Towards a Business Process Quality Culture: From High-Level Guidelines to Grassroots Actions

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Abstract

We present an information systems development (ISD) approach to integrate quality culture in business processes. Action research is our mode of inquiry and a company from the food industry provides the setting. Food production involves auditing throughout the supply chain and a demanding information system, with numerous goals and rules grounded on the organizational policies and values. However, there is a lack of holistic process-oriented approaches to leverage a quality culture. This paper provides a contribution, with the ISO_2 approach, offering a set of artifacts to support the ISD lifecycle. An audit from a food retail group confirmed the positive outcome of its use, internalizing quality principles while developing the IS, and it is planning to suggest its adoption by their network of food suppliers.
Keywords: Business Process Quality Culture, Information Systems, Quality, Synergies.

1. Introduction

Information systems (IS) development (ISD) takes place in regulated environments, influenced by organizational culture [6, 9]. In turn, ISD has an increasing influence on work practices and their underlying business processes [20]. When the processes are critical, a complex range of policies defines the regulatory space [5]. 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 processes and on the principles they embrace. One of the most popular standards for quality management is ISO 9001 [15], which is structured in eight principles that shape a quality culture [15, 19]: Customer focus; Leadership; Involvement of people; Process approach; System approach; Continual improvement; Factual approach to decision-making; and Mutually beneficial supplier relationships.

ISD must consider the context and the characteristics of the organization, namely its policies and procedures [9, 20]. Additionally, the IS has a significant impact on quality management and performance [22]. 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 [4]. 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 issues. For these reasons, the principles to implement a quality culture in the organization [19] are frequently underestimated in the design and run-time of the IS, when compared with operational requirements and rules of business processes.

This raises the question: "*How to create a business process quality culture?*" According to [6], 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 [6, 19]. The IS and the QMS require similar organizational cultures and may be combined for a cultural change [23]. Recent research points to the importance of combining culture and process management [25]. However, the literature does not provide approaches that

organizations can use to integrate quality culture with their processes, information, people, and IT. We argue that an approach named ISO_2 [4] can contribute to this purpose, while simultaneously addressing known difficulties with process management in quality systems [13]. Our work presents an action research cycle that extends the ISO_2 approach. The remainder of the paper is organized as follows. Section 2 establishes the background, describing the food industry context 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 future work.

2. Background

2.1. Food Industry Setting: Regulatory Space and Quality Culture

According to [28], 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 distinct business experts also influence the regulatory space. Law may impose regulations, or they may be voluntary, when standards, policies, and norms are adopted.

There are popular standards in use in the food sector, for example, ISO 9001 [15], ISO 22000, International Food Standard (IFS), and British Retail Consortium Food Global Standard (BRC). ISO 9001 aims at the continuous improvement of business processes and implies a set of principles that shape the quality culture [6, 19]. 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. 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 [17] outline three levels of integration: (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 [30]. The food industry must provide information about "what" is done to achieve compliance, "how" they achieve it, and which values ("why") are followed [21]. There is a need to create a quality culture in the entire organization [19], and the IS is critical to this effort [30], as explained in the next section.

2.2. Synergies of Information Systems and Quality Management Systems

Quality and regulatory compliance are well-known subjects in IS research. The literature addresses topics such as the compliance of business processes and services [24], requirements engineering [27], and auditing IS [18]. There are also contributions that provide automated approach for goal-modeling and reasoning [12], normative compliance [14], goal-process integration [8], and value modeling [26]. 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, technology independent.

Several authors have suggested synergies between the IS and the QMS. The IS and the QMS can be combined into an integrated approach that should leverage synergies from early stages of design [7], for example, by simultaneously developing the quality and IS plans [16]. The benefits of combining the systems are mutual, and must consider different phases of the development, as presented by [4] and [11]. Nevertheless, there are also problems: the need of an approach that is simple enough to be used simultaneously by IS and quality experts; the diversity of the legislation and standards; the pressure that continuous improvement represents to the IS in design and run-time; the need to translate the external requirements into internal practices; and the difficulty in evidencing regulatory compliance in audits, and statutory

reporting [1, 4]. ISD must deal with the issues of diversity, knowledge, and structure at distinct behavior levels; for example, the business, company, project, team, and the individual [9, 20]. Therefore, methodologies are vital for ISD and can be adapted or combined into specific situations [3]. The IS in the context of the food industry is a current concern. For example, [31] 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 [19, 25], applicable for the entire ISD lifecycle.

3. Research Approach

We selected action research (AR) to study ISD and quality culture, since we were simultaneously aiming at improving the body of knowledge and solve a practical problem [10]. We have followed a canonical form of AR, characterized by five phases of *Diagnosing, Action planning, Action taking, Evaluating, and Specifying learning* [29]. To ensure rigor and validity, we have relied on the principles proposed by [10]. One of those principles is 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. Table 1 describes the major steps of the approach.

Table 1. Summary of ISO_2 steps [4]

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.

Previous work with ISO_2 has focused on the artifacts to support the design stage. The result is a high-level blueprint of the five main ISD components: context; people; process; IT; and information/data. There are three core artifacts: the O_2 matrix; the O_2 artifact; and the O_2 map. The matrix identifies the information requirements for each process. Those requirements are then grouped in O_2 artifacts, which are IT artifacts. A layered map of the IS is obtained by connecting all the O_2 artifacts with the processes, regulations, and organizational functions. The work presented in Section 4 extends the ISO_2 approach, fostering a quality culture.

4. ISD Action: Towards a Business Process Quality Culture

4.1. Client-System Infrastructure

Our case reports to an agro-food organization with five lines of sauces and olive production. They export to pizza restaurant chains and supermarkets 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 another 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', being aware that, across the globe, a child may be eating our product and laughing with their parents. Our work contributes to that moment success (…)*". In this background, 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". The ISD challenge was socio-technical, researching the *why*!

4.3. Action Planning

We outlined a plan with the steps of ISO_2, described in Table 1. The initial meetings aimed to present the approach to the managers and indentify the IS and the QMS requirements. The steps 1 to 3 of ISO_2 were refined in previous action research cycles. Figure 1 presents an extract of the O_2 map for the maintenance process.

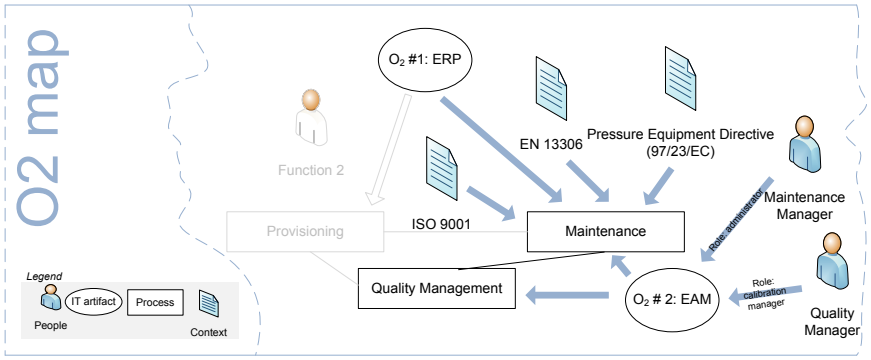

Fig. 1. O_2 map extract for the maintenance process at a high-level of abstraction.

The O_2 map can provide a simple portrait of which regulations affect the process, their users, and the IT artifacts that support 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, 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 [4]. ISO_2 required changes to fit our scenario, as we present in the next section.

4.4. Action Taking

This section summarizes the extension we made to ISO_2, by creating three 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	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	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 (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 (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 (…)

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

The organization selected eight principles drawn from ISO 9001, and added other three, namely: safety, ethics, and sustainability. 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. The second artifact, the *O_2 principles matrix*, is presented in Figure 3.

Maintenance Process		Outside-in	Within	Inside-out
Customer focus	Current	✓Complaints that can have maintenance causes	✓Materials used in equipment maintenance	✓Provide information to the customer regarding the equipment safety (customer audits)
	Planned	✓Regulatory product process and product constraints; ✓Universities and R&D institutes communication	✓Risk management;	✓Maintenance plan must be timely given to the production sector – integration with production plan ✓Integration with ERP stock management
Sustainability	Current	✓ -	✓Reduce water consumption in cleaning tasks	✓Energy consumption report ✓Water consumption
	Planned	✓Monitor energy consumption in all critical equipments	✓Increase the use of recycled materials in maintenance execution	✓Supply waste management reports to government entities

ISD goals and rules

Fig. 3. *O_2 principles matrix* (excerpt)

The *O_2 principles matrix* aims to identify the outside-in, within, and inside-out IS requirements (columns 3 to 4) related with quality principles (on the left). This matrix complements the original O_2 matrix proposed in [4], which focused on operational requirements for the process. By combining the matrix cells into a new matrix, new goals and rules of the IS are added, and others that are redundant can be eliminated. Next, we generated the improvement plan with the *O_2 principles development checklist*. The purpose 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, third 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)*

Fig. 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 for the IS and its development stage. Actions must be planned for each line that does not reach a grade of five. Each action is monitored considering the P-Plan, D-Do, C-Check, A-Act (PDCA) cycle [15]. The approach described above is now being applied to other processes in the company, besides the original maintenance process. 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 [4] 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.

4.5. Evaluating

The original ISO_2 approach could provide some support for user training, since part of the documents were software manuals and quality procedures. 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 missed when using the original O_2 matrix. There were two team meetings: first to apply the principles to the 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 of identifying processes that do not adhere to the policies and principles, 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 maintenance manager confirmed that the ISD 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]. The evaluation made possible by the *O_2 principles development checklist* was used to produce different charts and indicators for the IS and the QMS. According to a major customer of the organization: "*the approach puts forward the company interest in improvement and their commitment with the policies they defend*".

4.6. Specifying Learning

It is time to bring quality principles and values to development efforts. Although several standards and laws are built according to high-level principles that shape a quality culture, there is a risk of seeing those principles forgotten in daily practice. By including cultural aspects in a process-oriented approach, the findings suggest that we can increase the internalization of quality principles. The matrices provide auditing support, with the potential of diffusing the approach to other suppliers of the food chain. 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 contrast perspectives of improvement. It is difficult to connect generic principles such as "customer focus" and IS requirements, with specific goals/rules. With the proposed approach, we defy the process participants to think *why* their work is important, for them, for stakeholders, and ultimately for the society. Note that 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 business processes.

5. Conclusions, Limitations, and Future Work

We challenged and extended the 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.

This study has limitations. First, the scope is restricted to specific standards, namely those used by this particular company in the food sector. 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. Finally, in spite of the positive results that we observed for integrating cultural aspects in ISD, the approach still lacks a tool to support its expedite use by practitioners. Future work can also involve distinct sectors and larger scale scenarios, for example the aerospace, for which we already have planned interventions. It would be useful 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 metamodel or ontology to formally define the cultural integration. The approach can be further tested by ISD and quality efforts of supply chains, in quest for trust and trustworthiness [21].

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