Total Quality Management, 2017
Vol. 28, No. 5, 501–521, http://dx.doi.org/10.1080/14783363.2015.1099427

Routledge
Taylor & Francis Group

How companies use the information about quality-related costs

António Ramos Pires[a*], Jorge Novas[b], Margarida Saraiva[c,d] and Aida Coelho[e]

[a]*Polytechnic Institute of Setúbal, Setúbal, Portugal;* [b]*Management Department, CEFAGE-UE, University of Évora, Évora, Portugal;* [c]*Management Department, University of Évora, Évora, Portugal;* [d]*BRU-UNIDE/ISCTE-IUL, Lisbon, Portugal;* [e]*Polytechnic Institute of Santarém, Santarém, Portugal*

This work focuses on the broad topic of quality-related costs (QRC), which has been largely discussed in the literature. Nevertheless, one of the least studied issues relates to the way companies use QRC information. In this research the profile of use of QRC information is analysed considering the model proposed by Simons [(1991). Strategic orientation and top management attention to control systems. *Strategic Management Journal*, *12*(1), 49–62], from which it is possible to distinguish between a diagnostic and an interactive profile of use. The analysis of the data collected through a questionnaire survey to a sample of Portuguese certified companies (PCCs) involved the application of principal component analysis, cluster analysis, one-way analysis of variance and discriminant analysis. The results showed that a substantial part of PCCs use the QRC information according to a diagnostic and interactive profile. Managers of these companies use QRC information to set goals, monitor their implementation and motivate participants (according to a diagnostic profile), but also to foster organisational learning, the emergence of new ideas and strategies (according to an interactive profile). About 30% of companies favour a diagnostic profile. However, about 32% of companies report negative values for both profiles, indicating that these companies undertake initiatives to prepare QRC information but their leaders do not use it in the management process.

Keywords: quality-related costs; interactive and diagnostic systems; profiles of use of information; information to management

1. Introduction

Throughout the 1980s, organisations started to incorporate quality principles into their management systems in the scope of a broader view of Total Quality Management (TQM) (Weinstein, Vokurka, & Graman, 2009). Literature proposes a set of definitions for the concept of TQM. Despite this, there seems to be a common idea that TQM is an organisational approach to ensure the desired quality levels in an efficient way through the involvement of all members of the organisation (see Oakland, 1989; Smith, 2005). According to Kanji (1990), *Quality* refers to the continued satisfaction of the customer needs (internal and external), *Total Quality* refers to the attainment of quality with reduced costs and *TQM* refers to the attainment of total quality through the permanent commitment of all members of the organisation.

Any serious attempt to improve quality must address the costs related to the attainment of quality, as the purpose of continuous improvement programmes is not only to meet customers' demands, but also do so at the lowest cost. This may be achieved through an action on costs, seeking their reduction, for what it is necessary for their identification and measurement (Schiffauerova & Thomson, 2006). The process of identification and measurement of

*Corresponding author. Email: antonio.pires@estsetubal.ips.pt

quality-related costs (QRC) is therefore a basic process of TQM and is one of the main functions of quality costing (Jaju, Mohanty, & Lakhe, 2009). Much has been discussed regarding the adequacy of the identification and measurement methods of QRC. The literature is fully explicit about the limitations of the process of identification and measurement of QRC and the consequences that follow from these limitations. However, the quality costing perspective is not limited to the identification and measurement of QRC. Sansalvador and Brotons (2013) state that despite the importance of implementing a system that provides information about the distinct components of QRC, the benefits derived from it will be diminished considerably if a detailed analysis of the information obtained is not conducted. Moreover, the way how this information is mobilised to the management process may determine the momentum set to the process and the expected results.

The present work falls within the broad topic of QRC, which has been profusely analysed from several perspectives: identification and measurement of QRC (Dahlgaard, Kristensen, & Kanji, 1992; Kirlioğlu & Çevik, 2013; Makhopadhyay, 2004; Pursglove & Dale, 1996; Shah & Fitzroy, 1998; Yang, 2008), classification of QRC (Campanella, 1999; Chiadamrong, 2003; Yang, 2008), preparation and disclosure of QRC (Kirlioğlu & Çevik, 2013; Oliver & Qu, 1999; Shah & Fitzroy, 1998), among others, are examples of approaches in this area. One of the lesser studied perspectives relates to the way companies use information on QRC.[1] The concept of information use refers to the outcomes of applying and working with information as perceived and experienced by members of an organisation (Choo, Bergeron, Detlor, & Heaton, 2008). The profile of use of information is an important topic as it allows not only assessing how the management process relies on that information but also the effects that may be derived from that use.

In this context, this research has two main objectives. The first is to identify the extent to which companies use information about QRC. Despite some literature addressing the importance of the use of QRC information in the management process (Adams, Pryor, Keller, & Harston, 2003; Lari & Asllani, 2013; Morse & Roth, 1987; Oliver & Qu, 1999; Prickett & Rapley, 2001; Pursglove & Dale, 1996; Kajdan, 2007; Rapley, Prickett, & Elliott, 1999; Sailaja, Basak, & Viswanadhan, 2015; Shah & Fitzroy, 1998; Sohal, Ramsay, & Samson, 1992; Sower, Quarles, & Broussard, 2007; Su, Shi, & Lai, 2009; Williams, Wiele, & Dale, 1999), there is no in-depth knowledge in this field. The second, drawing on Simon's (1991, 1994, 1995) work, is to identify different profiles of use of QRC information, and simultaneously opening up avenues for further research.

This is the first study, of which authors are aware, that focuses specifically on how companies make use of QRC information. The study provides a contribution to an understanding of how companies use the information about QRC, identifying different usage profiles.

The remainder of the paper is structured as follows: the next section focuses on QRC, highlighting its importance to the management of organisations. In Section 3 the diagnostic and interactive profiles of use are described. Section 4 focuses on methodological issues and Section 5 on the results of the study developed with certified Portuguese companies. Finally, Section 6 discusses the results and presents the main conclusions.

2. Quality-related costs

QRC are commonly understood as the monetary expression of the efforts undertaken by the organisation to ensure the intended levels of quality. Therefore, QRC refer to prevention and assessment of quality costs, as well as to costs of correction and/or elimination of internal and external failures. According to Dale and Plunkett (1999) it is widely accepted that QRC correspond to the costs incurred with design, implementation, operation and

maintenance of the quality management system (QMS), the cost of resources directed to continuous improvement, the costs related to failures at the system, product and service level, as well as all other costs incurred to ensure the quality of products and services.

The QRC may represent a significant portion of the costs and total sales of an organisation (Giakatis, Enkawa, & Washitani, 2001; Jafari & Rodchua, 2014; Williams et al., 1999). The importance of QRC in the global quality management process has directed the concerns of management and research to the problem of QRC. Underlying the determination of QRC is the consideration that quality needs to be measured and that measurement will lead to holding a series of actions by the users of that information. Without the guidance of QRC information, efforts to improve quality may be misdirected (Morse, 1993). According to Campanella (1999), the perspective of QRC is to supply tools to management, allowing the adoption of programmes and the development of improvement activities. The use of information about QRC may provide benefits to companies, as it contains values and metrics that previously were not identified by the costing system.

However, before these benefits can be attained, the prerequisite for the effective use of QRC techniques is to quantify QRC. Without effective measurement, there cannot be an effective control (Krishnan, Kriebel, Kekre, & Mukhopadhyay, 2000). Quality costing is, in a preliminary form, a system developed and implemented by organisations to, in a systematic and systematised way, identify and measure the QRC. Quality costing is one of the tools and techniques that organisations may use in the introduction and development of TQM (Dale & Plunkett, 1999; Jaju et al., 2009), which means that it should not be understood as an end in itself, but rather as a means to achieve TQM. Montegomery (1996) pointed out that the main objective of a QRC system is to reduce costs through the identification of improvement opportunities.

The implementation of quality costing may, therefore, produce significant benefits. One of the most important benefits is that the resultant information may convert quality into a measurable concept, thereby understanding its impact on the organisation (Crosby, 1979). Another important benefit is the raising of awareness (inside the organisation) of the potential effects of poor quality on the results (Makhopadhyay, 2004; Prickett & Rapley, 2001). Then QRC enable organisations to concentrate on areas of low performance that need to be improved (Prickett & Rapley, 2001; Jafari & Rodchua, 2014; Yang, 2008), that follow the pace of continuous improvement actions (Prickett & Rapley, 2001) and the planning of quality improvement (Prickett & Rapley, 2001). Information about QRC helps communication inside the organisation towards general control of quality (Prickett & Rapley, 2001; Yang, 2008).

Despite the recognised importance of the implementation of quality costing systems, the concept is not widely applied (cf., p.e. Jafari & Rodchua, 2014; Rodchua, 2006; Schiffauerova & Thomson, 2006; Vaxevanidis, Petropoulos, Avakumovic, & Mourlas, 2009; Yang, 2008), which means that many companies do not have formal systems of identification, measurement and management of QRC, and are unable to take the opportunities for improvement that may result from its implementation.

In accordance with the literature (Chiadamrong, 2003; Dale & Plunkett, 1999; Prickett & Rapley, 2001; Pursglove & Dale, 1996; Rodchua, 2006; Sansalvador & Cavero, 2005; Sower et al., 2007; Su et al., 2009; Williams et al., 1999; Yang, 2008), there are many reasons why companies do not identify QRC:

- Lack of support or management indifference;
- Management unawareness of the concept and the underlying principles of quality costing;

- Out-of-date management philosophy;
- The fact the company is recent and small sized;
- Reduced importance of total company costs;
- The fact that business is profitable and, therefore, there is no pressing need to monitor costs;
- Lack of knowledge regarding how to identify and measure QRC and the underlying benefits;
- Lack of existence of accounting systems and/or of information and/or information technology attuned to the identification, measurement, filtering and report of QRC;
- Lack of an appropriate overall categorisation of quality costs and a consequent lack of an accurate classification of the various elements of quality costs within the product life cycle;
- Unawareness and/or uncertainty on behalf of management about the benefits of implementing a QRC system;
- QRC were not one of the key areas in terms of focusing efforts of the organisation.

Like any other technique, management must decide if it uses QRC and, if so, when and how to use it. It must also consider the level of commitment, the resources and competences required to make better use of this technique. These areas together with the identification and determination of costs are among the main factors to be considered in the use of this technique (Dale & Plunkett, 1999). It is important to highlight the proactive nature of these activities as the objective is not the sole detection of errors and failures or deviations from the plan. In fact, the use of a QRC system as a mere tool to collect data is a narrow view of the global quality process and it has been identified as one of the motives that explain the failure of QRC programmes (Montgomery, 1996).

Montgomery (1996) states that some companies develop activities in the scope of quality costs but the programme is abandoned, which is due in part to the fact that QRC is used as a tool to gather data and not as a mechanism to generate improvement opportunities, through carrying out awareness raising to identify problem areas and develop better procedures and operational processes. It pointed out, on the other hand, to an excessive concern of managers with the accuracy of quality-cost figures, directing too much attention to the treatment of QRC as part of the organisation's accounting system and not as a management and control tool.

3. Profile of use of information

While it is true that TQM presupposes the existence of complete measurement systems (Collier, 2012), the mere existence of QRC programmes does not promote the improvement of quality (Sower et al., 2007). Regardless of the adequacy of the QRC system that is implemented, the effectiveness of the system will be intrinsically dependent on the way in which management uses information on QRC to improve quality (Sower et al., 2007). Morse and Roth (1987) contended that the understanding of quality costs and the use of such information as a management tool can provide valuable benefits to a firm's quality programme, including improved quality, higher productivity and better cost management.

According to Adams et al. (2003), organisations use information on QRC for different purposes and different decisions; on the one hand, to ensure that managers and the rest of the organisation team may be able to gain awareness of the importance to improve quality.

The volume that QRC typically represents in total costs of the organisation will ultimately raise awareness and help people focus on the problem of quality. On the other hand, information about QRC quantifies quality in accordance with the language of business. Information relating to quality is not expressed solely in financial terms and quality programmes complement financial information with a wide range of nonfinancial data. However, routine use of financial information may determine the privilege of financial measurements, such as that given by the QRC system, simplifying and making more effective the communication process that relates to quality. A third area highlighted by Adams et al. (2003) relates to the identification of problems and action areas. QRC systems do not only offer a quantitative and financial expression of quality costs; the categorisation of costs into prevention costs, appraisal costs and internal and external failure costs, for example, enables a better identification of the origin and nature of costs, targeting the action and allowing the evaluation of the results. Finally, information on QRC allows the assessment of the financial efforts in the scope of quality. According to Adams et al. (2003), the maintenance of continuous improvement actions throughout time is also dependent on the progress achieved in financial terms.

The way how information provided by the QRC system is used is probably one of the least focused topics in the literature. However, the analyses of profiles of use of information enable not only the evaluation of the ways the management process relies on that information, as well as the effects of such use.

The distinction between interactive and diagnostic systems was proposed by Simons (1991) to define how management control systems are used (Tessier & Otley, 2012). Simons (1995) contended that the most important fact is not the identification of types of controls companies use, but rather how they are used, which led to the distinction between the diagnostic and the interactive use of controls.

The diagnostic and interactive notions of control proposed by Simons are part of a broader conceptual framework, extensively explained in Levers of Control (Simons, 1995). Diagnostic systems are formal information systems that managers use to monitor organisational outcomes and correct deviations from preset standards of performance (Simons, 1995). These systems are described by the ability to measure the outputs of processes, by the existence of predetermined standards against which actual results can be compared and by the ability to correct deviations from standards, thus approaching the traditional notion of management control. They allow a close control of the critical variables of organisational performance, without a permanent intervention by managers, whose attention is focused on negotiation and goal setting, in periodic reports that inform of ongoing actions and in specific interventions when critical variables are off target (Simons, 1995). In this way, the management by exception concept is something that underlies the diagnostic use. They are systems that limit the search for innovative solutions and the identification of opportunities, as attention is focused on the critical variables of performance.

As opposed to diagnostic systems, interactive systems stimulate the exploration of innovative solutions and learning, allowing new strategies to grow as participants interact, debate and dialogue in response to perceived opportunities and threats. As highlighted by Agbejule (2006), as opposed to diagnostic systems, the participation of managers is permanent and is directed towards breaking routines, fostering participation, interaction and generating a type of competitive pressure among participants that induces them in processes of continued demand for new solutions and to the creation of information networks.

An important feature of the interactive use is that senior managers use the control system to create a positive informational environment that generates dialogue and encourages information sharing (Bisbe, Batista-Forhuet, & Chenhall, 2007; Henri, 2006).

4. Methodological issues

This study has an exploratory nature and is based on primary data obtained through a questionnaire survey applied to Portuguese certified companies (PCCs) according to ISO 9001:2008. The focus on certified companies is due to the fact that these organisations are more aware of the issues of quality and due to the importance of the management of its variables, including QRC, although they are not required to implement and to certify formal QRC systems.

The selection of companies was based on the last edition of the Quality & Certification Yearbook, published in 2011. Aiming at obtaining a broad picture of PCCs, a random stratified and systematised sample procedure was adopted for the sample of companies to be surveyed. Considering the objectives of the study it was intended to investigate companies with some dimension, so that only certified companies of 20 or more staff members were selected, as it is more likely that larger companies have implemented more developed and better structured management accounting systems (Lal & Srivastava, 2009; Sansalvador & Cavero, 2005). According to Bouwens and Abernethy (2000), Widener (2004) and Henri (2006), for example, companies with a larger number of staff members are more likely to implement formal management accounting systems. Moreover, some studies show that companies of a larger dimension are more likely to implement recent techniques,[2] which may be an indicator of the degree of development of the systems.

Companies were selected in breaks of four records, with the aim of setting up a sample of companies to be surveyed equal to 25% of the total companies of the Quality & Certification Yearbook. When a company did not match the staff number (SN) criteria, the next company that fulfilled the criteria would be selected. In this way, 1.272 companies were selected to be investigated. An answer rate of 25.4% was obtained, corresponding to 323 validated questionnaires. It carries a sample error of 5.3% for a confidence interval of 95%. The profile of the sampled companies is presented in Appendix 1.

The instrument for data collection was constructed based on the literature. The first question refers to the type of information provided by the formal information system in regard to quality indicators (see Appendix 2 – panel 1). The formulation of this question was based on the extensive literature on QRC (Bamford & Land, 2006; Dale & Plunkett, 1999; Kirlioğlu & Çevik, 2013; Lari & Asllani, 2013; Plunkett & Dale, 1987; Sower et al., 2007; Tye, Halim, & Ramayah, 2011; Williams et al., 1999; Zimwara, Mugwagwa, Maranga, Mnkandla, & Ngwarati, 2013) and does not reproduce any question of an existing questionnaire. The second question referred to the presentation of information allowing measurement of the extent (diversity and level of detail) of information provided by the system (see Appendix 2 – panel 1). The formulation of this question was based on the works of Chenhall and Morris (1986), Bouwens and Abernethy (2000) and Rapley et al. (1999). Finally, the third question reproduces, with some adaptations, a section of a questionnaire developed by Naranjo-Gil and Hartmann (2006), and allowed the measurement of the profile of use of information provided by the system (see Appendix 2 – panel 2). Prior to the implementation of the questionnaire a pre-test was performed in 10 companies, leading to small adaptations of the original questionnaire.

The questionnaire was addressed to the boards of companies, allowing for this body to decide which would be the best member to answer the questionnaire. Of the 323 validated questionnaires, 200 (61.9%) were answered by the quality manager, 97 (30.0%) by administrators/directors and the remainder by other staff members.

Data obtained were analysed using IBM SPSS Statistics 21 software. Data regarding questions 1 and 2 were analysed using descriptive statistics while question 3 involved

the sequential application of principal component analysis (PCA), cluster analysis, one-way analysis of variance (one-way ANOVA) and discriminant analysis.

PCA is a multivariate exploratory analysis that transforms a set of correlated variables into a minor set of independent variables or components that are linear combinations of the initial variables (Hair, Black, Babin, & Anderson, 2010). The application of PCA sought the identification of components that represent the diagnostic and the interactive profile of use of QRC information. The application of cluster analysis aimed to identify groups of companies with different profiles of use of QRC information. Cluster analysis is an exploratory technique of multivariate analysis that groups subjects based on the existing information, in such a way that the subjects belonging to the same group are as similar as possible and always more similar to elements of the same group than to elements of the remaining groups (Hair et al., 2010). Therefore, the analysis may allow the identification of heterogeneous groups of companies in terms of profile of use of information, but each group will integrate companies with a similar profile of use of information. This was followed by variance analysis. Variance analysis (or one-way ANOVA) of a factor is an extension of the *t*-test, and the purpose is to find out whether the groups came from populations with different means, i.e. if the means of the group differ significantly (Hair et al., 2010). In this study, one-way ANOVA was applied aiming at detecting the existence of significant differences among groups of companies with relation to interactive and diagnostic factors. Finally the discriminant analysis was applied with the aim to identify the factor extracted in PCA that best discriminates the groups. The discriminant analysis may also validate the results of the previous analyses, namely the existence of significant differences among groups of companies in regard to PCA components. If significant differences existed among groups for that particular component, it is expected that discriminant analysis will display a significant discriminatory power to this component.

5. Results

A comprehensive analysis of the data obtained shows that Portuguese ISO 9001-certified companies have information systems that provide information on quality costs in an extensive way. In fact, considering the results obtained in question 1 (see Appendix 2 – panel 1), the average scores vary between 2.52 and 3.46, and only 7 of the 19 items analysed have average scores below the level 3.00. The systems in place are broader and developed to provide information related to internal cost failures, external cost failures, appraisal costs and prevention costs. However, regarding the detail of information provided by the information system it can be seen that the average values for 11 of the 12 items are below 3.00, which means that the level of detail of information is generally low. This finding raises questions as to the accuracy of information on quality costs to support the management process and, consequently, their use by managers in their day-to-day decisions.

In accordance with the objectives of the study and in order to identify companies with different profiles of use of QRC information, a PCA and a cluster analysis were performed. In what concerns the PCA, a solution was sought for two components that could be representative of diagnostic and interactive profiles of use. The preliminary analysis showed a level of significance of Bartlett's Test of Sphericity of 0.000 (4702.876; df = 66), leading to the null hypothesis of the variables not being correlated. On the other hand, the Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy showed a value of 0.947. The KMO statistic compares simple correlations with the partial correlation observed between the variables. The assumptions of PCA are confirmed when the partial correlations approach

zero, reproduced in higher KMO values. The application of PCA allowed the extraction of two components that correspond to diagnostic and interactive profiles of use which explain 81.187% of the variability of the initial data (see Appendix 2 – panel 2).

The objective of cluster analysis was the identification of groups of companies with differentiated profiles for use of QRC information. Groups were formed based on the components extracted in PCA. Four groups of companies that were differentiated by the profile of use of QRC information were extracted (cf. Figure 1).

Group 1 gathers a set of companies with an average SN of 50 and a sales volume (SV) of between 3 and 5 million euro. Companies of groups 2 and 3 have an average SN of 100 and a SV of between 5 and 7 million euro. Group 4 is of a much smaller dimension gathering companies which, in average, are also of a smaller dimension, considering the values for SN and SV (cf. Table 1).

Given the disparity between group 4 and the remaining groups, mainly with regards to dimension, the removal of this was considered. Group 4 also reports much lower average values than the remaining groups in what concerns the nature and the shape of information about QRC that is provided by the information system implemented at the company. Therefore, the analysis was carried out with groups 1, 2 and 3.

As mentioned, one-way ANOVA was performed aiming at detecting the existence of significant differences between groups with relation diagnostic and interactive components. The results of the analysis (cf. Table 2) show that group 1 reports a negative value in regard to the interactive profile of use of information and a markedly negative value in regard to the diagnostic profile of use of information. This group of companies reported relatively reduced values in what concerns the nature and shape of information about QRC that is provided by the information system implemented at the company (average values of 2.71 and 2.34, respectively (cf. Appendix 2 – panels 1 and 2)),

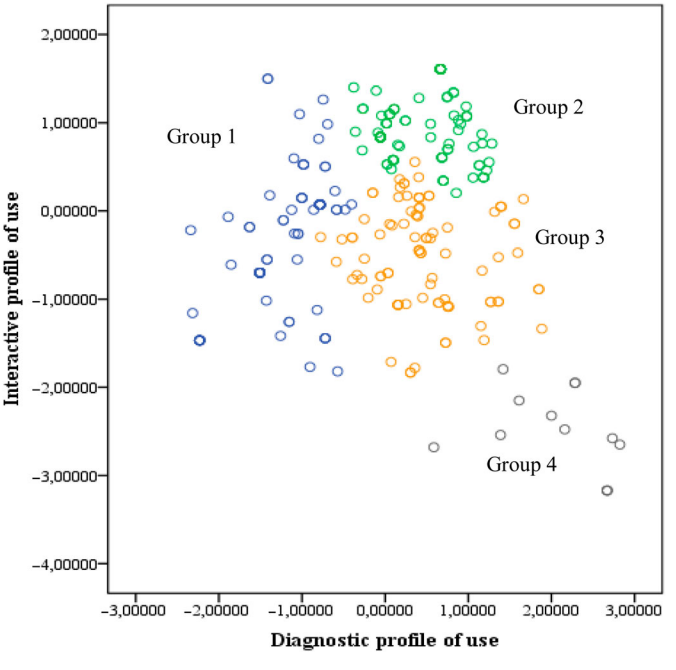

Figure 1. Groups of companies according to the profile of use of QRC information.

Table 1. Description of groups in accordance with SN and SV.

Groups	*n*	SN	SV
Group 1	99	4.47	6.58
Group 2	117	4.94	7.86
Group 3	94	4.90	7.48
Group 4	13	3.23	5.46

Table 2. Cluster analysis (average values) and significant differences between groups.

Components	Group 1	Group 2	Group 3	Significant differences
Number of observations	99	117	94	
F1. Interactive	−0.306	0.948	−0.511	(1; 2) (1; 3) (2; 3)
F2. Diagnostic	−1.178	0.371	0.489	(1; 2) (1; 3)

therefore corresponding to a group of companies whose information regarding QRC is incipient. This fact justifies a reduced use of this information to support management, as evidenced by the average value of 2.48 for the items corresponding to the actions described in Table 3. In about 41% of companies of this group the QRC reports are prepared by the quality department, in about 16% of the companies they are jointly prepared by quality and accounting departments and in about 23% of the companies the reports are prepared by the accounting department. However, production of information is mainly yearly (46% of companies report yearly, while 19% and 16% do so monthly and quarterly, respectively), which must be related to the production of yearly management reports and not as much to do with the maintenance of an information system to support management, which reinforces what was previously stated with regards to the use of information in management actions.

As regards group 2, a positive value is seen relating to the diagnostic profile of use of information and a markedly positive value in what concerns the interactive profile of use of information. In these companies managers use information about QRC to define objectives, monitor their fulfilment and motivate the participants (in accordance with the diagnostic profile), but also to foster organisational learning, the emergence of new ideas and strategies (in accordance with the interactive profile) as evidenced by the average values for the various actions presented in Table 3. Production of QRC information is the responsibility of the quality department (53.8%), of the accounting department (9.4%) or jointly (17.9%), with a monthly (36.8%) and a quarterly (30.8%) frequency.

As regards group 3, information is used as a means of monitoring and control of operational efficiency, a characteristic of the diagnostic profile of use, as evidenced by the average values shown in Table 3. The value of those items are, in any case, lower than the values obtained for the items corresponding to group 2, enhancing the use of information about QRC to the fulfilment of objectives, to compare results with the established objectives and to detect significant deviations. The production of information is the exclusive responsibility of the department of quality in 67.1% of the companies, of the accounting department in 16% of the companies and is jointly prepared by both departments in 8.5% of the companies of this group. The information is issued monthly and quarterly in 21.3% and 23.4% of the companies, respectively. 29.8% of the companies issued the information with a yearly frequency.

Table 3. Corresponding actions to diagnostic and interactive profiles.

Actions	Mean scores		
	Group 1	Group 2	Group 3
Diagnostic profile of use of QRC information			
Setting targets and objectives	2.45	4.55	3.78
Negotiate targets and objectives	2.39	4.38	3.35
Follow up significant exceptions and deviations	2.41	4.38	3.83
Follow up preset plans and goals	2.46	4.38	3.83
Align performance measures with strategic goals	2.58	4.44	4.06
Involve in a permanent attention with subordinates	2.53	4.31	3.53
Interactive profile of use of QRC information			
Signalling key strategic areas	2.40	4.21	2.82
Implement new ideas and ways for doing tasks	2.35	4.27	2.86
Debate data assumptions and action plans	2.40	4.44	3.36
Develop, implement and operate evaluation and control systems	2.58	4.35	3.45
Learning tool	2.53	4.26	3.04
Allow the company to focus on the critical factors for success	2.69	4.32	3.32

Considering the above and the average values for groups 2 and 3 concerning each one of the components, it is possible to describe as *interactive* the QMS implemented in companies belonging to group 2 and as *diagnostic* the QMS implemented in companies belonging to group 3, as the first ones report a markedly positive value in relation to the *interactive* component and a moderately negative value in relation to the *diagnostic* component, while the latter report a markedly positive value in relation to the *diagnostic* component and a strongly negative value in relation to the *interactive* component. Statistically significant differences were found among the three groups regarding the interactive profile of use of information and among group 1 and the remainder regarding diagnostic profile of use of information (cf. Table 2).

Table 4 shows the results of the discriminant analysis through which it is possible to infer that the component *Interactive profile of use of QRC information* has the greatest power to discriminate among groups of companies, which is in line with previous results that pointed to significant differences among the three groups regarding this component. This means that the groups of companies are better distinguished by the interactive use they make of QRC information that is provided by the implemented information system and to a lesser extent by the diagnostic use. Somehow this can be explained by the fact that companies that make an interactive use also make a diagnostic use of information (Haas & Kleingeld, 1999; Emsley, 2001; Widener, 2007; Mundy, 2010).

Additionally, we have performed parametric and nonparametric correlations between the profiles of use and the type and extent of QRC information for groups 2 and 3. According to prior research (Abernethy & Brownell, 1999), it would be expected that the variables were not correlated. Overall, results showed the absence of significant correlations

Table 4. Discriminatory power of the components extracted in PCA.

Step	Component (variable) introduced	Λ of Wilks	Significance
1	Interactive use of QRC information	0.315	0.000
2	Diagnostic use of QRC information	0.275	0.000

Table 5. Correlations between the profile of use and the type and extent of QRC information.

	Type of information		Extent of information	
Profiles of use of QRC information	Pearson	Spearman	Pearson	Spearman
Group 2				
Diagnostic profile of use of QRC information	0.963	0.803	0.406	0.356
Interactive profile of use of QRC information	0.760	0.984	0.230	0.548
Group 3				
Diagnostic profile of use of QRC information	0.383	0.669	0.288	0.860

between the profile of use and the quality (type and extent) of QRC information. Following these results, we may state that information quality is a factor that can determine whether or not managers use QRC information, but not the profile of use of this information (Table 5).

6. Discussion and conclusions

This study was mainly motivated by two factors. First, there is limited research that describes the way QRC information is used in the management process. Second, the profile of use of QRC is an important issue as it allows assessing how managers rely on this information and the effects that may derive from that use.

Quality costs are one of the most relevant aspects in the development of a QMS (Dahlgaard et al., 1992). QRC information is a key organisational resource allowing the maintenance of an attitude of constant attention towards issues related to quality, alerting managers to the potential impact of QRC, motivating action to improve quality, helping to define the activities to reduce and control QRC, and prioritising quality improvement efforts. Therefore, costing of quality is one of the elements of the quality system and as such it should not be understood as a complementary activity but as an integrated element in the strategic organisational thinking and in the daily activities of the organisation (Jaju et al., 2009).

The main objective of this study was the identification of different profiles of use of information about QRC in ISO 9001 PCCs, using as conceptual support the structure proposed by Simons (1991) which distinguishes between diagnostic and interactive control systems. Based on this structure, it was possible to identify three groups of companies with different profiles of use of information about QRC: one group of companies prepares information about QRC but ultimately does not use this information in the management process; a second group of companies uses this information in accordance with a diagnostic profile; a third group of companies show also an interactive profile of use of QRC information, which means that they are using this information in an extensive way.

Companies of group 1 show a profile which points to a weak use of information, which is triggered by the reduced extent of the support system that is implemented, either in terms of type of information or in terms of its presentation (see Appendix 2 – panel 1). The constraints at this level are noted in the literature as reasons that may determine a lesser use of the information provided by the QRC system (cf., p.e. Pursglove & Dale, 1996; Sower et al., 2007; Su et al., 2009; Williams et al., 1999; Yang, 2008). However, it is also necessary to point out that many companies identify and measure QRC and produce information about QRC, but managers do not analyse this information and consequently do not use it in the management process (cf., p.e. Chopra & Garg, 2012).

Companies of groups 2 and 3 seem to show a better framework in terms of use of information about QRC in the management process, although they present different profiles. The managers of companies of group 3 use the information about QRC in accordance with a diagnostic profile, and thus focused on the setting of targets and objectives, monitoring results and in the detection and correction of deviations. Montgomery (1996) highlighted that the traditional approach in terms of the use of information related with QRC was to compare actual performance with past performance which in effect focuses QRC programmes on the critical variables of performance. These analyses are essentially a mechanism to detect deviation and to bring them to the attention of managers, not actually being a tool to ensure the improvement of quality. A diagnostic use of information about QRC will be, therefore, more concerned with inspection activities. In accordance to Dahlgaard et al. (1992), QMS comprises two essential activities: activities of inspection and activities of prevention. Activities of inspection are focused on the detection and correction of failures. Activities of prevention seek to anticipate and prevent the existence of failures and comprise quality planning activities, improvement of quality activities, activities to inform about quality and activities to promote quality. These types of activities by their nature require a less mechanical approach which favours the involvement and participation of elements of the organisation. The systems and profile of use of information about QRC identified in group 2 are also in line with this type of activities. An interactive use of information is underlined by a less restrictive and penetrating control, with some informality, focused on cooperation and communication (Agbejule, 2006), and that may favour the information flows, the debate and the dialogue in an organisation.

In this research we have identified three profiles of use of QRC information. Conceptually, this does not mean that a company ranks high or low in different profiles of use; instead, it ranks high or low in each of the captured dimensions (diagnostic and interactive profile use of QRC information) and consequently will rank high or low in (be close to or far away from) one given profile of use (Bisbe et al., 2007). Another important issue to be considered is that the difference between the diagnostic and interactive dimensions is not correlated with the type of information but with the profile of use of the information (Abernethy & Brownell, 1999; Vaivio, 1999). Thus, the same piece of information (a budget, for example) may be used to monitor and control operational efficiency, in accordance with a diagnostic profile, or to stimulate dialogue and continuous learning, in accordance with the interactive profile.

A significant number of companies use QRC information according to diagnostic profile. QRC information is used primarily to measure outputs of processes, to compare outcomes with the preset standards and to correct detected deviations, following the traditional notion of management control (Simons, 1995). Working effectively, diagnostic use can streamline the amount of information managers must react to in the scarce time they have available. Diagnostic use can increase return on management, making it possible for managers to focus on exceptions (Norman, 2001; Widener, 2007). Despite its usefulness in terms of accomplishment and implementation of intended strategies, diagnostic use of information is seen as a constraint to innovation and opportunity-seeking (Simons, 1995; Norman, 2001). However, some authors (Kato, Boer, & Chow, 1995; Ittner & Larcker, 1999; Emsley, 2001; Norman, 2001; Mundy, 2010) contended that diagnostic use is not simply a constraining influence on managers' behaviour, to the extent that monitoring processes also highlight problems and motivate managers to achieve their goals, sometimes through novel solutions.

Companies of group 2 also make an interactive use of QRC information, which means that they are extensive users of QRC information since apart from the focus on outcomes of quality figures, on the deviations from preset standards and on the corrective actions, managers also use such information to foster dialogue and communication throughout the organisation. Some research focused more specifically on the use of information according to a diagnostic profile maintains that the use of the diagnostic type may not constitute an end in itself, but a necessary means to start and support an interactive use that privileges dialogue and communication among participants in order to produce new organisational strategies or solutions (Emsley, 2001; Haas & Kleingeld, 1999; Widener, 2007; Mundy, 2010). Understood in that sense, the diagnostic use of information constitutes a prerequisite for its interactive use (Haas & Kleingeld, 1999; Henri, 2006; Mundy, 2010; Widener, 2007), which may explain the widespread use of QRC information according to a diagnostic profile. Prior research also points to a prevalence of diagnostic use, since the interactive use is time-consuming, in that it requires an intensive use of information, a pervasiveness of communication and debates, a continued attention of managers and a non-invasive, facilitating and inspirational type of involvement (Bisbe et al., 2007).

In this research we have shown that companies have different profiles of use of QRC information and that this use is not contingent with the type and extent of information, which means that there are factors other than these features of QRC information that explain the existence of different profiles of use. These findings expand the knowledge in the field of QRC as previous studies have focused primarily on issues related to the identification, collection, measurement, classification, disclosure and control of QRC. The study also opens up some avenues for further research, namely as regards to the practical implications of the different uses of QRC information, such as the relations between the use of this information and performance, that is, to what extent the style of use of QRC information has an impact on organisational performance. How exactly is QRC information used by managers in day-to-day tasks and in discussions with subordinates and other managers, as well as the reasons why managers use the QRC information according to a diagnostic profile or an interactive profile are questions that should also be deeply investigated.

This study has several limitations, in addition to those related to the use of questionnaire survey. Although the study focuses on ISO 9001-certified companies, it covers a wide variety of companies without a focus on a particular industry. It is known that the business environment of an industry may determine the extent of the QRC system (Sansalvador & Cavero, 2005; Schiffauerova & Thomson, 2006), the frequency of QRC measurements (Schiffauerova & Thomson, 2006) or even the use of this information. The present study does not capture the specifics of each industry. Moreover, each company also has its own costing system and its own QRC model, so the quality of information – and its use – may depend, at least in part, on the type and robustness of the information system that is implemented. The issue of hidden costs was also not addressed. It is known that many organisations do not implement costing systems to capture and measure all information on QRC, namely the hidden elements (Chiadamrong, 2003; Sailaja et al., 2015). To that extent, we can assume that this research does not capture the effects of hidden quality costs on the use of information by managers. Finally, this research does not discuss the usefulness of the information, i.e. the relevance of the information to the user (Todd, 1999), assuming that the QRC information provided by the information system is useful for users (managers) and its use in accordance with a diagnostic or an

interactive profile depends on other factors. These idiosyncrasies have not been taken into account in the study.

Disclosure statement

No potential conflict of interest was reported by the authors.

Funding

The authors are pleased to acknowledge financial support from Fundação para a Ciência e a Tecnologia and FEDER/COMPETE (grant number UID/ECO/04007/2013).

Notes

1. It is not an exclusive feature of QRC information. Hall (2010), for example, contended that prior studies have devoted inadequate attention to how accounting information is used by managers in their work.
2. Askarany and Smith (2008), for example, identified significant positive relations between the dimension (considering the SN) and the implementation of activity-based costing systems.

References

Abernethy, M., & Brownell, P. (1999). The role of budgets in organizations facing strategic change: An exploratory study. *Accounting, Organizations & Society*, *24*(3), 189–204.

Adams, S., Pryor, L., Keller, D., & Harston, M. (2003). *Using management accounting information: A decision case approach* (2nd ed.). Mason, OH: South-Western Pub.

Agbejule, A. (2006). *How the diagnostic and interactive use of MAS determine the relationship between task uncertainty and organizational performance*. Paper presented at AAA 2007 Management Accounting Section (MAS) Meeting. Fort Worth, Texas.

Askarany, D., & Smith, M. (2008). Diffusion of innovation and business size: A longitudinal study of PACIA. *Managerial Auditing Journal*, *23*(9), 900–916.

Bamford, R., & Land, N. (2006). The application and use of the PAF quality costing model within a footwear company. *International Journal of Quality & Reliability Management*, *23*(3), 265–278.

Bisbe, J., Batista-Forhuet, J., & Chenhall, R. (2007). Defining management accounting constructs: A methodological note on the risk of conceptual misspecification. *Accounting, Organizations & Society*, *32*(7–8), 789–820.

Bouwens, J., & Abernethy, M. (2000). The consequences of customization on management accounting system design. *Accounting, Organizations & Society*, *25*(2), 221–241.

Campanella, J. (1999). *Principles of quality costs. Principles, implementation and use* (3rd ed.). Milwaukee: ASQC.

Chenhall, R., & Morris, D. (1986). The impact of structure, environment, and interdependence on the perceived usefulness of management accounting systems. *The Accounting Review*, *LXI*(1), 16–35.

Chiadamrong, N. (2003). The development of an economic quality cost model. *Total Quality Management & Business Excellence*, *14*(9), 999–1014.

Choo, C., Bergeron, P., Detlor, B., & Heaton, L. (2008). Information culture and information use: An exploratory study of three organizations. *Journal of the American Society for Information Science and Technology*, *59*(5), 792–804.

Chopra, A., & Carg, D. (2012). Cost of quality practices among Indian industries. *International Journal for Quality Research*, *6*(2), 109–112.

Colier, P. (2012). *Accounting for managers: Interpreting accounting information for decision making* (4th ed.). Wesr Sussex: Wiley.

Crosby, P. (1979). *Quality is free*. New York, NY: Mc-Graw-Hill.

Dahlgaard, J., Kristensen, K., & Kanji, G. (1992). Quality costs and total quality management. *Total Quality Management*, *3*(3), 211–221.

Dale, B., & Plunkett, J. (1999). *Quality Costing*. Aldershot: Gower Publishing.
Emsley, D. (2001). Redesigning variance analysis for problem solving. *Management Accounting Research*, *12*(1), 21–40.
Giakatis, G., Enkawa, T., & Washitani, R. (2001). Hidden quality costs and the distinction between quality cost and quality loss. *Total Quality Management*, *12*(2), 179–190.
Haas, M., & Kleingeld, A. (1999). Multilevel design of performance measurement systems: Enhancing strategic dialogue throughout the organization. *Management Accounting Research*, *10*(3), 233–261.
Hair, Jr., J., Black, W., Babin, B., & Anderson, R. (2010). *Multivariate data analysis – A global perspective* (7th ed.). Upper Saddle River, NJ: Pearson Prentice Hall.
Hall, M. (2010). Accounting information and managerial work. *Accounting, Organizations & Society*, *35*(2), 301–315.
Henri, J.-F. (2006). Management control systems and strategy: A resource-based perspective. *Accounting, Organizations & Society*, *31*(6), 529–558.
Ittner, C. & Larcker, D. (1995). Total quality management and the choice of information and reward systems. *Journal of Accounting Research*, *33*(Suppl.), 1-34.
Jafari, A., & Rodchua, S. (2014). Survey research on quality costs and problems in the construction environment. *Total Quality Management & Business Excellence*, *25*(3), 222–234.
Jaju, S., Mohanty, R., & Lakhe, R. (2009). Towards managing quality cost: A case study. *Total Quality Management & Business Excellence*, *20*(10), 1075–1094.
Kajdan, V. (2007). Why quality, cost and business excellence are inseparable. *Total Quality Management & Business Excellence*, *18*(1–2), 147–152.
Kanji, G. (1990). Total quality management: The second industrial revolution. *Total Quality Management*, *1*(1), 3–12.
Kato, Y., Boer, G., & Chow, C. (1995). Target costing: An integrative management process. *Journal of Cost Management, 9*(1), 39–51.
Kirlioĝlu, H., & Çevik, Z. (2013). Measuring and reporting cost of quality in a Turkish manufacturing company: A case study in electric industry. *Journal of Economic and Social Studies*, *3*(2), 87–100.
Krishnan, M., Kriebel, H., Kekre, S., & Mukhopadhyay, T. (2000). An empirical analysis of productivity and quality in software products. *Management Science*, *46*(6), 745–759.
Lal, J., & Srivastava, S. (2009). *Cost accounting* (4th ed.). Nova Deli: Tata McGraw-Hill.
Lari, A., & Asllani, A. (2013). Quality cost management support system: An effective tool for organisational performance improvement. *Total Quality Management & Business Excellence*, *24*(3–4), 432–451.
Makhopadhyay, A. (2004). Estimation of cost of quality in an Indian textile industry for reducing cost of non-conformance. *Total Quality Management & Business Excellence*, *15*(2), 229–234.
Montgomery, D. (1996). *Introduction to statistical quality control* (6th ed.). New York, NY: John Wiley & Sons.
Morse, W. (1993). A handle on quality costs. *Cambridge Managerial Accounting*, *67*(1), 21–24.
Morse, W., & Roth, H. (1987). Why quality costs are important. *Management Accounting*, November, 42–43.
Mundy, J. (2010). Creating dynamic tensions through a balanced use of management control systems. *Accounting, Organizations & Society*, *35*(5), 499–523.
Naranjo-Gil, D., & Hartmann, F. (2006). How top management teams use management accounting systems to implement strategy. *Journal of Management Accounting Research*, *18*(1), 21–53.
Norman, R. (2001). Letting and making managers manage: The effect of control systems on management action in New Zealand's Central Government. *International Public Management Journal*, *4*(1), 65–89.
Oakland, J. 1989. *Total quality management*. Oxford: Heinnemann Publishing.
Oliver, J., & Qu, W. (1999). Cost of quality reporting: Some Australian evidence. *International Journal of Applied Quality Management*, *2*(2), 233–250.
Plunkett, J., & Dale, B. (1987). A review of the literature on quality-related costs. *International Journal of Quality & Reliability Management*, *4*(1), 40–52.
Prickett, T., & Rapley, C. (2001). Quality costing: A study of manufacturing organizations. Part 2: Main survey. *Total Quality Management*, *12*(2), 211–222.

Pursglove, A., & Dale, B. (1996). The influence of management information and quality management systems on the development of quality costing. *Total Quality Management*, *7*(4), 421–432.

Rapley, C., Prickett, T., & Elliott, M. (1999). Quality costing: A study of manufacturing organizations. Part 1: Case studies and survey. *Total Quality Management*, *10*(1), 85–93.

Rodchua, S. (2006). Factors, measures, and problems of quality costs program implementation in the manufacturing environment. *Journal of Industrial Technology*, *22*(4), 236–245.

Sailaja, A., Basak, P., & Viswanadhan, K. (2015). Costs of quality: Exploratory analysis of hidden elements and prioritization using analytic hierarchy process. *International Journal of Supply and Operations Management*, *1*(4), 489–506.

Sansalvador, M., & Brotons, J. (2013). Quality costing analysis: A case study of a Spanish organisation. *Total Quality Management & Business Excellence*, *24*(4), 378–396.

Sansalvador, M., & Cavero, J. (2005). El coste total de la calidad en organizaciones ISO 9000: In estudio empírico. *Spanish Journal of Finance and Accounting*, *34*(127), 899–924.

Schiffauerova, A., & Thomson, V. (2006). A review of research on cost of quality models and best practices. *International Journal of Quality & Reliability Management*, *23*(4), 647–669.

Shah, K., & Fitzroy, P. (1998). A review of quality cost survey. *Total Quality Management*, *9*(6), 479–486.

Simons, R. (1991). Strategic orientation and top management attention to control systems. *Strategic Management Journal*, *12*(1), 49–62.

Simons, R. (1994). How new top managers use control systems as levers of strategic renewal. *Strategic Management Journal*, *15*(3), 169–189.

Simons, R. (1995). *Levers of control: How managers use innovative control systems to drive strategic renewal.* Boston, MA: Harvard Business School Press.

Smith, M. (2005). Performance measurement & management: A strategic approach to management accounting. London: SAGE.

Sohal, A., Ramsay, L., & Samson, D. (1992). Quality management practices in Australian industry. *Total Quality Management*, *3*(3), 283–299.

Sower, V., Quarles, R., & Broussard, E. (2007). Cost of quality usage and its relationship to quality system maturity. *International Journal of Quality & Reliability Management*, *24*(2), 121–140.

Su, Q., Shi, J., & Lai, S. (2009). Research on the trade-off relationship within quality costs: A case study. *Total Quality Management & Business Excellence*, *20*(12), 1395–1405.

Tessier, S., & Otley, D. (2012). A conceptual development of Simons' levers of control framework. *Management Accounting Research*, *23*(3), 171–185.

Todd, R. (1999). Back to our beginnings: Information utilization, Bertram brookes and the fundamental equation of information science. *Information Processing and Management 35*(6), 851–870.

Tye, L., Halim, H., & Ramayah, T. (2011). An exploratory study on cost of quality implementation in Malaysia: The case of Penang manufacturing firms. *Total Quality Management & Business Excellence*, *22*(12), 1259–1315.

Vaivio, J. 1999. Exploring a 'non-financial' management accounting change. *Management Accounting Research*, *10*(4), 409–437.

Vaxevanidis, N., Petropoulos, G., Avakumovic, J., & Mourlas, A. 2009. Cost of quality models and their implementation in manufacturing firms. *International Journal for Quality Research*, *3*(1), 27–36.

Weinstein, L., Vokurka, R., & Graman, G. (2009). Costs of quality and maintenance: Improvement approaches. *Total Quality Management & Business Excellence*, *20*(5), 497–507.

Widener, S. (2004). An empirical investigation of the relation between the use of strategic human capital and the design of the management control system. *Accounting, Organizations & Society*, *29*(3/4), 377–399.

Widener, S. (2007). An empirical analysis of the levers of control framework. *Accounting, Organizations & Society*, *32*(7/8), 757–788.

Williams, A., Wiele, A., & Dale, B. (1999). Quality costing: A management review. *International Journal of Management Reviews*, *1*(4), 441–460.

Yang, C. (2008). Improving the definition and quantification of quality cost. *Total Quality Management & Business Excellence*, *19*(3), 175–191.

Zimwara, D., Mugwagwa, L., Maranga, D., Mnkandla, A., & Ngwarati, T. (2013). Cost of quality as a driver for continuous improvement – Case study. *International Journal of Innovative Technology and Exploring Engineering*, *2*(2), 132–139.

Appendix 1. Profile of sampled companies

List of sampled companies by SN, SV and industry.
1. List of sample companies by SN.

SN	*n*	%	SN	*n*	%
20–49	86	26.6	100–249	91	28.2
50–99	100	31.0	250 or more	46	14.2
			Total	323	100

2. List of sample companies by SV.

SV	*n*	%	SV	*n*	%
<€5.0 million	181	56.1	€15.0–40.0 million	34	10.5
€5.0–15.0 million	64	19.8	€40.0 million or more	44	13.6
			Total	323	100

3. List of sample companies by industry.

Industry	*n*	%	Industry	*n*	%
Agriculture, livestock and forestry	15	4.6	Transportation and logistics services	16	4.9
Manufacturing	101	31.3	Financial intermediation services	3	0.9
Construction	25	7.7	Real state, renting and business services	48	14.9
Wholesale and retail	68	21.1	Health and social work	8	2.5
Accommodation and food services	27	8.4	Other service activities	12	3.7
			Total	323	100

Appendix 2. Questionnaire and results extracted from the statistical analysis

Items	Mean scores $n =$ 323	Std. dev. $n =$ 323	Mean scores (groups) Group 1	Group 2	Group 3	Significant differences between groups
Panel 1: Nature and shape of the information about QRC provided by the information system						
1. Information provided by the information system in regard of QRC Please, indicate if the information system implemented at the company provides information in relation to the following quality indicators: (1 – does not provide; 5 – provides extensively) ($n = 323$)						

(*Continued*)

Appendix 2. Continued.

Items	Mean scores $n = 323$	Std. dev. $n = 323$	Mean scores (groups) Group 1	Group 2	Group 3	Significant differences between groups
Internal failure costs						
1.1: Costs and other measures related with product or service conception failures and with the corrective actions	3.13	1.26	2.59	3.66	3.07	(1; 2) (1; 3) (2; 3)
1.2: Costs incurred by the company and/or other measures related with the replacement, correction or any other type of intervention on rejected materials and/or corrective measures with suppliers	3.14	1.20	2.77	3.64	3.04	(1; 2) (2; 3)
1.3: Costs incurred by the company and/or other measures related with the identification, correction and review of non-conformities in the production process and/or the service provision	3.11	1.16	2.66	3.68	2.95	(1; 2) (2; 3)
1.4: Costs incurred by the company and/or other measures related to products and/or irreparable service	3.07	1.19	2.70	3.57	2.98	(1; 2) (1; 3) (2; 3)
1.5: Costs resulting from errors and failures (mechanical and/or human) in the productive process	2.98	1.15	2.73	3.32	2.99	(1; 2)
1.6: Costs incurred by the company and/or other measures related to product sales at a reduced price due to defects, surplus stock, etc.	2.73	1.30	2.38	3.15	2.70	(1; 2) (2; 3)
External failure costs						
1.7: Costs of refusal of products and services on behalf of the client and/or its repair	3.15	1.27	2.94	3.50	3.14	(1; 2)
1.8: Costs incurred by the company related to complaints management	3.36	1.20	3.05	3.77	3.28	(1; 2) (2; 3)
1.9: Costs incurred by the company and/or other measures related with the processing of client returns	3.06	1.29	2.88	3.36	2.98	(1; 2)
1.10: Costs of production borne by the company and/or other indicators related with the withdrawal of products from the market	2.52	1.32	2.35	2.95	2.27	(1; 2) (2; 3)

(*Continued*)

Appendix 2. Continued.

Items	Mean scores $n =$ 323	Std. dev. $n =$ 323	Mean scores (groups) Group 1	Group 2	Group 3	Significant differences between groups
1.11: Costs incurred by the company and/or other measures related with delays in delivery of products and/or in the provision of services	3.07	1.19	2.94	3.37	3.00	(1; 2)
1.12: Costs incurred by the company and/or other measures related with loss of actual and/or potential clients	2.65	1.27	2.56	3.11	2.40	(1; 2) (2; 3)
1.13: Costs and other indicators related with customer care service	2.89	1.27	2.60	3.48	2.64	(1; 2) (2; 3)
Appraisal costs						
1.14: Costs associated to inspection/evaluation of raw materials and other materials	2.84	1.27	2.52	3.34	2.72	(1; 2) (2; 3)
1.15: Costs incurred by the company and/or measures related with inspections, tests and audits throughout the production process or service provision	3.21	1.17	2.90	3.52	3.22	(1; 2)
Prevention costs						
1.16: Costs associated to the evaluation of client satisfaction after supply of product and/or service provision	3.04	1.25	2.62	3.68	2.79	(1; 2) (2; 3)
1.17: Costs incurred by company and/or other measures related to the evaluation/review of new products and/or services	2.83	1.17	2.57	3.32	2.65	(1; 2) (2; 3)
1.18: Costs incurred by the company with planning quality control in production and/or service provision	3.07	1.16	2.78	3.50	2.94	(1; 2) (2; 3)
1.19: Costs incurred by the company with the QMS	3.46	1.09	3.07	3.68	3.56	(1; 2) (1; 3)
2. Presentation of the information provided by the information system relative to QRC						
Please indicate to what extent the information system implemented in the company provides information relative to QRC: (1 – does not provide; 5 – provides extensively) ($n = 323$)						
2.1: QRC are broken down into fixed and variable costs	2.51	1.27	2.17	2.98	2.39	(1; 2) (2; 3)
2.2: QRC are broken down into direct and indirect costs	2.48	1.26	2.14	2.99	2.30	(1; 2) (2; 3)
2.3: Evidences, separately, prevention costs and occurrence of errors/defects	2.47	1.19	2.09	2.95	2.44	(1; 2) (2; 3)

(*Continued*)

Appendix 2. Continued.

Items	Mean scores $n =$ 323	Std. dev. $n =$ 323	Mean scores (groups) Group 1	Group 2	Group 3	Significant differences between groups
2.4: Evidences, separately, appraisal costs	2.65	1.23	2.30	2.98	2.69	(1; 2)
2.5: Evidences, separately, the costs of internal failures (failures detected before the product is supplied or the service provided to the client)	2.66	1.20	2.29	3.04	2.74	(1; 2) (1; 3)
2.6: Evidences, separately, the costs of external failures (detected after the product is supplied or the service provided to the client)	2.85	1.27	2.64	3.09	2.86	(1; 2)
2.7: Indicators of qualit/lack of quality with a quantitative/ financial expression	2.94	1.22	2.62	3.27	2.99	(1; 2)
2.8: Indicators of quality/lack of quality with a qualitative/ financial expression	2.98	1.21	2.43	3.24	3.21	(1; 2) (1; 3)
2.9: Information in an appropriate format for the structuring of indicators, decision models, etc.	3.18	1.21	2.52	3.57	3.39	(1; 2) (1; 3)
2.10: Evidences, separately, QRC in the operational results	2.74	1.20	2.38	3.14	2.68	(1; 2) (2; 3)
2.11: Evidences, separately, QRC by the organic unit (sector, department, business unit, etc.)	2.56	1.22	2.20	3.01	2.56	(1; 2) (2; 3)
2.12: Evidences, separately, QRC by product/service	2.59	1.21	2.20	3.03	2.62	(1; 2) (1; 3) (2; 3)
Panel 2: Profile of use of information						
3. Profile of use of information about costs and other quality indicators provided by the information system Indicate in which way the information provided by the information system about costs and other quality indicators is used for the following actions (1 – not used; 5 – used extensively) ($n =$ 323)						
3.1: Signalling key strategic areas	3.16	1.19	2.45	4.55	3.78	(1; 2) (1; 3) (2; 3)
3.2: Implement new ideas and ways for doing tasks	3.19	1.16	2.39	4.38	3.35	(1; 2) (1; 3) (2; 3)
3.3: Setting targets and objectives	3.67	1.14	2.41	4.38	3.83	(1; 2) (1; 3) (2; 3)
3.4: Negotiate targets and objectives	3.43	1.14	2.46	4.38	3.83	(1; 2) (1; 3) (2; 3)
3.5: Debate data assumptions and action plans	3.45	1.10	2.58	4.44	4.06	(1; 2) (1; 3) (2; 3)
3.6: Follow up significant exceptions and deviations	3.59	1.08	2.53	4.31	3.53	(1; 2) (1; 3) (2; 3)
3.7: Follow up preset plans and goals	3.64	1.04	2.40	4.21	2.82	(1; 2) (1; 3) (2; 3)

(*Continued*)

Appendix 2. Continued.

Items	Mean scores $n =$ 323	Std. dev. $n =$ 323	Mean scores (groups) Group 1	Group 2	Group 3	Significant differences between groups
3.8: Align performance measures with strategic goals	3.77	1.05	2.35	4.27	2.86	(1; 2) (1; 3) (2; 3)
3.9: Involve in a permanent attention with subordinates	3.49	1.03	2.40	4.44	3.36	(1; 2) (1; 3) (2; 3)
3.10: Develop, implement and operate evaluation and control systems	3.50	1.05	2.58	4.35	3.45	(1; 2) (1; 3) (2; 3)
3.11: Learning tool	3.25	1.09	2.53	4.26	3.04	(1; 2) (1; 3) (2; 3)
3.12: Allow the company to focus on critical factors of success	3.44	1.05	2.69	4.32	3.32	(1; 2) (1; 3) (2; 3)

Interactive profile of use (3.1, 3.2, 3.5, 3.10, 3.11, 3.12): Cronbach's $\alpha = 0.939$; diagnostic profile of use (3.3, 3.4, 3.6, 3.7, 3.8, 3.9): Cronbach's $\alpha = 0.957$.