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Key Quality Management Practices for Productivity Indicators in the Colombian Dairy Industry

Prácticas de gestión de calidad claves para indicadores de productividad en la industria láctea colombiana

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ABSTRACT

The aim of this study was to investigate how productivity indicators in the Colombian dairy industry can be strengthened with quality management practices (QMp). This research was conducted under a multiple case study approach, analyzing two companies within the Colombian dairy industry. The primary data collection method used was in-depth interviews, supported by secondary sources such as internal documents and company websites. According to the main findings, the interviewees perceive that the key QMp to strengthen the seven productivity indicators of the Colombian dairy industry include all practices related to top management support, human resources management, process management, and process control, as well as individual practices like innovation and feedback and auditing. Furthermore, the indicators with the highest number of key QMp were those related to the amount of whey and defective product. This research provides valuable and original insights for practitioners, managers, and policymakers. In addition, it contributes to theoretical progress by outlining how specific productivity indicators within the Colombian dairy industry can be improved through key QMp, proposes a theoretical framework that suggests the possible sequence of implementation and the interrelationships between these practices, and lays a foundation for future research in this field.

Keywords: quality management, productivity, dairy industry, sustainability

RESUMEN

El objetivo de este estudio fue investigar cómo los indicadores de productividad en la industria láctea colombiana pueden fortalecerse con prácticas de gestión de calidad (QMp). Esta investigación se llevó a cabo bajo un enfoque de estudio de casos múltiple, analizando dos empresas dentro de la industria láctea colombiana. El método principal de recolección de datos utilizado fue la entrevista en profundidad, respaldada por fuentes secundarias como documentos internos y sitios web de empresas. Según los principales hallazgos, los entrevistados perciben que las QMp clave para fortalecer los siete indicadores de productividad de la industria láctea colombiana incluyen todas las prácticas relacionadas con el apoyo de la alta dirección, la gestión de recursos humanos, la gestión de procesos y el control de procesos, además de prácticas individuales como la innovación y la retroalimentación y auditoría. Además, los indicadores con el mayor número de QMp clave fueron aquellos relacionados con la cantidad de suero y producto defectuoso. Esta investigación proporciona perspectivas valiosas y originales para profesionales, gerentes y formuladores de políticas. Adicionalmente, contribuye al progreso teórico al describir cómo se pueden mejorar indicadores específicos de productividad dentro de la industria láctea colombiana a través de QMp clave, propone un marco teórico que sugiere la posible secuencia de implementación y las interrelaciones entre estas prácticas, y establece una base para futuras investigaciones en este campo.

Palabras clave: gestión de calidad, productividad, industria láctea, sostenibilidad

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Introduction

Quality management (QM) is recognized as a strategy for organizational improvement [1]. Consequently, it has been extensively researched and utilized in both the manufacturing and services industries. The global food industry faces increasing challenges due to the rising demand for high-quality food and rigorous and strict local and international regulations [2]. However, in the food sector, there is still little work on the benefits of QM. The limited adoption of QM and its resulting benefits may be attributed to the sector's low exposure to international competition and the industry's failure to learn from best-practice companies [3], added to the characteristics of the food industry (*i.e.*, demand uncertainty, seasonality, type of equipment, variety of products/raw material, among others), which are a barrier in the implementation of quality management [4].

Notable studies in the food sector include [5], who evaluated the relationship between QM and innovation performance in small and medium-sized enterprises (SMEs) in the West Bank region of Palestine. Similarly, [2] examined its association with sustainability performance in the Saudi Arabian food manufacturing industry, while [6] explored the link between QM and sustainable performance in Malaysia's food and beverage sector. [7] and [8] analyzed its impact on operational and organizational performance in Pakistani and Palestinian food-processing SMEs, respectively.

Further contributions were made by [9] in Malaysian food manufacturing, focusing on operational and market performance; by [10], who investigated employee work engagement in the Nigerian food and beverage industry; and by [11], who assessed operational and organizational performance in Mauritius food manufacturing. Earlier studies by [3], [12], and [13] assessed organizational and operational outcomes in the Malaysian and Greek food industries. [14] focused on quality performance in Greek food manufacturing, while [15] compared organizational performance across food SMEs in Belgium, Germany, and Hungary. Finally, [16] examined market performance within the Greek food industry.

As in traditional sectors, research in the food industry has predominantly focused on studying the key quality management practices (QMp) for overall performance approaches, encompassing organizational, operational, quality, innovation, sustainability, or market aspects. However, most of these studies treat performance as an aggregated construct rather than disaggregating it into specific operational indicators. Consequently, there is still limited understanding of which particular QMp contribute to improving well-defined productivity indicators.

The aforementioned studies also suggest that, in order to strengthen the overall performance, the most recurrent key QMp constructs in the food sector, are *top management support*, *human resource management*, *process control*, *customer focus*, and *process management*. However, while these studies identify what practices are important, they rarely provide guidance on how or in what sequence these QMp should be implemented, an issue of particular relevance for companies with limited resources, which must prioritize actions to obtain immediate benefits.

Notably, none of the reviewed studies considered the Latin American food sector. Moreover, they have a broad focus on the overall food sector, failing to focus on crucial sectors such as the dairy industry, which is important for the sustainability of developing countries [15], [17]. Moreover, these studies often lack a clear distinction between individual QMp and their corresponding constructs, complicating meaningful comparisons between findings.

The landscape described above confirms the need recognized by [15], [17], and [18] for conducting additional empirical QM research in key sectors for developing countries—like the dairy industry. These empirical endeavors should shed light on how these QMp can strengthen specific performance indicators that are critical for organizational competitiveness, notably productivity, providing an initial framework for implementing them with the purpose of realizing immediate benefits.

In light of the above, the following research question arises: How can key QMp strengthen productivity indicators in the Colombian dairy industry? To address this question, it is crucial to analyze which QMp are deemed key and how they can enhance specific productivity indicators in the dairy industry, in addition to proposing a possible implementation sequence to perceive the initial benefits for these indicators.

Given that the research question is exploratory, we adopted the multiple case study approach. This research examined two Colombian dairy companies that have implemented QM and have experienced its benefits. We considered 32 QMp and seven productivity indicators. The data were collected through in-depth interviews. Additionally, internal documents and company websites were employed as secondary sources.

This study breaks new ground by examining how key QMp can strengthen specific productivity indicators within Colombia's dairy industry. This research is significant in identifying new possibilities for enhancing productivity within developing economies. Additionally, it proposes a strategic implementation sequence for these practices to realize initial benefits. This contribution not only advances the theoretical consolidation of the field of study; it also provides practitioners and managers with actionable insights for a more effective QM implementation.

This article is organized as follows. First, the literature review is outlined, and the research methodology is explained. The findings and their discussion are then presented, followed by the corresponding conclusions and implications, as well as some potential avenues for future research.

Research methodology

To fulfill the objective of this research, we employed a multiple case study. This approach is particularly suitable for investigating significant and underexplored topics [17], and it aids in comprehending complex phenomena [19], *e.g.*, the way in which key QMp can strengthen productivity indicators in the dairy industry.

Selection of cases

Following the suggestions of [19], [20], and [21], theoretical and convenience sampling was carried out for the selection of cases. Theoretical and convenience sampling is a non-probabilistic sampling method in which significant cases are selected for research following theoretical, non-statistical reasons [22]. It should also be noted that, in a multiple case study, the number of cases that can be analyzed in depth is limited, which is why [20] and [21] suggest identifying a set of criteria for the selection of potential cases.

The set of criteria considered in this research is presented below:

- Considering the diversity of products within the dairy industry, this study was limited to firms that produce the two most common dairy products in Colombia: Campesino cheese and/or yogurt. These products are widely consumed and constitute a significant share of the national dairy output, which makes them suitable for comparative analysis. This criterion also ensures greater comparability across firms and enhances the robustness of the findings.
- We considered companies that document productivity indicators. Firms that systematically document these indicators are essential for this type of analysis, as previous studies revealed that some firms lacked evidence of monitoring such measures and were therefore unable to demonstrate changes over time. Therefore, including only companies with properly recorded productivity data was crucial to effectively addressing our research question.

The initial sample that accepted to participate in the study included 29 companies, which were identified within the database of the Superintendence of Corporations. Out of the 29 companies, 19 met the two previous selection criteria.

- The selection of firms with good performance records is considered to be a valid strategy for case selection and contributes to strengthening research quality [21]. Therefore, this study focused on companies with high financial performance indicators. These were identified through a financial data analysis using the data envelopment analysis (DEA) methodology. Out of the 19 companies that met the previous selection criterion, only seven were classified as high-performing (*i.e.*, 100% efficient). The data analysis is detailed in [23].
- According to [24], one of the most widely adopted QM approaches is the implementation of the ISO 9000 International Standards series. Therefore, an additional selection criterion involved considering companies that had implemented ISO 9001 and had reported perceived improvements in their productivity indicators after its adoption. Out of the seven firms that passed the previous filter, only two met this requirement. These companies were identified through the findings of [25]. This final filter ensured that the selected firms not only exhibited strong performance but also had an established QM system in place, facilitating the analysis of the relationship between QMp and productivity outcomes. Further details on the selection process can be found in the aforementioned study.

A characterization of the cases is presented in Table I, where each company has been coded with letters to preserve confidentiality and anonymity.

Table I. Characterization of the cases

Case code	Size	Type of approach to QM	Product
A	Medium	ISO 9001	Campesino cheese
B	Large	ISO 9001	Yogurt

Source: Authors

In addition to the selection criteria mentioned above, both cases reported having internal and external motivations for adopting QM and had been applying it for more than ten years. The informants possessed education or training related to the topic of this research and reported positive changes in productivity indicators following the implementation and continued use of QM. Therefore, the selection of these two companies followed both theoretical and convenience sampling criteria, making them suitable cases for addressing the research question [19].

Although the exploratory analysis of two cases does not enable statistical generalization to the entire Colombian dairy industry (since the sampling is not probabilistic), our case study allows for theoretical or analytical generalization (transferability), as indicated by [19] and [20]. In this sense, the findings of a multiple case study can be used to support broader theoretical propositions, which may then be applied to other cases under similar conditions [19], [26]. To enable such transferability, the research must follow specific tactics that ensure *validity and reliability* [19], [20], [21], [26], [27], [28], which are detailed in the section under that title. Therefore, the main limitation of this exploratory design is that it supports theoretical rather than statistical generalization, meaning that the results cannot be extended to all companies in the sector, as would be the case with explanatory research.

Data collection instruments

In order to promote data triangulation, strengthen the research findings, and minimize the limitations of using a

single data collection instrument [19], [20], [27], [29], in this research, we used unstructured interviews with open questions as the primary data source. Internal documents and company websites were employed as secondary sources.

The unstructured interviews addressed 32 QMp and seven productivity indicators of the dairy industry as analysis variables, and they were specifically developed and validated in the study by [30] for the Colombian dairy sector. The contents of the interviews were validated through an exhaustive literature review. Content validity was reinforced with the advice of a panel of academic and industry experts, and, finally, with a pre-test carried out by top managers from five Colombian and two Italian companies in the dairy industry, which included the evaluation of grammar, writing, ease of comprehension, ambiguity, and technical vocabulary. For more details on the structure of each data collection instrument and its corresponding development, please refer to the work of [30], which addresses the process for the identification of variables, the development of the instruments, the questions asked, and the validation of the instruments.

Data collection and analysis

Data collection was carried out in the manufacturing plants of the two studied companies between November 2020 and May 2021. Considering the recommendation of [27], this research included top managers with knowledge of QM and the productivity indicators of the company, as they are best informed about the studied data. In each case, two face-to-face interviews were conducted at the companies' headquarters: one with the General Manager and one with the Director of Operations or Quality. This resulted in a total of four in-depth interviews as the primary data source. Each interview lasted approximately two hours.

An audio recorder was used to support the information collection process. Following [21], prior to the start of the data collection, the objective of the study and the content of the instrument were explained to the participants, and any doubts that arose during the process were clarified in order to ensure that the interviewees used the same terminology. The data obtained from the interviews were transcribed, coded, and stored in a database. In addition, the informants reviewed the transcript of the interview to ensure data consistency and provide feedback. Data encoding helped to organize the information and reduce it into categories [27]. The codes were defined while considering the variables identified by [30]. These variables are presented in Table II, where the column titled *Identification* refers to the code used in the analysis of the information. The codes for the variable dubbed *productivity indicators* were identified with the help of academic and industry experts, based on the definition of *productivity* expressed as the relationship between outputs and inputs. Seven indicators were identified: one related to economic sustainability, two related to economic and social sustainability, and four related to economic and environmental sustainability.

The indicators refer to the following: *Kg of product/Kg of milk* evaluates the amount of milk used for the production of 1 kg of product; *Kg of product/#h worker* evaluates the number of hours used for the production of 1 kg of product; *Kg of product/# of workers* represents the number of workers required for the production of 1 kg of product; *Kg of product/KWh* is the electrical consumption for the production of 1 kg of product; *Kg of product/m^3 of water* refers to the water consumption for the production of 1 kg of product; and *Kg of product/Kg of whey* evaluates the amount of whey obtained per kg of product and only applies for products where the whey is a waste of the production process.

Table II. Variable encoding

Variable	Category	Code	Identification
Quality management practices (QMp)	Top management support (TMS)	Leadership	TMS1
		Top management commitment	TMS2
		Strategic quality planning	TMS3
	Customer focus (CF)	Customer satisfaction	CF1
		Customer involvement	CF2
		Customer relationship	CF3
	Human resources management (HRM)	Employee training and education	HRM1
		Reward and recognition to employee	HRM2
		Employee relationship	HRM3
		Employee involvement	HRM4
		Employee empowerment	HRM5
		Employee satisfaction	HRM6
		Teamwork	HRM7
		Working attitudes	HRM8
		Working environment	HRM9
	Supplier management (SM)	Supplier involvement	SM1
		Supplier quality	SM2
		Supplier relationship	SM3
	Continuous improvement (CI)	Feedback and auditing	CI1
		Benchmarking	CI2
		Continuous support	CI3
		Prevention of non-conformities	CI4
	Process management (PM)	Technology management	PM1
		Process focus	PM2
		Standardization of process instructions	PM3
		Steady processes	PM4
	Product design (PD)	Inter-functional design	PD1
		New product quality	PD2
		Innovation	PD3
	Process control (PC)	Quality data analysis and reporting	PC1
		Monitoring, documentation and control	PC2
		Quality tools and techniques	PC3
Productivity Indicator (PI)	Economic	Kg product/kg of milk	PI1
	Economic	Kg product/h worker	PI2
	Economic	Kg product/# of workers	PI3

	and social		
	Economic and environmental	Kg product/kWh electric power	PI4
		Kg product/m³ water	PI5
		Kg product/Kg whey	PI6
		Kg product/kg defective product	PI7

Source: Authors

As a secondary data source, information from internal documents (*e.g.*, emails, reports, and presentations) and information reported on the company's website were used. Our data collection ended once conceptual saturation was reached [31].

Validity and reliability

To ensure the validity and reliability of this research and to promote the transferability of the findings (*i.e.*, theoretical or analytical generalization) to other cases under similar conditions, the suggestions of [19], [20], [21], [26], [27], and [28] were applied throughout the process, as detailed below.

Construct validity:

- **Use of multiple data sources.** In this research, unstructured interviews and secondary sources were used for data collection.
- **Use of triangulation technique.** According to [19] and [32], the most common type of triangulation used in multiple case study is data triangulation, which consists of verifying and comparing the information obtained from different sources. In this study, we triangulated findings from different data sources was conducted to increase construct validity.
- **Chain of evidence.** The entire methodological process and the results found throughout this research are described in detail in the present document.
- **Review of draft case study report by key informants.** After data collection, the informants reviewed the draft case study report to ensure data consistency and provide feedback.
- **Iterative process.** Iteration between the literature and the data obtained was carried out throughout the research process, as detailed in the findings and discussion sections.

External validity:

- **Use of replication logic (more than one case).** Two cases were addressed in this research.

Reliability:

- **Use of a case study protocol.** In the methodology section, all steps are detailed so that they can be replicated.
- **Transcribing the data shortly after the visit to the manufacturing plant and storing the information in a database so that it can be easily recovered.** The data obtained from the interview and the secondary sources were transcribed, coded, and stored in a database immediately after collection.

Findings

The results of this research are presented in two sections. The first identifies the QMp that the interviewees deemed relevant for strengthening productivity indicators in the dairy industry. Based on these findings, the second section addresses the research question by explaining how key QMp contribute to improving productivity outcomes in the aforementioned industry.

Key QMp to strengthen productivity indicators in the Colombian dairy industry

Table III summarizes the informants' perceptions regarding the key QMp that strengthen each productivity indicator in the Colombian dairy industry, based on the coding shown in Table II. The last column and row report the total number of citations for each QMp and productivity indicator, in relation to the number of possible citations.

Table III. Key QMp for each productivity indicator

QMp	PI1	PI2	PI3	PI4	PI5	PI6	PI7	Total
TMS1	✓	✓	✓	✓	✓	✓	✓	7/7
TMS2	✓	✓	✓	✓	✓	✓	✓	7/7
TMS3	✓	✓	✓	✓	✓	✓	✓	7/7
CF1				✓	✓	✓	✓	4/7
CF2				✓	✓	✓	✓	4/7
CF3				✓	✓	✓	✓	4/7
HRM 1	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 2	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 3	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 4	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 5	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 6	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 7	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 8	✓	✓	✓	✓	✓	✓	✓	7/7
HRM 9	✓	✓	✓	✓	✓	✓	✓	7/7
SM1	✓					✓	✓	3/7
SM2	✓					✓	✓	3/7
SM3	✓					✓	✓	3/7
CI1	✓	✓	✓	✓	✓	✓	✓	7/7

CI2				✓	✓	✓	✓	4/7
CI3	✓			✓	✓	✓	✓	5/7
CI4	✓	✓	✓			✓	✓	7/7
PM1	✓	✓	✓	✓	✓	✓	✓	7/7
PM2	✓	✓	✓	✓	✓	✓	✓	7/7
PM3	✓	✓	✓	✓	✓	✓	✓	7/7
PM4	✓	✓	✓	✓	✓	✓	✓	7/7
PD1						✓	✓	2/7
PD2	✓	✓	✓			✓	✓	5/7
PD3	✓	✓	✓	✓	✓	✓	✓	7/7
PC1	✓	✓	✓	✓	✓	✓	✓	7/7
PC2	✓	✓	✓	✓	✓	✓	✓	7/7
PC3	✓	✓	✓	✓	✓	✓	✓	7/7
Total	27/32	23/32	23/32	26/32	26/32	32/32	32/32	-

Source: Authors

According to Table III, the interviewees perceive that the key QMp for improving the seven productivity indicators of the Colombian dairy industry include all practices related to top management support (TMS), human resources management (HRM), process management (PM), and process control (PC), as well as individual QMp like innovation (PD3) and feedback and auditing (CI1).

Added to the above-presented QMp, continuous support (CI3) is relevant for the indicators related to the quantity of milk (PI1), electricity consumption (PI4), water consumption (PI5), the quantity of whey (PI6), and the quantity of defective product (PI7). Prevention of non-conformities (CI4) and new product quality (PD2) are relevant for indicators PI1, PI6, and PI7 and those related to the number of hours (PI2) and to the number of workers (PI3). Benchmarking (CI2) and all the practices related to customer focus are relevant to indicators PI4, PI5, PI6, and PI7, and all the QMp in the supplier management construct are relevant to indicators PI1, PI6, and PI7.

The indicators with the highest number of key QMp were those related to the amount of whey (PI6) and defective product (PI7). These results are in line with those of [25], who found that, after the implementation of QMp, the greatest changes were perceived (immediately) in the productivity indicator related to defective product. This is noteworthy since the quantity of defective product is one of the main aspects addressed by QM—it is also considered to be a critical indicator for the food industry. Defective food products can pose a risk to the health of consumers and cause foodborne diseases, as the manufacture of these products is extremely sensitive to hygiene and safety issues at all stages of the process [13].

Like PI7, the indicator related to the amount of whey (PI6) is not only an indicator of economic sustainability, but also of environmental sustainability in relation to waste, another QM priority [15], [33]. The reduction of whey waste or its use is essential in the cheese industry because, as reported by [34], [35], and [36], it is a by-product with a high chemical oxygen demand (COD; 60-80 g/L) and a high biological oxygen demand (BOD; 30-60 g/L), which, when eliminated in water sources, causes serious environmental problems, endangers the physical and chemical structure of the soil, and reduces aquatic life by depleting the dissolved oxygen from the water. Therefore, the identification of key QMp that promote the improvement of this indicator is a great contribution to the industry.

Perception of how key QMp strengthen the productivity indicators of the Colombian dairy industry

This section explains why and how the QMPs identified as key by the interviewees contribute to strengthening productivity indicators in the dairy industry.

Top management support

The informants perceived that productivity indicators were strengthened through this construct when managers invested resources for the adequate implementation and maintenance of QM. For them, this availability of resources was a tangible demonstration of managerial commitment. These resources were mainly invested in acquiring and updating technology, training and motivating employees, and adapting the infrastructure of the production plant.

In addition, the interviewees highlighted the active involvement of managers through their participation in training sessions, their demonstrated knowledge of QM, their role in fostering a favorable quality culture, and their engagement in strategic actions to communicate the benefits of QM, not only for the organization but also for all stakeholders.

The participants stated that the application of this construct directly influences other QMp such as employee motivation, commitment, and empowerment. Likewise, it aligns organizational efforts towards the achievement of QM objectives by means of clear and well communicated quality planning, which was integrated into overall corporate planning. Finally, the informants considered that these top management practices facilitate and support the implementation of other QMp, positioning this construct as a mediating factor in the strengthening of productivity indicators.

Consistent with these findings, several authors [37], [38], [39], [40], [41], [42] have argued that a successful QM implementation is only possible through TMS, as it is considered to be the primary driver of QM. Therefore, the degree to which employees adopt a QM strategy largely depends on the level of involvement and commitment of top managers.

Human resources management

According to the arguments of the interviewees, the implementation of this construct triggers the strengthening of all seven productivity indicators in the dairy industry, since the employees are directly involved in every stage of the production process and are therefore directly linked to each of the indicators. In this sense, a trained, empowered, motivated, and satisfied workforce will perform its tasks efficiently, using fewer resources (raw material, milk, time, labor, electricity, water) and producing less waste (*e.g.*, whey) as well as fewer non-conforming products.

Employees participate in control and process management, which suggests that rigorous training is necessary to ensure an accurate and timely measurement that fosters the continuous improvement of the indicators. As stated by [40], in order to collect and use reliable data, training on process improvement techniques is essential since it allows employees to generate alternatives for continuous improvement. Together with TMS, this construct is considered by [38] and [43] as an imperfectly imitable tacit resource that provides companies with a competitive advantage.

Process management

The cases studied revealed that the acquisition or updating of machinery and technology contributed to the strengthening of all seven productivity indicators. This was reflected in reduced labor requirements for dairy production, more stable end products, shorter production times, increased output relative to raw material usage, and an improved control of critical variables through standardized instructions.

The interviewees also reported that standardization mitigated variations in the process, non-conformities, and, consequently, the amount of waste. Standardization allowed employees to understand and adopt established procedures and control parameters. Combined with process control, it facilitated timely decision making to maintain process stability.

These findings are in line with the position of [40], who argued that process management reduces process variation, leading to uniformity in the outputs and minimizing rework and waste. Thus, quality problems are identified and corrected immediately in support of process control. Furthermore, [40] stated that preventive machinery maintenance improves the reliability of technology and prevents production interruptions, resulting in cost reductions and quick order deliveries.

Process control

Maintaining standardization and process stability is achieved via process control. According to the informants, monitoring involves collecting and documenting data that are later analyzed using quality tools and techniques such as cause-effect diagrams, Pareto diagrams, histograms, and/or control charts. These tools make it possible to detect non-conformities or deviations from the parameters established during process management. Only then is it possible to carry out an analysis that promotes evidence-based decision-making for continuous improvement through preventive or corrective actions.

In both cases studied, the interviewees reported that process management was first implemented to standardize and clearly define the necessary processes and controls. Subsequently, process control was introduced, enabling the stabilization of processes and the reduction of deviations. As a result, reductions were observed in production times, workforce requirements, resource consumption, and waste generation.

For this construct to deliver tangible benefits, rigorous training is essential, as well as the commitment of the workers involved and the support of top managers, who provide the resources and lead the initiatives.

Feedback and auditing

This practice is transversal to all QMp. Therefore, its adequate implementation favors the good functioning of the other practices. The two case studies in this research have internal auditors belonging to different areas and hierarchical levels of the company. This helps to constantly look for alternatives and strategies to strengthen productivity indicators and to easily identify problems and their causes, as well as possible solutions, thanks to transversal teamwork. An interviewee in Case B explained this by stating that "feedback and auditing have promoted continuous improvement through the participation and linkage of all actors involved".

Innovation

Within companies, innovation includes the improvement of products, manufacturing processes, and organizational processes, with the aim of increasing the value and performance of products, processes, or procedures [44], [45]. According to the interviewees, this individual practice strengthens productivity indicators when it is supported by knowledge mainly derived from the QMp constructs corresponding to human resources management, customer focus, and supplier management.

On the one hand, the interviewees affirmed that the implementation of human resources management fostered employee involvement, training and education, teamwork, recognition, empowerment, and satisfaction. These elements collectively contributed to creating a favorable working environment for knowledge management and, consequently, for innovation. Employees began proposing ideas to improve productivity indicators, which aligns with [46] and [47], who argue that the QMp related to human resources are strongly associated with knowledge transfer, creativity, and innovation.

On the other hand, in both cases, the implementation of supplier management fostered innovation in production processes by jointly managing knowledge with stakeholders. This knowledge transfer improved the quality of the raw material from the moment it was purchased, resulting in a lower milk consumption during product elaboration. In addition, the knowledge acquired from

suppliers led to changes in product formulations, incorporating new inputs or process variables, in addition to proposing alternatives for by-product utilization, thereby optimizing processes.

Participants in the two cases also emphasized that innovation brings benefits in productivity indicators through the implementation of the construct *customer focus*. This occurs because customers openly communicate their needs, suggest alternatives to enhance products, and feel committed to the sustainability of the company.

Through the creation, transfer, and appropriation of knowledge, innovations have been developed to strengthen the seven productivity indicators. As production and management processes were improved, raw material usage for products elaboration was reduced. Water and electric energy consumption also decreased through the implementation of strategies to prevent waste, and alternatives were created for waste utilization, thereby reducing environmental impacts and economic losses. The informant of Case A illustrated these improvements with a specific example: "the water consumption indicator (PI5) improved through innovative processes that enabled water recirculation and optimized cleaning and disinfection".

To conclude this section, these findings should not be interpreted as an invitation to implement only the QMp that interviewees identified as relevant to strengthening specific productivity indicators in the Colombian dairy industry. On the contrary, echoing previous studies [38], [39], [48], [49], the evidence supports a comprehensive rather than selective implementation of QM in order to fully reap its benefits. However, as these studies also suggest, prioritizing the most critical QMp according to each organizational context can serve as a strategic entry point to accelerate the realization of early improvements and build momentum for broader adoption. Accordingly, the theoretical framework of this article proposes an implementation sequence tailored to dairy companies, not only to secure early results, but to pave the way for sustained and scalable QM adoption.

Discussion

This section presents the differences and similarities identified between the cases, compares the findings of this research against those in the existing literature, introduces a proposal for a theoretical framework, and discusses the implications of the study.

Differences and similarities between cases

The two cases studied differ in size, product portfolio (Table I), and the length of experience with QM implementation. Case A began aligning with ISO 9001 in 2008 and has fully implemented QMp, but it has not yet pursued certification. Case B, in contrast, initiated its alignment process earlier, in 2002, and has also fully implemented QMp and achieved certification.

Despite these structural and experiential differences, both cases converged in identifying the same set of QMp as relevant for strengthening productivity indicators in the dairy industry.

However, notable differences emerged regarding the time required to perceive tangible benefits from QM implementation. In Case A, the realization of benefits was slower. Although implementation began several years ago, initial efforts lacked top management support, which delayed progress. Only after middle management trained the owners and clearly communicated the value of QM did executive support materialize. Based on this experience, Case A emphasized that securing top management commitment from the outset is essential for accelerating the adoption of QMp and, consequently, the achievement of productivity outcomes.

Case B, in contrast, had top management support from the outset, which enabled a faster implementation of all QMp and an earlier perception of benefits. This evidence aligns with previous studies indicating that significant QM outcomes tend to materialize only once the system has matured and become fully embedded in organizational routines, a process that often takes several years after implementation [25], [50]. Such a maturation period is reasonable, given that developing a quality-oriented culture requires profound transformations in attitudes, behaviors, and organizational structures [51].

Comparison with the literature

To reinforce the transferability of the findings, a comparison was made between the results of this study and previous research, following the recommendations of [20] and [28]. This analysis was structured using the work of [33] as a reference model.

The results of this research partially align with those reported by [18], who, through a systematic literature review, identified human resources management, top management support, and process management as the key QM constructs associated with productivity in both the manufacturing and service sectors. However, unlike that study, the findings presented herein advance this understanding by showing that, for the seven productivity indicators of the Colombian dairy industry, additional constructs (namely process control, feedback and auditing, and innovation) also play a relevant role.

When comparing these findings against those of studies conducted in the broader food industry, consistent patterns emerge. Similar to the present research, multiple studies carried out in non-Latin American contexts, including [2], [3], [5], [6], [7], [8], [9], [10], [11], [12] [13], [14], [15], and [16], consistently identify top management support, human resources management, process control, and process management as key drivers of overall performance in food sector organizations. However, while these previous studies reported such relationships in broader agri-food contexts—and often based on general performance measures—, our work confirmed these patterns specifically within the Colombian dairy sector, using concrete productivity indicators rather than aggregated ones.

These similarities between studies can be attributed to the fact that the food sector (including the dairy industry) has distinctive characteristics that are not shared with other manufacturing industries. One of them is that process control is mandatory in the food industry to ensure safety and prevent the risk of spreading foodborne diseases. Thereupon, [15] argue that quality control is the distinctive characteristic that differentiates the food sector from others.

Regarding the differences, previous studies in the broader food industry revealed that feedback and auditing and innovation have been studied in an undifferentiated manner within the constructs of continuous improvement and product design, respectively, rather than as individual practices. Continuous improvement was deemed relevant to strengthening general performance approaches in six out of the 14 studies reviewed, as well as product design in two studies. In contrast, in this work, feedback and auditing and innovation were considered relevant for the seven productivity indicators of the dairy industry.

It was also found that nine out of the 14 studies on the overall food sector [3], [7], [8], [10], [11], [12], [13], [14], [16], considered the construct of customer focus as relevant to strengthening general performance approaches. Similarly, four studies [3], [8], [11], [12], considered supplier management to be relevant. Contrary to the findings of broader food sector studies, the findings of this research reveal that the informants perceived these two constructs as relevant for some indicators, not for all productivity indicators in the dairy industry.

The differences identified can be attributed to three factors. Firstly, unlike this study, previous research on the food sector as a whole has dealt with general approaches to performance (organizational, operational) and not with specific productivity indicators, since, as shown by the results of [18], studies analyzing the relationship between QM and specific productivity indicators are still rare. Secondly, previous studies have operationalized QM from general constructs and not from individual QMp. Finally, these differences may also be due to the characteristics of the national context, since, as mentioned by [52], many theories for developed countries may need to be reevaluated in developing countries, as each region requires different approaches to successfully implement QM initiatives.

This statement is in line with the findings of [53], who found differences between countries in terms of the perception of QMp relevant to organizational performance. As an example, the authors comment that some countries consider the satisfaction of employees to be more relevant than customer satisfaction, a fact that can be attributed to the job insecurity experienced in these countries, making it necessary to consider human resources management first.

Furthermore, in this study, the informants did not directly consider the constructs of customer focus and supplier management as relevant for the specific productivity indicators of the dairy industry. However, they stated that innovation needs inputs from these two constructs—therefore, their implementation is indirectly necessary for strengthening productivity.

The previous paragraphs show that the findings of this work have great similarities with those of other studies on the broader food sector, and that the differences can be attributed to the national context and the nature of the specific indicators analyzed. Therefore, in addition to the fact that this research meets all the requirements to guarantee validity and reliability, it is concluded that it is possible to transfer the findings of this study to broader contexts, thus contributing to the development of a theory that can be applied to other cases with similar theoretical conditions [19], [26].

In addition, the findings of this research could be taken as a theoretical proposal for other sectors of the Colombian food industry, as well as for other developing countries (transferability), since these sectors share common characteristics, including the production of highly perishable products; the mostly manual operation; the variation in the quality of raw materials; the low batch volume; the high variation in composition, formulations, products, and processing techniques; and the obligation to produce safe products that do not pose any risk to consumer health [15].

Theoretical framework

Considering the findings and discussion of this research, the following framework proposes the key QMp to strengthen the seven productivity indicators in the dairy industry, as well as their possible implementation sequence. Fig. 1 shows that the key QMp to strengthen all seven productivity indicators are those enclosed in the outer box, *i.e.*, all QMp related to top management support, process management, process control, and human resources management, as well as innovation and feedback and auditing.

The theoretical framework also illustrates that, although the QMp of the constructs *customer focus* and *supplier management* are not key for all seven indicators, they provide inputs for innovation, a very relevant practice. Furthermore, all the QMp related to the customer focus are relevant to indicators PI4, PI5, PI6, and PI7, while those of supplier management contribute specifically to PI1, PI6, and PI7.

In addition, the inner box of the framework highlights that top management support facilitates the implementation and maintenance of all other practices. Therefore, its implementation is essential for achieving the expected benefits of QM.

Lastly, the theoretical framework suggests that the implementation sequence should begin simultaneously with top management support, process management, and human resources management, followed by the implementation of process control and the individual QMp innovation and feedback and auditing.

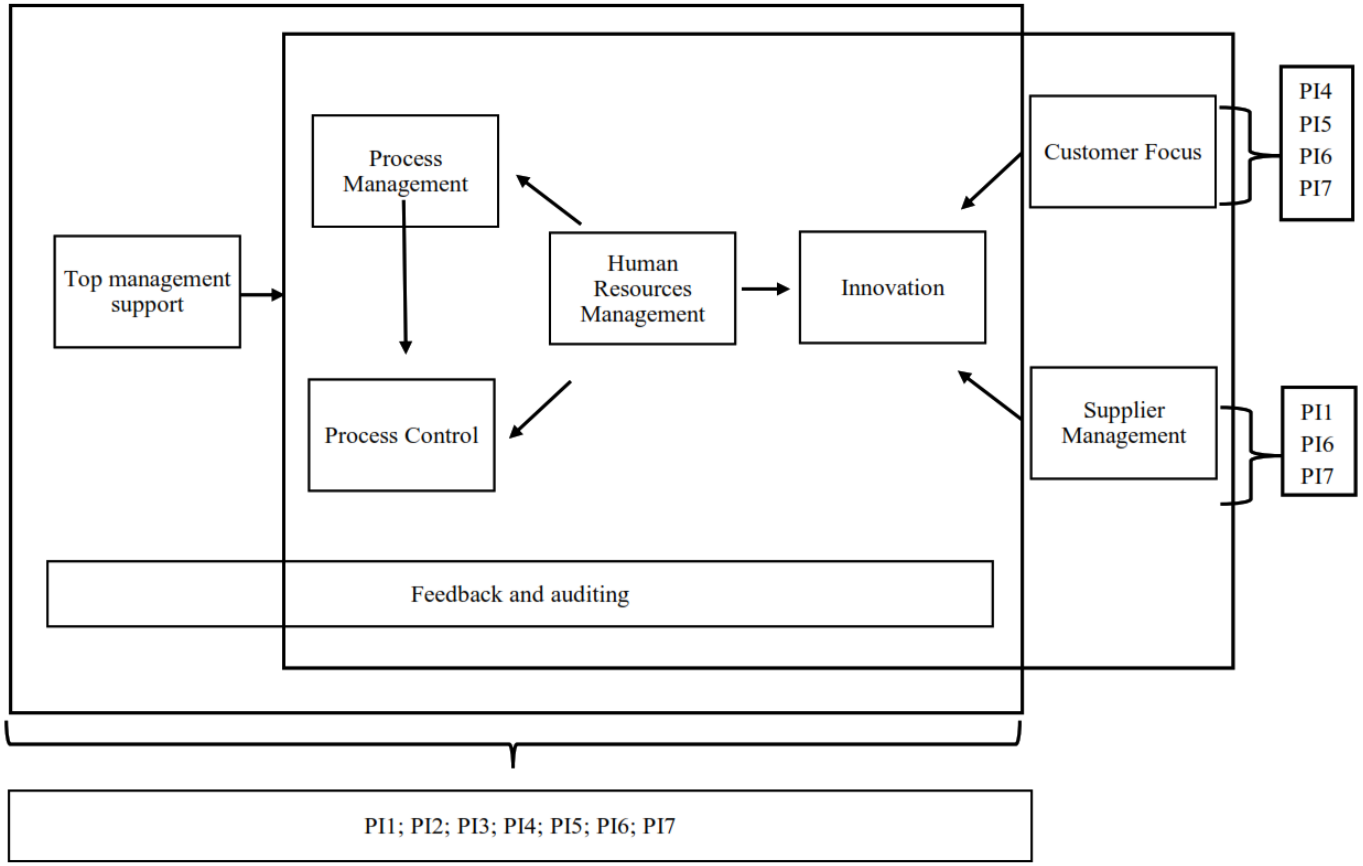

Figure 1. Theoretical framework

Source: Authors

Implications of the study

This study makes an important contribution to the advancement of QM theory by offering novel empirical evidence derived from rigorous and transparent procedures. Unlike previous research, which has predominantly identified QM constructs associated with general performance outcomes in non-Latin American contexts and within the broader food industry, this study deepens the theoretical understanding by demonstrating how specific QMp influence concrete productivity indicators in an underexplored sector (the dairy industry) and an understudied context (a developing country such as Colombia). Beyond identifying relevant practices, this research introduces a QMp implementation sequence designed to accelerate early improvements, an aspect that is largely overlooked in prior theoretical models.

Regarding the practical implications, the findings of this research offer clear, actionable guidance for managers and practitioners in the dairy sector to improve productivity indicators through the adoption of relevant QMp. Strengthening these indicators can, in turn, enhance both operational and organizational performance. Moreover, this study contributes not only by identifying what practices matter, but also how they can be effectively implemented. The proposed implementation sequence is particularly valuable for firms facing resource constraints that prevent the simultaneous deployment of all QMp. A staggered implementation approach allows companies to capture early benefits and strategically use them to sustain motivation and commitment towards the adoption and long-term maintenance of the remaining practices.

The findings of this research also carry important implications for society: they provide a basis for associations and policymakers to design strategies that enhance productivity in the dairy industry through the effective implementation of QM, thereby stimulating regional economic growth and contributing to job creation.

Conclusions and future research

This research helps to consolidate the theory of the field of study and constitutes an input for managers and policymakers, since, unlike previous studies in the food sector, it analyzes how key QMp strengthen specific productivity indicators in the dairy industry, taking Colombian companies as a case study. This study focuses on crucial performance indicators for regional growth, such as productivity, and it is carried out in contexts such as developing countries, where QMp implementation and research is scarce. Furthermore, it provides an initial approach to the sequential implementation of these practices, with the aim of obtaining the first benefits in companies with insufficient resources for simultaneous deployment. The main findings are summarized below.

The informants identified the following QMp as relevant for strengthening the seven productivity indicators in the Colombian dairy industry: feedback and auditing, innovation, and all practices associated with the constructs of top management support, human resources management, process management, and process control. Additionally, the QMp under customer focus were deemed relevant to four out of the seven productivity indicators (PI4, PI5, PI6, and PI7), while those under supplier management contributed to three (PI1, PI6, and PI7). Notably, both constructs also act as inputs for innovation, reinforcing its role as a pivotal practice within the system.

The findings of this study show how each of the key QMp can strengthen specific productivity indicators. Based on these results, an implementation sequence can be suggested for each QMp. The initial step in the implementation is to simultaneously undertake practices related to top management support, process management, and human resources management, followed by the implementation of process control, innovation, and feedback and auditing.

Given that this study was limited to firms within the Colombian dairy sector, future research should explore whether these findings hold in dairy industries from other developing economies. Replicating our work across different countries would strengthen theoretical transferability. To minimize the perception bias inherent to the reliance on managerial views, future studies should also incorporate additional respondent profiles (*e.g.*, operational workers, external auditors) and, as in this research, combine interview data with secondary sources to enhance the triangulation of information.

Furthermore, since the benefits of QM often manifest only after several years of sustained implementation, longitudinal research designs are recommended to track the evolution of productivity indicators over time, ideally over a minimum of four years following the adoption of QMp.

While this study focused on seven specific productivity indicators, future research could broaden the scope by integrating social and environmental sustainability metrics. Including indicators that reflect the interests of multiple stakeholders would provide a more holistic understanding of QM outcomes and potentially increase organizational commitment to long-term implementation.

Finally, although this study allows for theoretical generalization (transferability), its findings cannot be statistically generalized to the broader dairy sector. Therefore, future research should test these results through quantitative studies using probabilistic sampling, thereby enabling statistical generalization. Such efforts would help refine QM theory in emerging economies and provide decision-makers with more robust and scalable implementation guidelines.

CRediT author statement

Bertha Viviana Ruales Guzmán: conceptualization, collected the data, formal analysis, investigation, writing (original draft, review, and editing), visualization.
Oscar Fernando Castellanos Domínguez: conceptualization, resources, writing (review and editing), critical feedback.

Conflicts of interest

The authors of this paper declare that they have no conflicts of interest.

Access to research data

The datasets generated and/or analyzed during this study are available from the authors upon reasonable request.

Statement on artificial intelligent

The authors did not use IAG. The authors take full responsibility for the contents of this publication.

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