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ASSESSING RELATIONSHIPS BETWEEN KNOWLEDGE MANAGEMENT, TOTAL QUALITY, AND ICT ACCORDING TO AN IMPROVEMENT LOGIC

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Abstract *The present article suggests assessing the relationships between three fundamental managerial practices, namely, total quality management (TQM), knowledge management (KM), and information and communication technologies (ICT). The idea is to analyze such links at several levels, i.e., theoretical, practical, and empirical levels. It attempts to answer the following question: how are the relations between TQM, KM, and ICT shaped? The aim is to examine the presumed relationships based on the main hypothesis suggesting the existence of a reciprocal relationship between TQM and KM moderated by the impact of ICT. Qualitative exploratory research is conducted using action research based on abductive reasoning. Data collection methods combine primary sources (semi-structured interviews and participative observation) and secondary sources (documents, reports, quality manuals, audit reporting ...); the method of content analysis is used. Literature review highlights the existence of interrelationships between KM, TQM, and ICT in a plan-do-check-act (PDCA) cycle yielding to the formalization of a conceptual model. The findings of the case study show that such relationships are still in an embryonic phase gaining further maturity through "common sense" and "enactment". The study presents several theoretical, methodological, and managerial implications.*

Keywords: *TQM, KM, ICT, ISO, Case Study*

Introduction

In an economic environment marked by an exponentially growing competitiveness, quality has become not only an obligation but also a managerial solution to achieve a competitive advantage. To be successful, companies need to consider quality as an essential part of their strategic agenda. In fact, TQM is based on a stream of ideas whose goal is to optimize quality by adopting a continuous improvement approach. To facilitate this activity, the International Standardization Organization (ISO) upgraded its 9001 standards in 2015 version to ensure the effectiveness of Quality Management System (QMS) by meeting the requirements of customers and other interested parties. The novelty of the upgraded standards lies in the consideration of knowledge in the seventh chapter[1] devoted to organizational resources.

In Tunisia, the TQM imposes itself on any company wishing to satisfy an increasingly demanding clientele while remaining competitive given the post-revolutionary context. To date, only 13.52% of firms employing more than 10 employees are certified ISO 9001, a proportion considered low compared to the stakes involved. Added to that, Tunisia has witnessed alarming recoil in its global competitiveness index (GCI) ranking 95th in 2019 compared to 33rd in 2010 according to the World Economic Forum (WEF).

In addition, the base of competition in the contemporary economy is no longer based on the tangible resources of firms but on their knowledge (Wong & Aspinwall, 2005). Indeed, in the 2015s version of ISO 9001, the focus is on knowledge management as a real strategic issue in order for firms to face new challenges especially in a digital era.

The contribution of the present article is part of the investigation of the relevant interrelationships between TQM, KM, and ICT based on an action research aimed at transforming the reality and producing significant knowledge according to the logic of continuous improvement.

Such an assertion is debated on the theoretical level yielding to an attempt of the formalization of a conceptual model. On the empirical side, a case study based on research action is conducted aimed at providing evidence to research

[1] ISO 9001:2015, Systèmes de management de la qualité — Exigences. www.iso.org/fr/standards.

assumptions. The final section comes up with major conclusions, limitations, and future research tracks.

Theoretical Framework of the Study

From a managerial point of view, the adoption of new modes of management embodies a revolution in paradigms. Such a revolution is generally associated with reconsidering the business model in order to enhance organizational effectiveness. That is the case when an organization decides to implement TQM and KM; the query for a multi-paradigm approach becomes a relevant issue. Such approach may be apprehended by first explaining its theoretical background and second establishing the links that may exist between TQM and KM.

In fact, two main theories provide some arguments explaining the presumed relationships. On one hand, the Resource-based view (RBV) developed by Barney (1991) based on the original work of resource theory established by Wernerfelt (1984). This view focuses on the development of resources and their role in contributing to firm's performance. Indeed, "the development of the firm do not only depend on its external positioning and the game of forces to which it is subjected, but also on the resources it has at its disposal and mobilized in its own way in the service of its offer for customers" (Durand, 1997, p. 4).

On the other hand, the evolutionary theory is based on a set of principles judged relevant for our analysis. In fact, the first principle gains its essence in the "routines" practiced within the organization whereas the second is based on the "changes" that mark the deep evolution and dynamism of a system. The third principle of "selection" affects both "genes" and "mutations". The idea is that the organization adapts to this selection mechanism via its repertoire of routines. The phenomenon of selection is realized by the environment by judging the viability of the organization while taking into account both external and internal variables.

Total Quality Management (TQM) as a Revolutionary Paradigm

According to Beaumont (1996, pp. 89–90), "TQM, by recognizing a primordial place for man in production and for the firm, leads to perturbation of the distribution of information, power, and rewards becoming thus incompatible with the dominant managerial theory. It implies the recommendation of a radical change".

In fact, Grant, Shani & Krishnan, (1994) consider TQM as a new management paradigm which is by all means incompatible with the "classical" management paradigm by affirming "TQM is a real conceptual revolution that requires radical changes within the whole company" (p. 59). Such a revolutionary paradigm has its origins in both, as previously debated, resource-based view (RBV) and evolutionary theories.

As a matter of fact, TQM may be viewed as an extension to RBV in a sense that it provides a mechanism allowing organizations to build and improve their internal resources favorable to sustainable variations. Such mechanism is illustrated by the Deming Wheel and activated by the PDCA cycle.

In fact, the Deming Wheel, composed of four phases, is constantly oriented toward continuous improvement by providing a general framework for Kaisen:

- **Plan:** Setting objectives of the quality system, arranging its processes, and specifying the resources needed to reach results that meet both customers' requirements and organization's policies.
- **Do:** Implementing what has been planned in terms of critical resources.
- **Check:** Monitoring and measuring processes, products, and services obtained against policies, objectives, and requirements, and then report results in terms of added value.
- **Act:** Undertaking actions to improve performance included resources' outputs.

The relevance of continuous improvement principle lies in the fact that it embodies the creation of knowledge that should be managed and shared in order to optimize the quality system. In this regard, the integration of knowledge management in the 2015 version of ISO 9001 may be justified by the fact that reported deficiencies of TQM are largely attributed to the lack of knowledge capitalization and sharing, thus, depriving organizations from added value.

Knowledge Management and Quality Improvement

It was not until the early 1990s that the term "Knowledge Management" appeared in the literature mainly with Peter Senge's work on "The Learning Organization" (Senge, 1990). In 1998, Harvard Business Review published its "Review on Knowledge Management" devoted to unveil some research questions on such issue. As a matter of fact, KM may be defined as "The process of capturing, organizing, and storing information and experiences of workers and groups within an organization and making them accessible to others" (Masa'deh et al., 2016).

As such, KM is inscribed in the improvement rationale upon which it is viewed as a four-phase process of acquisition, storage, dissemination, and use of knowledge (Vangala & Banerjee, 2018; Durst & Edvardsson, 2012; Liao, Chuang & To, 2011; Argote, Mcevily & Reagans, 2003; Cormican & O'Sullivan, 2003).

- *Knowledge Acquisition:* According to Gonzalez and Martins (2017), it is the creation of knowledge through a learning process and the acquisition of external knowledge from associative action with other organizations, companies, and universities.
- *Knowledge Storage:* The organizational memory consists of information gathered during the history of an organization that can be expressed in its decisions (Walsh & Ungson, 1991).
- *Knowledge Distribution:* It is the process by which new information from different sources is shared and eventually leads to the creation of new knowledge (Huber, 1991).
- *Knowledge Use:* It is associated with the ability of individuals in an organization to locate, access, and use knowledge stored in memory systems (Zack, 1999).

It follows that the process of KM may reinforce the quality system by making the improvements happen, a fact that legitimates the underlying hypothesis of the present study pertaining to the assessment of the relationship between the two paradigms. Such a relationship may be moderated by the degree to which ICT are deployed.

Indeed, the interest in ICT lies in the fact that they have gained momentum consideration as to their strategic role in the management of organizations. Such a role has shifted from simply bringing together techniques that help digitize process and store information (Chatelain & Roche, 2000) to providing competitive advantage through quality assurance of information flow and communication (Vangala & Banerjee, 2018).

ICT may also be viewed as an organizational capacity consisting of IT infrastructure, technical, and managerial IT knowledge as well as the integration of IT into business strategy (Perez-Arostegui, Benitez-Amado & Tamayo-Torres, 2012).

Reciprocal Relationship between TQM and KM

To begin with, it may be advanced that TQM and KM have common management objectives and positions; they seem to be closely related and even consistent (Stewart & Waddell, 2008). Although some researchers have considered KM as a facilitator of TQM (Barber, Munive-Hernandez & Keane, 2006, Stewart & Waddell, 2008), others have deemed the opposite (Colurcio, 2009).

Literature review allows viewing the relation between TQM and KM according to two logics.

On one hand, KM is considered an activator of TQM and a significant factor for measuring quality "through the acquisition and development of knowledgeable and skilful employees" (Sharma & Bagdare, 2019, p. 42). This is to confirm why ISO urges firms to integrate KM in their quality system. Indeed, Barber et al., (2006, p. 1006) demonstrated that a KM system supports continuous improvement through the "use of accessible and held data in enterprise management databases". It shows that better knowledge of customers and suppliers leads to better management of the relationships with them.

Moreover, Stewart and Waddell (2008) argue that acquiring and disseminating knowledge contribute to the creation of a quality culture that builds an understandable framework for quality and KM programs.

On the other hand, many approaches assume that TQM is a support for KM. Indeed, based on a case study, Colurcio (2009) alleges that TQM practices facilitate the creation and dissemination of knowledge. In the same vein, based on their case study, Jayawarna and Holt (2009) concluded that TQM practices improve knowledge creation and transformation.

In addition, by adopting TQM, organizations are motivated to improve their relationships with customers. As a result, they need to gain in-depth knowledge about themselves, which allows them to gain insights from outside and inside the organization and disseminate it within their organization and with their suppliers (Ooi, 2012). Thus, the first research proposition is formulated as follows:

Assumption 1: There is a reciprocal relationship between TQM and KM.

In order to better apprehend this relationship, it would be relevant to examine the role of ICT associated with the successful deployment of TQM (Davenport, 1993) and of KM in organizations (Gloet & Samson, 2012).

Role of ICT in the Knowledge Management Process

KM requires combining information technology with business processes to create an activity that develops, stores, and transfers knowledge to provide members of the organization with the information they need to make the right decisions (Pinho, Rego & Cunha, 2012, Hung & Chou, 2005). In addition, Karami, Alvani, Zare & Kheirandish (2015) demonstrate that the reliance on ICT such as databases, platforms, internet, intranet, and workflow yields to the acquisition, transformation, distribution, and integration of knowledge.

Nowadays, ICT are considered as an enabler factor having significant influence on KM since they "cover most fundamental and important elements [hard and soft] of knowledge management programme" (Vangala & Banerjee, 2018, p. 29). Given the attested importance of ICT in

building a KM system, the second assumption suggests the following:

Assumption 2: The information and communication technologies contribute to the effectiveness of KM.

Contribution of ICT to Quality System's Performance

The first studies on information technology and quality management go back to the 1990s by focusing on these technologies as facilitators in setting up a TQM program (Kondstadt, 1990). In addition, Martínez-Lorente, Sánchez-Rodríguez & Dewhurst (2004) point out that the implementation of these technologies favours the identification of customers and their needs, the measurement and analysis of their satisfaction, and the improvement of communication with them. Moreover, the introduction of ICT in quality management has been instrumental in raising awareness of quality (Mjema, Victor & Mwinuka, 2005). Besides, the ICT may be considered as advanced tools to increase the amount of data, information, and knowledge that can be handled throughout the process (Nambisan, 2003). Finally, Matta, et al. (1998) state that TQM is an information-driven management system as all quality-improvement activities rely on informed decision-making (Garvin, 1991; Lin, 1991; Flynn, Schroeder & Sakakibara, 1994). The study tries to provide support to the following assumption:

Assumption 3: ICT contribute to the effectiveness of quality systems.

An Illustrative Conceptual Model

In light of the literature review piercing the existing and potential links between KM, ICT, and the effectiveness of TMQ, it appears that the concept of continuous improvement may be suited as a common denominator for the following arguments. First, it allows the quality system to develop a know-how within the organization, make changes to processes, and adapt new ways of working (Perdomo-Ortiz, Gonzalez-Benito & Galende, 2009; Prajogo & Sohal, 2004; Satish & Srinivasan, 2010). Then, it is neatly integrated in knowledge-creation mainly through "The PDCA of capitalization" (Jean-Yves Prax, 2012). Finally, it contributes to the implementation of ICT by ensuring regular updating which can be done by adopting the PDCA principle. Furthermore, such an approach aims at providing a result-oriented framework based on which, as best put by Mbassegue, Gardon, and Tahboub (2017, p. 11), "the evaluation and performance of any system is an important basis for learning and developing successful and robust practices". It follows that the relationships between TQM, KM, and ICT may be uttered around the continuous improvement mechanism taking the form of a three-loop system composed of three conceptual levels (see Fig. 1).

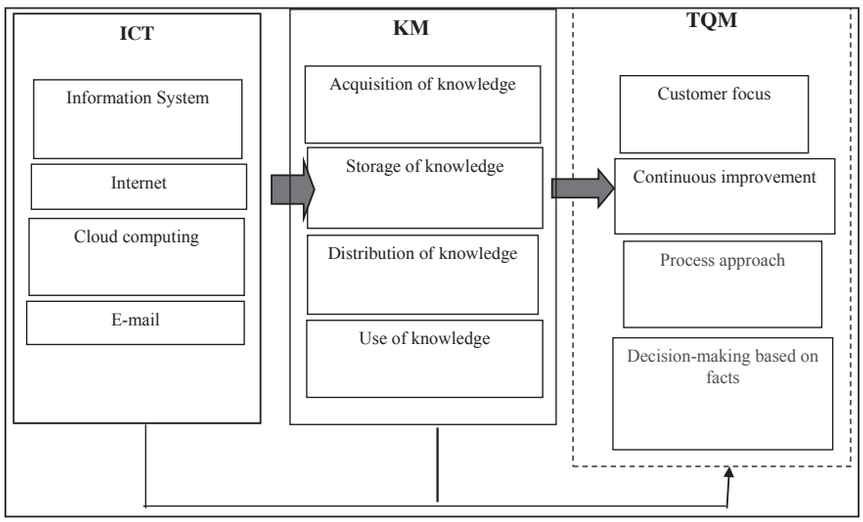

Fig. 1: Conceptual Model of the Study

Empirical Foundation of the Study

Research Methodology

In order to assess the relationships between TQM, KM, and ICT, our choice is oriented toward an exploratory-qualitative approach. This research follows an abductive approach using action research geared toward making change in the studied firm.

The study is conducted at a medium-size manufacturing firm specialized in the printing industry mainly for pharmaceutical packaging. It is a family-owned firm created in 1991, which

has been facing several difficulties to remain competitive in an environment characterized by fierce competition, saturated market, and risky socioeconomic conditions in a post-revolutionary country. As a consequence, the owner has decided to engage the quality approach by getting its production system certified in 2016 (ISO 9001). Such a mission has been confided to an external consultant seeking assistance in upgrading its quality system.

The data-collection methods adopted combine semi-structured interviews, participant observation, and document analysis. The idea is to meet the parsimony requirement for qualitative research in order to better apprehend the reality in its context.

The method of content analysis is used which is composed of three steps namely transcription, coding, and data processing (Andreani & Conchon, 2005).

Findings

Given the fact that content analysis implies, as Mucchielli (2006) states "looking for the information contained in the context, identifying the meanings of what is presented, formulating, and classifying everything contained in a document or a communication" (p. 24), it is relevant to specify the nature of information gathered as well as the themes of meanings elucidated.

As a matter of fact, the findings of the present study are based on two sources of information. On one hand, secondary sources are made available in the form of documents, archives, reports, manuals, audit reporting … On the other hand, primary sources engaged combine in-depth interviews with active participant observation. On the firm's side, an interview is conducted with the responsible of quality management who has a degree in computer science, an experience in industrial management, and in teaching as a consultant and expert in some universities.

On the external side, an interview is led with the consultant charged of implementing the firm's quality system who is an industrial engineer specialized in packing and packaging. Both interviewees are males, in their thirtieth, and have an experience of about ten years in the field.

Perception of the Meanings of the Concepts

Content analysis is oriented toward the study of the meanings of uttered words or ideas in an approximated manner. As such, it relies on the deep understanding of the data collected (Andreani & Conchon, 2005). In this regard, the analysis yields to the following inferences as to the meanings of diverse managerial techniques mobilized in the present study:

- An increased awareness of the relevance of the evoked notions by respondents who use the same lexical terms mainly with regard to the concepts of TQM and KM.
- The prevalence of a reference frame related to quality logic denoting a positive perception.
- The concept of knowledge management remains in its embryonic phase in practice and requires further consideration from managers and quality experts.
- The trend toward coherence between discourse and action implying the preference of a pragmatic approach grounded in the fieldwork is discerned.
- The assessed links between the concepts investigated seem to be implicit and relatively blur for the interviewees since they have not come to their mind before. In light of these assertions, it becomes relevant to extend the analysis in order to explain and substantiate the causes of differences in perception.

Interviewees' Assessment of the Relationships Investigated

According to Wacheux (1996, p. 220), qualitative analysis consists of an operation of « structuring scattered information » about a subject. In fact, the field study has yield to a great amount of information regarding the nature, strength, and intensity of the relationships between TQM, KM, and ICT. The analysis is oriented toward pairwise associations according to research assumptions.

- *Assessment of Reciprocal Relationship between KM and TQM*

The idea behind such an assumption is to demonstrate the extent to which there is a certain degree of congruence between these two managerial practices. By inquiring the relationship between KM and TQM, two main arguments may be highlighted.

On one hand, the interviewees emphasize the role of KM in overcoming nonconformities as well as assuring knowledge transfer to assure continuous improvement. The contribution of knowledge acquisition to a better customer relationship management is accentuated through its impact on the satisfaction of their explicit and implicit needs. Such objective is realized through efficient claims management and customer satisfaction surveys.

On the other hand, it is reported that a well-founded and well-structured KM system would be able to promote the introduction of quality culture through registration and traceability as well as the constitution of historical records for possible use by stimulating acquisition, storage, and sharing knowledge related to quality system.

As for the degree of correspondence between TQM and KM, the following effects may be underlined:

- International quality standards propose a new recording and documentation approach by providing a certain traceability and internal knowledge transfer that promotes learning about standards, customer requirements, and specificities of products.
- The impact of customer's orientation on knowledge transfer is justified by the development of a win/win strategy.
- A complaint received or a nonconformity detected can create new knowledge that may be eventually used to develop any process and consequently avoid the appearance of other nonconformities or claims.

Operationally, the interviewees accentuated the development of quality-related practices that facilitate the creation and dissemination of knowledge such as listening to customers, handling complaints, managing training and skills' development, establishing records, improving operating procedures of quality system, and intensifying quality committee meetings and brainstorming sessions.

Needless to say that such practices verse directly into the principle of continuous improvement in terms of actions to be undertaken after discussion sessions, brainstorming, and exchange of opinions, which implicitly and explicitly yield to the acquisition and transfer of knowledge.

It may inferred that the phases of KM process studied (acquisition, storage, distribution, and use), supported in several works (Durst & Edvardsson, 2012; Liao et al., 2011; Argote et al., 2003; Cormican & O'Sullivan, 2003), seem not to be well understood by the interlocutors. This may be due to the fact that, until today, there is not a clear standard to follow for the adoption of this approach. In addition, there seems to be certain confusion between not only the concepts of knowledge and competence but also as to the effect of the process approach on KM. In this regard, Mbassegue, et al. (2017) submitted a six-step framework of knowledge-benchmarking process aimed at identifying "the best performance that generates good practices and that can be adopted in other sectors, circumstances, and projects" (p. 12). By focusing on the management of megaprojects, the authors demonstrate that the reliance on the community of practices, as a collective framework, not only favors learning, sharing, and transfer of tacit and explicit knowledge, but also enlightens critical decisions. Hence, the first assumption is partially validated.

- *Evaluation of ICT's Contribution to KM Performance*

According to the second assumption, the success of KM is tributary to the degree of information technology infrastructure's maturity. By inquiring the interviewees on such assumption, certain statements are worth mentioning related to the influence of ICT on KM. It is asserted that ICT provide a significant value added to the optimization of KM process by:

- acquiring new skills and new knowledge in computer science and management;
- creating a machine history;
- generating and stocking records and follow-ups;
- avoiding as much as possible the loss and waste of information;
- sharing procedures and work instructions; and
- upgrading knowledge.

It follows that ICT are considered as a prerequisite for a dynamic KM process even though their use is not fully optimized in the studied firm according to quality management responsible.

Such findings provide empirical evidence to the second assumption pertaining to the significant contribution of ICT to KM performance. Such finding seems to be coherent with those of Karami et al. (2015) and Ben Abderrahmane-Bouriche (2012) who emphasize the effect of ICT's maturity and documentation on the constitution of a knowledge base. Recent empirical quantitative study confirms the significant and positive effect of ICT on knowledge management process in the Indian milk co-operatives (Vangala & Banerjee, 2018).

In methodological terms, it may be asserted that they are viewed as a mediator variable in explaining the association between KM and TQM.

- *Evaluation of the Contribution of ICT on TQM performance*

The role of ICT may be further apprehended in relation to TQM as suggested in the third assumption. In this respect, the interviewees justify such role by the fact that ICT:

- facilitate contact with customers mainly with social customer relationship management;
- contribute to managing the needs and requirements of customers;
- allow realizing the progress of a project according to the phases of the PDCA loop;
- facilitate the synergy that can take place between different activities of a process; and
- provide visibility to the company via social networks as well as technology monitoring via Internet.

These arguments highlight the contribution of ICT to quality system's effectiveness as largely supported by research works (Vangala & Banerjee, 2018; Martínez-Lorente et al., 2004; Dewhurst, Martinez-Lorente & SánchezRodríguez, 2003). Consequently, the third assumption is empirically grounded.

- *What is the Bottom Line?*

Based on the abductive reasoning, it is relevant to review research question in light of the empirical findings and the theoretical underpinning in order to better apprehend the phenomenon investigated. Indeed, we may infer that the adoption of the three managerial techniques studied can be apprehended in a systematic and evolutionary manner. First, before implementing a quality system, companies need to have a solid ICT infrastructure. Second, the implementation of a quality management system is undergone according to standards designed, as preconized by both the RBV and evolutionary theory, to improve both internal and external resources in terms of processes, leadership, employees' implication, customers' satisfaction, and stakeholders' involvement. As a matter of fact, the paradigm of TQM is to be inscribed in the business model of an organization and thus overtaking the institutional approach.

Finally, knowledge management may add value by playing a double role: it is a cornerstone of the ISO-9001's 2015 standards and, at the same time, a loopback of the whole system. The bottom line is that the emphasis on the relevant links between diverse managerial practices is a matter of "common sense" and a question of enactment.

Mostly, it is legitimate to affirm that the quality system of the studied firm is relatively efficient and needs to be potentially improved by instituting a KM process and optimizing ICT's utilization. This is to reiterate on the "tacitness" nature of the links assessed evoked in this study. It seems that we are witnessing what Polanyi (1966, p. 4, cited in Datoussaid, 2019) stated "we know more than we say" associated with the prevalence of a product-driven quality orientation whereas in reality, total quality extends to all aspects of management is a way it is appropriate to evoke such concepts as "the quality of knowledge", "the quality of information", and even "the quality of innovation" (Singh Chib & Sehgal, 2019). Otherwise, a firm may undergo a "continuous loss of tacit knowledge capital" (Datousaid, 2019, p. 8) which is costly in terms of non-quality as well as underperforming.

Conclusions

The present article is part of a strong ambition to examine and explain the interrelationships between TQM, KM, and ICT. In order to achieve this goal, a synthesis of the research work in the field is mobilized in favor of the elaboration of an explanatory conceptual model.

From a theoretical point of view, this research proposes a combination of diverse paradigms grounded into a systemic perspective. On one hand, the reciprocal relationship between TQM and KM is demonstrated. On the other hand, the important role of ICT in contributing to the effectiveness of these two managerial techniques has been underlined. Such combination is likely, in our opinion, to favor the performance of a quality management system.

The second theoretical implication is that the model proposed would, not only enrich the theoretical knowledge but also serve as a support for future research related particularly to management fads.

From a methodological point of view, the interest of this research lays in the use of qualitative analysis via the triangulation of different data collection techniques, namely, interviews, participant observation, and document analysis.

On the managerial level, the study provides leaders and quality practitioners with a model to succeed a quality certification project. Such a project is to be incorporated in the organization's business model in order to create value and enhance performance by focusing on knowledge as intangible assets as well as a component of the continuous improvement approach.

Besides the contributions of this study, some limitations are to be mentioned which are related to the fact that qualitative analysis challenges the researcher to be rigorous and objective and, at the same time, get immersed into the interlocutors' perceptions and intentions (Bardin, 1977).

Such a state of affairs presents an incidence on the possibility of generalization and the external validity of the findings. That is why, it would be conceivable to extend the analysis to other companies, in different contexts to assess if the nature of these relationships would be the same or rather contingent. It would also be interesting to study the degree of employees' involvement in implementing a quality system to increase the chances of success by enacting, for instance, a community of practices. In addition, the formulation of a change strategy involving all stakeholders could be a very interesting research track. The focus would be on the organizational, human, technical, and managerial aspects favorable to the performance of a quality-management system within a knowledge-benchmarking process framework.

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