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Developing an IS Quality Culture with ISO 9001: Hopefully, a Never Ending Story

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Abstract

We present an approach to develop IS Quality Culture, in the context of ISO 9001. The research design begins with semi-structured interviews with eight auditors, followed by action research. We confirmed that auditors recognize the importance of five distinct IS Quality dimensions: information/data, software, administrative, service, and infrastructure. However, the audit practice reveals the risk of considering IS as mere support, disregarding the cultural aspects of IS Quality. Our contribution addresses this gap by providing an audit checklist and an approach accessible to IS non-experts. An IS Quality Culture is vital in regulatory environments, and may raise the audit effectiveness and confidence in ISO 9001 as an improvement model. ISO 9001 diffusion and acceptance by more than one million companies worldwide creates an exceptional opportunity to continuously development of the IS Quality Culture. The obtained findings can also contribute to the discussion of the next ISO 9001 revision, expected to be published in 2016.

Keywords

Information systems, IS Quality, ISO 9001, IS Quality Culture, Audit.

INTRODUCTION

Information System (IS) Quality is an holistic concept that combines technological, human, and organizational issues (Von Hellens 1997). This is a critical research topic, presented at top IS conferences around the globe, for instance, in ACIS 2012, by Anstiss (2012), Gao et al. (2012), and Lee et al. (2012). A number of contributions have been made to the literature in data/information quality. In addition to this dimension, we add four others in our investigation: software, service, administrative, and infrastructure quality (Stylianou and Kumar 2000), aiming at integrating the managerial, engineering and organizational viewpoints of IS Quality (Von Hellens 1997).

ISO 9001 is an international standard for quality management (ISO 2008). By adopting the standard, organizations in different industries apply a set of principles that shape their organizational culture (Barney 1986; Kanji and Yui 1997). They promote a quality culture focused on the customer satisfaction, continuous improvement, and the involvement of people in quality efforts (Kanji and Yui 1997).

There is a mutual influence between IS Quality and ISO 9001. On one hand, ISO 9001 is an information-demanding system that requires decisions based on facts, data analysis, and evidences of improvement (ISO 2005). It demands the development of documented procedures, evidences of quality conformity, and audits by internal and external entities. On the other hand, the IS research has been influenced by quality principles for decades (Lin 2010; Ravichandran and Rai 2000), creating synergies between both fields (Barata and Cunha 2013). When combined, the IS and quality management domains contribute to business transformation, by promoting cultural changes (Philip and McKeown 2004), improving quality and organizational performance (Hartman et al. 2002), and IT adoption (Lin 2010). However, as Dahlberg and

Jarvinen (1997) observe, an overall IS quality is more likely to be accidental rather than a result of systematic practices.

The discussed open issues led us to establish three core purposes for our research: (1) know how the ISO 9001 auditors address IS Quality; (2) create a checklist to guide IS Quality audit in ISO 9001; and (3) propose an approach to guide the development of IS Quality Culture. We append the following restrictions: (1) the context of ISO 9001, (2) the approach must consider the distinct dimensions of IS Quality, (3) must be used by IS non-experts, and (4) take advantage of IS and quality management synergies.

We organized the remainder of the paper as follows. The next section introduces ISO 9001, IS Quality, and the foundations of IS Quality Culture. Next, we present the research design in two stages, namely: (1) exploratory interviews to study the IS Quality audit in ISO 9001 and their contribution to the development of a checklist to guide the auditors in their activities; and (2) action research to propose an approach that IS non-experts can use to develop IS Quality Culture. The subsequent section details the checklist, followed by the integration of the insights obtained with action research, and the evolution of the approach. Lastly we discuss the study limitations and opportunities for future research.

BACKGROUND

ISO 9001

By the end of 2011, this standard had been adopted in 180 countries, by 1.111.698 organizations (ISO 2012). It allows organizations to implement a quality management system, which can optionally be certified by an external entity. When adopting the standard, organizations must carry out an internal and external audit program. Audits are more than simple non-conformance identification; its purposes involves keeping the system "alive" and suggesting improvement opportunities (ISO 2011). Eight quality principles outline the context of ISO 9001 management systems, as enunciated in Table 1.

Table 1. Quality Management Principles (ISO 2005)

Quality Principle [QP]	Description
Customer focus [CF]	Organisations depend on their customers and therefore must understand their present and future needs, satisfy their requirements and make an effort to exceed their expectations
Leadership [LE]	Leaders establish the unity of purpose and orientation of the organisation. They must create and maintain an internal atmosphere that promotes people involvement in the achievement of the organisation objectives
Involvement of people [IP]	People are the essence of the organisation and their total commitment enables to exploit their skills for the benefit of the organisation
Process approach [PA]	A result is achieved more effectively when the related activities and resources are managed as a process
System approach to management [SA]	Identifying, understanding, and managing interrelated processes as a system, contributes to the effectiveness and efficiency of an organisation in the achievement of its objectives
Continual improvement [CI]	Continual improvement of the organisation's overall performance must be a permanent objective
Factual approach to decision-making [FA]	Effective decisions are based on data analysis and information
Mutually beneficial supplier relationships [SR]	An organisation and its suppliers are interdependent and a mutually beneficial relationship increases their ability to create value

IS Quality

The IS Quality is a multidimensional concept, and there are distinct managerial, organizational and engineering viewpoints. According to Von Hellens (1997), managers are interested in how the use of IS and their administration can contribute to the firm profitability; while engineers are more concerned with the quality of the development processes and the quality attributes of software as a product. In turn, the organisational viewpoint focuses on the impact that systems and IT have on the way organisations work and compete. There is a need to integrate these three socio-technical viewpoints (Von Hellens 1997).

The terms data and information are often used interchangeably in practice (Nelson et al. 2005; Wang 1998). The intrinsic view of information quality considers the properties of information in isolation from a specific user, task, or application. The contextual view suggests that it needs to be defined relative to the user of the

information, the task being completed, and the application being employed (Nelson et al., 2005), similar to the ISO 8402 and Juran (1974) definitions of quality as "fitness for use". The context view includes elements such as relevance, completeness, and timeliness of the information (Wang 1998). For instance, Baroudi et al. (1986) present a study that explores connections between user involvement and satisfaction with the system Wang and Strong (1996) also suggest the representational view, reflecting the degree to which information presentation facilitates interpretation and understanding. In turn, Lee, Strong, Kahn, and Wang (2002) include accessibility in their methodology to assess information quality.

Data and information are only a piece of the puzzle. According to Stylianou and Kumar (2000), the combination of technical, organizational and social dimensions defines IS Quality, influencing the quality of the enterprise and of its business processes. See Table 2.

Table 2. IS Quality Dimensions (adapted from Stylianou and Kumar, (2000))

Dimension	Description
Infrastructure Quality	The quality of the infrastructure (hardware and enabling software) that is fielded and maintained by IS –it includes, for example, the quality of the networks and systems software
Software Quality	The quality of the software applications built, or maintained, or supported by IS
Data Quality	The quality of the data used by the various information systems
Information Quality	The quality of the output obtained from the IS. In many cases, the output of one system becomes the input of another. In such cases, information quality is related to data quality
Administrative Quality	The quality of the management of the IS function – it includes the quality of budgeting, planning, and scheduling
Service Quality	The quality of the service component of the IS function – it includes the quality of customer support processes such as those related to a help desk

Each dimension is usually addressed separately. In addition, there are a few studies that consider an holistic perspective and have attempted to explore their connections (Ozkan 2006; Salmela 1997; Stylianou and Kumar 2000; Wang 1998). The IS Quality dimensions reinforce and support each other, as shown by Gorla, Somers, and Wong (2010), who underline a positive relation between system and information quality. These two dimensions, together with service quality have presented a positive influence on organizational impact. The model by DeLone and McLean (2003) includes information, service, system quality and use, as key dimensions of IS success.

IS Quality Culture

There is no unanimous definition of organizational culture. According to Barney (1991), the organizational culture is "a complex set of values, beliefs, assumptions, and symbols that define the way in which a firm conducts its business". Diverse authors interpret culture in different ways (Gallear and Ghobadian 2004): as "shared values", "way of working", and a combination of both cases. Schein (1990, p.111) characterizes it "as (a) a pattern of basic assumptions, (b) invented, discovered, or developed by a given group, (c) as it learns to cope with its problems of external adaptation and internal integration, (d) that has worked well enough to be considered valid and, therefore (e) is to be taught to new members as the (f) correct way to perceive, think, and feel in relation to those problems".

According to (Kanji and Yui 1997), the principles of ISO 9001 have its foundations in Total Quality Management (TQM), and can create a quality culture. According to Vidgen et al. (1993, p.107), "The cultural stream of analysis leads to a different perspective on quality. The objective of introducing a quality management system is not necessarily the direct improvement of quality; the aim might be to change the culture in such a way that the introduction of a quality management system becomes culturally feasible". Quality culture is complex, combining national, organizational, and individual cultures, as well as quality principles (Hildebrandt et al. 1991; Kanji and Yui 1997).

IS scholars have developed cultural studies that underline a mutual influence between IS and organizational culture. The influence of IS Quality may be observed in principles such as the customer orientation, flexibility, quality focus, empowerment, and integration (Doherty and Doig 2003; Doherty and Perry 2001). Other authors address the impact of culture in the IS (Leidner and Kayworth 2006), exposing how cultural values aid to define the boundaries and behaviour rules for the firm members (Leidner and Kayworth 2006).

In the IS literature, we could not find a definition for a multidimensional IS Quality Culture. The ones available are mainly focused on data quality perspectives. They consider that IS Quality Culture exists when all organisational processes take into account data quality issues in order to improve it (Caballero et al. 2004). For our study, we adopt an integrated definition that is a *set of values, beliefs, assumptions, and symbols that an*

organization develops in order to improve the distinct IS Quality dimensions and quality principles. This definition has emerged from a related work, that includes a comprehensive literature review of IS Quality and its cultural aspects, presented in Barata et al. (2013). Figure 1 represents the framework of IS Quality Culture.

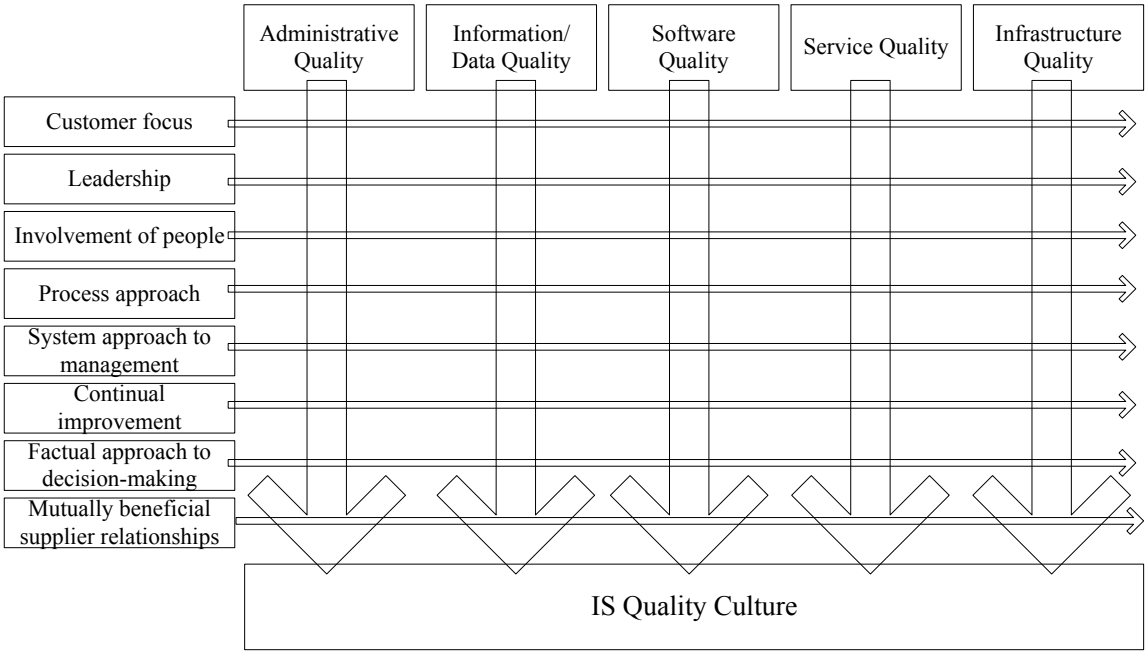

Figure 1: IS Quality Culture Framework (Barata et al. 2013)

At the top of Figure 1 we can see the dimensions of a holistic IS Quality. On the left side are listed the quality principles that influence the creation of a quality culture, in the context of ISO 9001.

RESEARCH DESIGN

Since our goal was to evaluate the auditors' perspective and develop an approach to IS Quality culture, we selected a dual research method. First, we have conducted semi structured interviews (Myers and Newman 2007) with eight ISO 9001 auditors. We aimed to understand which IS Quality aspects were covered in ISO 9001 audits. The interviews were interpreted (Walsham 2006) in the light of the literature to identify gaps in audit practice and propose improvements. We assigned a number to each auditor. The first five are lead auditors, while the remaining are technical auditors. All have over eight years of experience, and [AUD1, AUD2 and AUD4] have 14 years of auditing experience. The fields of expertise include mechanical engineering [AUD1], chemical engineering [AUD2 and AUD3], materials [AUD4], environmental engineering [AUD5], industrial management [AUD6], food safety [AUD7], and occupational health and safety [AUD8]. The interviews were personal, in two rounds, averaging 30 minutes per auditor. We knew the interviewees from audits in our institution or from past projects. In round one, we prepared two questions beforehand, namely: (1) "How do you audit IS Quality in ISO 9001 audits?" and (2) "Which additional aspects of IS Quality do you consider that should be audited?". We clarified the context of our research in the beginning of the interviews. We used a smart pen to tape the answers, ensuring the capture of accurate information in a natural way. Simultaneously, we took notes to facilitate the transcription and the comparison of results (McLellan et al. 2003). After the first round of interviews, we have developed a preliminary version of a checklist to audit and guide the development of IS Quality Culture. The first version had its rationale in the auditors' insights and literature review (Barata et al. 2013). Next, we conducted a second round of interviews to refine our previous findings.

Taking as starting point the insights obtained in the interviews, we decided to test and improve the audit checklist with action research, an approach that simultaneously improves scientific knowledge and assists a practical problem (Baskerville and Wood-Harper 1996). We have followed the five phases of canonical action research: *Diagnosing, Action planning, Action taking, Evaluating, and Specifying learning* (Susman and Evered 1978). The initial checklist was our frame of reference. The evaluation of the research was done according to the principles of (Davison et al. 2004): *Researcher–Client Agreement, Cyclical Process Model, Theory, Change through Action, and Learning through Reflection*. In the first cycle, we studied the contributions leverage by the use of the checklist in a technological institute, that was already joint designing the IS and the ISO 9001 system (Barata and Cunha 2013). We performed a second cycle in the paper industry. The lessons learned led us to create an improved approach for the development of the IS Quality Culture.

THEORY BUILDING

Insights from the Auditors

Auditing IS Quality with ISO 9001: As It Is

Mostly data and administrative dimensions of IS Quality were mentioned by the eight auditors, though superficially. The words that came up more often were "backup" and "access". For instance: "we ask for backups, backup routines, data access protection" [AUD1]; and "document control and file access protection in specific spreadsheets for critical calculation" [AUD5]. It was also noticeable that auditors aim the effectiveness of the IS, "documentation must suit organization needs and be available to everyone that needs it" [AUD3].

We found some inconsistencies between the ISO 9001 and the insights from the interviews. On one hand, the auditors stress the *efficacy* of the IS and the contextual notion of IS Quality, similar with the "fitness for use". On the other hand, the audit seems to ask for specific technical issues (*efficiency*) such as backups, file protections, document management, and distribution. Curiously, the need to continuously improving the IS Quality was not mentioned. Although the eight auditors acknowledged IS Quality relevance, the practice does confirm it as a priority of ISO 9001 audits: nor as a corrective effort in distinct dimensions, nor as a preventive effort, systematically finding opportunities to improve IS Quality. The audit also does not address how organizations share values of IS Quality and create ways of working, which is crucial for a cultural approach.

Auditing IS Quality with ISO 9001: As it Should-Be

The auditors do not consider one needs to be IS specialists for auditing ISO 9001. According to [AUD3] "I audit the systems in good faith, auditors are not IS experts, we do not know all the possible technologies and technical details". However, seven of the eight auditors answered that the existing guides need improvement. One of the reported difficulties is the unfamiliarity of the auditors with the domain, which makes it difficult to formulate questions. According to [AUD2], "auditors have different backgrounds and some of them try to escape from IS issues. The majority only scratch the surface of information quality indirectly, checking contradictions in data and procedures: a checklist made by experts could help". We knew that something should be done to improve the auditors' work, but we were not sure if the difficulty was in the auditors or in the standard. The auditors do not feel that they need to be IS experts, but they feel they would benefit from a guide. Additionally, there is a discrepancy between the IS Quality audit and the "fitness of use". For instance, we did not find auditing practices of information quality for business processes. Furthermore, there is a lack of practices to identify users' satisfaction concerning information quality and software quality. To clarify this problem, we present the excerpt of an interview transcription, concerning clause 7.6, control of monitoring and measuring equipment (ISO 2008).

> *[AUD7] "Quality requires rigor in measured data; if the equipments do not provide correct values, we can't have quality. Therefore, the equipment calibration is a major concern"*
>
> *[Question] "Is it a critical requirement in ISO 9001 audits?"*
>
> *[AUD7] "Yes, the organization can't use equipments that are not suitable to the process. It is a common cause of non-conformance, if the equipments are not properly identified, the calibration plan is not complete, and the data is not evaluated to ensure that the acceptance criteria are met for that process."*
>
> *[Question] "Can we compare the impact on quality of software and measurement equipment?"*
>
> *[AUD7] "Yes, they are similar tools to provide trust to quality"*
>
> *[Questions] "And have they received similar attention in ISO 9001 audit? For example, do you need to track software changes as you do with measuring equipment? Do you need to ensure that people have proper training in using software? Is it relevant to identify which software is used in which process?"*
>
> *[AUD7] "Care has to be taken to ensure validity of the [formulas] results if the software is used for monitoring and measuring. However, its is possible that the importance that clause 7.6 gives to measurement equipments is not so developed for software (...) it is easier to audit 7.6 for equipments. We have laboratorial reports and training in metrological calculations. To audit software we mainly have the organization -limited- records and our experience as software users. For instance, equipment manufacturers provide declarations of equipment conformity, while the software providers do not."*
>
> *[Question] "And what about information quality? For instance, how do you audit to ensure that the information provided the organization product is correct and reliable?"*
>
> *[AUD7] "We need to cross information sources to find discrepancies. Although it is not easy to audit information quality, or other aspects besides calculations, backups, and access permissions. The depth of the audit depends on the background and experience of the auditor."*

A Checklist for Auditing IS Quality: Scratching a Cultural Perspective

This section details the final version of the checklist, structured by the proposed framework, as presented below.

Table 4. IS Quality Checklist for ISO 9001

QP	Administrative Quality Checklist
CF	(1) The users feedback is registered (e.g. questionnaires) and considered for budgets and plans of the IS department; (2) The IS management direct interacts with end customers, to understand needs and opportunities
LE	The IS has a defined strategy that aligns business and IT
IP	Distinct functions are involved in establishing IS plans and acquisitions, for example, the process participants are involved in evaluating requirements for new IT initiatives
PA	Processes of IS management are defined (the process approach is used for IS administration)
SA	(1) There is an established procedure that defines the IS in all its dimensions of people, process, information, IT, and quality context; (2) The potential of IS standards is known and used as a guidance for the organization
CI	The projects and budgets are monitored and evaluated at the end. Preventive and improvement actions are established (e.g. risks are identified before each project and actions planned)
FA	The plans and budgets are evaluated and lessons are used in future IS projects
SR	Suppliers have documented procedures and adopt standards for each key service/product
	Information/Data Quality Checklist (for each organizational process)
CF	(1) Process users are inquired on the quality of input data and actions are taken to improve information processing; (2) Incomplete information/data is identified and treated as non-conformity. Actions are taken to solve the identified problems (e.g. minimize errors, provide indicators that are more representative of process performance)
LE	Information quality is recognized as an essential aspect of quality, similar to any other resource
IP	(1) Users are aware of the need to protect access to sensitive data; (2) Users participate in data validation tasks (e.g. validate calculations of specific software or spreadsheet) and consider information/data quality as a problem that concerns all the stakeholders of the organization
PA	Information requirements can be associated with organizational processes and activities
SA	There are no “islands” in the IS: the users have the required information to develop their work and consider that information reliable
CI	The organization is concerned in improving quality of information, such as accuracy, objectivity, believability, access, security, value-added, timeliness, completeness, interpretability, and ease of understanding (Wang 1998)
FA	Records allow traceability, for instance, to know who and when important records are created, changed or deleted
SR	Information provided by suppliers can be validated (evidences of quality, such as digital signature, test reports)
	Software Quality Checklist
CF	(1) Software requirements were identified by the users; (2) Users requests are recorded and appropriated actions taken to improve the software
LE	(1) Business-IT alignment is a permanent concern of management and evidenced in corporate reports and plans; (2) There is a strategic plan that includes IT
IP	User satisfaction is monitored concerning software solutions
PA	The organization can identify every process that each software application support (IT inventory for the process)
SA	There is an integrated perspective of software applications (integration, software is managed as a valuable asset)
CI	(1) The most relevant software has maintenance contracts (if applicable); (2) There is a plan for the evolution and update of internal developed software (if applicable)
FA	There are evidence of software testing, software validation, and acceptance (not only for clause 7.6)
SR	(1) Suppliers provide validation evidences of software products; (2) improvements are suggested to the suppliers
	Service Quality Checklist
CF	(1) There is a help desk procedure; (2) There are adequate tools to monitor service quality (e.g. response time is recorded, as well as user validation of the interventions)
LE	Quality principles are applied to IS management

IP	The service is evaluated (e.g. questionnaires) and actions taken to ensure the users suggestions
PA	Non conformity or user requests can be traced for each process
SA	The IS function considers both technical (e.g. hardware and software support) and human aspects of service (e.g. identify training needs, provide training for internal and external elements of IS service)
CI	Service has quality indicators (e.g. number of interventions and mean time) and improvement actions are taken
FA	(1) There are evidences of each intervention. The time, scope, and solution are recorded; (2) The users satisfaction is monitored, for instance by validating finished IS requests or with specific questions in questionnaires
SR	When services are outsourced, the supplier has complete records according to the adopted service procedure
	Infrastructure Quality Checklist
CF	(1) The network performance is adequate both for internal and external access (see users feedback); (2) Computers are suitable for each function – It is possible to identify infrastructure requirements for each organizational function
LE	Organization considers IT requirements when planning process changes and new organizational investments
IP	There is feedback from users concerning infrastructure performance (e.g. workers satisfaction inquiries include items concerning computers or network compliance with their functions)
PA	IT can be connected with the process map. IT requirements are identified for specific activities and responsibilities (for instance, process X, developed by function Y, requires operating system Z, and internet access G)
SA	(1) Organizational infrastructure is identified (e.g. IT network map); (2) Backups of data/information and software applications are identified and there are recovery plans (and contingency plan)
CI	Organization updates IT according with the needs of the processes and technological innovations
FA	The selection of IT includes criteria other than price, for instance, process requirements, performance requirements, specific applications for the function
SR	(1) IT suppliers provide clear and timely information concerning new IT in the market; (2) The IT interventions (e.g. repair) is recorded by the suppliers IS

Legend of column 1: [QP] Quality Principle; [CF] Customer focus; [LE] Leadership; [IP] Involvement of people; [PA] Process approach; [SA] System approach to management; [CI] Continual improvement; [FA] Factual approach to decision-making; [SR] Mutually beneficial supplier relationships.

We excluded items considered difficult to audit by non-experts, for instance, a first version included "network security is adequate concerning external access". The information in each table is not exhaustive and may be adapted. However all the IS Quality dimensions and ISO 9001 principles must be addressed, with a continuous effort of IS Quality culture learning and improvement, as explained in the next section.

Lessons from the Action Research – Towards the Development of IS Quality Culture

This section presents two action research cycles, conducted during the first semester of 2013, after the interviews to the auditors, to improve and validate the checklist items in the context of ISO 9001 audits, with the collaboration of [AUD2] and [AUD6]. Their organizations consist of our client settings for action research. Both found the checklist simple to use. They considered it an advance when compared with the existing practice and even added a few questions to it. The checklist has helped the auditors on what to ask for, improving their image in the organization, particularly when relating to IS departments: "My IS colleague asked me if I was getting IS lessons, because I was asking interesting things that she would like to be written and known by the top manager: actions, not only logs" [AUD6]. The auditor also said that "the audit process is nearly the same that was followed in previous audits, but there is a major change in the focus of the audit and the depth of IS Quality issues that we can search for and improve (…) not only in the IS department, but to audit IS quality all over the organizational processes. This is a potential tool to train the organization in IS Quality and extend the audit benefits over time".

However, we identified three major drawbacks: (1) lack of impact if the checklist is seen as a mere tool for audits once or twice a year; (2) the approach only takes into account the perspective of the auditor; and (3) not enough guidance in the internalization of practices, dynamic of improvement, learning and people focus, as demanded by our IS Quality Culture framework. Balancing the positive aspects and the problems, we made changes to the checklist during the action research case of the technological institute. First, we included two columns that allow the IS manager and the ISO 9001 auditor to classify each item in a scale from 1 (inexistent) to 5 (very good). We intended to combine the perspectives of the IS and the quality experts. This is a simple change, but in our opinion creates a debate between auditors and organizations that may promote the achievement of a common understanding. Second, we included additional columns that allow detailing necessary improvement actions and the state of implementation. Actions must be planned for each line that does not reach a grade of 5. Each action is

monitored considering the PDCA (ISO 2005): P–Plan, D–Do, C–Check, and A–Act. We present an example of this change in Table 9.

Table 9. IS Quality Dimension: Service [Excerpt of one line of the checklist]

Quality Principle	Service Quality Checklist	IS Function*	Auditor*	Action	Action Stage
Customer focus	There are adequate tools to monitor service quality	2	2	(A1) Implement help desk portal	
				(A2) Online questionnaire	

*evaluate from 1(inexistent), 2(weak), 3(satisfactory), 4(good), and 5(very good)

After implementing actions, the IS function re-evaluates the checklist item (that is only a tool to coordinate the IS Quality efforts) and proposes new actions to improve. The steps of the approach can be synthesized with *1-Complete/adapt the Checklist to the characteristics of the organization* (if necessary); *2 -Evaluate each item with the checklist*; *3- Propose and monitor the actions to improve the state of the principle adoption*; *4-Re-evaluate and propose new actions* (if required). The ISO 9001 audit is the moment to update the auditors' column, compare their evaluation with the organizational assessment, and propose actions. The other columns are dynamic. After the introduced changes, this approach was a starting point to an action research case in the paper industry. The cycle includes the end users perspective of IS Quality Culture, that was still missing in the first cycle (addressing only auditors and IS function). We are using questionnaires and comparing the same items of the checklist with the IS department and the auditor evaluation. This confrontation of viewpoints may develop the "shared values" and led to a right "way of working", agreed by the firm elements.

The client organizations decided to create quality indicators for IS Quality, to pass the message that IS Quality is a priority, that it has impact in everyone's work, and that it must be improved by everyone. ISO 9001 proved to be a good vehicle of IS Quality in the two cases. So far, the visibility of IS Quality and the awareness among the firm participants has improved, according to managers and auditors (also quality managers). For example, critical laboratorial software of the technological institute suffered changes after the application of the checklist, because they found problems on the information and software dimensions. The checklist was also useful to validate those changes. We found a strong support from the administration of both companies, which struggle everyday with IS quality issues (mostly information/data and software). They expect that the approach may increase everyone's responsibility in IS Quality. However, as stated by the IS manager of case 2, this is not a one time approach, it is a continuous process. A holistic perspective of IS Quality creates challenges, for instance, the need to map processes and IT; organizational functions and IT; training actions; improve software auditability; and detailing information requirements for each process. We underline that this approach is a mean for guiding the constructing IS Quality Culture, not an end.

CONCLUSIONS

We present a contribution for IS Quality Culture in the context of ISO 9001: a comprehensive checklist and an approach to develop the IS Quality Culture. The findings are relevant for both the IS and quality communities. With the adoption of quality principles in a holistic IS quality perspective, new tools become available for the IS function. The tools proactively guides the IS action. For quality, a new audit guide is available, helping auditors in the critical field of IS Quality. It is not possible to trust certifications if IS Quality is not a priority to organizations. It needs to be seen as a shared and daily effort.

This research has limitations. First, the scope is restricted to ISO 9001. Second, the exploratory interviews and the action research case provided important contributions, but we detected the need to perform additional cycles, and other checklist items can be considered. Third, the benefits of the approach were only assessed using the auditors and the organizational feedback, who provided indications about the IS Quality Culture management practices. However, they did not address the impact in the organizational performance. Finally, cultural studies are complex and our proposal is one of first contributions in the field of IS Quality. We plan to go back to both organizations in the next year to assess the enduring cultural changes in IS Quality practice.

IS Quality and ISO 9001 are evolving research arenas. Future studies can consider other standards, for example, in the context of environment, health, and safety ISO management systems. Each organization can be in a distinct stage of IS Quality Culture, opening up the potential for the development of a maturity model, or improving the existing models. A software tool could assist the approach in daily practice (such as action planning and notifications, audit evidences, and indicators). Our approach adds to the literature of joint management of IS and quality systems: guides organizations and auditors in IS Quality Culture; helps to evidence the history of

improvements in IS Quality; is proactive and has as one of its priorities to promote improvement; provides a holistic perspective of IS Quality; and can be used by IS non-experts.

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