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Do You Walk the Talk in Quality Culture?

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Abstract

We present an action research project to foster quality culture in business processes. The client setting is in the food industry, a vital sector for our society and one of the most regulated in the world. Food production involves auditing throughout the supply chain and a demanding information system (IS), with numerous requirements grounded on the organizational policies. Our ISO_2 approach – for joint development of IS and quality management system (QMS) – was tailored with a set of routines and artifacts to promote quality culture in the maintenance process of the selected organization. This contribution enables a graphical visualization of existing gaps between the high-level principles endorsed by an organization and its confirmation: (1) instantiating company policies at process level; (2) contrasting the assessment of the process owner and of the quality auditor; and (3) comparing the desired and the real practices in a specific business process. An audit from a food retail group confirmed the positive outcome of ISO_2 approach in what regards the internalization of quality principles while developing the IS. Moreover, we performed a longitudinal evaluation to verify enduring effects of the ISO_2 approach in business processes. We gathered evidence that ISO_2 can (1) improve process users' awareness of quality culture; (2) suggest an approach to increase trust in company policies; and (3) contribute to business process improvements.
Keywords: Business Process Quality Culture, Information Systems, Quality, Synergies, BPM, Audit

1. Introduction

Information systems development (ISD) has the power to "*transform organizations and societies*" [20]. It takes place in regulated environments, influenced by organizational culture [7], [15]. In turn, ISD has an increasing influence on work practices and their underlying business processes [34]. When the processes are critical, a complex range of policies defines their regulatory space – where the state, the organizational principles and rules, and other regulatory entities compete for social organization [48]. That is the case of the food sector, one of the most important in the world economy. Moreover, the trust that consumers put in this industry depends on the quality of the business processes across the value chain and on the principles that they embody. One of the most popular standards for quality management is ISO 9001 [29], which is structured in principles that shape a quality culture [29], [33]: Customer focus (CF); Leadership (LE); Involvement of people (IP); Process approach (PA); System approach (SA); Continual improvement (CI); Factual approach to decision-making (FA); and Mutually beneficial supplier relationships (SR). However, trust can be compromised when we recognize that a "*substantial gap may exist between how the processes are described in the quality system and how they are practiced by the employees*" [24].

ISD must consider the context and the characteristics of the organization, namely its policies and procedures [15], [34]. Additionally, the IS has a significant impact on quality management and performance [41]. Yet, there are difficulties in the articulated development of the IS and of the quality management system (QMS), since organizations do not usually

leverage the synergistic potential in combining their efforts [5]. Grounded on narrow perspectives, quality experts view the IS as mere support, while the IS experts view the QMS as a mere matter of compliance. For these reasons, the principles to implement a quality culture in the organization [33] are frequently underestimated during the design-time and the run-time phases of ISD.

This raises the question: "*How to assess and cultivate business process quality culture?*" According to [7], organizational culture is a set of shared values that define the way in which a firm conducts its business. Therefore, a quality culture requires the combination of organizational culture and quality principles [7], [33]. The IS and the QMS require similar organizational cultures and can be combined for a cultural change [42], with mutual benefits as presented by [25] in the purchasing process, and by [36], [44] in the case of QMS and Enterprise Resource Planning (ERP) implementations. Recent research points to the importance of combining culture and process management [46]. However, the literature does not provide approaches that organizations can use to integrate quality culture with their context, people, processes, information, and IT [4]. We argue that our approach, named ISO_2 [5], can contribute to this purpose, while simultaneously addressing known difficulties with process management in quality systems [27]. Our work presents an action research cycle with the ISO_2 approach, showing how organizations can use it in practice for assessing quality principles and bridging the gaps found in business processes.

The remainder of the paper is organized as follows: section 2 establishes the background, describing the context of the food industry and the challenges for ISD. Next, we present our research approach. Section 4 details the action research project – the case reports to the joint development of the IS and QMS for the maintenance process of the organization, integrating quality principles from standards and policies. Finally, Section 5 presents the conclusions, the study limitations, and opportunities for further research.

2. Background

2.1. Regulatory Space and Quality Culture

According to [48], the regulatory space is a social space "*in which different regulatory schemes operate simultaneously* [and] *the state must compete for control of regulation with other regulatory entities*". Therefore, private regulators, interest groups, customers, and business experts can influence the regulatory space. Law may impose regulations, or they may be voluntary, when standards, policies, and norms are adopted.

The development of a quality culture involves the adoption of high-level principles in daily practice. There are recognized standards such as ISO 9001 [29] that suggest specific principles, nevertheless, cultural approaches are complex [26]. Moreover, culture can be learned and developed by a community [45]. An organization may be looking after principles such as "*customer focus*" and "*social responsibility*", yet, a major issue is to attain and evaluate those practices in business processes. Some authors pointed to the potential risk of "*ceremonial conformity*" [9], when the written procedures are compliant, but practice is not. We highlight the possibility that "*culture eats strategy for breakfast*", a sentence attributed to Peter Drucker, and the epigraph selected by [10] to argue that human aspects should be considered in good strategic decisions.

There are other popular standards in use in the food sector. For example, ISO 22000, International Food Standard (IFS), and British Retail Consortium Food Global Standard (BRC). ISO 22000 for food safety combines the key components of interactive communication, system management, prerequisite programs, and the principles of Hazard Analysis Critical Control Point (HACCP). BRC was created in 1998 for UK retailers and manufacturers, while German, French, and Italian counterparts developed IFS. In a situation of multiple standards, some authors outline three levels of integration [31]: (1) "*compatibility with cross-references between parallel systems*"; (2) "*coordination of business processes*";

and (3) "*an organizational culture of learning, continuous improvements of performance and stakeholder involvement related to internal and external challenges*".

Quality requires transparency towards government entities, business partners, and the consumer society in general [50]. A case study to achieve transparency by cooperating in the supply chain is presented by [8], pointing to the need to share quality standards and information between the different actors. The food industry must provide information about "what" is done to achieve compliance, "how" they achieve it, and which values ("why") are followed [37]. There is a need to create a quality culture in the entire organization [33], and the IS is critical to this effort [50], as explained in the next section.

2.2. Synergies Between Information Systems and Quality Management Systems

According to [39], "*the IS is what emerges from the usage and adaptation of the IT and the formal and informal processes by all of its users*". The IS includes a combination of social and material aspects that must address ethical issues, social responsibility concerns, and the study of flows [14]. Therefore, the design of artifacts [35], [52] to assist ISD must tackle distinct components: context, people, process, IT, and information [4]. Moreover, a quality culture involves "*ways of working*" [22], suggesting that artifacts are not sufficient and must be complemented by routines that process users are willing to follow [40].

Quality and regulatory compliance are well-known subjects in IS research. The literature addresses topics such as the compliance of business processes and services [43], requirements engineering [23], and auditing IS [32]. There are also contributions that provide automated approach for goal-modeling and reasoning [24], normative compliance [28], goal-process integration [13], and value modeling [47]. However, the majority of studies focus on the perspective of modeling and checking compliance, lacking the human behavior and the guidance to allow cooperation between different experts.

The IS and the QMS can be combined into an integrated approach that should leverage synergies from early stages of design [11], [17], for example, by simultaneously developing the quality and IS plans [30]. The benefits of combining the systems are mutual, and must consider different phases of the development, as presented by [5] and [19]. Nevertheless, there are also problems: any approach must be accessible to be used simultaneously by IS professionals and experts from other areas of the organization; there is a diversity of legislation and standards; there is the pressure that continuous improvement represents to the IS in design-time and run-time; there is a need to translate the external requirements into internal practices; and there is a difficulty in evidencing regulatory compliance in audits and in statutory reporting [1], [5].

The IS in the context of the food industry is a current concern. For example, [51] consider both the organizational and technical aspects for process management in food sector. Still, existing studies do not include a cultural quality perspective in business processes [33], [46], applicable for the ISD lifecycle. ISD must deal with the issues of diversity, knowledge, and structure at distinct behavior levels; for example, the business, project, team, and the individual [15], [34]. Therefore, methodologies are vital for ISD that can be adapted or combined into specific situations [3].

3. Research Approach

We selected action research (AR) to study business process quality culture, since we were simultaneously aiming at improving the body of knowledge and solve a practical problem [16]. We have followed a canonical form of AR, characterized by five phases of *Diagnosing, Action planning, Action taking, Evaluating, and Specifying learning* [49]. To ensure rigor and validity, we have relied on the principles proposed by [16]. One of those principles is the definition of a frame of reference, for which we elected the ISO_2 approach. ISO_2 was originally proposed for the joint development of IS and QMS, in the context of ISO 9001.

ISO_2 suggests a sequence of steps that IS/QMS practitioners can follow to obtain synergies in their work while developing both systems. Specific artifacts support the

practitioners in the identification of the IS and QMS requirements, using tables and matrices, accessible to different experts. The purpose of those artifacts is to identify the goals and rules that must be designed and put into operation to achieve a synergistic IS and ISO 9001-based QMS. Table 1 describes each step of the ISO_2 approach.

Step	Description
1	***Prepare the mindset:*** Both systems must be entwined from the start. This step may contribute for the team coordination, management commitment and an awareness campaign;
2	***Diagnosis (as-is):*** Identify current quality and IS practices, ISO 9001, and other contextual requirements. Define and assess the current processes from the users perspective;
3	***Define a Vision (ought-to-be):*** Define quality and IS policies. Create the desired process map;
4	***Design (to-be):*** Detail each process and indicators. Establish the plan and ISD objectives;
5	***Code the systems:*** Develop the IT artifacts and the QMS documents;
6	***Deploy:*** Implement the systems, train, internalize, transfer to daily practice;
7	***Evaluate:*** Audit, test, validate, and perform user acceptance. Restart to improve.

Table 1. Summary of ISO_2 steps [5]

Previous work with ISO_2 has focused on the artifacts to support the design-time stage of the IS and the QMS synergistic development. The result is a high-level blueprint of the five main IS/QMS components, for each business process: context; people; process; IT; and information/data. There are four core artifacts to use in practice: the O_2 matrix; the O_2 list; the O_2 5W, and the O_2 map. The O_2 matrix identifies the information requirements for business processes, considering the information flows that occur outside-in, within, and inside-out. Those requirements are then grouped in O_2 lists, which are IT solutions to be built, changed, or acquired in the software market. The O_2 5W provides finer grained information about each goal/rule and identifies its reasons (why), the persons involved (who), when the goal/rule occurs / events that trigger it (when), where we can obtain evidence of its implementation (where), and the type of information that is needed (what).

The purpose of the O_2 map is to graphically depict the interactions and links between regulations, business processes, people, and IT. One benefit of such representation is to support quality audits; for example, to guide the auditor in which IT to ask for compliance evidence. Other benefits are internal to the organization; for example, to identify which IT component or which regulations are required for a specific function (e.g., to ensure that the required tools and training are provided to the persons that are involved in business processes). The work presented in Section 4 extends the ISO_2 approach to (1) assess IS/QMS requirements, (2) identify gaps between the perspective of the process owner and the quality auditor, (3) evaluate changes in quality principles adoption over time, and (4) discover opportunities for business process improvement.

4. Business Process Quality Culture: Assessing Principles, Bridging the Gaps

4.1. Client-System Infrastructure

Our case reports to an agro-food organization. They export sauces and food products to supermarkets and restaurants around the globe. Audits by customers, government bodies (e.g., FDA - Food and Drug Administration), and certification authorities are quite regular, at four times on average each month. The company adopted ISO 9001, IFS, BRC, and ISO 22000 standards. One of their major problems was managing the maintenance process of their industrial equipment. Records were scarce and the process should conform to the standards, laws, and their principles. To address this problem, a team of consultants was assisting the organization with the standards and a different one was responsible for the ISD.

4.2. Diagnosing

According to the company's quality manager, "*there is a gap between policies and processes (…) top level quality principles are translated into standards requirements that, in turn, direct our process information requirements. Ok, processes comply with requirements, but they should conform to the principles*". She presents an example: "*We comply with the complaints management requirement in commercial process, which is the 'rule' (…)* [although] *that does not mean that we are fully integrating customer focus principle in the process. A traditional process matrix links the requirements with clauses, not with the higher principles that truly matters*". As stated by the quality manager, "*people issues are our problem, not the technological ones (…) they know 'what' to do and 'how', but we want them to incorporate our values. People must understand the importance of the 'why' (…)*". In this context, we understood that our action plan could not simply be a matter of compliance, or whether the IS and the QMS "violates or not a set of obligations".

4.3. Action Planning

We outlined a plan using the steps of ISO_2, described in Table 1. The initial meetings aimed at presenting the approach to the managers and identifying the IS and the QMS requirements. Figure 1 presents an extract of the O_2 map for the maintenance process.

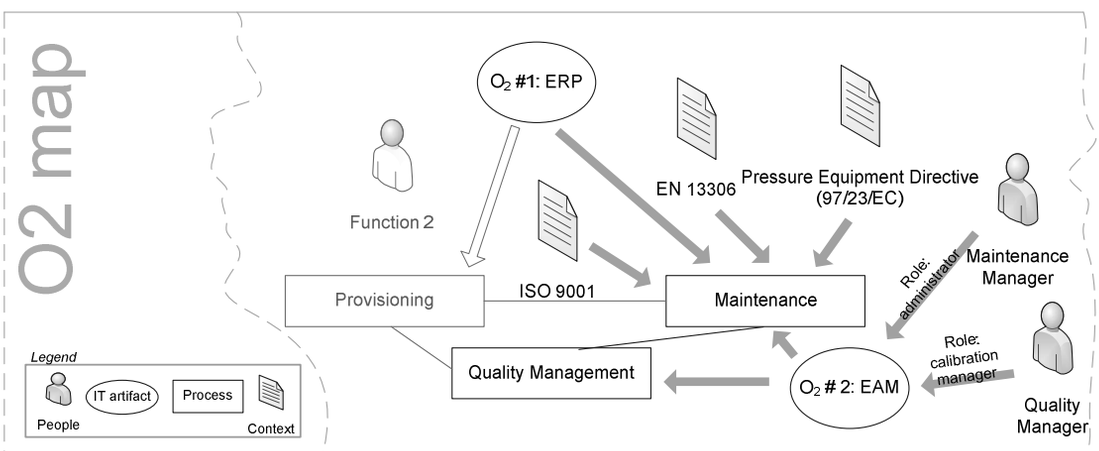

Figure 1. O_2 map extract for the maintenance process.

The O_2 map can provide a simple portrait of which regulations affect the process, their users, and the IT that supports them. In our case, there are two main IT systems to support the maintenance process – the Enterprise Resource Planning (ERP) and a new Enterprise Asset Management (EAM) system. Additional spreadsheets and desktop databases, specific laws and procedures were omitted to simplify the figure at the highest abstraction level. The map can be drilled-down by sub-levels of analysis; for example, the standard can be "zoomed" into goals and rules to comply with, the process expanded into its sub-processes, and the O_2 artifacts detailed by their services, forms, or fields. After creating the map, the requirements for the maintenance process IS were obtained by the O_2 matrices [5]. ISO_2 required changes to fit our scenario, as we discuss in the next section.

4.4. Action Taking

This section summarizes the extension we made to ISO_2, by creating additional artifacts to use in the ISD lifecycle while solving the organizational problem. Figure 2 presents an extract of the first new artifact that is the *O_2 principles evaluation*.

Main Principle	General Description	Business Process Quality Culture
Customer focus (CF)	Organizations depend on their customers and therefore must understand their present and future needs, satisfy their requirements and make an effort to exceed their expectations.	Consider external and internal customers. External customer interest includes the safety of materials used in maintenance, avoiding food contamination. They may ask for maintenance evidences in case of product traceability. Maintenance must ensure that (…)
Factual approach to decision-making (FA)	Effective decisions are based on data analysis and information.	Maintenance IS quality must be measured and continuously improved. Records must ensure traceability and proper identification (…)
(...)	(...)	(...)
Ethics (ET) - company policies	Our stakeholders must ensure transparency and a code of conduct that respect our tradition.	Materials and services acquisition must be decided after requesting proposals from at least three suppliers (…)
Sustainability (SU) - company policies	Our activity must respect the environment and ensure energy optimization.	Maintenance must ensure the minimum waste in equipments. Suppliers must be identified for dangerous materials and their disposal (…)

Figure 2. The *O_2 principles evaluation* for the maintenance process (excerpt).

The organization selected eight principles drawn from ISO 9001 and added another three, namely: safety (SF), ethics (ET), and sustainability (SU). These are core values for their future, so they decided to evaluate them specifically (column 1). By creating the *O_2 principles evaluation*, the users perceive the process by the lens of the principles that they defend, as described in column 3. "*Participants may have a generative, improvisational mindset, where they are empowered to make significant choices about how work gets done. To the extent this is true, users become designers*" [40]. The second new artifact – the *O_2 principles matrix* – is presented in Figure 3.

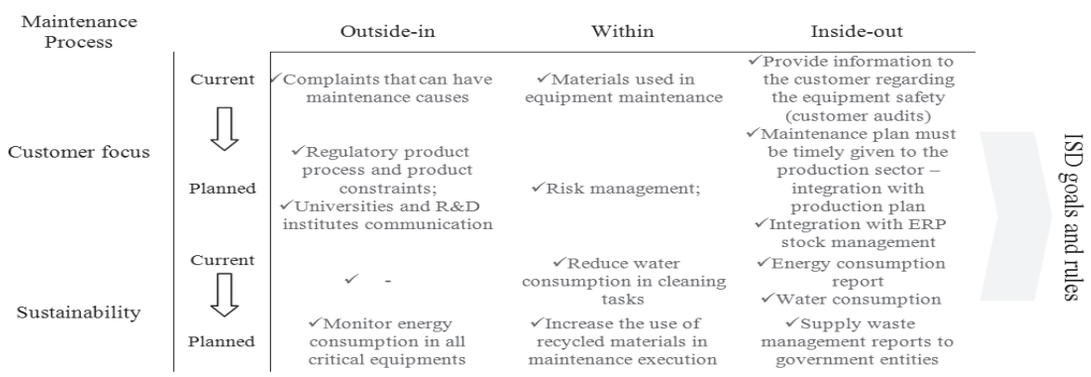

Figure 3. *O_2 principles matrix* (excerpt)

The *O_2 principles matrix* identifies the outside-in, within, and inside-out requirements (columns 3 to 4) related with quality principles (leftmost column), complementing the original O_2 matrix. By combining the matrix cells, new goals and rules of the IS are added, and others that are redundant can be eliminated. According to [18], "*a system must have an aim. Without an aim, there is no system. The aim of the system must be clear to everyone in the system. The aim must include plans for the future. The aim is a value judgment*". The *O_2 principles matrix* allows uniting operational requirements (current and planned) with foremost organizational principles.

Next, we have generated the improvement plan with the *O_2 principles development checklist*. The goal is to establish actions to implement the planned requirements of the *O_2 principles matrix*, to evaluate them, and to improve. Figure 4 presents an example regarding the goal established in the second line of Figure 3, rightmost column (inside-out).

Quality Principle	Goal/Rule Checklist	Process Owner *	Auditor*	Action	Action Stage
Customer focus	Maintenance plan must be timely given to the production sector	3	2	(A1) Integration between maintenance plan and ERP purchase plans	
				(A2) Develop a decision support system to simulate plan changes	

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

Figure 4. *O_2 principles development checklist* (excerpt)

The first column identifies the quality principle; the second describes the goal/rule for that principle. One principle may have several goals/rules. Since our purpose was also to perform an evaluation, we added two columns to compare the perspective of the process owner and that of the quality auditor (internal or external). The last two columns identify the improvement actions established and its development stage.

The organization can always improve a goal/rule, but this does not mean that an action must always exist if the evaluation is less than 5/5. For example, some actions may involve investments that may not be easy to approve, and it depends on the priorities that the top management of the organization establishes. Our suggestion in ISO_2 is to record the proposed actions, identifying the ones that were discarded/postponed by the top management. This identification allows picking those actions in the future, if and when appropriate, simultaneously providing evidence to external auditors about the organization transparency in their decisions. The ISO_2 approach suggests top management involvement (at least) in the initial phases of preparing the establishing a mind set, and in the final stages of evaluating improvement and validating actions.

Each action is monitored considering the P-Plan, D-Do, C-Check, A-Act (PDCA) cycle [29]. The artifacts are created according to the following steps, for each business process:

1. Identify quality principles adoption to the process (*O_2 principles evaluation*);
2. Define outside-in, within, and inside-out information [5] required to develop the quality principle in the process (*O_2 principles matrix*);
3. Establish an improvement plan (*O_2 principles development checklist*);
4. Continuously revise the O_2 matrices and propose improvement actions.

The gap between the evaluation of the process owner and the evaluation of the auditor can be represented graphically, as illustrated in Figure 5. The calculation is made with the average values suggested by the process owner and the auditor, for each high level principle.

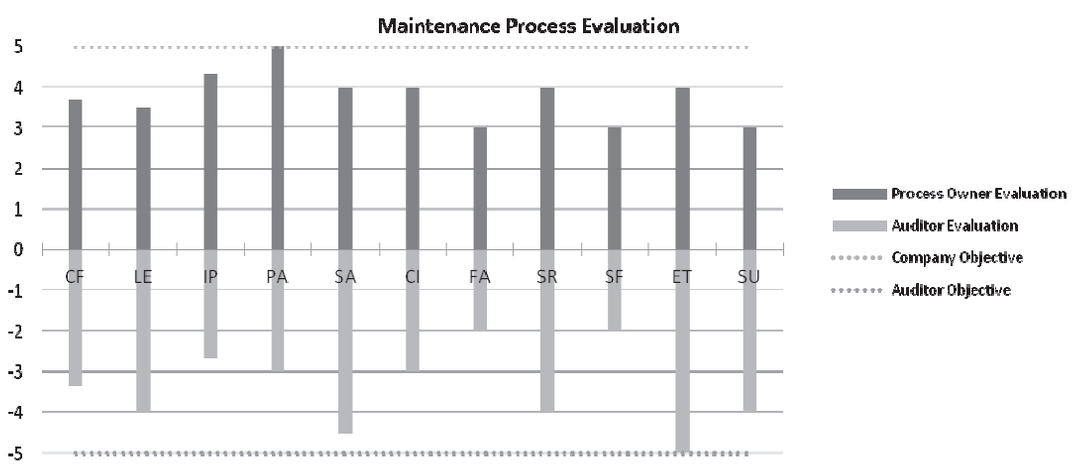

Figure 5. Graphical representation of the principles evaluation for maintenance process

Figure 5 compares the process owner assessment grade and the auditor assessment grade for each principle of the selected process. The first eight columns refer to the quality

principles presented in ISO 9001 [29], namely Customer focus (CF); Leadership (LE); Involvement of people (IP); Process approach (PA); System approach (SA); Continual improvement (CI); Factual approach to decision-making (FA); and Mutually beneficial supplier relationships (SR). The other three columns refer to Safety (SF), Ethics (ET), and Sustainability (SU), included in the quality policy of the company.

In our case, the maintenance manager decided to reach an agreement with the members of his team about the evaluation and then decided on a consensual grade (process owner evaluation series, on the top). The auditor evaluation was obtained by the company quality manager in the scope of an internal audit (on the bottom). Another representation of the quality principles assessment is offered in Figure 6.

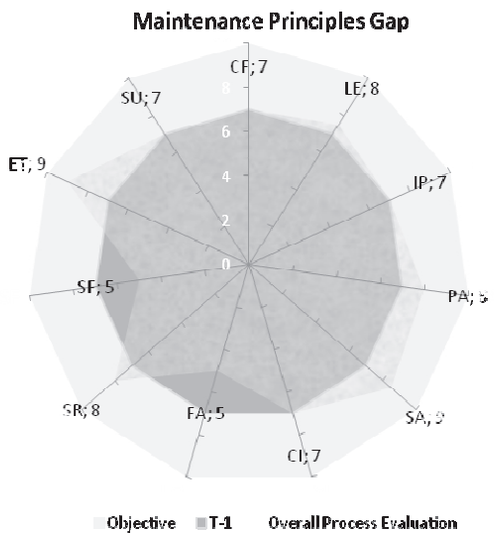

Figure 6. Graphical representation of the maintenance principles gap

Figure 6 presents a different perspective of the principles gap when compared to Figure 5. It is accomplished by summing the evaluation of the process owner and the auditor (maximum of 5 each), for each quality principle (maximum of grade 10 each). The radar chart is inspired by the ISO 10014 standard that provides guidelines for realizing financial and economic benefits with ISO 9001 [29]. This graph highlights the principles that require more attention from the organization in the maintenance process. For example, FA (grade 5) – factual approach to decision-making, is more problematic when compared to SR (grade 8) – mutually beneficial supplier relationships.

The series T-1 represents the prior evaluation period, allowing us to see if there were changes (comparing the evaluation at T-1 and the present) or the sustainable achievement of grades, according to the perspective of the process owner and the auditor. We only obtained a single evaluation during the period of our research with the maintenance process; therefore, we represented T-1 in Figure 6 with an average value (grade 7) for illustrative purposes: for example, current FA evaluation (grade 5) is below FA at T-1 (grade 7) that would correspond to a deterioration of the quality principle, while ET (grade 9), is above T-1 grade (the arbitrary value of 7 in our case), which would signal an improvement.

4.5. Evaluating

The original ISO_2 approach could provide some support for ISD and for user training in regulations and quality requirements. However, we did not have a quality culture perspective with the initial tools, justifying the new artifacts presented in Section 4.4. Interestingly, the use of the *O_2 principles matrix* allowed the identification of new ISD requirements that were missing when using the original O_2 matrix. There were two team meetings for the extension

of ISO_2: first, to apply the principles to the maintenance process and an initial draft of the *O_2 principles matrix*. A week later, the team refined the O_2 information. If we combine the information of the same lines of all process matrices, we can identify how the organization globally internalizes each principle. There is the potential for identifying processes that do not adhere to the policies as they should, or principles that are not addressed by the processes. This cannot be achieved with traditional matrices that are common to ISO 9001, mixing processes with standard clauses. The organizational managers confirmed that the meetings were effective for learning-by-doing, increasing process knowledge by process users, sensing their motivation, and perceiving effort/value to follow the process principles [2]. According to a major customer of the organization: "*the approach puts forward the company's interest in improvement and their commitment to the policies that they defend*".

A few months after this AR cycle concluded, we called the maintenance manager to obtain his opinion about enduring effects. According to him: "*Quality principles are important, but at the same time they are far away from our daily concerns. We can easily talk about them regarding our policies printed somewhere, however it is more difficult if we try to bring them to small things that occur every day, some of them apparently with no link with such 'high-level' and abstract guidelines (…) at first* [when we initiated our research with them]*, I admit thinking that our exercise in the process would be more theoretical than practical (…). But the result was positive, and this happened because our team was 'remembered' why their work is important for the entire organization and we talked about processes in a positive and free way.* [We asked to be more precise] *(…) maintenance team felt that they are the owners of their processes, deciding about important things that were not a result of some hierarchic order (…) in a certain sense, the process seemed more important than it usually is recognized* [maintenance is sometimes seen as a matter of costs, rather than an investment]". He found another benefit with the artifacts we developed that was "*the possibility to justify to top management the need for some actions, not because they are important to our team, but because they are important to everyone in the organization*".

4.6. Specifying Learning

Our approach to foster a business process quality culture enables the assessment of three types of gaps, namely by contrasting: (1) the quality principles at organizational level and at process level, (2) what should be done (principles) and what is really executed in practice; and (3) the perspective of process owner (which may consult process users to decide the assessment grade) compared to the viewpoint of the process auditor.

Although several standards and laws are built according to high-level principles that shape a quality culture, there is a risk of those principles being forgotten in daily practice. By including cultural aspects in a process-oriented approach, the findings suggest that we can increase the perception and adoption of quality principles by the process users. The matrices provide auditing support. A customer of the firm suggested using the average evaluation of the *O_2 principles development checklist* to measure the quality principle internalization, comparing distinct processes.

The crosscheck evaluation by process owners and auditors is an opportunity to identify improvements. It is difficult to assess generic principles such as "customer focus" or "factual approach to decision-making", at a process level. With the proposed approach, we challenge the process participants to think *why* their work is important: for them, for stakeholders, and ultimately for the society. The extension that we introduced to ISO_2 is not specific to the food industry; however, this sector provides an example that can benefit from the approach due to its increasing need for transparency and quality culture in its business processes.

It is possible to create synergies between the IS and the QMS, at design-time and at run-time [6]. One important consequence is the integration of compliance by design. "*The fundamental feature of the compliance by design approach is the ability to capture compliance requirements through a generic requirements modeling framework, and subsequently facilitate the propagation of these requirements into business process models and enterprise applications*" [1]. At run-time, it is possible to assess and foster a quality

culture based in the most fundamental principles of the organization. We agree with [38] when they "*propose that IS researchers should adopt a more dynamic view of culture – one that sees culture as contested, temporal and emergent*".

5. Conclusions, Limitations, and Future Work

We challenged and extended our existing ISO_2 approach to bridge the gap between overall quality principles and business processes, within the ISD lifecycle. With the support of the O_2 artifacts, process users can collaborate in the joint design of the goals and rules of the IS and the QMS. At run-time, there is guidance to internalize quality culture in daily practice. Moreover, we gathered evidence during our research that ISO_2 approach presented benefits for interactive communication throughout the supply chain. The case company in the food industry asked us to create an "ISO_2 kit" that they could distribute to their partners and suppliers, representing a distinctive image of their process quality culture.

All that said, this study has limitations to consider. First, the scope is restricted to specific standards, namely those used by this particular company. Second, our contribution only addresses the quality culture dimension, according to a set of predefined principles selected by the organization. Cultural studies are complex and we did not consider individual or national culture aspects. Third, the positive results in our socio-technical context must be carefully evaluated due to the potential risk of the Hawthorn effect, suggesting that the observed participants behavior could be "*related only to the special social situation and social treatment they received*" [21]. Forth, in spite of the positive results that we have observed for integrating cultural aspects in ISD, the approach still lacks a tool to support its expedite use by practitioners. Professor George Box, a distinguished statistician once said that "*all models are wrong; some models are useful*" [12]. ISO_2 is well founded in our case but we cannot claim that it is a total solution to synergistically developing the IS and the QMS in every possible case or scenario to foster a quality culture in business processes. At each step of our research, ISO_2 evolved, and we expect that it continues to evolve even further as it is applied in new settings. Currently, ISO_2 presents a model, and, as all models, we simplify the real system by selecting specific elements that we found more relevant than others, according to our research setting. ISO_2 shortcomings are also opportunities for future improvement.

Future work can involve distinct sectors and larger scale scenarios; for example, the aerospace, for which we already have planned interventions. It would be important to extend our study with additional standards and models that have a great impact on the business processes and ISD; for example, the ones related with IT service management, IT governance, business continuity management, and human resource management. Moreover, it would be interesting to create a meta-model or ontology to formally define the cultural integration.

We also found that the graphical representation of the gaps can be explored by global organizations, with presence in multiple countries (possibly different cultures), but sharing the same corporate principles. There are potential uses of our approach for benchmarking between corporate subsidiaries and to suggest improvement actions to ensure that quality principles are adopted worldwide. The approach can be further tested by ISD and quality efforts of supply chains, in a quest for trust and trustworthiness [37].

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