An Exploratory Analysis of Quality Costing in Greek Food and Beverage Enterprises

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Abstract

Purpose – Given the fact that the Greek Food and Beverage (F&B) sector, along with the Tourism sector, is the basis of Greek economy, this paper attempts to depict the extent to which Greek F&B enterprises have embraced Quality Costing, as a means toward economic development and quality assurance. Since no previous research has taken place in this area, the paper aims to analyze whether the Quality Costing approach has been adopted, in order to achieve quality improvement and a reduction of production costs.

Methodology – As the variables in this research are mostly nominal, and no similar work has been previously conducted in Greece, an exploratory approach is adopted, specifically Multiple Correspondence Analysis. This approach enables the researcher not only to analyze the phenomenon in a more holistic way, but also to highlight potential issues and questions that have not been previously identified.

Findings - The research concludes that Greek F&B enterprises have not yet accepted the assumption that Quality Costing leads to a reduction of production costs and to quality improvement. Furthermore, a second analysis highlights that 'Turnover' and 'ISO-HACCP systems' are the most dominant demographic variables, which have a direct relationship to Prevention and Internal Failure Costs.

Originality/Value – Since the Greek F&B industry constitutes the larger 'employer' of domestic Manufacturing, this research sheds light on the role that Quality Costing plays in the development and success of the Greek F&B sector, by exploring the approach that has been adopted by F&B enterprises, as well as the economic outcome of this process.

Keywords: Quality Costing, PAF Model, Greek F&B Enterprises, Exploratory Data Analysis, Multiple Correspondence Analysis.

Introduction

The term Quality Costing is not new in the literature surrounding the depiction and analysis of world-class Manufacturing. The major role that Cost of Quality (CoQ) plays in the continuous improvement process of manufacturing companies has been largely analyzed and its importance emphasized (Ahmed Al-Dujaili, 2013; Dale and Plunkett, 1999). The work of Juran (1951), Feigenbaum (1956, 1991) and other gurus on the Quality Cost models has been implemented in numerous cases, where researchers focused on quality costs and the impact of their analysis in the Manufacturing sector. A thorough examination of the relevant literature, however, led us to the ascertainment that there existed a lack of attention to the Food and Beverage (F&B) industry, as far as the Quality Costing analysis is concerned. There is not ample evidence on the extent to which F&B enterprises are familiar with and/or implement any of the known Cost of Quality models that are in use in the majority of the Manufacturing sector. Especially in the case of Greece, there is almost no indication in the literature that Quality Costing in the F&B sector is implemented or even heard of. According to a recent survey conducted among 159 Greek supermarkets (Chatzipetrou and Moshidis, 2016), limited answers were given on the scale of Cost of Quality. The results showed that, even in supermarkets that have implemented Cost of Quality systems, Cost of Quality as a percentage of annual sales was below 5%.

The Food and Beverage industry in Greece covers almost one fifth (21,2%) of the Greek Manufacturing sector, followed by Metal Products (14,9%) and Clothing (12%). At the same time, it constitutes the larger 'employer' of domestic Manufacturing, since one fourth (25,2%) of the total workforce in Manufacturing is

employed in F&B. Furthermore, as far as the annual Turnover is concerned, the F&B sector is at the second place, with 19.7% of the total Manufacturing Turnover.

It is interesting to note, however, that in terms of company numbers, the 'micro' or very small companies (i.e. the ones with less than 10 employees) cover 94% of the Food sector and 87% of the Beverage sector. On the other hand, in terms of Turnover, the large companies (i.e. with more than 250 employers) of the Food sector reach 36.8%, while the large companies of the Beverage sector reach 56.5%. At the same time, the very small companies cover 18.6% of the total Food Turnover and 8.5% of the total Beverage Turnover (*source: Foundation for Economic and Industrial Research, Food and Beverages Industry, Facts and Figures 2014,www.iobe.gr).*

The categorization of companies follows the Definition of Micro, Small and Medium-sized Enterprises adopted by the European Commission (Commission Recommendation 2003/361/EC – Figure 1).

THRESHOLDS *(Art. 2)*

Enterprise category	Headcount: Annual Work Unit (AWU)	Annual turnover	or	Annual balance sheet total
Medium-sized	< 250	≤ €50 million (in 1996 € 40 million)	or	≤ €43 million (in 1996 € 27 million)
Small	< 50	≤ €10 million (in 1996 € 7 million)	or	≤ €10 million (in 1996 €5 million)
Micro	< 10	≤ €2 million (previously not defined)	or	≤ €2 million (previously not defined)

Figure 1: Size Definition

In the present paper emphasis is placed on the Food and Beverage Manufacturing sector in Greece. Statistics show that it constitutes an important part of Greek Manufacturing industry, with a large number of employees and a significant percentage in the total manufacturing Turnover. In addition to that, it is recognized that there is a gap in literature as far as Quality Costing is concerned. Not much attention has been paid by researchers to the depiction and analysis of CoQ practices in Greek Manufacturing, and especially F&B enterprises. The main aim of the paper is to explore the extent to which Greek companies adopt and implement the PAF model in respect to certain characteristics and to depict any possible interrelations among quality cost elements. Furthermore, emphasis is put on the identification of the most important factors that could lead to the adoption of a CoQ mentality or may discourage any attempt towards its embracement.

Literature Review

'Quality Costing' was first introduced in the 1950s by Juran (1951) and Feigenbaum (1956), in an attempt to define not only the cost associated with the quality of the products but also the cost that arises when quality is not achieved (quality loss). A number of different but often complementary terms have been proposed throughout the years (Lari A. and A. Asllani, 2013; Yang, 2008; Campanella, 1999). Crosby (1979) defined it as 'the expense of nonconformance, the cost of doing things wrong' (p. 17). According to BS 6143: Part 2, it is 'the expenditure incurred by the producer, by the user and by the community associated with product or service'. Roden and Dale (2000) alternatively mention that, 'Quality Costing can be considered as a measurement of a company's performance with respect

to the process by which a product is produced or a service delivered' (p. 179). An interesting point is made by Dale and Plunkett (1999), who suggest that Quality Costing is about knowing what non-quality or poor quality is costing the organization, tracing its causes and effects, working out solutions using a range of improvement methods and monitoring progress.

The P-A-F Model is the most widely accepted model on Quality Costing. It categorizes costs under three major categories (Prevention, Appraisal and Failure Costs), and manages to capture all the costs related to the quality system and the inspection of products, as well as the costs incurred when the product fails to meet the requirements. It originates from the work of Juran (1951) and Feigenbaum (1956) and has since been developed, expanded and enriched. Its initial categorization, however, has been used as a useful tool in a number of studies, in an attempt to better depict and re-organize a company's structure and processes. Kirlioğlu and Çevik (2013), Tye et al. (2011), Jafar et al.(2010), Desai (2008) are only a few of the numerous studies that have been conducted, based on the P-A-F Model. The traditional premise of the above model presupposes a static representation of quality cost economics, and suggests that investment in prevention and appraisal activities will reduce Failure Costs, while further investment in prevention activities will reduce Appraisal Costs. It is supported that non-conformance costs (Internal and External Failure Costs) can only be reduced by increasing expenditures on conformance activities (Ittner, 1996). The curve "costs of appraisal plus prevention" rises, therefore, to infinity as perfection is approached, and the optimal level of quality is somewhere below perfection. This concept has been challenged, however, by a more modern view, which proposes that spending on Prevention could always be justified and that optimum quality level

equals zero defects (Crosby, 1979; Schiffauerova and Thomson, 2006). The new COQ model represents conditions that evolved later in the twentieth century, when advances in technology, robotics and automation reduced failure rate in production. Consequently, there is a weaker increase in Appraisal and Prevention Costs, while the cost optimum shifts to the perfect quality level, as perfection can be achieved at finite costs (Burgess, 1996). It can be argued that in firms committed to continuous incremental improvement, 'a relatively *fixed* level of conformance expenditures can lead to reductions in nonconformance costs *over time* as quality improvements teams continuously identify and eliminate quality problems' (Ittner, 1996, p. 116).

The above trade-off (or lack of it) has been supported in literature in a number of papers. Omurgonulsen (2009) presents an interesting survey to express that there is 'a trade-off between conformance and non-conformance costs. The non-conformance costs can be reduced by increasing conformance expenditures'. Moreover, Omachonu et al.(2004) describe a case study, which concludes that an increase in Prevention Cost plus Appraisal Cost leads to an improvement in quality, as well a decrease in Failure Cost. An analysis of the relations that exist among quality costs is further done by Kazaz et al. (2005), who conduct a case study in a construction project in a developing country, based on an economic model of optimum quality cost. Towards the same direction is the work of Su et al. (2009) and Chatzipetrou and Moschidis (2016) who present the trade-off relationship within quality-costs and conclude that there is a balanced point (a set of proportions) that can make a firm obtain the lowest level of the sum of quality costs. Kiani et. al (2009) also focus on the effects of cost factors on Cost of Quality, by proposing a model which reveals that Prevention Costs have the most intense effect on Total Cost of

Quality and especially External Failure Costs. Similarly, Sailaja et al. (2014) conduct a study among manufacturing units, which provide an insight to the major quality cost categories and reveals the statistical interrelationship patterns between them. Superville and Gupta (2001) provide evidence that the highest percentage of quality expenses is spent not on Prevention but on Internal and External Failure Costs. A useful analysis and possible explanations are given in their work. Kim and Nakhai (2008), finally, develop a model which does not depend on any assumptions on a firm's dynamic allocation of its quality improvement efforts, but rather assesses the impact of quality improvement efforts under different dynamic scenarios.

Research Methodology and Data Analysis

Given the fact that Quality Costing in the F&B industry in Greece is not sufficiently documented, a survey was undertaken with the use of a questionnaire, in order to depict the extent to which CoQ is monitored, and to investigate the general impact of the implementation process.

The questionnaire was sent to 387 F&B companies and 250 usable responses were collected (64% response rate). In order to reach the highest response level possible, personal interviews were pursued, in cases where the returned questionnaires were incomplete or not returned in time. The previous work of Moschidis et al (2009) and Arvaiova et al. (2009) has been a useful guide for the structure of the questionnaire. The questions were categorical and had a 3-, 5- and 6-point scale.

The costs we chose to analyze are grouped according to the PAF model (Campanella, 1999; BS 6143:1990) and are presented in Table 1. Under the

‘Prevention Costs’ category, questions dealt with quality planning, the design and development of quality measurement and test equipment, and the costs associated with the maintenance of the production and handling premises. ‘Appraisal Cost’ questions included the costs surrounding the inspection and testing of incoming parts and materials and the inspection and testing that takes place during the manufacturing process. ‘Failure Cost’ questions were subdivided into Internal and External Failure Costs. Internal Failure Cost questions were related to the costs of materials, parts and components that fail to conform to quality requirements and their re-inspection and retesting, while the External Failure Cost questions investigated the cost of dealing with returned defective products or components and the costs incurred as a result of a liability claim.

Table 1: Costs of Quality

Prevention Costs	E1: Design and development of quality systems
	E2: Maintenance of production and handling premises
Appraisal Costs	E3: Inspection of incoming parts and materials
	E4: Inspection and Testing during Manufacturing
Internal Failure Costs	E5: Scrap (items which cannot be economically reworked)
	E6: Re-inspection and retesting of defectives
External Failure Costs	E7: Replacement costs
	E8: Product liability

The demographic variables that were analysed, are presented in Table 2 and were structured according to the Commission Recommendation 2003/361/EC concerning the definition of micro, small and medium-sized enterprises.

Table 2: Demographic Variables

M1	Number of employees
M2	Annual Turnover
M3	Annual balance sheet total
M4	Manufacturing sector
M5	ISO-HACCP systems

In order to collect as much data as possible, concerning the behavior of F&B companies in terms of their business area, we analyzed M4 variable (Manufacturing sector) in subsectors, according to the Foundation for Economic and Industrial Research.

As far as the formation of variable M5 (ISO/HACCP systems) is concerned, we took into consideration all positive responses to the Question "Which of the following Certificates does your company hold and at which annual cost". The possible answers, apart from ISO 22000 and HACCP, included IFS (International Food Standard) and BRC (British Retail Consortium), which, however, collected 1% of responses and have been, therefore, omitted from the analysis. The individual answers that were received on ISO 22000 and HACCP are presented below (Table 3).

According to the EC Regulation No 852/2004 of the European Parliament and of the Council on the hygiene of foodstuffs, it is imperative (among other provisions) that the primary responsibility for food safety rests with the food business operator and that the general implementation of procedures based on the HACCP principles, together with the application of good hygiene practice, should reinforce food business operators' responsibility. Consequently, the mere existence of a Food Safety

Certificate is not an end in itself. Even non-certified companies are required to apply procedures based on the HACCP principles, which are about to bring the least expected level of performance for consumer protection. The same concept applies to private standards, such as ISO 22000, BRC, IFS etc. However, according to Sitki Ilkay and Aslan (2012), certification showed no direct effect on performance. Food Safety Management Systems based on HACCP could be regarded as tools of self-regulation, but could never replace controls by the official food authorities. Furthermore, both ISO standards and HACCP focus on Prevention and Appraisal, by controlling processes and conforming to regulations (Nguyen et al, 2004; Romano et al, 2004). Their operational procedures can be incorporated within a system of total quality management, therefore they are dealt with as one common variable in this research (M5: ISO/HACCP Certification). The operational costs for ISO/HACCP systems are measured as part of the Prevention and Appraisal quality costs of the companies.

Table 3: ISO-HACCP Certification and Operational Annual Costs

Company size	no. of respondents	ISO-HACCP certified	ISO-HACCP systems operational annual costs	
very large	16	16	8 companies 8 companies	1000-2000 € more than 2000 €
large	28	28	28 companies	1000-2000 €
medium-sized	85	75	27 companies 40 companies 8 companies	500-1000 € 1000 -2000 € more than 2000 €
small	79	67	6 companies 52 companies 9 companies	up to 500 € 500-1000 € 1000 -2000 €
micro	42	19	17 companies 2 companies	up to 500 € 500 - 1000 €
TOTAL	**250**	**205***		

*The difference between the total number of respondents (250) and the total number of certified companies (205) represents the companies that are not officially certified, but are

nevertheless required by EC Regulation No 852/2004 to apply with the procedures based on the HACCP principles. All 250 companies have implemented ISO/HACCP procedures.

General analysis of Axes 1-4

In the present analysis, the behavior of the Costs of Quality in relation to company size is firstly investigated. The following Tables (4,5,6,7) present the amount (in Euros) that companies spend on each cost category, according to their size.

Table 4: Prevention Costs

	Prevention Costs				
Company size	less than 10.000 €	10000-30.000 €	30.000-50.000 €	more than 50.000 €	NO MONITORING
very large	-	5%	15%	80%	-
Large	-	10%	18%	72%	-
medium-sized	22,5%	27,5%	7,5%	40%	2,5%
Small	30,5%	20,5%	14%	17%	18,3%
Micro	33,6%	15,3%	12,2%	14,2%	24,4%

Table 5: Appraisal Costs

	Appraisal Costs				
Company size	less than 10.000 €	10.000-30.000 €	30.000-50.000 €	more than 50.000 €	NO MONITORING
very large	-	-	-	100%	-
Large	10%	-	20%	70%	-
medium-sized	30%	22,5%	12,5%	35%	-
Small	53%	28%	3%	11%	5%
Micro	43%	19%	2%	6%	30%

Table 6: Internal Failure Costs

	Internal Failure Costs				
Company size	less than 10.000 €	10.000-30.000 €	30.000-50.000 €	more than 50.000 €	NO MONITORING
very large	-	50%	25%	25%	-
Large	10%	30%	30%	30%	-
medium-sized	55%	7,5%	12,5%	15%	10%
Small	47%	22%	3%	3%	25%
Micro	53%	9%	7%	5%	25%

Table 7: External Failure Costs

	External Failure Costs				
Company size	less than 10 .000 €	10.000-30.000 €	30.000-50.000 €	more than 50.000 €	NO MONITORING
very large	50%	-	-	-	50%
Large	50%	10%	10%	-	30%
medium-sized	22,5%	5%	15%	7,5%	50%
Small	44%	8%	3%	11%	34%
Micro	32%	7%	6%	3%	52%

It is evident from the above that companies, regardless of their size, invest more on Prevention and Appraisal costs (conformance costs), than on Failure costs (non-conformance costs). As far as the Total Quality Cost Index is concerned, it is obvious that it is influenced by the companies' size, as it increases accordingly. The Total Quality Cost Index (TQCI) is based on sales and PAF data (Zugarramurdi, 1995; Shah & Mandal, 1999; Lupin et al, 2010; Djekic et al, 2014) and is defined as follows:

$$TQCI = TQC / \text{net sales} \times 100$$

According to our data, TQCI ranges from 1.14 % in micro companies and reaches 4.3% in very large companies, which falls within the published range of values (1-6%) for the Food industry (Romano et al, 2004; Lupin et al, 2010). According to Zugarramurdi (1995), an index value of 6% can be taken as indicative regardless of the product, whereas a value of 2-2.5% is an indication that quality and quality costs are managed satisfactorily. The fact that the TQCI of the majority of Greek F&B companies reaches values outside the 2-2,5% range, however, reveals the limited importance of Quality Costing for Greek companies.

In order to answer the questions set in the present research, the methods of Multidimensional Data Analysis are chosen, specifically Multiple Correspondence Analysis (Moschidis, 2015; Moschidis, 2009; Greenacre, 2007). The basic premise of the above method is the holistic approach of the phenomenon under research. Through the available data, the interaction and interrelations among all elements are explored, aiming at the identification of the dominant and most substantial tendency in their structure. Correspondence Analysis depicts complicated information in factorial diagrams. The visualization of those results, which is a basic characteristic of the method, is not random. The optimum visualization is provided. Through the Multidimensional Data Analysis methods, data is presented in matrixes of multiple dimensions, i.e. multiple rows and multiple columns. This multidimensional character of the data lies in the core of these methods, and constitutes their competitive advantage against the methods of Classical Statistics. Moreover, Multidimensional Data Analysis methods can also reveal potential errors or important unexpected

effects of the phenomenon under examination. Finally, they can highlight research questions that have not occurred to the researcher before.

The data was transformed into a BURT Matrix, which is the symmetric matrix of all two-way cross tabulations between all categorical variables.

Figure 2 makes it obvious that by analyzing the 4 Axes, there is a 55.34% interpretation of the total inertia, while only the first factorial level covers 42.81% of the available information.

Figure 2: Eigenvalues and Inertia

TOTAL INERTIA 0,53532

	INERTIA	%INTERPRETATION	SUM	SCREE PLOT
1	0,1276378	23,84	23,84	|**********
2	0,1015578	18,97	42,81	|**********
3	0,0350013	6,54	49,35	|**********
4	0,0320479	5,99	55,34	|**********
5	0,0269704	5,04	60,38	|*********

The results of Multiple Correspondence Analysis are presented in Table 8. In the analysis, we take into account the variables that had the highest Contribution indicator (CTR). The points with high CTR emphasize the importance of each variable (characteristic) in the axes construction process. The average CTR is 1000:105= 9.52, where 105 is the number of points-elements. Points of high contribution in axis construction are generally those points with CTR value above average. However, in this case, we choose to focus on CTR>15 in the first factorial level and CTR>25 in the other levels, in order to strongly highlight the variables that have the highest possible contribution to the construction of each axis. The first Axis presents the dominant trend of the data.

Table 8: Interpretation Indicators: Coordinates (#F), Correlations (COR), Contributions (CTR) of the first 4 axes.

	#F1	COR	CTR	#F2	COR	CTR	#F3	COR	CTR	#F4	COR	CTR
M11	-288	175	5	216	99	4	-63	8	1	-274	158	**21**
M12	-127	142	3	115	119	3	162	234	**18**	7	0	0
M13	286	143	5	-192	64	3	-404	283	**41**	464	376	60
.....	.....	.....	.....	.....	.....	**.....**	.....	.....	.....	.....	.....	.....
E101	-1662	654	**64**	-1079	275	34	45	0	0	366	31	12
.....	.....	.....	.....	.....	.....	**.....**	.....	.....	.....	.....	.....	.....
E103	104	60	1	90	45	1	123	84	7	156	136	13
E105	284	122	4	-278	117	5	-60	5	0	-374	212	**30**
.....	.....	.....	.....	.....	.....	**.....**	.....	.....	.....	.....	.....	.....
E111	-248	165	6	-375	378	**19**	277	206	30	-52	7	1
E114	51	4	0	262	118	4	-367	229	**26**	-77	10	1
.....	.....	.....	.....	.....	.....	**.....**	.....	.....	.....	.....	.....	.....
E131	-1544	641	**56**	-1017	278	30	13	0	0	424	48	16
E141	-1544	641	**56**	-1017	278	30	13	0	0	424	48	16
E151	-1048	559	**42**	-832	352	34	96	4	1	179	16	5
E161	-507	313	**18**	-662	535	**38**	166	33	7	-11	0	0
E162	153	41	1	158	44	1	417	310	**34**	14	0	0
E164	63	11	0	294	248	11	-315	283	**36**	61	10	1

Axis 1

The analysis of the first axis (Figure 3) shows a diversification between companies with low Turnover (M2_1: less than 500.000 €) and companies with high cost of ISO/HACCP systems (M5_5: more than 2000 € operational costs).

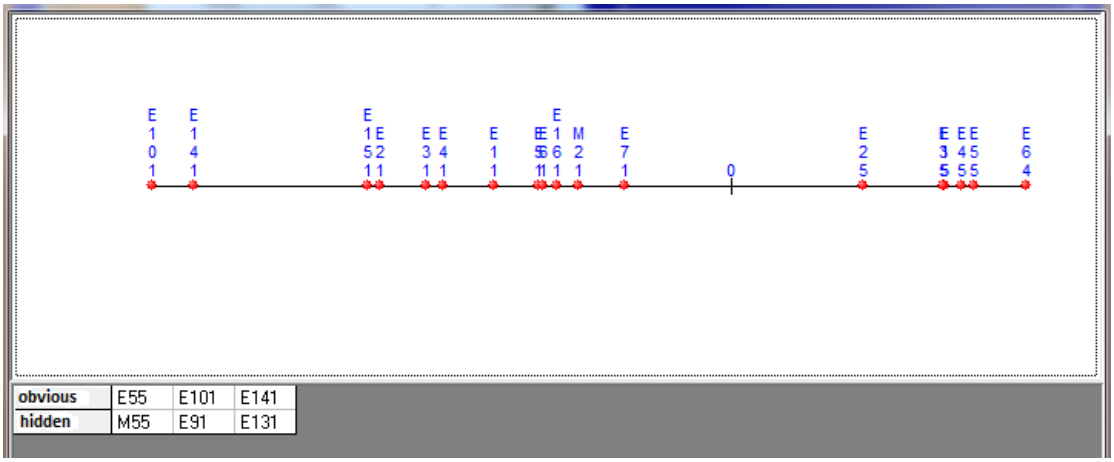

Figure 3: Axis1

The companies of the first group do not monitor Prevention, Appraisal and Failure Costs (E1_1, E2_1, E3_1, E4_1, E5_1, E6_1, E7_1). They characterize the 'increase of workload' due to Quality Costing as NOT negative (E15_1) and rate 'quality improvement' (E9_1) and 'reduction of total cost' (E10_1) as reasons of NO IMPORTANCE for the adoption of Quality Costing. Finally, they rate 'reduction of defects' (E13_1) and 'reduction of production costs' (E14_1) as NOT IMPORTANT results of the monitoring of quality costs.

On the other hand, the second group of companies seem to spend more than 50.000 € on Prevention and Appraisal Costs (E2_5, E3_5), while they spend on average over 30.000 € on Internal Failure Costs (E5_5, E6_4).

Axis 2

From the analysis of the second axis (Figure 4) it can be deduced that 2 groups of companies emerge: the first group consists of companies which share low ISO/HACCP systems costs (M5_2: less than 500 €) and the second group consists of

very large companies (M1_5: number of employees more than 500, M2_6: Turnover more than 200 million €, M3_6: Balance sheet total 100 million €).

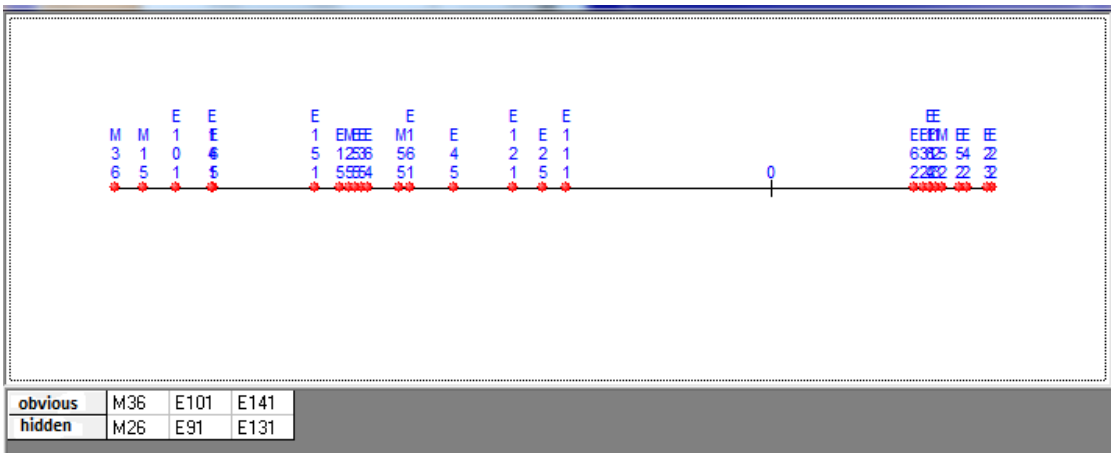

Figure 4: Axis 2

According to the second axis, companies in the first group spend less than 10.000 € on Quality Costs (E2_2, E3_2, E4_2, E5_2, E6_2), rate the 'difficulty to access production data' as of LIMITED importance (E12_3) and evaluate the 'emphasis on quality costs rather than on quality itself' as VERY negative (E16_4).

On the contrary, very large companies generally spend more than 50.000 € on each of Prevention (E1_5), Appraisal (E4_5), and Internal Failure Costs (E6_5). They evaluate that 'the inability of the Quality Management Department to cooperate with Top Management' (E11_1) and the 'difficulty to access production data' (E12_1) is of NO importance in the Quality Costing process. Finally, they do NOT rate the 'emphasis of quality costs rather than on quality itself' as negative (E16_1).

Axis 3

Axis 3 (Figure 5) presents the diversification of 2 groups of companies. The first group are medium-sized companies (M1_3: number of employees 51-250, M2_4: Turnover 10-50 million €, M3_4: Balance sheet total 10-43 million €).

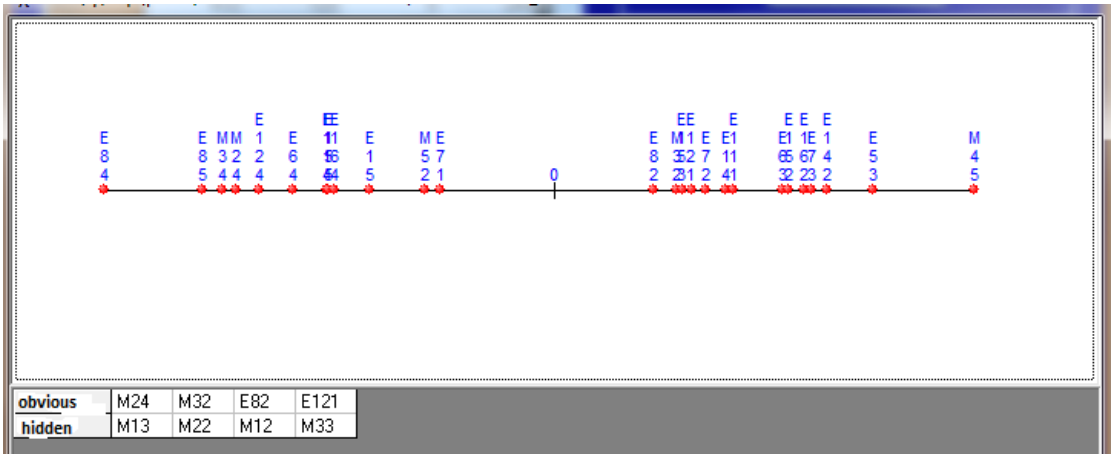

Figure 5: Axis 3

They seem to spend more than 30.000 € on External Failure Costs (E8_4, E8_5) and rate the 'increase in workload' (E15_5) as a VERY negative result of Quality Costing monitoring. Furthermore, they evaluate 'the inability of the Quality Management Department to cooperate with Top Management' (E11_4) and the 'difficulty to access production data' (E12_4) as VERY important barriers in the Quality Costing process.

The second group of companies in Axis 3 are small companies (M1_2: number of employees 11-50, M2_2: Turnover 500.000 €-2 million €, M3_3: Balance sheet total 2-10 million €, M4_5: Meat and Fish sector). These companies spend 30.000 € to 50.000 € on Prevention Costs (E1_4) and 10.000-30.000 € on Failure Costs (E5_3, E6_3, E7_3). They rate 'reduction of production costs' (E14_2) as a FAIRLY positive

result and the ‘emphasis on quality costs rather than on quality itself’ (E16_2) as a FAIRLY negative result of Quality Costing.

Axis 4

In axis 4 (Figure 6), there is a diversification of 2 F&B sectors, Fruit and Vegetables (M4_3) and Bakery (M4_1).

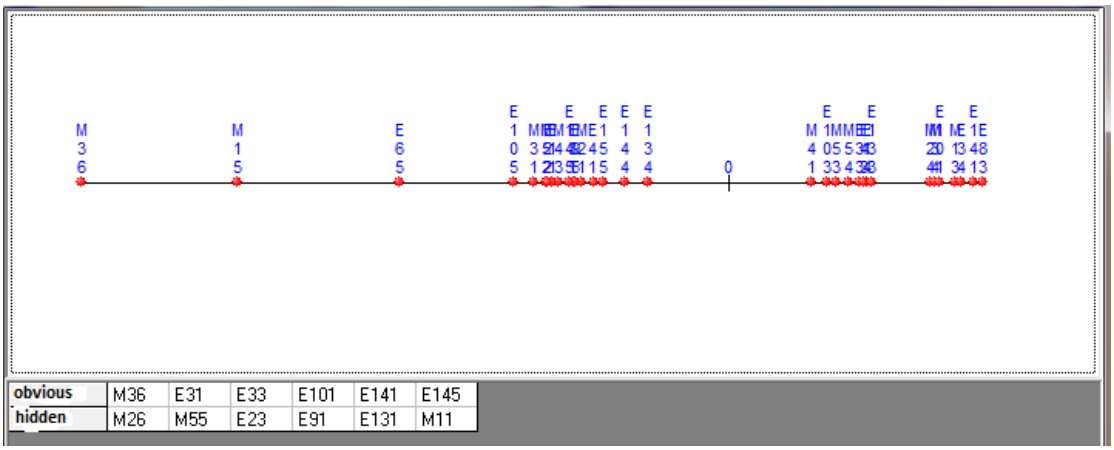

Figure 6: Axis 4

Companies in the Fruit & Vegetables sector seem to employ less than 10 employees (M1_1), while they evaluate the ‘quality improvement’ (E9_5) and the ‘reduction of total cost’ (E10_5) as VERY important reasons in favor of Quality Costing. They also rate the ‘reduction of production costs’ (E14_4) and the ‘reduction of defects’ (E13_4) as VERY positive results of the monitoring of Quality Costs.

Companies in the Bakery sector, on the other hand, spend over 500 € annually on ISO/HACCP systems (M5_3, M5_4) and more than 10.000 € on Appraisal and External Failure Costs (E3_4, E4_3 and E8_3). They evaluate the ‘reduction of defects’ (E13_3) and the ‘reduction of total cost’ (E10_3) as FAIRLY important in the Quality Costing process.

Focused analysis of Axis 1 & 2

The previous analysis of all 4 axes presents a depiction of the correspondence between certain company characteristics (size, sector, ISO-HACCP systems) and a number of Quality Costing variables. In order to gain a deeper insight into the phenomenon under examination, we proceed to a further analysis. We choose to emphasize on **the two first axes (Axis 1 and 2)** and investigate in a more detailed manner the relationship that emerged between the dominant demographic variables (Turnover and ISO/HACCP systems) and the categorical characteristics of Quality Costing

Axis 1 – Turnover (M2)

In this deeper analysis of Axis 1 we focus only on variable M2 – 'Turnover', since it has the highest COR and CTR indicators. The following Figure (Figure 7) presents a 'magnified' depiction of the correspondences that emerge between M2 (Turnover) and the most dominant quality cost characteristics of Axis 1. Based on the interpretation percentages of the total inertia, the following analysis has been conducted.

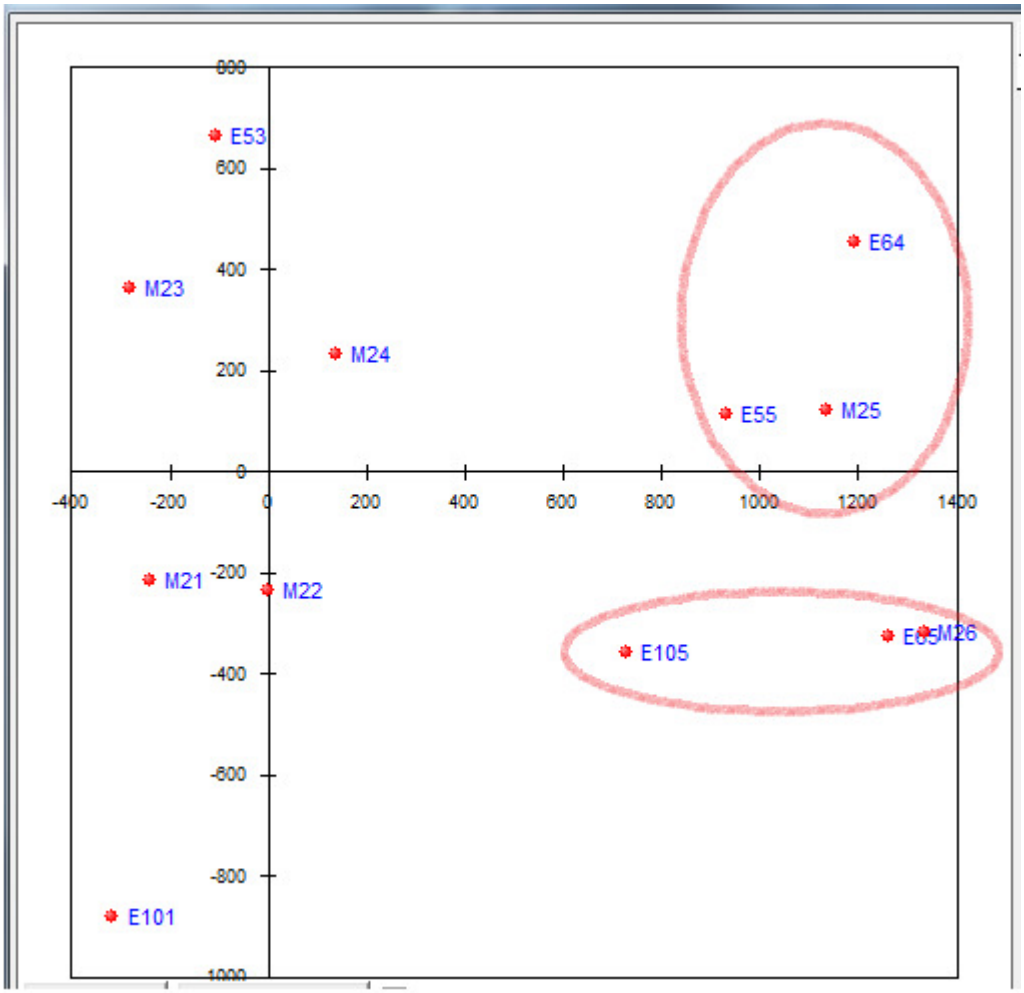

Figure 7: Analysis of variable M2 (Turnover)

In order to proceed to this more detailed analysis, we take into account only the characteristics and the variables with the highest CTR indicator (CTR for the M2 variable (Turnover) > 200, CTR for the characteristics (E) > 100 – Table 9). The combination of high CTR and high COR for each element, results in two major groups of correspondences that can be analyzed. The first group is defined by large companies with an annual Turnover of 50-200 million Euros (M2_5), which spend more than 30.000 € on Internal Failure Costs (E5_5 and E6_4). The second major group involves very large companies (Turnover more than 200 million Euros - M2_6), which spend more than 50.000 € on Internal Failure Costs (E6_5) and feel

that 'reduction of total costs' is a VERY important reason in favor of Quality Costing (E10_5). What is interesting in both groups is the relationship that emerges between Turnover and ONLY Internal Failure Costs.

Table 9: Interpretation Indicators: Coordinates (#F), Correlations (COR), Contributions (CTR) of Axis 1 - Variable M2 (Turnover).

	#F1	COR	CTR
M21	-240	406	111
M22	2	0	0
M23	-280	289	104
M24	140	123	29
M25	**1137**	**854**	**483**
M26	**1337**	**647**	**264**

	#G1	COR	CTR
E51	-311	731	41
....	....	....	....
E55	**935**	**975**	**160**
....	....	....	....
E64	**1195**	**600**	**151**
E65	**1263**	**750**	**146**
E91	-314	106	10
...	...	...	...
E105	**729**	**626**	**138**

Axis 2 – ISO-HACCP systems (M5)

From the analysis of Axis 2 and the relevant CTR indicators, it can be concluded that variable M5 (ISO-HACCP systems) is the most dominant. We, therefore, proceed to a further analysis of the correspondences that exist between the level of ISO/HACCP programs and the quality cost characteristics of companies. Figure 8 presents the depiction of variable M5 in relation to these characteristics. In

order to identify the correspondences, we again take into account only the variables with CTR > 200 and the characteristics with CTR > 100. All relevant COR indicators confirm the analysis below (Table 10).

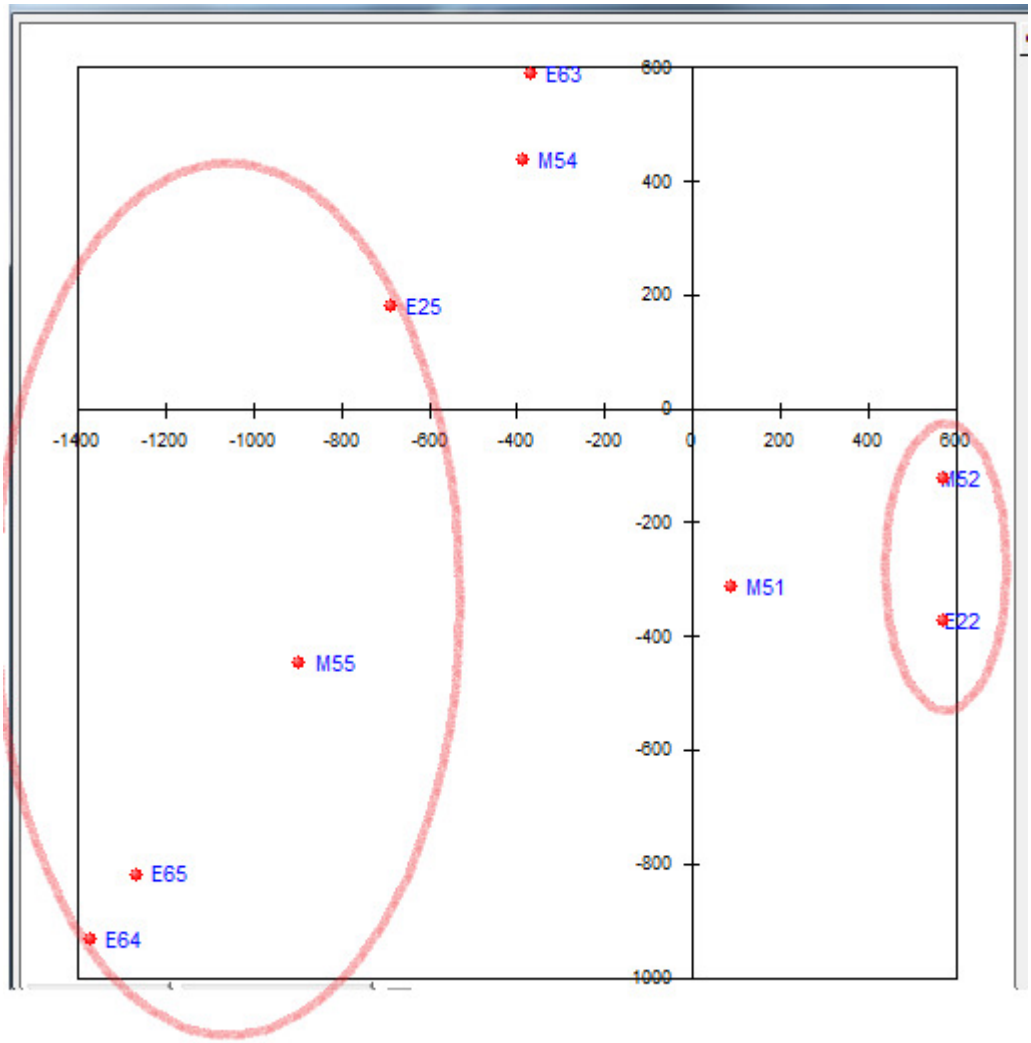

Figure 8: Analysis of variable M5 (ISO-HACCP systems)

Table 10: Interpretation Indicators: Coordinates (#F), Correlations (COR), Contributions (CTR) of Axis 2 - Variable M5 (ISO/HACCP systems).

	#F1	COR	CTR
M51	92	23	5
M52	**572**	**715**	**331**
M53	203	232	53
M54	-383	390	147
M55	**-892**	**760**	**458**

	#G1	COR	CTR
E21	364	151	18
E22	**573**	**592**	**147**
E23	409	273	42
E24	-413	356	21
E25	**-685**	**914**	**248**
E61	390	760	63
....	....	....	....
E64	**-1369**	**667**	**178**
E65	**-1263**	**696**	**122**
E151	93	15	1
....	....	....	....
E155	347	331	38

Two major groups of characteristics stand out. The first group incorporates variable M5 _2 - companies that spend annually up to 500 € on ISO-HACCP, which also spend little on Prevention Costs (E2_2). On the other hand, the second group consists of companies that annually spend more than 2.000 € on ISO-HACCP (M5_5) and seem to invest in the importance of Internal Failure Costs (E6_4 and E6_5) and on Prevention Costs (E2_5). This finding also confirms that the costs mostly related to the variables under examination (Turnover and ISO-HAACP), are only the Internal Failure and the Prevention Costs.

Discussion of Findings

The analysis of the findings has been conducted with the use of Exploratory Data Analysis, as it is the most appropriate research tool for identifying the most significant and dominant tendency in the structure of all elements. Furthermore, the above methodology offers better recognition of possible issues that have not yet been identified, which may lead to the formation of new questions and tendencies. Consequently, it constitutes a more holistic approach of the analysis, which has led to interesting findings in relation to the companies' size, subsector, TQCI and Cost Elements, ISO/HACCP systems and Turnover.

- *size*

The analysis of the data collected in the present research proves that there is a direct relationship between the size of the companies and the investment on Quality Costs. Very large companies spend well over 50.000 € annually on Quality Costs, especially conformance costs, in contrast to small and micro companies, which show less interest in the process. It is evident, furthermore, that the size of the companies is also directly related to the way they perceive Quality Costing as a whole, its culture, its characteristics, its usefulness, its advantages and drawbacks. Smaller companies do not rate certain elements of Quality Costing as important or even interesting, whereas large and very large companies evaluate the same elements as highly important and totally integrated in their processes. Moreover, major barriers and limitations, as proposed in literature (Jafari and Rodchua, 2014; Arvaiova et al., 2009) are supported by our findings, which state that larger companies identify them as important in their effort to implement or monitor Quality Costing processes.

- *subsector*

As far as the manufacturing subsector is concerned, there is no evidence that the Manufacturing sector of the companies is related to their behavior. The fact that it doesn't appear in the first two Axes suggests that the individual F&B subsectors are of limited importance, in relation to the companies' attitude toward Quality Costing. Given the fact that the individual F&B subsectors (Bakery and Cereals, Dairy Products, Fruit and Vegetables, Meat products etc) have common problems and weaknesses, common food safety risks and trends in food technology, it can be concluded that they have similar behavior in relation to Quality Costing and its implementation and do not differentiate in the way they adopt (or not) quality costing systems.

- *Total Quality Cost Index (TQCI)*

According to our data, Total Quality Cost Index ranges from 1.14 % in micro companies to 4.3% in very large companies, which falls within the published range of values for the Food industry (1-6%). According to Zugarramurdi (1995), a value of 2-2.5% is an indication that quality and quality costs are managed satisfactorily. Although it would be expected that as quality systems mature, the TQCI decreases (Djekic et al, 2014; Albliwi et al, 2014), it is obvious that the TQCI of Greek F&B companies reach very low and very high values. Literature suggests that very high or very low values indicate poor quality management or/and costing system. Our findings, therefore, emphasize the fact that F&B companies are very much affected by the economic pressure and the financial difficulties of the Greek economic environment and do not seem to appreciate the beneficial results of systematic and organized Quality Costing. It is the authors' concern that the low percentage (1.14%)

of small and micro companies does not imply high quality, but rather limited attention to quality. What is interesting to note is that External Failure Costs is the quality costs category that is *the least* monitored by the respondents even by very large companies, which would normally be expected to monitor every cost category in an efficient and organized manner.

- *Cost Elements*

The analysis of the results also highlights the interrelations among quality cost elements. It is concluded that companies spend more on Prevention and Appraisal Costs (conformance costs) than on Failure Costs (non conformance costs). This finding is consistent with the work of Chopra and Gang (2011), Sower et al. (2007), Plunkett and Dale (1988), Hwang and Aspinwall (1996), who support the traditional view of CoQ, implemented in *static* environments, that if there is an increase in costs of conformance, the costs of non conformance will decrease. It is obvious by this research that Greek F&B companies do operate in a static environment. Learning and continuous improvement are not the center of their attention, attributes which would ideally lead to a more modern CoQ model, where conformance expenditure (Prevention and Appraisal) would not need to increase in order to achieve ongoing reductions in Failure Costs (Crosby, 1979; Ittner, 1996; Schffauerova and Thomson, 2006)

- *ISO-HACCP systems - Turnover*

The appearance of the ISO/HACCP variable in the first two axes verifies the assumption that ISO/ HACCP programs play an important role in the implementation of Quality Costing. It is confirmed that ISO/HACCP systems is an established policy

among most F&B companies (Ismyrlis and Moschidis, 2015; Lupin et al, 2010, Trigueros Pina, & Sansalvador Sellés, 2008), which is supported by the fact that 82% of the respondents have certified ISO-HACCP programs. This implies a more 'conscious' attitude towards prevention and appraisal processes. It is suggested that, although, on occasions, the ISO/HACCP certification is considered an aim in itself, aiming at commercial advantages, it would be ideal if companies applied to the requirements as a means for quality culture, in order to achieve effective management and positive results.

It is striking that, from the second detailed analysis of the two dominant demographic variables (Turnover' and 'ISO-HACCP systems'), only Prevention and Internal Failure Costs appeared as the most 'powerful' CoQ elements. Only these costs emerged as the most important among the total Quality Costs of the companies we examined, and were directly affected by (and dependent on) Turnover and ISO-HACCP programs. Neither Appraisal nor External Failure Costs appeared in the factorial axes, which emphasizes the fact that 'Turnover' and 'ISO-HACCP systems' are two factors that have a direct relationship to the way companies manage Prevention and Internal Failure Costs. The second analysis, therefore, significantly indicates the following:

-there is a direct relationship between 'ISO/HACCP systems' and Prevention cost.

- there is a direct relationship between 'ISO/HACCP systems' and Internal Failure Costs.

- there is a direct relationship between 'Turnover' and Internal Failure costs.

Limitations and Future Research

The respondents in the present survey self-reported not only the financial data they provided, but also their perception of the implementation level of Quality Costing and the possible barriers or advantages of the whole process. The reliability of self-reported information is a cause for concern (Sower et al, 2007), since accuracy of data is often a consideration. We attempted to overcome this limitation by addressing the questionnaire only to the Financial or/and Quality Manager of the companies, who by definition are the most trained and experienced in our area of interest.

Despite the fact that the F&B industry has attracted considerable attention in international literature (Zugarramurdi, 1995; Dale and Wan, 2002; Romano et al, 2004; Lupin et al, 2010), the Greek F&B industry is unfamiliar territory for studies, since very limited data have been recorded about Greek companies (Chazipetrou and Moschidis, 1916). Furthermore, the collection of data proved to be a difficult task, since the existing accounting systems could not record costs in the specific categories outlined in the PAF model. Although a number of costs were directly identified and related to company operations, some costs could not be allocated to the cost elements of the PAF model. The traditional accounting practices used by companies, as well as the Greek Uniform Chart of Accounts and the Greek Accounting Standards, do not include specific quality-related accounts, so companies have no other option but to categorize quality costs under the general categories of overheads or other operating expenses (Chatzipetrou & Moschidis, 2016). We believe it is imperative that the State, the responsible Chambers and the scientific community provide proper

guidance, in order for the necessary accounting framework, relevant to the requirements of Quality Costing, to be formed and implemented.

Furthermore, further research among F&B companies could shed light on the deeper causes that hinder the implementation of Quality Costing, mainly in relation to the economic restrictions on Greek economy since summer 2015, in the form of capital controls, which unbalanced the Greek economic and manufacturing environment and disorganized Greek enterprises. Under these circumstances, it would be interesting to explore which quality costs are, nevertheless, monitored the most and which quality costs are constantly ignored, and reach some useful conclusions about the way Greek F&B companies perceive not only the value of Quality Costing in general, but also the essence and the content of each individual quality cost, especially in comparison to other industries or business settings.

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