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Information-technology-supported financial management model for SMEs in the food sector

Modelo de gestión financiera apoyado por tecnologías de la información para PYMES del sector alimentario

Aurora María Palmett Urzola 

Universidad Nacional Experimental de los Llanos Ezequiel Zamora, Táchira, Venezuela

Corresponding Author: despachorectoral@unellez.edu.ve

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Abstract

Limited access to technological tools for financial management remains a challenge for Small and Medium-sized Enterprises (SMEs), particularly in contexts where financial constraints limit their growth opportunities. Against this background, this study aimed to propose an information technology-supported financial management model for SMEs in the non-perishable food sector. A quantitative approach was used to assess the financial and technological gaps of 18 SMEs through a 35-item questionnaire, validated by experts, with reliability estimated using Cronbach's alpha coefficient. The results showed that 94 % of the SMEs do not use financial planning tools, 56 % do not have access to credit lines, 78 % do not take advantage of tax incentives, and only 22 % use formal planning methods. Based on this assessment, a model was designed that integrates five technological components through a data architecture, a prioritization mechanism, and a twelve-month implementation roadmap. The findings suggest that the proposed model could translate the identified gaps into a gradual technology adoption strategy, providing a structured framework to guide the digitalization of SME financial management according to their specific needs and capabilities.

Keywords: Financial management, information technologies, SMEs, food sector, financing, information systems

Resumen

El acceso limitado a herramientas tecnológicas para la gestión financiera continúa siendo una dificultad para las Pequeñas y Medianas Empresas (PYMES), especialmente en contextos donde las restricciones financieras reducen sus posibilidades de crecimiento. En este escenario, el objetivo del estudio fue proponer un modelo de gestión financiera apoyado en tecnologías de la información para PYMES del sector de alimentos no perecederos. Se empleó un enfoque cuantitativo para diagnosticar las brechas financieras y tecnológicas de 18 PYMES mediante un cuestionario de 35 ítems, validado por expertos y con confiabilidad estimada mediante el coeficiente Alfa de Cronbach. Los resultados mostraron que el 94 % no utiliza herramientas de planificación financiera, el 56 % no accede a líneas de crédito, el 78 % no aprovecha incentivos fiscales y solo el 22 % emplea métodos formales de planificación. A partir del diagnóstico, se diseñó un modelo que integra cinco componentes tecnológicos mediante una arquitectura de datos, un mecanismo de priorización y una hoja de ruta de doce meses. Se concluye que la propuesta podría transformar las brechas identificadas en una estrategia gradual de adopción tecnológica, proporcionando un marco estructurado para orientar la digitalización de la gestión financiera de las PYMES según sus necesidades y capacidades.

Palabras clave: Gestión financiera, tecnologías de la información, PYMES, sector alimentario, financiamiento, sistemas de información

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1. Introduction

At present, SMEs play a relevant role in generating employment, ensuring the supply of goods, and sustaining local economic activity. However, their permanence in increasingly competitive markets remains constrained by difficulties in planning their resources, controlling their operations, and gaining timely access to financing sources. This situation is especially important in the non-perishable food sector, where everyday decisions about how much to purchase, what inventory levels to maintain, how to manage liquidity, or when to resort to financing can directly affect the continuity of operations. Added to this are tax obligations and the need for timely financial information. Although digital technologies offer new possibilities for meeting these demands, many SMEs still manage their finances through traditional procedures that make it difficult to integrate the data generated by their operations and turn it into information useful for decision-making.

Given this scenario, the literature shows different technological alternatives applicable to specific components of financial management. Al-Okaily et al. [1], for example, indicate that cloud-based accounting systems favor SME performance, while Al-sharafi et al. [2] linked cloud computing to their sustainable performance. In the field of business intelligence, dashboards make it possible to organize and visualize relevant information to support decision-making without requiring costly infrastructure [3]. From the financing perspective, Rehman et al. [4] found that technologies such as *blockchain*, big data, and mobile banking can favor access to credit. In a complementary way, Kurniasari and Lestari [5] point out that the adoption of financial technologies can facilitate SMEs' access to financial services and resources, thereby broadening the possibilities for digitalizing their management and, in turn, raising the need to link these tools with their planning, control, and decision-making processes.

This need for articulation therefore leads to a central question for SME financial management: how can information originating from different processes be integrated to support decisions that, in practice, are closely related? For example, inventory behavior can change liquidity needs, accounting information can condition a financing decision, and tax obligations can affect the availability of resources for operations. In this regard, the available evidence also shows that digitalization can extend to the management of tax obligations. Bellon et al. [6], based on an analysis of the rollout of electronic invoicing, identified favorable changes in tax compliance reported by firms, while Hesami et al. [7] examine how the use of digital technologies can help reduce the administrative costs associated with such compliance. In this context, the role of technology in financial management takes on particular relevance because of its relationship with the availability and planning of business resources, although it is still necessary to examine how these solutions can be integrated with accounting, management information, and access to financing through a management structure that responds to the particularities of SMEs in the non-perishable food sector.

In response to this need, the main contribution of this study consists of providing an information-technology-supported financial management model for SMEs in the food sector, structured through an architecture that links cloud accounting, business intelligence, *fintech* solutions, and tax digitalization with the financial processes of the business context studied. The proposal also incorporates a data architecture to organize the information flows among its components and a roadmap to guide its progressive implementation. In this way, the integration makes it possible to jointly address processes that are usually managed through independent tools and provides a structure for linking financial information with planning, control, and financing decisions. The following sections therefore present the theoretical and methodological foundations underlying the proposal, its results, and, subsequently, the discussion, limitations, and main conclusions.

2. Related work

This section examines work related to information-technology-supported financial management in SMEs, considering the main approaches from which its incorporation into business processes has been studied. The literature reviewed includes contributions related to process automation, business intelligence, digital financing, tax management, digital capital, and cloud accounting.

Along these lines, Nugraheni et al. [8] developed a structural equation model using SEM-PLS to analyze the

performance of Indonesian micro, small, and medium enterprises, considering process automation, digital payments, financial inclusion, and financial literacy. Their results show a greater influence of automation and financial literacy on business performance. Although this approach makes it possible to explain the relationships and the degree of influence among the factors analyzed, its scope is mainly concentrated on the statistical estimation of these associations, without translating the results into an operational structure that defines how to incorporate, articulate, and prioritize technologies within SME financial processes. In relation to this study, the present work broadens this perspective by linking the needs identified through the business diagnosis with a data architecture that organizes information flows, a prioritization mechanism that establishes the order in which technological solutions should be incorporated, and a roadmap that guides their progressive implementation in food-sector SMEs.

Likewise, Ragazou et al. [3] proposed a conceptual business intelligence model for SMEs based on the technology-organization-environment framework. Their proposal makes it possible to identify the technological, organizational, and contextual factors involved in the incorporation of these tools and provides a basis for understanding the conditions that can favor their adoption. However, the model remains at a conceptual level and does not address its application in a specific business environment based on primary evidence that would allow financial needs to be related to concrete business-intelligence functionalities. In view of this scope, the present study incorporates business intelligence as part of an integrated financial-management structure, whose configuration considers the planning, control, and decision-support needs of food-sector SMEs. In this way, the analytical component is not proposed as an independent tool, but as a means of organizing and relating financial information through indicators that facilitate its monitoring and subsequent use in the different processes contemplated by the model.

Regarding financing, Rehman et al. [4] analyzed the effect of different financial technologies on credit access for manufacturing SMEs, based on a sample of 381 participants linked to the Pakistani financial sector. The authors examined the adoption of tools such as *blockchain*, big data, and mobile banking, identifying their relationship with the conditions of access to and supply of bank credit for this business segment. This work provides a relevant perspective on the role of digital technologies as facilitators of financial intermediation, although its scope is mainly focused on external financing and does not delve into its articulation with other internal financial-management processes. In view of this scope, the present study incorporates digital financing as a component integrated with financial planning and control, the information generated by the firm, tax management, and the strengthening of digital capabilities, so that access to financial resources is considered as part of a management structure rather than an independent technological process.

Similarly, Bellon et al. [6] addressed digitalization from the standpoint of tax compliance by analyzing the rollout of electronic invoicing and its relationship with the tax compliance reported by firms, paying special attention to smaller business units. This work broadens the understanding of the role of digital technologies in financial management by incorporating the tax dimension, although its scope is concentrated on this process and does not delve into its articulation with planning, financing, and the information generated by the firm. In view of this scope, the present study incorporates tax digitalization within an integrated financial-management structure that makes it possible to relate it to the other technological components through a traceability matrix and a data architecture aimed at organizing the information flows among the different processes.

Added to this is the work of Saruchera and Mpunzi [9], who analyzed the effect of digital capital on the performance of agri-food SMEs located in three South African provinces, considering the existing differences in their capacities to incorporate and leverage technological resources. This precedent is especially relevant because it addresses firms linked to the agri-food sector and considers the conditions that can influence their processes of technology adoption. However, its scope is mainly oriented toward analyzing digital capital and its relationship with business performance, without developing an operational structure that articulates the different technologies with financial-management processes. In relation to this study, the present work incorporates the particularities of the food sector into the configuration of the technological components, the information flows, and the stages envisaged for the progressive implementation of the model.

Based on the work reviewed, it can be observed that the literature has developed relevant contributions to understanding the incorporation of technologies into different areas of SME financial management, although these advances have mainly been addressed from specific components such as automation, business intelligence, digital financing, tax management, and digital capital. This orientation leaves room to further explore how these technologies can relate to one another within the same structure and respond to the particular needs of a given business sector. The present study therefore proposes a model that articulates the different technological components with financial-management processes, organizes their information flows through a data architecture, and establishes criteria to guide their progressive incorporation in food-sector SMEs.

3. Methodology

This section describes the case study, the research approach, the data-collection instrument, the variables and indicators considered, and the analysis procedure used to generate the diagnosis underlying the proposed model.

3.1 Case study

The study was carried out in the Fernández Feo municipality, Táchira state, Venezuela, on a population of 30 SMEs in the non-perishable food sector, classified as finite since the totality of its elements is known. The units of analysis corresponded to personnel with direct knowledge of the financial management of these firms: administrators, accountants, and managers, as shown in Table 1.

Tabla 1. Population distribution

Position	Number
Administrator	30
Accountant	30
Manager	30
Total	90

From this population, a purposive sample of 18 SMEs in the non-perishable food sector was selected, distributed across two strata: formal trade and informal trade, as detailed in Table 2. The selection criterion was based on the capacity of managers and administrators to answer questions about the financial and technological management of their businesses, considering their experience, leadership, and knowledge of internal administrative processes.

Tabla 2. Sample distribution

Stratum 1: formal-trade SMEs	Stratum 2: informal-trade SMEs
Los Rosales	Abasto Doña Susa
Superabasto Éxito	Abasto y carnicería Zambrano
Distribuidora los Florideños	Bodega Ana
Distribuidora Yoleida	Bodega 95
Abasto El amanecer	Bodega El Diamante
Inversiones Serrano Ramírez 2017	Inversiones Soriangely
Supermercado La Estrella	Bodega La Estrella
Inversiones La Orquídea	Bodega La Fortuna
Comercial Sandoval	Bodega La Esquina

In this way, the 18 SMEs display characteristics similar to those described by Jiménez-Rico et al. [10] in the Latin American context, being small-sized firms with poorly formalized administrative structures and a significant presence of manual processes in financial and accounting management. According to the literature reviewed in Section 2, these conditions can hinder both access to formal financing and the incorporation of information systems into their management processes. Given these characteristics, the

case study offers a pertinent context for examining the technological and financial gap of agri-food SMEs and, based on its particularities, substantiating the formulation of the proposed model.

3.2 Research approach and type

The research was developed under a quantitative approach, supported by the numerical and statistical resources it offers for representing and interpreting results. The type of research corresponded to a feasible project, supported by field research, aimed at the elaboration and development of a viable operational model to address the requirements identified in the SMEs of the case study. In this way, the design made it possible to gather information in the natural context in which events occur, combining the evaluation of documentary sources with the direct application of an instrument to the study subjects, as explained in the next subsection.

3.3 Data-collection instrument

The technique used to collect information was the survey, and the instrument used was a questionnaire made up of 35 polytomous items, organized through a frequency scale with five response alternatives corresponding to Always, Almost always, Sometimes, Almost never, and Never. The instrument was applied to administrators, accountants, and managers of the 18 SMEs considered in the sample, given their direct participation in the firms' administrative, financial, and accounting processes. Content validity was established through the judgment of three experts, who evaluated the correspondence of the items with the dimensions considered, as well as their clarity, relevance, and coherence with the object of study.

A pilot test was subsequently carried out with 6 participants belonging to SMEs with characteristics similar to those considered in the study, who were not part of the final sample. This preliminary application made it possible to review the understanding of the items, the clarity of the response alternatives, and the overall functioning of the instrument before its final application. Based on the responses obtained, internal consistency was estimated using Cronbach's alpha coefficient [11], appropriate for examining the reliability of instruments composed of multiple items. The coefficient was determined using Equation 1.

$$\alpha = \frac{k}{k-1} \left(1 - \frac{\sum_{i=1}^k \sigma_i^2}{\sigma_T^2} \right), \quad (1)$$

Where α represents the reliability coefficient, k corresponds to the number of items in the instrument, σ_i^2 represents the variance of each item, and σ_T^2 corresponds to the variance of the total score. For the 35 items evaluated, a coefficient of $\alpha = 0.84$ was obtained, a value indicating adequate internal consistency of the questionnaire. With this verification, the instrument was administered in its final form to the participants of the 18 SMEs considered in the study.

3.4 Variables and indicators

The instrument was structured around two construct variables corresponding to information-technology-supported financial management and economic growth. For its operationalization, four analytical dimensions were considered, related to financial planning and adoption of technological tools, tax management, access to financing, and talent training and development. These dimensions group indicators associated with the use of planning tools, cost control, tax compliance, access to formal sources of financing, and the development of digital capabilities, among other aspects linked to business management. The organization and relationship among the variables, dimensions, and indicators considered in the instrument are presented schematically in Figure 1.

3.5 Analysis procedure

Once the instrument had been administered, the responses were organized using absolute and percentage frequencies for each item and subsequently grouped according to the four dimensions defined in the study. Processing was carried out using descriptive statistics, with the purpose of characterizing financial-management practices and the level of incorporation of information technologies in food-sector SMEs. Based on this organization, the predominant behaviors, recurring needs, and the aspects with the lowest

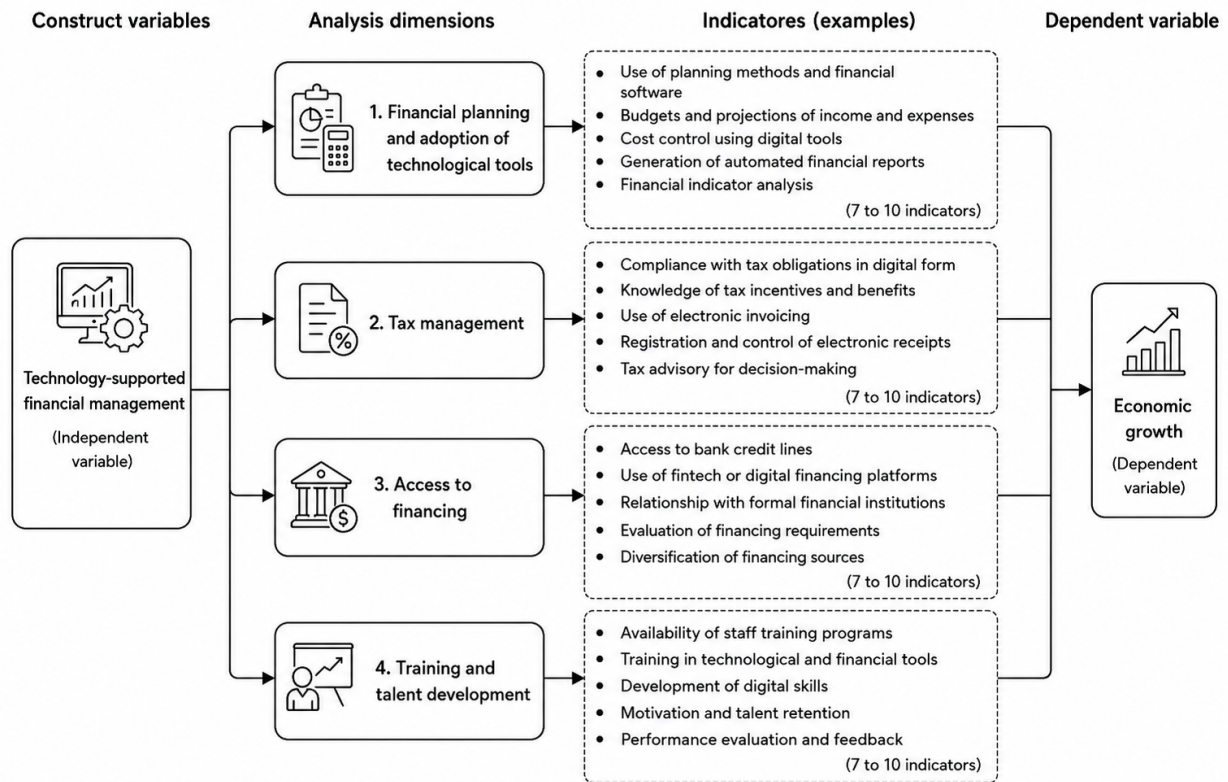


Figure 1. Relationship among the variables, dimensions, and indicators considered in the study.

level of development in each dimension were identified, providing a quantitative basis for establishing the priorities that guided the formulation of the financial-management model. In this way, the analysis was not limited to describing the responses obtained, but made it possible to establish the correspondence between the needs identified and the technological components considered in the proposal, particularly those related to financial planning and control, tax management, access to financing, and the strengthening of digital capabilities. Owing to the descriptive, diagnostic, and proposal-oriented nature of the research, no hypotheses were formulated and no inferential contrast tests were applied, since the study's interest was centered on obtaining evidence from the business context to support the design and prioritization of the components of the proposed model.

4. Results

This section presents the findings obtained from the analysis of the 35 responses provided by administrators, accountants, and managers of the 18 SMEs in the case study, organized into the four dimensions described in the methodology, and concludes with the presentation of the information-technology-supported financial-management model, its data architecture, a component-prioritization algorithm, and its implementation roadmap.

4.1 Financial planning and adoption of technological tools

The first finding of the diagnosis, and the most decisive for the technological orientation of the proposed model, is the limited use of financial-planning tools or software: only 94 % of the surveyed SMEs stated that they never use this type of tool, while only 6 % use them occasionally, with no firm reporting frequent use. Figure 2 illustrates this distribution.

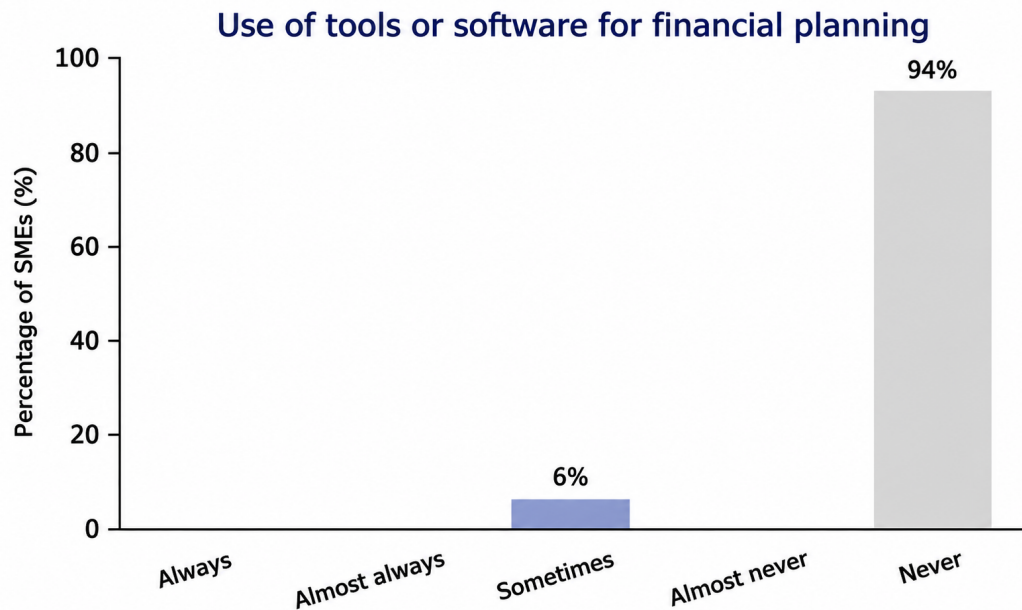


Figura 2. Use of tools or software for financial planning

This finding becomes even more relevant when contrasted with the formal-planning indicators, where 39 % of firms never apply short- or long-term financial-planning methods, and 56 % never review or update a financial plan, while only 22 % and 27 %, respectively, state that they always do so. This gap is not merely quantitative: it reveals that more than half of the diagnosed SMEs operate without a management tool capable of anticipating variations in costs, revenues, or demand, leaving them exposed to reactive rather than planned decisions. The disparity between those who plan occasionally and those who never do so also suggests that the absence of technological tools not only prevents financial planning from being initiated, but also prevents it from being sustained over time once undertaken, which explains why periodic review of the plan proves even more deficient than its initial formulation. Figure 3 compares these three indicators and visually shows how the lack of updating constitutes, within this dimension, the most critical point of the diagnosis.

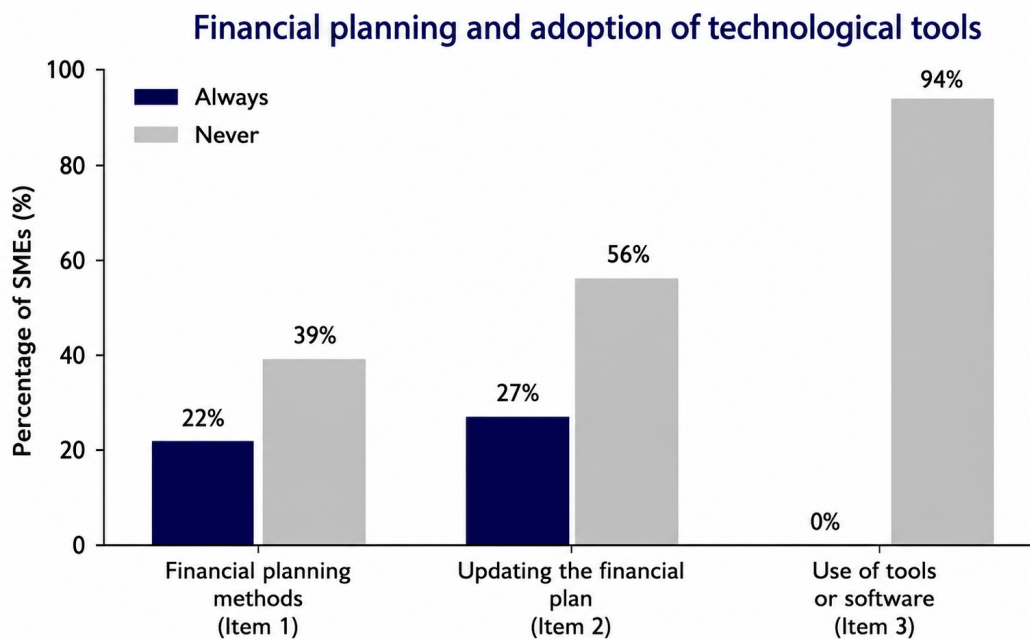


Figura 3. Financial planning and adoption of technological tools

Reading these three indicators shows that the absence of formal planning in the SMEs studied is not solely a matter of knowledge or administrative discipline, but is closely associated with the lack of technological tools that facilitate the recording, projection, and monitoring of financial information. In the absence of these tools, preparing and updating a financial plan requires a sustained manual effort that, in small organizations with poorly formalized processes, is difficult to maintain over time, which explains why the gap widens as the plan requires periodic updates rather than just an initial formulation. This issue is therefore consistent with what was noted by Osorio-Gallego et al. [12], for whom the perception of technological complexity discourages ICT adoption among Latin American SMEs, a pattern that in the case studied translates in practice into the almost total absence of financial-planning instruments sustained over time.

4.2 Tax management

Regarding the tax dimension, 78 % of SMEs never take advantage of any type of tax incentive, and the entire sample (56 % always and 44 % almost always) reported having encountered barriers to accessing such incentives whenever they have tried to do so. In addition, 50 % of firms consider that tax compliance always or almost always entails additional costs for the business. Taken together, these three indicators describe a scenario in which the tax burden does not stem solely from the amount of taxes owed, but from the practical difficulty of accessing the mechanisms that, in principle, should ease it. The fact that no firm reported easy access to the available incentives shows that these mechanisms, although formally in place, are inoperative for the SME segment studied.

Indeed, this situation is especially relevant because it reveals a double penalty for smaller firms. On one hand, they face a widespread perception of additional costs associated with tax compliance and, on the other, they lack effective means of reducing that burden through the incentives the system itself provides. Likewise, in the absence of specialized advisory services and digital channels that simplify procedures, tax compliance ends up functioning as an additional administrative barrier rather than a predictable process, which reinforces reliance on manual, in-person, and often poorly documented procedures. Figure 4 summarizes the findings for the three indicators and makes it possible to visualize the relative magnitude of each one within this dimension.



Figura 4. Tax management and compliance

This pattern indicates that the relationship of the SMEs studied with the tax system is not limited to the tax burden, but also includes barriers to accessing the available tax-relief mechanisms. In the absence of electronic tax-management systems and technical support, these barriers can translate into higher administrative compliance costs. This finding is consistent with the evidence presented by Bellon et al. [6] for Peru, where electronic invoicing favored reported tax compliance, especially among the smallest firms.

Likewise, Hesami et al. [7] document that these tools simplify recordkeeping and reduce the administrative burden associated with tax compliance.

4.3 Access to financing

Regarding access to financing, 56 % of SMEs have never found the available credit lines accessible, and 84 % (50 % always and 33 % almost always, in addition to 17 % sometimes) have experienced difficulties accessing credit in the past. Consistent with this, 56 % of firms have never used banks, microfinance institutions, or investors as a source of financing. The convergence of these three indicators does not seem coincidental, since a firm that perceives credit as inaccessible and has also experienced concrete difficulties in trying to obtain it eventually stops trying, which explains why more than half of the sample has never resorted to a formal source of financing. In other words, it is a self-reinforcing cycle in which accumulated negative experience discourages new attempts, and that absence of attempts prevents the firm from building, over time, a credit history that would improve its future access conditions.

Looking more closely at these findings, the difficulties in accessing financing do not appear to be associated exclusively with the conditions set by financial institutions, but also with certain internal practices of the SMEs studied. Incomplete accounting records, the limited separation between the firm's finances and those of the owner, and the absence of systematized information on financial performance can make it difficult to present sufficient background information to meet credit-evaluation requirements. In this way, these issues make it possible to relate the findings of the financing dimension to those previously identified in financial management, showing that the two dimensions do not operate independently. In this sense, internal organizational conditions and the availability of financial information are relevant for understanding the difficulties in accessing formal sources of financing and are aspects that must be considered in the configuration of the proposed model. Figure 5 presents the behavior observed in this dimension.

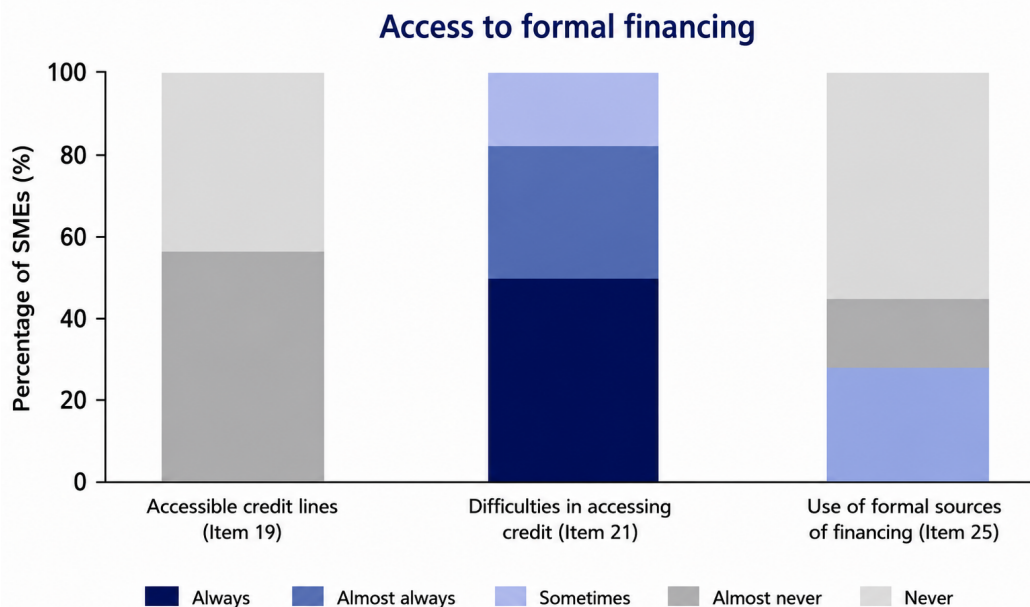


Figura 5. Access to formal financing

4.4 Training and talent development

After examining the conditions related to financial planning, tax management, and access to financing, the analysis is completed with the training and talent-development dimension, since the incorporation of technological tools also requires the capabilities needed to use them appropriately within management processes. In this dimension, 83 % of SMEs indicated that they do not regularly have training programs for their employees, distributed between 33 % who answered never and 50 % who answered almost never. Likewise, 100 % of the sample, represented by 44 % in the never category and 56 % in the almost never category, stated that they had not identified areas for improvement in existing training programs, reflecting limited formalization of training processes within the firms studied. The behavior of these indicators is

presented in Figure 6.

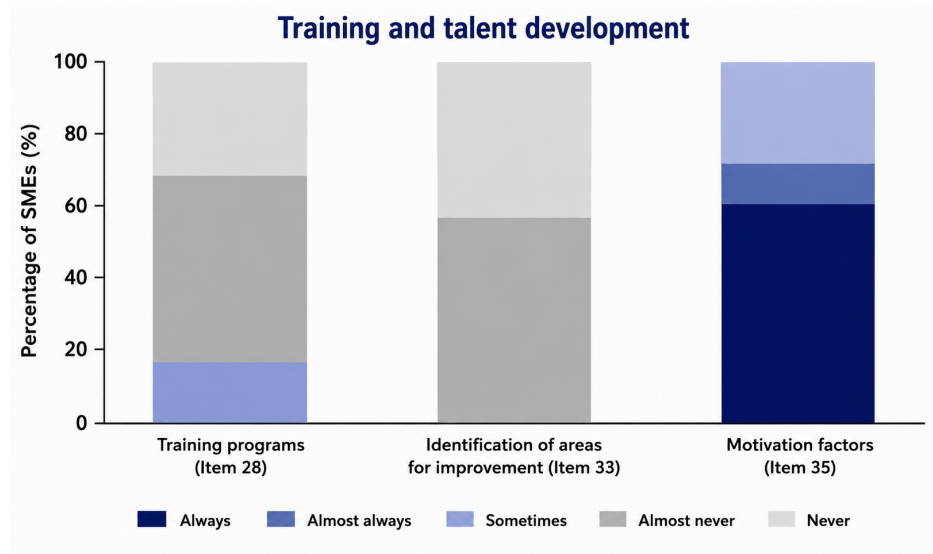


Figura 6. Training and talent development

In contrast, 100 % of SMEs recognized the factors considered important for maintaining employee motivation and commitment, of which 61 % answered always, 11 % almost always, and 28 % sometimes. This behavior thus reveals a difference between recognizing the needs associated with talent management and the existence of formal mechanisms to address them, since this knowledge is not accompanied by systematic training programs. In the firms studied, this situation therefore takes on particular relevance in view of the incorporation of technological tools into financial management, since their proper use requires administrative and accounting staff to develop the capabilities needed to manage information, interpret indicators, and use the digital solutions considered in the proposed model.

4.5 Information-technology-supported financial-management model

The diagnosis developed in the preceding subsections shows that the financial limitations identified in the non-perishable food-sector SMEs of the Fernández Feo municipality are related not only to resource availability, but also to a technological gap present across the four dimensions analyzed. Based on this relationship, Table 3 establishes the correspondence between the gaps identified, the technological components considered to address them, the tools proposed, and the evidence supporting their incorporation. In this way, the proposed organization makes it possible to link each need identified in the diagnosis with a specific technological response and to establish a traceability basis for the configuration of the model, so that the tools considered respond to the requirements of the SMEs studied and are articulated within a single financial-management structure.

Tabla 3. Traceability matrix between diagnosed gaps and technological components of the model

Diagnosed gap	Technological component	Tools	Ref.
94 % without planning tools	Digital financial planning	Budgeting and cash-flow projection software	[8, 13]
56 % without use of formal cash sources	ICT-based cash-flow control	Mobile banking, electronic collections and payments	[4, 5]
78 % without tax incentives leveraged	Electronic tax management	Electronic invoicing and tax portals	[6, 7]
56 % without accessible credit lines	Access to digital financing	Online banking	[10, 1]
83 % without training programs	Analytics and indicator dashboard	Financial-indicator dashboard	[3, 14]
Absence of digital competencies	Training in digital competencies	Ongoing training in the tools incorporated into the model	[15, 16]

Based on the traceability matrix, a financial-management model is proposed that articulates five components on a common technological infrastructure and a cross-cutting digital culture, as shown in Figure 7. Its configuration starts from a central question related to how an SME can turn the gaps identified into concrete decisions about technology incorporation. For example, given the 94 % of firms that do not use planning tools, the first component incorporates digital budgeting and cash-flow-projection mechanisms that make it possible to anticipate resource needs. The second component integrates cash control with mobile banking and electronic collection and payment mechanisms, considering the relationship between cash availability and business performance [17]. From this information, another relevant question arises about how to relate day-to-day financial movements to tax obligations and financing possibilities. To this end, the third component incorporates electronic invoicing and digital tax portals to support tax management [6], while the fourth contemplates online banking, *fintech* platforms, and *scoring* mechanisms aimed at having organized financial information available for financing processes. The fifth component corresponds to training and developing the digital competencies of administrative and accounting staff, necessary for using the preceding tools. In this way, the components are not proposed as independent solutions, but as interrelated parts that generate, share, and use information within a single financial-management structure.

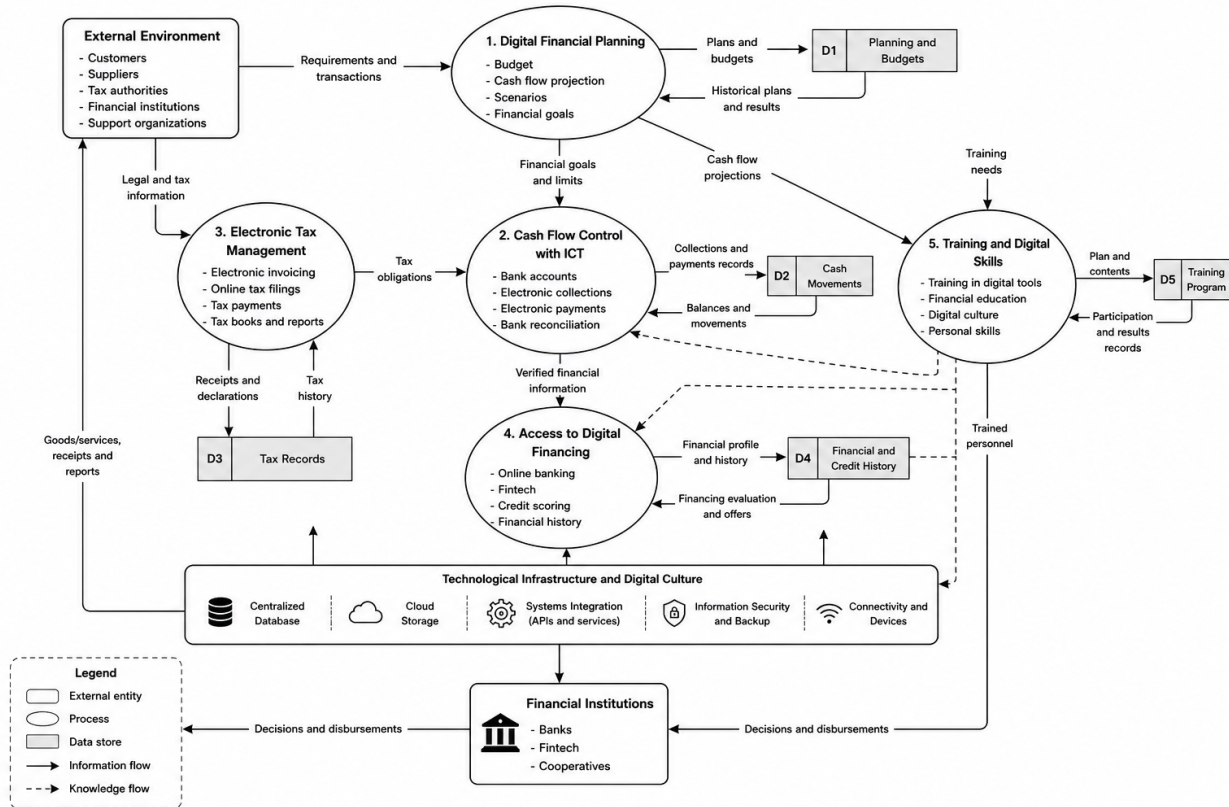


Figure 7. Information-technology-supported financial-management model for SMEs in the food sector

The model's contribution lies precisely in this articulation, since it does not propose the adoption of technologies as isolated actions, but establishes a correspondence between the needs identified, the tools that can address them, and the information that must flow among the different components. Thus, a record generated by a collection transaction can feed cash-flow control, update financial planning, and provide information for tax management or a subsequent financing request. This logic allows technology to function as support for interrelated financial processes and provides a structure to guide its progressive incorporation according to the operating conditions and digital capabilities of food-sector SMEs.

4.5.1 Data architecture of the model

For the five components to operate in an articulated manner rather than as isolated tools, the model incorporates a four-layer data architecture, illustrated in Figure 8. The first layer integrates the data sources available in a typical SME in the sector: the point of sale, mobile banking, electronic invoicing, and, during

the transition phase, the manual recordkeeping that currently predominates in the diagnosed firms. The second, integration, layer consolidates this information through lightweight extract-transform-load mechanisms or low-cost application programming interfaces, thereby avoiding the need for the SME to maintain its own information-technology infrastructure, in line with the argument made by Ragazou et al. [3] regarding the viability of low-cost analytical solutions for this segment. The third, analytical, layer translates the integrated data into a financial-indicator dashboard that allows planning, cash flow, tax compliance, and access to financing to be monitored in near real time, following the low-cost business-intelligence approach documented by Babalghaith and Aljarallah [14]. The fourth layer corresponds to the financial decision itself, made by the SME's manager or administrator based on the consolidated information, with a feedback loop that allows the model's goals to be adjusted as the indicators evolve.

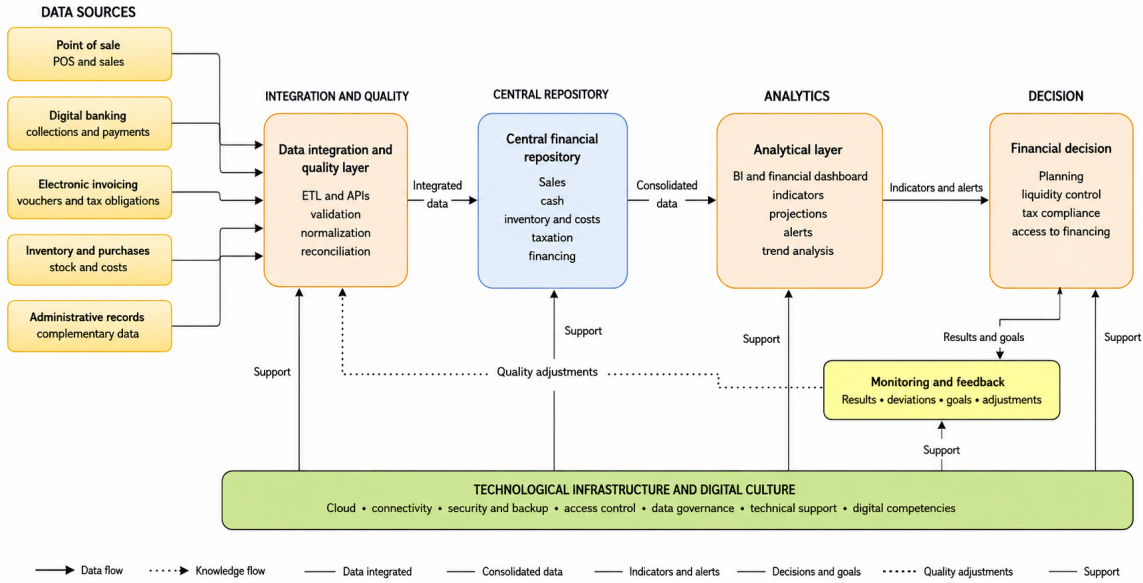


Figure 8. Data architecture of the ICT-supported financial-management model

4.5.2 Algorithm for prioritizing technological components

At present, not all SMEs have the resources needed to implement all five components of the model simultaneously. For this reason, a procedure is proposed to identify where it is best to start, using the main needs found in the diagnosis as a reference. The idea is that each SME can direct its resources toward the aspects where it faces the greatest difficulties, rather than incorporating all the technologies simultaneously. To this end, Algorithm 1 calculates the gap for each component based on the responses obtained in the instrument. The larger this gap, the higher its priority for attention. In this way, the diagnostic results are converted into an implementation sequence tailored to each SME's situation.

Algorithm 1 Prioritization of technological components according to the needs identified

Require: Model components $C = \{c_1, \dots, c_5\}$ and indicators I_i obtained from the diagnosis

Ensure: List of components ordered according to their implementation priority

- 1: **for** each component $c_i \in C$ **do**
 - 2: $gap(c_i) \leftarrow \frac{1}{|I_i|} \sum_{j \in I_i} (Never_j\% + AlmostNever_j\%)$ ▷ Average of responses indicating greater need
 - 3: **end for**
 - 4: Sort the components from highest to lowest according to $gap(c_i)$
 - 5: $priority_1 \leftarrow$ component with the largest gap
 - 6: **while** components remain to be assigned **do**
 - 7: Select the next component according to the order obtained
 - 8: Assign it to the corresponding implementation phase
 - 9: Check whether it requires another component to have been previously implemented
 - 10: **end while**
 - 11: **return** List of components ordered with their implementation phase
-

In practical terms, this procedure makes it possible to answer a simple question: what does the SME need to address first? To determine this, the gaps identified in the diagnosis are used as a starting point, so that the aspects with the greatest difficulties receive higher priority. In the case analyzed, the main gap corresponds to digital financial planning, at 94 %, followed by electronic tax management, at 78 %, and access to digital financing, at 56 %. These results make it possible to establish a starting point consistent with the needs observed in the firms. As these gaps narrow, the SME can move on to other components, such as ICT-based cash-flow control and the strengthening of digital competencies. Thus, priority is defined not merely by incorporating more technology, but by first addressing the most important needs and progressing according to the capabilities the firm develops over time. The proposed order is therefore based on the results presented in Sections 4.1 through 4.4 and makes it possible to adapt the roadmap to each SME's particular situation, rather than assuming that all of them must follow exactly the same process.

4.5.3 Implementation roadmap

This section presents the implementation cycle of the proposal, which is sequentially organized into three progressive and continuous phases over twelve months, as illustrated in Figure 9. Each phase groups a specific set of technological actions, consistent with the priority order derived from Algorithm 1, and culminates in a quantifiable goal that makes it possible to verify progress before starting the next phase. The first phase, lasting four months, lays the SME's digital and financial foundation through a digital-maturity diagnosis, financial planning, digital payments, and basic staff training, with the goal of raising the proportion of firms with a formal financial plan from 22 % to 45 %. The second phase integrates electronic invoicing, indicator dashboards, and process automation, guiding the SME toward data-driven decision-making. The third phase incorporates *FinTech*-type platforms and digital credit-scoring mechanisms, with the goal of raising the proportion of SMEs accessing formal financial products from 34 % to 70 %.

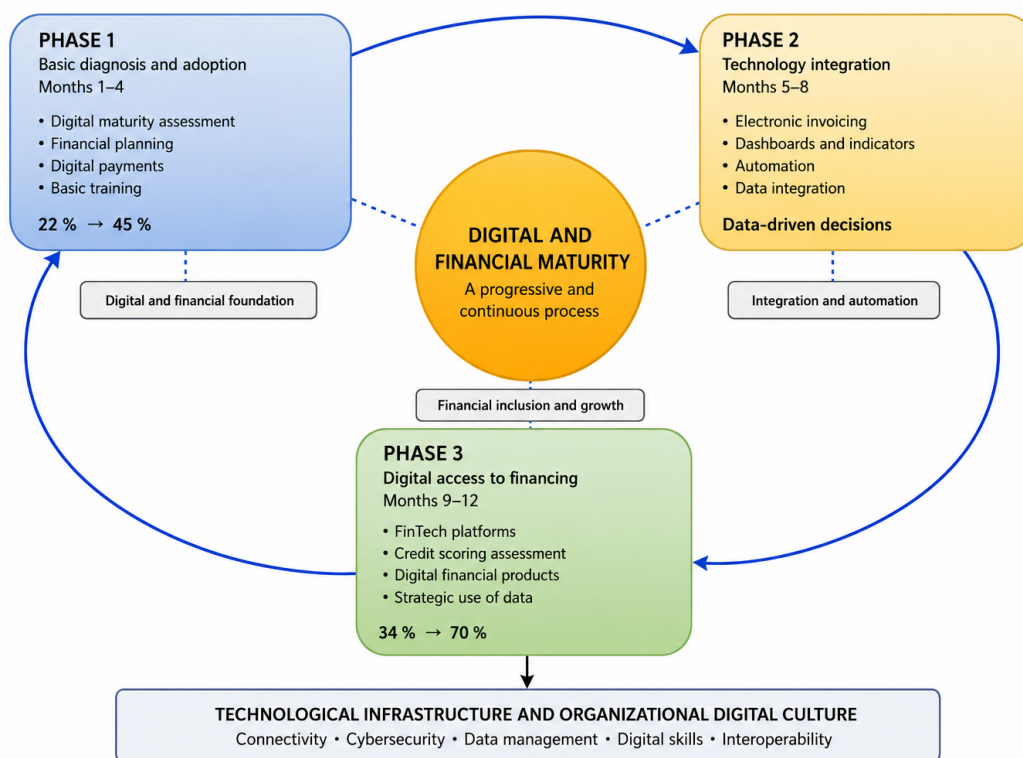


Figure 9. Implementation roadmap of the model

A more natural way to understand this rollout is to consider that each phase paves the way for the next. The SME begins by strengthening basic aspects, such as planning and digital payments, which, besides improving its day-to-day management, make it possible to generate information about its operations. Over time, this data can be organized and leveraged through management dashboards, providing greater insight into the firm's financial situation. As this information accumulates, a clearer and more verifiable financial history is also built, which can later be used by *FinTech* platforms to assess credit risk and facilitate access

to new financing alternatives. However, this progress does not depend solely on incorporating new tools. It requires a technological and organizational foundation that supports the entire process, especially in connectivity, cybersecurity, data management, digital capabilities, and interoperability. For this reason, the three phases should be understood as parts of the same digital-maturity process, in which technology is incorporated according to the SME's capabilities and needs and gradually contributes to improving its financial inclusion and growth prospects.

5. Discussion

The results show that the financial difficulties of the non-perishable food-sector SMEs in the Fernández Feo municipality cannot be explained solely by a lack of resources. There is also a technological gap that limits the way these firms plan, record, and use their financial information. The most representative finding is that 94 % of firms never use financial-planning tools. This result is consistent with what was noted by Osorio-Gallego et al. [12], who identify the perceived complexity of ICT as an important barrier to its adoption among Latin American SMEs. In the context studied, this difficulty takes on an additional implication, since the limited use of technological tools coincides with limitations observed in financial management. This suggests that both gaps may be related: a firm with limited technological capabilities faces greater difficulty organizing and leveraging its financial information, and at the same time, a limited financial situation reduces its possibilities of investing in technology. This interpretation is likewise consistent with Raya et al. [13], who highlight that perceived usefulness and ease of use influence SMEs' decisions to adopt new technologies.

Based on this relationship, incorporating technology on its own does not guarantee an improvement in firm performance. Nugraheni et al. [8] found that process automation can favor the performance of micro, small, and medium enterprises, but they also warn that the isolated adoption of digital tools, without integration with business processes, can have limited effects. This evidence helps explain why the proposed model does not simply propose incorporating digital programs or platforms. The proposal seeks to connect the tools with one another and to ensure that their incorporation responds to the needs previously identified. To this end, the data architecture presented in Section 4.5.1 makes it possible to organize the information generated by the different components, while the prioritization algorithm in Section 4.5.2 helps determine which one should be addressed first. In this way, technology adoption follows a sequence consistent with each SME's capabilities and reduces the risk noted by Babalghaith and Aljarallah [14], who warn that a technology can add little value when the organization lacks the conditions needed to take advantage of it.

This same logic proves important when analyzing access to financing. The results are consistent with Jiménez-Rico et al. [10], who point out that smaller firm size constitutes a disadvantage in accessing bank credit in Latin America. However, the findings of the present study suggest that technology can help reduce part of this difficulty. When an SME keeps orderly records of its sales, payments, obligations, and cash movements, it begins to generate a financial history that can be verified and used to demonstrate its economic behavior. This information is especially important for digital financing alternatives, given that, as Rehman et al. [4] point out, *FinTech* solutions can broaden SMEs' financing possibilities. Digitalizing internal financial processes therefore not only facilitates the day-to-day administration of the business, but can also prepare the firm to access new sources of financing later on.

Similar reasoning applies to tax management, where Bellon et al. [6], based on evidence from Peru, show that electronic invoicing can improve tax compliance and that its effects are especially relevant among smaller firms with lower initial compliance levels. This precedent is pertinent for the SMEs analyzed, given the gaps found in this dimension. Incorporating electronic tax management into the roadmap therefore does not respond solely to the need to digitalize an administrative obligation. Its incorporation also makes it possible to generate more orderly and verifiable records that can subsequently feed other components of the model. In this way, tax information ceases to function in isolation and becomes part of the financial history the firm needs to improve its management and support future financing decisions.

On the other hand, the results related to training show a different situation. Although sufficiently developed formal training programs do not exist, respondents recognize the factors that can motivate and enhance their workers' performance. This indicates that there is some awareness of staff needs, but this awareness

has not yet been systematically translated into training actions. In this regard, Bawono et al. [15] and Kumar et al. [16] highlight the importance of deliberately developing financial and digital capabilities. For the proposed model, this aspect is especially important because the incorporation of new tools also depends on people knowing how to use them and understanding their usefulness. Training should therefore not be understood as an independent activity or one that follows digital transformation, but as an element that progressively accompanies the implementation of the different components.

In this way, the findings make it possible to understand the proposal as a gradual path in which financial needs, technological capabilities, and people's competencies are interrelated. The model's main contribution therefore does not consist of proposing a greater quantity of technologies, but of establishing what to incorporate first, how to connect the information generated, and under what conditions to move toward components of greater complexity. However, the model developed has a diagnostic and prescriptive scope, so its results should not be interpreted as evidence that its implementation will, by itself, produce financial improvements. The next step consists of evaluating this proposal in SMEs through a controlled implementation that makes it possible to observe the changes obtained from the roadmap and the indicators defined in Section 4.5.3. This will make it possible to determine to what extent the proposed sequence effectively contributes to reducing the gaps identified and to improving the firms' financial management.

6. Conclusions

The objective of this study was to propose an information-technology-supported financial-management model for non-perishable food-sector SMEs in the Fernández Feo municipality, Táchira state, based on the gaps identified in their management. The results show that these firms face difficulties combining financial and technological aspects. In particular, 94 % never use financial-planning tools, 56 % do not have access to credit lines, 78 % do not take advantage of tax incentives, and 83 % lack training programs. In response to this reality, the proposed model organizes the needs identified and relates them to technological solutions that can be incorporated gradually. Its main contribution lies in integrating a traceability matrix, a four-layer data architecture, and a prioritization algorithm, making it possible to move from diagnosing the gaps to a concrete roadmap that guides which components to address first and how to progress as each SME's capabilities are strengthened.

That said, the scope of this work is diagnostic and proposal-oriented, so the model establishes an implementation route but does not yet demonstrate the effects that its application would produce in the firms studied. This delimitation opens a line of work aimed at verifying its usefulness under real conditions. As a next step, it is proposed to develop a pilot implementation in a group of SMEs and to evaluate, before and after the intervention, the indicators defined in the roadmap in Section 4.5.3. This would make it possible to determine whether the progressive incorporation of the proposed tools improves financial planning, cash-flow control, tax management, access to financing, and digital competencies. In future research, it will also be important to apply the model in firms of different sizes, activities, and territorial contexts, in order to identify which components can be retained, which require adaptation, and under what conditions the model can be used as a reference for other Latin American SMEs.

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