also suggested that COQ should be used for setting priorities for necessary improvement actions to be taken to areas that are expected to cause future performance deterioration.

These findings were also supported by the work of Moschidis et al. (2018) who found that COQ provides clarity for organizational management around necessary corrective actions to maintain performance excellence and competitive advantage. This was evident in the work of Rema (2014) who asserted that the importance of COQ practices can be seen through improvement to productivity levels that can positively impact organizational bottom line. It is, therefore, obvious that COQ could be used as a tool for enhancing the overall organizational performance. This discussion has allowed for the formulation of the following hypothesis:

H1: COQ practices have a significant positive relationship with PFMO performance.

However, Bayram and Ünğan (2020) illustrated that the application of COQ can become an organizational weapon to improve processes before failure through the lens of PC. According to authors, PC practices are essential for enhancing organizational learning capabilities and performance. This view was also shared by Ayach et al. (2019) who found that PC and AC activities have the power to reduce overall quality costs of manufacturing systems and concluded that such activities are linked with better financial performance for manufacturing organizations. In fact, the work of Teli et al. (2013) provided evidence that elimination of causes of failures as part of the COQ system in the production system can play a major role in enhancing productivity and, thus, meeting customer demands on time. According to authors, cause and effect analysis techniques coupled with a PC activities system can reduce cost of poor quality. Based on this discussion, the following hypothesis is proposed:

H2: PC have a significant positive relationship with PFMO performance.

Shin et al. (2018) discussed the importance of investing in AC. Authors explained that practices such as equipment testing, materials inspection, laboratory testing play a significant part of the scrap and waste reduction struggle within manufacturing organizations. This would imply that AC practices are strongly linked with reduced customer complaints and loss of customers. In the same vein, Akenbor (2014) argued that customer satisfaction is dramatically impacted by an increase in number of products that are non-confirming to quality requirements and suggested that AC application is a must to enhance organizational image and reputation as it is necessary to reduce number of failures. However, even though the complete elimination of AC in manufacturing organizations is impossible, their impact on organizational attempts for achieving competitive advantage is essential (Sturm et al., 2019). This view was reflected by the work of Reema (2014) who asserted that manufacturing quality managers should not underestimate the value of investing in AC, as their application can result in reducing number of failure occurrences. This would suggest that less failures can enhance organizational waste reduction efforts and competitiveness (Ayach et al., 2019). Based on these views, the following hypothesis is presented:

H3: AC have a significant positive relationship with PFMO performance.

Based on the work of Cermakova and Bris (2017), it was asserted that IFC and EFC of a COQ system have great potential for organizational performance enhancement. This was evident in the work of Guinot et al. (2017) who explained that IFC and EFC are particularly important for maintaining high quality products low-cost products for customers. According to authors, IFC and EFC resemble a measure of the organizational capability to delivery adequate quality level, and it is also an indicator that PC and AC are adequately applied. However, Kerfai et al. (2016) also indicated that organizations can better control their operational costs when they apply IFC and EFC within a well-designed COQ system. Furthermore, Akenbor (2014) confirmed that tracking internal and external failure costs has several benefits to organizations including customer satisfaction, reduces complaints, and improved market demands satisfaction. Consequently, the following two hypotheses are proposed:

H4: EFC have a negative relationship with PFMO performance.
H5: IFC have a negative relationship with PFMO performance.

The above formulated hypotheses were integrated in a research conceptual model as shown in Figure 1.

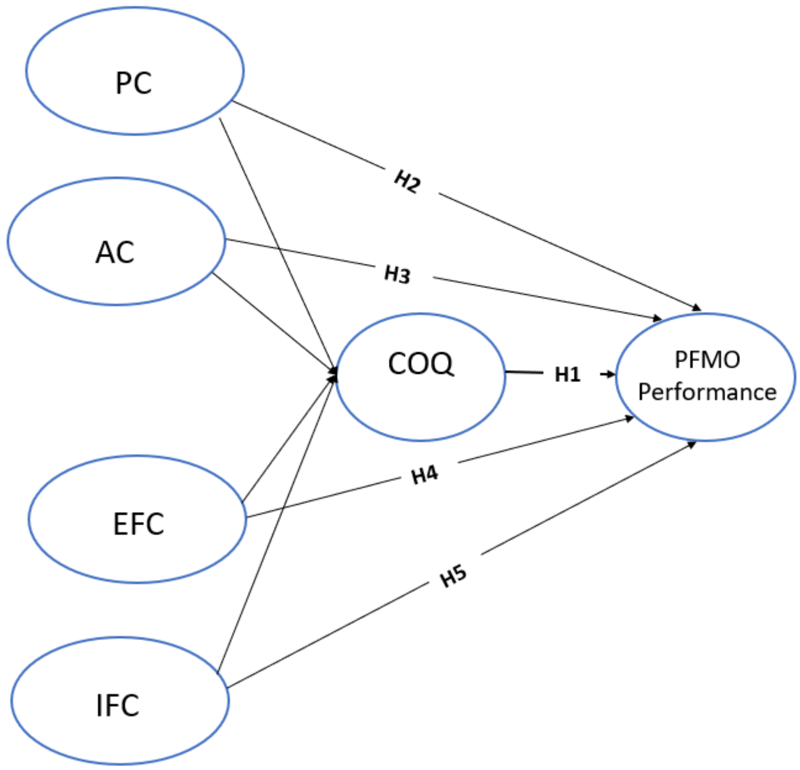

Figure 1. Research conceptual model

4. Research Methods

A quantitative research methodology using a survey instrument was employed in this research inquiry. Literature review of similar previous studies allowed for the identification of survey items, COQ practices, and organizational performance indicators to be investigated. In total, there are four main parts of the survey. The first part contained 10 items and covered demographic information of respondents. A second part contained 22 items and covered the COQ practices. A third part contained 20 items and provided items and covered organizational performance indicators. Finally, the fourth part was a note box to allow respondents to share any other remarks they might find necessary. A 1-5 Likert scale was used in the survey with 1 reflected “not at all” practice, whereas 5 reflected “to a very great extent” practice.

At the time of the study, 167 PFMO were found to match the selection criterion for this research. The selection criterion stated that only those PFMO that are licensed by Palestinian Authorities and has a quality function or a quality officer. Based on this number, the minimum required sample was calculated to be 117. The questionnaire was sent over email and in person to the 167 PFMO in the population, and 119 complete and valid surveys were returned. This provided a response rate of 72.4%. However, data collected in this research was analyzed using partial least square structural equation modelling technique (PLS-SEM).

5. Results and Discussion

To assess the measurement model Cronbach’s alpha, internal consistency, and composite reliability (CR) values were assessed. It was found that all values were above 0.60, which reflects an acceptable internal consistency of the measurement model. In addition, the average variance extracted (AVE) values were also calculated. All values of AVE were above the value of 0.5 which are considered sufficient (Hair et al. 2014).
Table 2 summarizes the main results of the measurement model.

Table 2. Main results of the measurement model.

First order latent variable	Second order latent variable	AVE	CR
COQ	PC	0.614	0.917
	AC	0.697	0.920
	IFC	0.637	0.898
	EFC	0.658	0.906
OP	FP	0.517	0.809
	CP	0.629	0.894
	IP	0.700	0.921
	LGP	0.756	0.939

However, for the purpose of assessing the structural model in this study and to validate the proposed hypotheses, it was deemed necessary to assess the latent variable's path coefficients (Hair et al. 2011). Based on the work of Hair et al. (2016), the path coefficients must be higher 0.100 to reflect a specific effect inside the model and be significant at the 0.05 value. Table 3 shows the standard beta, T-Values, standard error, and P-Values. In addition, Figure 2 shows P-Values for the blindfolding model generated by Smart-PLS.

Table 3. Path Coefficients - Results of Hypotheses Testing

No	***Hypotheses***	***Std. Beta***	***Std. Error***	***T-Value***	***P-Values***	***Decision***
H1	COQ -> PFMO Performance	0.827	0.186	4.458	**0.000**	**Supported****
H2	PC -> PFMO Performance	0.372	0.097	3.812	**0.000**	**Supported****
H3	AC -> PFMO Performance	0.082	0.075	1.102	**0.270**	**Not Support**
H4	EFC -> PFMO Performance	-0.278	0.094	2.939	**0.003**	**Supported****
H5	IFC -> PFMO Performance	-0.313	0.078	4.040	**0.000**	**Supported****

The results shown in Table 3 indicate that four hypotheses are supported (i.e., H1, H.2, H4, and 5). However, H3 testing the relationship between AC and PFMO performance was not supported.

The results achieved have shown a positive and strong relationship between COQ and PFMO performance (i.e., H1). This is in line with various recent studies such as Ghanem (2018) and Kerfai et al. (2016) who found that COQ practices promote procedures for cost control and financial improvement. The result is also congruent with the work of Modhiya and Desai's (2016) who stated that COQ has the potential to reduce customer complaints because of reducing defects and after sale malfunctions. However, the results also show that PC has a positive and strong relationship with PFMO performance (i.e., H2). In fact, when increasing PC, it is expected that IFC and EFC will be reduced. Subsequently, this will mean that organizations can increase their products quality levels and competitiveness. This will, in turn, foster customer satisfaction levels and brand image that are all necessary for improving PFMO performance (Psomas et al. 2018; Ayach et al. 2019). The results are also in congruence with the findings of Kerfai et al. (2016), who discussed that PC activities such as employees training will automatically increase organizational learning and growth performance. According to authors, learning and growth is among the most important organizational performance indicators. However, results show that the third hypothesis (i.e., H3) testing the positive relationship between AC and PFMO performance was not supported. This was in contradiction to what was found by several scholars such as Ayach et al. (2019), Ahmad et al. (2015), and Kerfai et al. (2016) and several others. This contradictory result reported here can be understood through the type of structure followed by PFMO. PFMO follow a top-down structure where managers are the center of the decision-making process and employees have little freedom to change sources of errors or failures. Thus, AC in these organizations remove bad products but does not remove the cause of the error. Furthermore, the results of the last two hypotheses (i.e., H4 and H5) were widely supported by literature. For example, Chopra and Singh (2015) explained that increasing EFC and IFC is a measure of the number of resources wasted and additional costs incurred by the organization. That was also evident in the work of Kerfai et al. (2016) who concluded that organizational performance can be improved when IFC and EFC are reduced.

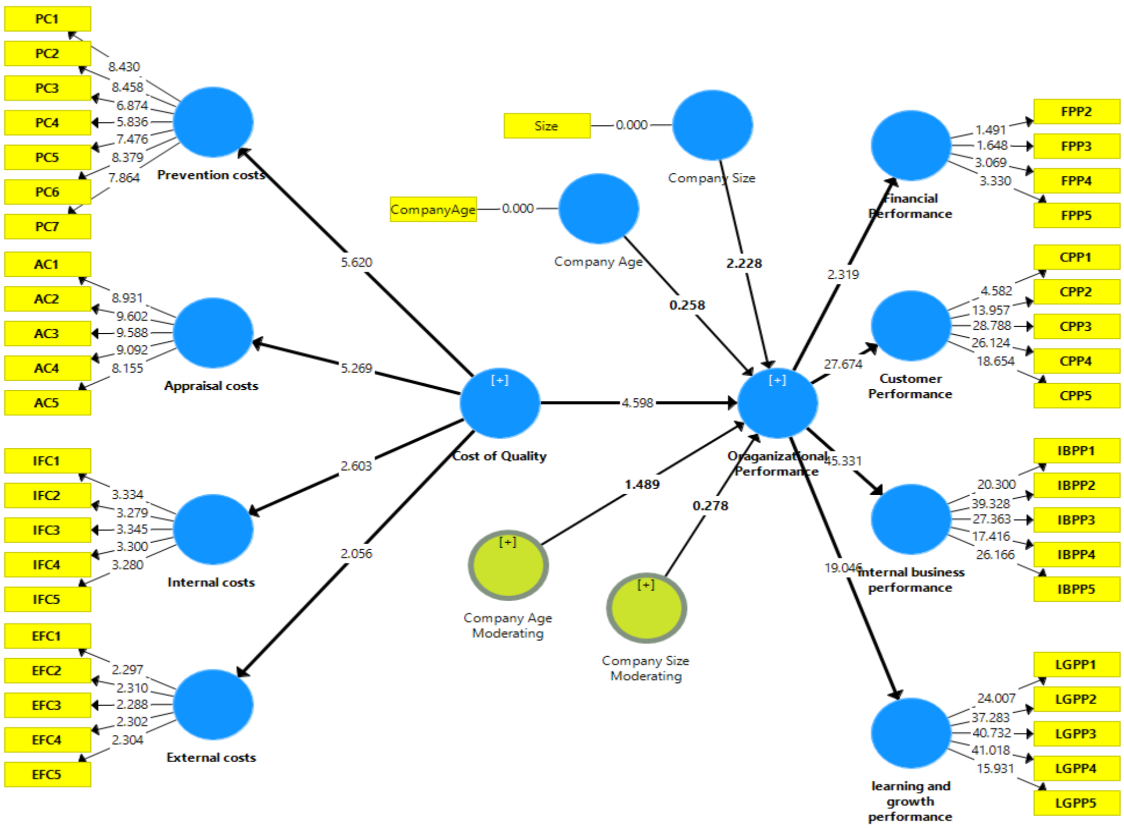

Figure 2. P-values of structural model generated by SmartPLS

6. Conclusion

The current study provided a critical investigation of the interrelationships between the application of COQ practices and organizational performance in PFMO. This study confirmed a strong relationship between COQ and PFMO performance. It was also confirmed that PC, EFC, and IFC all have a strong relationship with PFMO performance. The only relationship that was not supported is the relationship between AC and PFMO performance. In addition to the new insights that this paper provides on the investigated relationships in the context of developing countries, it has interesting theoretical and practical contributions. The current study provides evidence on the need for mangers to invest more in PC such as customer analysis, quality planning activities, and training of employees. Consequently, this can help managers to dramatically reduce IFC and EFC that can increase competitive advantage. The paper also theorizes the concept of COQ with food manufacturing industry in the context of developing countries for the first time. This theorization also provided empirical evidence about the role of COQ practices in boosting organizational performance in the food manufacturing sector. Therefore, it is essential that future research work consider replicating this study in other food manufacturing organizations in other developing countries to confirm and compare results. It would also be worthy to replicate this study through applying longitudinal research methods to capture the changes in organizational performance indicators over a long period of time. Finally, future studies may consider the inclusion of the customer voice in the tested relationships to investigate their perception of organizational performance improvements.

References

Ahmad, S., Pesch, M. J., and Gulati, R., *Cost of quality: Lessons from toy recalls*, Journal of International Business Research, vol. 14, pp. 1-14, 2015.

Alglawe, A., Schiffauerova, A., and Kuzgunkaya, O., *Analysing the cost of quality within a supply chain using system dynamics approach*, Total Quality Management & Business Excellence, vol. 30, pp. 1630-1653, 2017.

Akenbor, C. O., *An accounting reflection of quality cost and customer satisfaction of health products in Nigeria*. Journal of Business and Retail Management Research, vol. 8, pp. 42-53, 2014.

Ayach, L., Anouar, A., and Bouzziri, M., *Quality cost management in Moroccan industrial companies: Empirical study*, Journal of Industrial Engineering and Management, vol. 12, pp. 97-114, 2019.

Bayram, M. and Üngan, M.C., *The relationships between OHS prevention costs, OHSMS practices, employee satisfaction, OHS performance and accident costs,* Total Quality Management & Business Excellence, vol. 31, pp. 1325-1344, 2020.

Cermakova, C. and Bris, P., *Managing the costs of quality in a Czech manufacturing company*. Scientific Papers of the University of Pardubice. Series D, Faculty of Economics and Administration, vol. 25, pp. 6-18, 2017.

Chatzipetrou, E., and Moschidis, O., *An exploratory analysis of quality costing in Greek F&B enterprises*, The TQM Journal, vol. 29, pp. 324-341, 2017.

Chopra, A., and Singh, B. J., *Unleashing a decisive approach to manage quality costs through behavioural investigation*, Business Process Management Journal., vol. 21, pp. 1206-1223, 2015.

Costa, L.B.M., Filho, M.G., Fredendall, L.D., and Paredes, F.J.G., *Lean, six sigma and lean six sigma in the food industry: A systematic literature review*, Trends in Food Science & Technology, vol. 82, pp. 122- 133, 2018.

Diefenbach, U., Wald, A., and Gleich, R., *Between cost and benefit: investigating effects of cost management control systems on cost efficiency and organisational performance*, Journal of Management Control, vol. 29, pp. 63–89, 2018.

Djekic, I., Zaric, V., and Tomic, J., *Quality costs in a fruit processing company: a case study of a Serbian company*, Quality Assurance and Safety of Crops & Foods, vol. 6, pp. 95-103, 2014.

Elyazid, S., *Performance Measurement: Quality, Cost, and Time Is New System: So Called Strategic Cost Management,* Research Journal of Finance and Accounting, vol. 7, pp. 1-11, 2016.

Farooq, M. A., Kirchain, R., Novoa, H., and Araujo, A., *Cost of quality: Evaluating cost-quality trade-offs for inspection strategies of manufacturing processes*, International Journal of Production Economics, vol. 188, pp. 156-166, 2017.

Ghanem, F. A., *Cost of quality ad a tool to improve the Palestinian industrial organization competitive advantage*, International Journal of business quantitative economics and applied management research, vol. 4, pp. 35-53, 2018.

Glogovac, M., and Filipovic, J., *Quality costs in practice and an analysis of the factors affecting quality cost management,* Total Quality Management & Business Excellence, vol. 29, pp. 1521-1544, 2018.

Guinot, J., Sinn, J.W., Badar, M.A. and Ulmer, J.M., *Cost consequence of failure in failure mode and effect analysis*, *International Journal of Quality & Reliability Management*, vol.34, pp. 1318-1342, 2017.

Guinot, J., Evans, D. and Badar, M.A., *Cost of quality consideration following product launch in a present worth assessment, International Journal of Quality & Reliability Management*, vol. 33, pp. 399-413, 2016

Hair Jr, J. F., Hult, G. T. M., Ringle, C., and Sarstedt, M*., A primer on partial least squares structural equation modeling (PLS-SEM).* Thousand Oaks, California: Sage publications, 2016.

Hair, J. F., Ringle, C. M., and Sarstedt, M., *PLS-SEM: Indeed a silver bullet,* Journal of Marketing theory and Practice, vol. 19, pp. 139-152, 2011.

Hair Jr, J. F., Sarstedt, M., Hopkins, L., and Kuppelwieser, V. G*., Partial least squares structural equation modeling (PLS-SEM),* European business review, vol. 26, pp. 106-121, 2014.

Herzallah, A. M., Gutiérrez-Gutiérrez, L., and Munoz Rosas, J. F., *Total quality management practices, competitive strategies and financial performance: the case of the Palestinian industrial SMEs*, Total Quality Management & Business Excellence, vol. 25, pp. 635-649, 2014.

Kerfai, N., Ghadhab, B. B., and Malouche, D., *Performance measurement and quality costing in Tunisian manufacturing companies,* The TQM Journal, vol. 28, pp. 588-596, 2016.

Khozein, A., Mohammadi, J., and Abbasi Zarmehri, M., *Cost of quality and quality optimization in manufacturing*, European Online Journal of Natural and Social Sciences, vol. 2, pp. 1070-1081, 2013.

Lari, A., and Asllani, A., *Quality cost management support system: an effective tool for organisational performance improvement,* Total Quality Management & Business Excellence, vol. 24, pp. 432-451, 2013.

Modhiya, S. and Desai, D., *A review on cost of quality methodology and hidden costs in manufacturing industries*, REST Journal on Emerging trends in Modelling & Manufacturing, vol. 2, pp. 87-94, 2016.

Moschidis, O., Chatzipetrou, E., and Tsiotras, G., *Quality costing and quality management maturity in Greece: An exploratory multi-dimensional data analysis,* International Journal of Productivity and Performance Management, vol. 67, pp. 171-191, 2016.

Omar, M. K. and Murgan, S., *An improved model for the cost of quality*, *International Journal of Quality & Reliability Management*, vol. 31, pp. 395-418, 2014.

Pattanayak, A.K., Prakash, A. and Mohanty, R.P*., Risk analysis of estimates for cost of quality in supply chain: a case study*, Production Planning & Control, vol. 30, pp.299-314, 2019.

Plewa, M., Kaiser, G., and Hartmann, E., *Is quality still free? Empirical evidence on quality cost in modern manufacturing*, International Journal of Quality & Reliability Management. Vol. 33, pp. 1270-1285, 2016.

Psomas, E., Dimitrantzou, C., Vouzas, F., and Bouranta, N., *Cost of quality measurement in food manufacturing companies: the Greek case,* International Journal of Productivity and Performance Management, vol. 67, pp. 1882-1900, 2018

Rahmat, S.; Cheong, C.B. and Abd Hamid, M.S., *Challenges of Developing Countries in Complying Quality and Enhancing Standards in Food Industries,* Procedia - Social and Behavioral Sciences, vol. 224, pp. 445-451, 2016.

Rema, S., *Modeling Cost of Quality in the Construction Industry A closer look at the Procurement Process using System Dynamics*, Doctoral dissertation, Concordia University, Canada, 2014.

Saleh, R.A., Sweis, R.J., and Mahmoud Saleh, F.I., *Investigating the impact of hard total quality management practices on operational performance in manufacturing organizations: Evidence from Jordan*, *Benchmarking: An International Journal*, vol. 25, pp. 2040-2064, 2018.

Shin, W.S., Dahlgaard, J.J., Dahlgaard-Park, S.M., and Kim, M.G., *A Quality Scorecard for the era of Industry 4.0,* Total Quality Management & Business Excellence, vol. 29, pp. 959-976, 2018.

Sturm, S., Kaiser, G., and Hartmann, E., *Long-run dynamics between cost of quality and quality performance dynamics,* International Journal of Quality & Reliability Management, vol. 36, pp. 1438-1453, 2019.

Teli, S.N., Majali, V.S., Bhushi, U.M. et al*., Cost of Poor Quality Analysis for Automobile Industry: A Case Study*, J. Inst. Eng. India Ser., vol. 94, pp. 373–384, 2013.

Biographies

Ayham Jaaron, Ph.D., CMBE, PGCAP, MCMI, FHEA is an experienced Senior Lecturer in Business and management at the Department of Management and Entrepreneurship of De Montfort University, UK. Before this, he was an Associate Professor in Industrial Engineering at An-Najah national University in Palestine 2010-2019. During this time, Ayham served as Head of Industrial Engineering Department for three consecutive years 2011-2014, and also served as Director of Quality Assurance Unit of the University 2014-2016. Ayham is recognized for his expertise and contributions to the quality of education in Palestine. He led the largest ABET Accreditation project in the region for seven engineering programs simultaneously at An-Najah National University, that resulted in a successful ABET Accreditation process. He received his PhD degree (full time) in Manufacturing Engineering and Operations Management from the Wolfson School of Mechanical and Manufacturing Engineering, Loughborough University in 2010. Ayham is a Member of the Chartered Management Institute (MCMI) and a Certified Management and Business Educator (CMBE). He is also an Associate Fellow with Advance HE. Ayham's multidisciplinary high-quality research has introduced him as a leading researcher with an established and growing national and international profile in his research areas. Ayham's research activities have recently focused on the intersection between the areas of service operations management, logistics and supply chain management, organizational sustainable performance, service quality, industry 4.0 and sustainability, organizational resilience, systems thinking, and green human resources management in the manufacturing and service sectors.

Niveen Ghunaim, M.A. received her Master's in Quality Management in 2020 from the Arab American University in Palestine. Her primary research areas are quality management systems, TQM, cost of quality in the manufacturing sector. Her latest research work appears in the TQM journal and the repository of the Arab American University in Palestine.