Preliminar

Ingeniería Solidaria

Innovation capability gaps in medium-sized enterprises of Chiriquí, Panamá: empirical evidence and strategic implications

Brechas en la capacidad de innovación en empresas medianas de Chiriquí, Panamá: evidencia empírica e implicaciones estratégicas

Lacunas na capacidade de inovação em empresas de médio porte em Chiriquí, Panamá: evidências empíricas e implicações estratégicas

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Abstract

Introduction: This article is the result of the doctoral research project titled "Strategic Innovation Guidelines for Leveraging Organizational Resources in Medium-Sized Enterprises in the Province of Chiriquí," carried out at the Universidad del Istmo during the 2024–2025 period.

Problem: Previous studies suggest that weak competitive performance is linked to deficiencies in innovation capability (IC), particularly in its definition, management, and measurement. However, there is a lack of localized empirical evidence detailing these gaps.

Objective: To diagnose the main limitations of IC in MEs in David–Chiriquí and propose strategic guidelines to transform available resources into sustainable competitive advantages.

Methodology: A sequential exploratory mixed-methods design was employed. The qualitative phase involved 15 semi-structured interviews with business leaders; findings informed a 16-item Likert-scale survey applied to key employees (α = 0.87). The analysis used thematic coding and descriptive statistics.

Main Results: Innovation is mainly reactive; none of the firms has a formal R&D unit. While 93.34% perceive efficient resource use, only 46.67% report consistently using updated technology. Although 86.67% allocate funds to innovation, knowledge remains largely tacit. These gaps limit both radical and incremental innovation.

Implications: A four-phase roadmap is proposed—structured ideation, an internal innovation fund, knowledge management, and continuous improvement cells—to shift toward proactive innovation.

Originality: This is the first post-pandemic diagnosis of IC in Panamanian MEs using a mixed-methods approach.

Limitations: Non-probabilistic sampling and sectoral concentration restrict generalizability to other contexts.

Keywords: innovation; small and medium enterprises; competitiveness; organizational learning.

Resumen

Introducción: El presente artículo es producto de la investigación doctoral titulada *"Lineamientos estratégicos de innovación en el aprovechamiento de los recursos organizacionales de las empresas medianas de la provincia de Chiriquí"*, desarrollada en la Universidad del Istmo durante el periodo 2024–2025.

Problema: Estudios previos vinculan este bajo desempeño competitivo con deficiencias en la capacidad de innovación (CI), especialmente en su definición, gestión y medición. Sin embargo, existe una escasez de evidencia empírica local que detalle estos vacíos.

Objetivo: Diagnosticar las principales limitaciones de la CI en empresas medianas de David–Chiriquí y proponer lineamientos estratégicos para transformar los recursos disponibles en ventajas competitivas sostenibles.

Metodología: Se aplicó un diseño mixto secuencial exploratorio. La fase cualitativa incluyó 15 entrevistas semiestructuradas con líderes empresariales; los hallazgos guiaron un instrumento tipo Likert de 16 ítems aplicado a empleados clave (α = 0.87). El análisis combinó codificación temática y estadísticas descriptivas.

Resultados principales: La innovación es principalmente reactiva; ninguna empresa posee unidad formal de I+D. Aunque el 93.34 % percibe un uso eficiente de los recursos, solo el 46.67 % reporta contar siempre con tecnología actualizada. El 86.67 % destina fondos a innovación, pero el conocimiento sigue siendo tácito. Estas brechas limitan la innovación radical e incremental.

Implicaciones: Se propone una hoja de ruta en cuatro fases: ideación estructurada, fondo interno de innovación, gestión del conocimiento y células de mejora continua.

Originalidad: Es el primer diagnóstico postpandemia de la CI en empresas medianas panameñas con enfoque mixto.

Limitaciones: Muestreo no probabilístico y concentración sectorial limitan la generalización.

Palabras clave: innovación; pequeñas y medianas empresas; competitividad; aprendizaje organizacional.

Resumo

Introdução: Este artigo é produto de uma pesquisa de doutorado intitulada “Diretrizes Estratégicas de Inovação para Alavancar Recursos Organizacionais em Empresas de Médio Porte na Província de Chiriquí”, realizada na Universidade do Istmo durante o período de 2024–2025.

Problema: Estudos anteriores relacionam esse baixo desempenho competitivo a deficiências na capacidade de inovação (CI), especialmente em sua definição, gestão e mensuração. No entanto, há uma carência de evidências empíricas locais que detalhem essas lacunas.

Objetivo: Diagnosticar as principais limitações da CI em empresas de médio porte em David, Chiriquí, e propor diretrizes estratégicas para transformar os recursos disponíveis em vantagens competitivas sustentáveis.

Metodologia: Foi aplicada uma abordagem exploratória sequencial de métodos mistos. A fase qualitativa incluiu 15 entrevistas semiestruturadas com líderes empresariais; os resultados orientaram um instrumento do tipo Likert com 16 itens, aplicado a funcionários-chave (α = 0,87). A análise combinou codificação temática e estatística descritiva.

Principais resultados: A inovação é principalmente reativa; Nenhuma empresa possui uma unidade formal de P&D. Embora 93,34% percebam o uso eficiente de recursos, apenas 46,67% relatam ter sempre tecnologia atualizada. 86,67% alocam fundos para inovação, mas o conhecimento permanece tácito. Essas lacunas limitam a inovação radical e incremental.
Implicações: Propõe-se um roteiro de quatro fases: ideação estruturada, fundo interno de inovação, gestão do conhecimento e equipes de melhoria contínua.
Originalidade: Este é o primeiro diagnóstico pós-pandemia de inovação interna em empresas de médio porte panamenhas utilizando uma abordagem de métodos mistos.
Limitações: A amostragem não probabilística e a concentração setorial limitam a generalização.
Palavras-chave: inovação; pequenas e médias empresas; competitividade; aprendizagem organizacional.

1. INTRODUCTION

Innovation capacity (IC) refers to the set of knowledge, skills, organizational resources, and processes required to systematically generate, implement, and manage innovations. According to the Oslo Manual, these capabilities enable companies to absorb and apply new knowledge, anticipate environmental changes, and transform ideas into solutions with economic or social value [1], [8]. In the case of SMEs, this capacity largely depends on a committed, skilled, and motivated workforce, as well as an organizational culture that fosters creativity, adaptability, and continuous learning [2].

In emerging economies, innovation capability enables firms to transform ideas into economic value, leading to wealth creation and sustainable SME performance in competitive environments [3]. In the Panamanian context, small and medium-sized enterprises (SMEs) constitute the vast majority of formally registered businesses. They play a critical role in national innovation efforts, although they face persistent limitations in areas such as technological investment, the availability of specialized human capital, and the standardization of operational processes [5], [6], [24].

In Panama, the lack of empirical studies focused on regional dynamics has limited the understanding of the competitive challenges faced by medium-sized enterprises (MEs). In provinces like Chiriquí, these businesses contribute significantly to the local economy, yet many continue to experience barriers to sustained growth despite having operational experience and organizational capabilities [25], [7].

Some studies point out that limited innovation capabilities may restrict business performance, particularly in technology-driven sectors [8].

This article aims to present evidence of the critical weaknesses in IC among MEs in David–Chiriquí, to discuss their strategic implications, and to propose

guidelines to transform existing resources into sustainable competitive advantages—thus contributing to bridging the regional empirical gap.

Based on this, the study seeks to answer the following research question:

What are the critical limitations of innovation capability in medium-sized enterprises in David–Chiriquí, and how can they be strategically overcome by leveraging existing resources?

1.1 Literature review or research background

The relationship between organizational resources (OR) and innovation performance has been widely explored in the Latin American context. Quezada and Delgado [9] emphasize that innovation and technology represent critical factors for business competitiveness, especially in environments where traditional structures dominate managerial practices. Their framework underscores the role of intangible resources and organizational learning as levers of strategic transformation, particularly for medium-sized enterprises facing digital and operational constraints.

At the international level, emerging economies face substantial obstacles related to weak institutional capacities and scarce resources, affecting their technological development and innovation capabilities [10]. These limitations are particularly evident in SMEs, which often lack formal innovation processes or systems for knowledge transfer. Similarly, the Foro Consultivo [11] clarifies key conceptual distinctions between types of innovation, such as radical versus incremental, and highlights the importance of routinization in achieving sustainable impact over time.

Empirical contributions from Latin America add further depth. Barbosa Lozano [12] proposes a management model tailored to SMEs that integrates innovation into decision-making processes, considering the operational culture and informal dynamics of these firms. Benítez Pincay et al. [6] examine how resource management and internal leadership shape innovation efforts, identifying organizational learning and team empowerment as key enablers. These findings align with the observations in Innovation in Service Firms [13], which states that in many service-sector firms, innovation occurs informally and is not necessarily organized as a structured process. This often leads to reactive, unsystematic innovation, lacking institutional support and formal planning structures.

Palacios Osma et al. [14] highlight that knowledge management within the framework of Industry 4.0 and open innovation lays the foundation for structured and anticipatory innovation—reinforcing the need for strategic alignment between technological adoption and innovation capabilities in emerging contexts.

Furthermore, Arjona Blanco [15] stresses that digital transformation alone is insufficient to generate competitive advantages unless it is accompanied by governance mechanisms and learning structures. This is particularly relevant for MEs in Chiriquí, where technology adoption tends to be partial, uncoordinated, and decoupled from strategic objectives. As such, innovation efforts remain fragmented and often disconnected from long-term competitiveness goals.

In summary, the literature reviewed confirms that while MEs may possess tangible and human resources, the absence of formal routines, strategic governance, and structured knowledge management results in reactive and low-impact innovation processes. This study builds on these insights to offer a contextualized diagnosis and roadmap for transforming existing capabilities into sustainable competitive advantages, emphasizing a balance between incremental improvements and structural innovation pathways.

MATERIALS AND METHODS

2.1 Type of Study

The research was developed under an emerging post-positivist paradigm, using a multimodal approach that integrates both quantitative and qualitative methods. It is classified as an explanatory study, as it seeks to deepen the understanding of the phenomenon under investigation, and also as a projective study, given its aim to propose improvement alternatives based on the findings. This mixed methodological combination allowed the collection of both objective numerical data and subjective evidence, providing a comprehensive perspective to address the research objectives [16], [17], [18].

2.2 Population and sample

The study population consisted of medium-sized enterprises (MEs) registered in the Chamber of Commerce and Industries of Chiriquí, located in the city of David, totaling 386 companies [19]. Due to internal privacy policies and limited access, a non-probabilistic convenience sampling method was used, selecting 15 companies that provided the necessary logistical and human resources. No statistical formula was applied to calculate the sample size, as the selection was intentional and constrained by the researcher's accessibility.

2.3 Data Collection Techniques

Two primary data collection techniques were employed, aligned with the mixed-methods approach of the study:

- Survey: Used to obtain quantitative data through structured questions with closed-ended responses, allowing the collection of objective participant information.

- Semi-structured interview: A qualitative tool based on direct dialogue with key informants, aimed at exploring their perceptions and experiences regarding resource management and innovation.

This combination ensured the collection of both quantitative and qualitative data, enabling a more holistic understanding of the investigated phenomenon [20], [21].

2.4 Instruments

Two instruments were designed to implement the aforementioned techniques:

- A structured questionnaire consisting of 15 Likert-scale items (1 = Strongly disagree, 5 = Strongly agree), aimed at evaluating various aspects of organizational resources. It was self-administered by a representative from each company (15 respondents in total).
- A semi-structured interview guide comprising 8 open-ended questions, conducted with executives from the same 15 companies. The questions explored innovation capability more deeply, allowing participants to provide detailed insights based on their experience [16], [21].

2.5 Data Analysis

Data were processed according to their nature:

- Quantitative data were analyzed using descriptive statistics in Microsoft Excel, obtaining absolute and relative frequencies (%).
- Qualitative data (interviews) were analyzed through content analysis using ATLAS.ti software, applying inductive coding. Emerging themes were grouped into categories that reflected the most relevant dimensions associated with innovation capability.

Finally, both data types were integrated through a comparative analysis aligned with the study's objectives [16], [17], [18].

2.6 Ethical Considerations

Participation was voluntary, and each company formally authorized the data collection. The confidentiality of information and anonymity of participants were

guaranteed at all times, and all data were used exclusively for academic purposes. The researcher adhered to the ethical principles of respect, integrity, and responsibility throughout all phases of the study, in compliance with the Thesis Regulations of the Universidad del Istmo (Art. 2) [23] and the publication standards required by Ingeniería Solidaria [24].

The study was approved by the Bioethics Committee of the Technological University of Panama (Protocol P-CIBIO-002-2025). All participants signed informed consent forms. Anonymity was ensured through the use of coded identifiers (E01–E18, Q01–Q47), and all data were stored in an encrypted repository (AES-256) for five years, in accordance with Panama's Data Protection Law 81/2019.

2. RESULTS

This section presents the findings derived from the exploratory sequential mixed-methods design implemented in the study. It begins with the quantitative analysis, based on a Likert-scale questionnaire administered to key employees from 15 medium-sized enterprises located in the city of David. Subsequently, the qualitative findings obtained from semi-structured interviews with company owners and managers are described. The combination of both approaches enables a more accurate characterization of the existing gaps in innovation capability (IC) and its relationship with organizational resources.

3.1 Quantitative Analysis Results

The Likert survey administered to 15 medium-sized enterprises assessed 16 indicators grouped into four dimensions of organizational resources: human, technological, financial, and organizational. Most items received high levels of agreement. On average, 68.13% of the responses fell into the "Strongly agree" category, highlighting a generally positive perception of resource management.

The organizational dimension was the most positively rated: 86.67% of respondents indicated that their companies have clear operational standards and participative leadership. However, the technological dimension revealed a significant gap: although 93.34% of respondents perceived that resources are used efficiently, only 46.67% reported consistently having access to up-to-date technology.

Regarding human resources, 73.34% stated that their organization has qualified personnel, but fewer than 40% reported having formal ongoing training programs. In terms of financial resources, 86.67% indicated that their company allocates funds for innovation, yet the interviews revealed that the knowledge generated remains largely tacit, lacking structured processes for systematization or transfer.

Overall, the quantitative results highlight a disconnection between the availability of resources and their effective conversion into sustainable innovation, particularly in the technological domain.

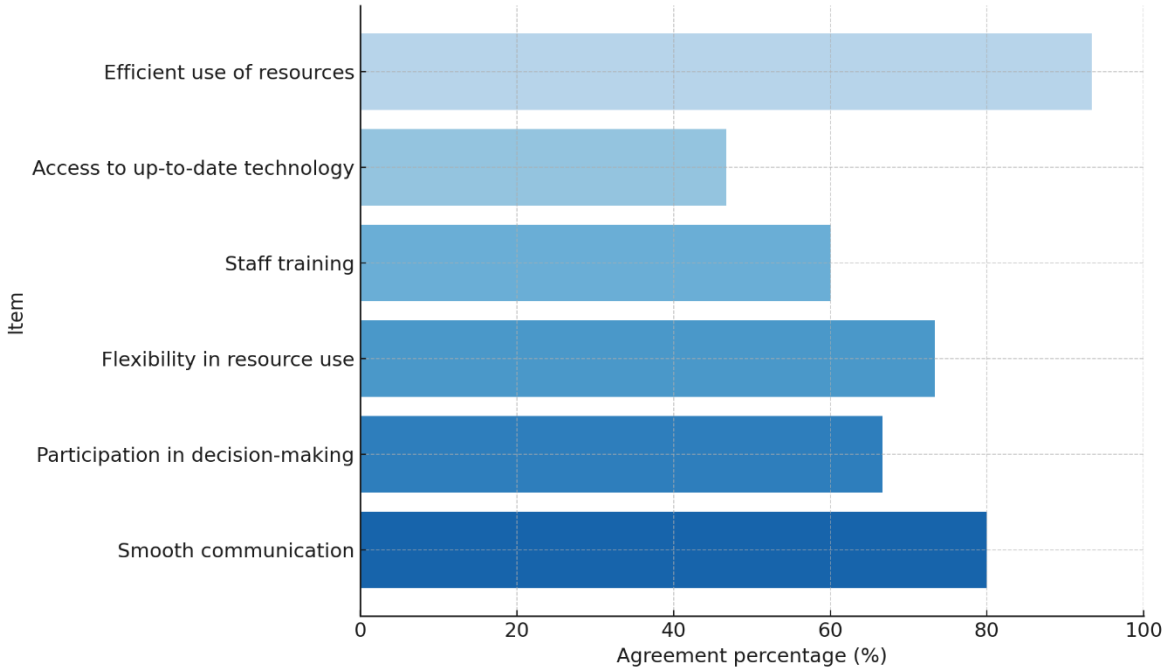


FIGURE 1. How do companies perceive the availability and use of their organizational resources?
Source: own work

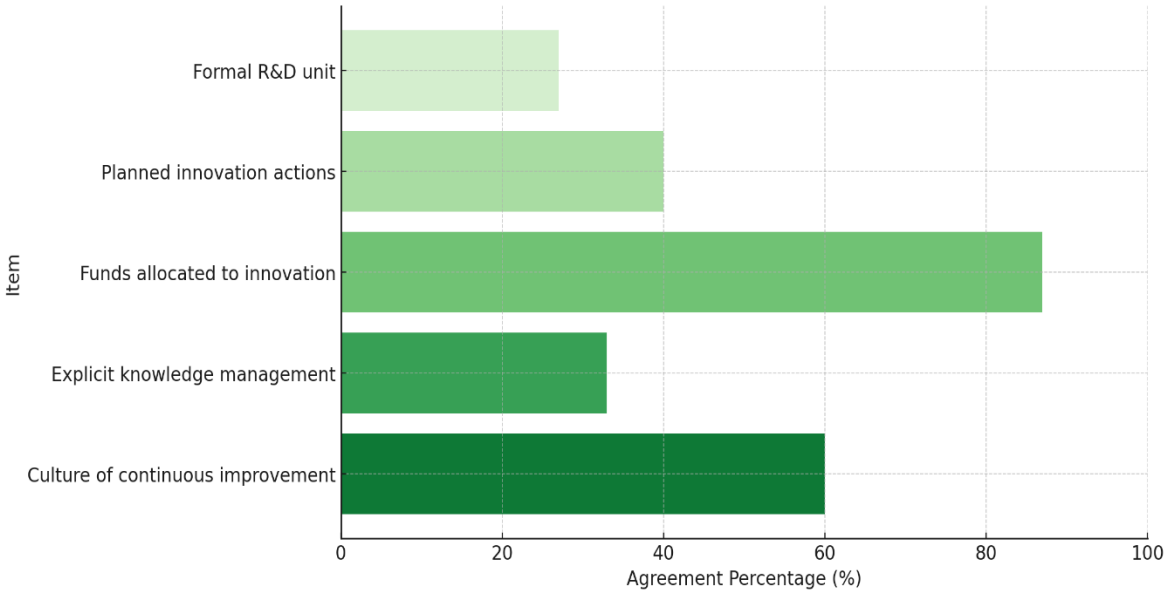


FIGURE 2. Level of Innovation Process Systematization in Companies
Source: own work

The charts illustrate the gaps between available resources and the structured innovation capability in the companies:

- Chart 1: Shows a high positive perception regarding efficient resource use (93.34%) and fluent communication (80%), reflecting a favorable organizational environment. However, only 46.67% report having up-to-date technology, suggesting a lag in infrastructure that may hinder innovation.
- Chart 2: Reveals a significant weakness in innovation systematization: only 26.67% have a formal R&D unit, and just 33.33% report explicit knowledge management. This indicates that, although 86.67% allocate funds to innovation, these resources are not being strategically channeled.

3.2 Qualitative Results (Based on the Interviews)

To identify the underlying dynamics related to innovation capability in the studied medium-sized enterprises, an inductive coding of the interview transcripts was conducted, grouping meaning units into emerging categories. These categories were organized according to the type of innovation identified (radical or incremental). Table 1 summarizes these categories along with representative examples of the associated codes.

Table 1. Emerging Categories and Themes by Type of Innovation in Medium-Sized Enterprises in David

Emerging Category	Associated Code(s)
Ideation capacity (radical)	“we generate ideas together,” “proposals arise in meetings"
Absence of formal R&D (radical)	“we don't have an innovation department,” “everything is done empirically"

Crisis response (radical)	“when COVID hit, we had to reinvent ourselves,” “we adapted out of necessity”
Partial technological adaptation (incremental)	“we upgrade equipment as we can,” “we have technology, but not cutting-edge”
Internal process improvement (incremental)	“we review processes periodically,” “we seek to improve what we can”
Informal staff training (incremental)	“they learn on the job,” “if someone knows something new, they share it”
Experience-based decision-making (radical)	“it all depends on what we know how to do,” “there's no system, it's more intuition”

Source: Own work

Enterprises exhibiting radical innovation more frequently mention structural transformations, such as complete process digitalization or the redesign of business models (“Total operational transformation,” “New products developed from crisis”). In contrast, those aligned with incremental innovation refer to gradual improvements, such as the use of basic digital tools or internal optimization without strategic changes (“Adaptation of existing processes,” “Basic software use”). These differences reflect not only the levels of risk and investment assumed but also the strategic orientation and organizational culture toward innovation.

The qualitative analysis allowed for the identification of emerging categories that reveal how innovation capabilities manifest in the medium-sized enterprises studied. Through a process of open and axial coding, the testimonies of key informants were grouped into two main innovation approaches: radical and incremental. These capabilities were organized around seven main categories, whose specific themes are illustrated in Table 2.

Table 2. Emerging Categories and Themes by Type of Innovation

Type of Innovation	Emerging Category	Associated Codes
Radical	Disconnection from institutions	"we don't rely on universities", "we've never worked with SENACYT"
	Lack of formal R&D	"we don't have a research department", "we run tests, but they're empirical"
Incremental	Unsystematized ideas	"we don't have an idea bank", "everything depends on what the owner says"
	Improvement in internal processes	"inventory control improved", "we automated the orders"
	Resource optimization	"staff was reorganized", "expensive materials were replaced"
	Partial digitalization	"we started using basic systems", "we have something in the cloud"
Both	Organizational learning	"we learned from mistakes", "the team trains by watching examples"

Source: Own work

The qualitative results reveal predominantly incremental innovation, with efforts focused on optimizing existing processes, partial digitalization, and resource reorganization. These actions are largely driven by immediate operational needs rather than a strategic vision of transformation. The category *improvement of internal processes* stands out for frequent mentions of basic automation and logistical adjustments, without implying significant disruptions to business models.

In contrast, radical innovation capabilities appear weakened. The absence of formal R&D is common across all companies, which lack dedicated units, budgets, or personnel for research and development activities. The disconnect from innovation ecosystem actors (such as universities and promotion agencies like SENACYT) highlights a lack of collaborative networks that foster disruptive processes. Likewise, the *unsystematized ideas* category reveals a low level of knowledge institutionalization: proposals depend on the intuition of leaders or are shared informally, without systematic documentation or evaluation.

Regarding *organizational learning*, which is present in both innovation approaches, it occurs informally through observation of external practices, trial-and-error, and empirical knowledge transfer among team members. Although not formalized, this process represents an opportunity to strengthen dynamic capabilities in the future.

3.2.1 Comparative Analysis between Firms with Radical and Incremental Innovation

When comparing firms that exhibited radical innovation capabilities with those operating under an incremental or reactive approach, key differences emerge regarding their internal structures, leadership styles, openness to change, and relationships with the external environment. Firms engaged in radical innovation are characterized by a greater willingness to experiment, take strategic risks, and establish connections with external actors such as universities or science and technology promotion agencies. These organizations tend to adopt a long-term vision and show evidence of structural transformation processes.

In contrast, firms practicing incremental innovation focus their efforts on operational adjustments and internal improvements that, while contributing to efficiency, do not significantly alter their business model. In these organizations, innovation often arises as a response to specific needs or crises, without formal strategic planning. Moreover, they rely heavily on accumulated tacit knowledge and traditional leadership centered on founders or owners.

Table 3 summarizes the main contrasts identified:

Table 3. Comparative Dimensions of Radical vs. Incremental Innovation in Medium-Sized Enterprises

Dimension	Radical Innovation	Incremental or Reactive Innovation
Leadership	Distributed, open to external ideas	Centralized, based on personal experience

Organizational Structure	Flexible, with space for experimentation	Hierarchical, focused on operational processes
Relationship with the Environment	Partnerships with universities, SENACYT, trade associations	Limited external institutional linkage
Knowledge Management	Formalized learning, recorded ideas	Informal transfer, no systematization
Technology	Planned and ongoing investment	Partial and occasional updates
Innovation Culture	Proactive, change-oriented	Reactive, focused on immediate needs

Source: Own work

This comparative analysis reinforces the premise that radical innovation requires different structural, cultural, and relational conditions than incremental innovation. While both forms may coexist, the absence of formal mechanisms in firms with reactive innovation limits their growth potential and adaptability in dynamic environments.

3.2.2 Analysis of Organizational Learning and Informal Knowledge Transfer

A cross-cutting theme that emerged strongly from the qualitative analysis was organizational learning, particularly how it occurs informally within medium-sized enterprises. Despite the absence of formal systems for research and development, many companies reported learning processes based on trial-and-error, observation of external practices, and experience sharing among employees.

Interviewees frequently mentioned learning "by doing," informal mentorship within teams, and collective problem-solving as common practices. For instance, phrases such as "we learn from mistakes" or "someone teaches others when they discover something new" were repeatedly cited. This mode of learning, while valuable, is highly dependent on interpersonal dynamics and lacks mechanisms for knowledge retention or scalability.

The reliance on tacit knowledge means that innovations often remain undocumented, which poses risks for continuity and replication. When knowledge is not formalized, it is easily lost due to employee turnover or leadership changes. Additionally, this informal structure limits the ability of companies to evaluate the effectiveness of innovations or to build upon previous experiences systematically.

Nevertheless, this spontaneous learning environment represents an opportunity. If supported by minimal formal structures—such as knowledge logs, best practices repositories, or peer-led training sessions—these learning dynamics could evolve into a foundational component of a proactive innovation strategy.

Therefore, strengthening organizational learning through simple, scalable mechanisms can serve as a stepping stone for more structured innovation processes. It can also bridge the gap between isolated improvements and a continuous innovation culture aligned with long-term competitiveness.

3.2.3 Implications for Organizational Strategy and Innovation Culture

The analysis reveals that innovation, particularly in the radical form, is closely linked to an organization's strategic orientation and its internal culture. Companies that exhibit strategic alignment toward innovation tend to embed innovation in their mission, invest consistently in technology and human capital, and pursue long-term transformation goals.

However, many medium-sized enterprises in David operate within a reactive framework, driven by short-term demands and limited by fragmented processes. This hinders their ability to formulate and execute innovation strategies. Without a clear roadmap or dedicated units for innovation, their culture remains centered on operational efficiency rather than creative disruption.

Transforming this reality requires not only structural adjustments but also a cultural shift. Leadership must champion innovation beyond immediate survival,

fostering an environment where experimentation, risk-taking, and continuous improvement are encouraged and rewarded.

Moreover, building an innovation culture implies rethinking talent management practices, promoting cross-functional collaboration, and institutionalizing feedback mechanisms. These changes align with international best practices, which emphasize the importance of internal coherence between values, practices, and systems to sustain innovation.

3.3 Representative Cases

During the qualitative phase, distinct innovation patterns were identified based on the strategic approach adopted by each company. The following cases were developed as anonymous and synthesized representations of the common patterns observed during the interviews, in order to preserve the confidentiality of the participating firms. Below are three representative cases that illustrate the diversity of strategies observed:

Case A – Incremental Innovation Based on Operational Improvement

An agribusiness company implemented a basic inventory management system in response to losses due to input expiration. Although it did not adopt a full ERP system, the use of shared spreadsheets and weekly control routines helped reduce waste by 25%. According to its manager: *"It wasn't a big investment, but it changed how we view our data."* While this improvement did not imply a strategic transformation, it optimized key processes, showing how small actions can create value when there is organizational will.

Case B – Radical Innovation Driven by Crisis

A company in the commercial sector, affected by the pandemic, redesigned its business model toward e-commerce. It developed its own online store and an

internal logistics system with home delivery services. The initiative was led by the administrative team without external support and required role reassignments and internal training. The manager stated: "*It was a leap without a safety net, but it saved us from closing. Today, the digital channel accounts for 40% of our sales.*" This case exemplifies how a critical situation can trigger radical innovation when leadership and flexibility are present.

Case C – Low Formalization Despite Available Resources

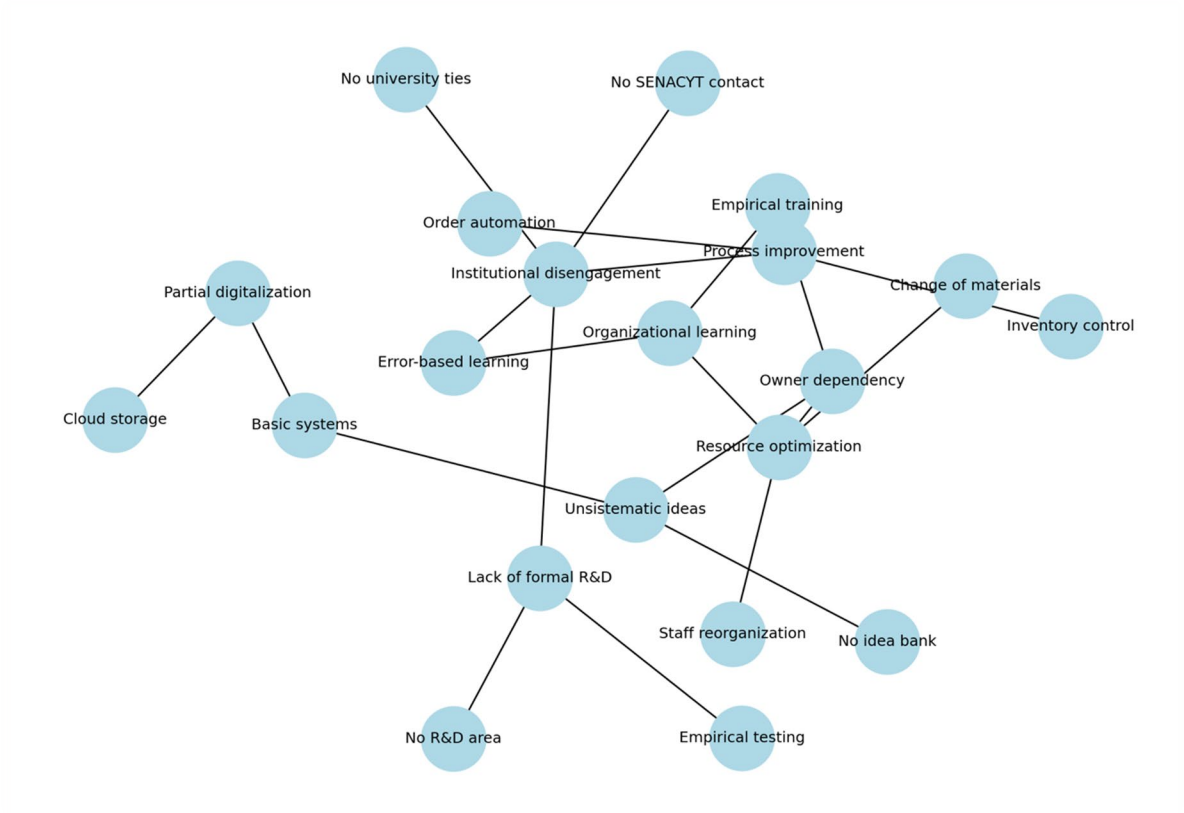
A metalworking company owns modern machinery and has highly trained technical staff, but lacks a system for recording improvements or evaluating new ideas. According to one of its directors: "*Suggestions come up, but they're not written down or followed up.*" Although the company invests in technology, the absence of formal R&D processes or documentation limits its ability to generate structured innovation. This case reflects one of the main gaps identified: resources without systematization do not guarantee sustainable innovation.

Partial Conclusion

The category analysis shows that, although the companies have accumulated experiences in continuous improvement and minor adaptations, the conditions for radical innovation are weak. This limits their ability to generate sustainable competitive advantages. The emerging categories help to understand the roots of these limitations and serve as a key input for the formulation of the strategic guidelines proposed in the next section.

Figure 3 below presents a thematic map that synthesizes the main emerging categories related to innovation capability identified through the qualitative analysis, organized according to their connection with radical and incremental innovation.

Figure 3. Thematic Map: Emerging Categories and Associated Codes



Source: Own work

The thematic map visually synthesizes the hierarchical organization of innovation capabilities identified in medium-sized enterprises in David, Chiriquí. It originates from the central axis “Innovation Capability," which branches into two main areas:

a. Radical Innovation

This represents disruptive changes—deep transformations in products, processes, or business models. It is driven by organizational capabilities that enable a strategic leap into entirely new scenarios.

Associated themes:

- Digital transformation: Initiatives related to deep digitalization, automation, or the incorporation of advanced technologies.
- Disruptive projects: Creation of new services or products not previously available in the local market.
- External partnerships: Collaboration with universities, R&D centers, or institutions that promote open innovation.

Example codes:

- “Change in the entire work model”
- “We partnered with an international firm”
- “We created a product that didn’t exist in Panama”

b. Incremental Innovation

This refers to continuous improvements to existing products, processes, or practices. While less disruptive, it is essential for sustaining competitiveness.
Associated themes:

- Internal improvements: Resource optimization, partial technological upgrades, or process adjustments.
- Tacit knowledge: Internal experiences and learnings that enable gradual improvements.
- Talent management: Initiatives to train staff and encourage idea generation from within teams.

Example codes:

- “We improved what we already had with ideas from the team”
- “We updated some equipment that was becoming outdated”
- “We trained staff in new tools”

Overall Interpretation

The map illustrates how the interview responses reflect two coexisting approaches: one more conservative yet steady (incremental), and another more strategic and visionary (radical). This structure supports the study's main argument: most companies operate under a reactive logic of innovation, with only occasional instances of radical innovation driven by external contexts or partnerships.

The representation also reveals that organizational capabilities are present but scattered, highlighting the need for a coordinating model to transform these isolated efforts into a comprehensive innovation strategy.

Quantitative and qualitative findings converge in identifying a predominantly reactive approach to innovation, constrained by structural limitations in resource utilization and knowledge formalization. The following section discusses these results in light of specialized literature and in alignment with the study's objectives, highlighting strategic implications for transforming innovation capability in medium-sized enterprises.

3. DISCUSSION AND CONCLUSIONS

4.1 Integrated Interpretation of Findings

The quantitative and qualitative findings enable an integrated interpretation of the main limitations affecting innovation capability (IC) in medium-sized enterprises (MEs) in David, Chiriquí. They reveal a complex situation that combines structural strengths with critical weaknesses in resource, technology, and knowledge management.

From a quantitative perspective, respondents generally express a favorable perception regarding the use of existing resources: 93.34% believe their organization manages resources efficiently, and 86.67% report allocating funds to innovation processes. However, only 46.67% state they have consistently updated technology. This dissonance indicates a gap between intention and the actual infrastructure for innovation. These results align with previous studies that warn of the technological investment deficit in MEs in emerging economies [5], as well as

with Panamanian reports highlighting the lack of formalization in innovation processes [4].

The qualitative analysis, in turn, reveals that innovation in these companies is predominantly reactive. No systematic research and development (R&D) practices were identified, nor organizational structures focused on knowledge generation. The statements from managers and owners emphasize strategies centered on environmental adaptation (incremental innovation) and operational survival, rather than market transformation (radical innovation). This finding is consistent with studies that distinguish between proactive innovation (oriented toward disruptive change) and reactive innovation (linked to external pressures) [22].

The convergence of both approaches confirms that, while the MEs in David possess competent human capital and a certain collaborative culture, they lack structured mechanisms to transform knowledge into competitive advantages. This situation creates a dependency on tacit experience, limiting the replicability and scalability of innovations. Additionally, the absence of R&D units, internal funds for prototyping, and knowledge management impedes the transition from reactive to proactive innovation.

Finally, the findings support the relevance of the proposed guidelines: implementing an organizational roadmap that begins with structured ideation, continues with the creation of internal R&D funds, incorporates knowledge management, and culminates in the formation of continuous improvement teams. This framework would enable the shift toward a sustained innovation culture, in line with international recommendations for strengthening IC in SMEs.

This discussion highlights the urgent need to bridge the gap between potential and execution. A concerted effort—combining organizational commitment with supportive public policies and institutional partnerships—is essential to elevate innovation from a reactive necessity to a proactive driver of sustainable competitiveness and regional development.

4.2 Political and Institutional Implications

Strengthening innovation capability (IC) in medium-sized enterprises (MEs) in Chiriquí is not only an organizational task but also a public policy priority. The study's findings reveal structural gaps that could be mitigated through stronger articulation with institutions within the science, technology, and innovation (STI) ecosystem.

First, the absence of formal R&D units and the low degree of knowledge systematization highlight the need for policies that encourage the development of internal capabilities. These may include tax incentives for innovation, soft loans for prototyping, and training in knowledge management. In this regard, institutions such as the National Secretariat of Science, Technology, and Innovation (SENACYT) can play a central role by launching targeted calls for MEs, including lines focused on organizational innovation and improvements in production processes.

Moreover, the disconnection between business and academia—evident in the interviewees' testimonies—suggests a gap in technology transfer mechanisms. It is proposed to strengthen university–business partnerships through technology extension programs, professional internships, and open innovation laboratories, led by institutions such as the Universidad Autónoma de Chiriquí (UNACHI) and the Technological University of Panama (UTP).

From a regional perspective, local governments and business associations such as the Chamber of Commerce, Industry, and Agriculture of Chiriquí could act as coordination platforms, promoting territorial innovation agendas, business collaboration networks, and shared governance spaces to foster digital transformation, sustainability, and productive development initiatives.

These institutional actions would allow the proposed guidelines to scale beyond the individual company level, enabling their integration into a broader regional innovation strategy aligned with the Sustainable Development Goals (SDGs) and post-pandemic economic recovery policies.

4.3 Conclusions

1. The study confirms that innovation capability in medium-sized enterprises in David is predominantly reactive, constrained by informal knowledge management, limited systematic investment in R&D, and intermittent use of updated technologies.
2. Although 93.34% of companies perceive efficient resource utilization, only 46.67% report consistently having up-to-date technology, highlighting a critical gap between perception and operational reality.

3. At the qualitative level, incremental innovation dominates the business landscape, focusing on operational improvements, process adjustments, and customer service. In contrast, radical innovation is scarce and hindered by barriers such as risk aversion, low systematization of prior learning, and the absence of structured strategies.
4. The organizational culture shows signs of commitment to innovation but lacks formal structures (such as continuous improvement teams or internal innovation funds) to translate intention into sustained action.
5. Emerging categories were identified, grouping the main limiting and enabling factors of innovation capability (IC), providing insight into the phenomenon from the internal perspective of key stakeholders.

4.4 Strategic Recommendations

Based on the diagnosis, a four-phase roadmap is proposed, adapted to the context of local medium-sized enterprises:

Phase 1: Structured Ideation

- **General Description:** Foster regular spaces to identify innovation opportunities, promoting divergent thinking and cross-departmental participation.
- **Concrete Actions:**
  - Monthly ideation meetings.
  - Use of techniques such as guided brainstorming and customer trend analysis.
  - Systematic registration of ideas in a digital idea bank.
- **Expected Impact:**
  - Stimulates collective creativity.
  - Enables faster identification of improvements and opportunities.
  - Democratizes innovation beyond senior management.

Phase 2: Internal Innovation Fund

- **General Description:** Allocate a percentage of net profits (e.g., 2–5%) to an exclusive internal fund for innovation activities.
- **Concrete Actions:**
  - Finance pilot tests, prototype acquisition, or product validation.
  - Establish policies for transparent and focused fund management.
- **Expected Impact:**
  - Strengthens autonomy to experiment.
  - Reduces dependence on external subsidies.
  - Supports the creation of solutions adapted to the local context.

Phase 3: Knowledge Management

- **General Description:** Systematize organizational learning through accessible platforms for documenting and sharing best practices.
- **Concrete Actions:**
  - Innovation logbooks.
  - Lessons learned by area or work cell.
  - Use of digital tools (e.g., Google Drive, Notion, Trello).
- **Expected Impact:**
  - Enhances organizational memory.
  - Facilitates knowledge transfer across generations or departments.
  - Increases efficiency by avoiding previously resolved mistakes.

Phase 4: Continuous Improvement Cells

- **General Description:** Form small multidisciplinary teams to address specific challenges through short innovation cycles.
- **Concrete Actions:**
  - Define quarterly OKRs.
  - Train cells in agile methodologies (scrum, lean).
  - Link challenges to actual performance indicators.
- **Expected Impact:**
  - Promotes a culture of sustainable improvement.
  - Encourages horizontal leadership.
  - Generates immediate, low-cost, high-return solutions.

This roadmap is not only viable for medium-sized enterprises with flexible structures but can also be scaled to business networks, chambers of commerce, or productive clusters, generating a regional ecosystem of distributed innovation.

4.5 Limitations of the Study

While offering a comprehensive diagnosis of innovation capabilities in medium-sized enterprises (MEs) in David, Chiriquí, this study presents several limitations.

1. **Sample Size:** The study included 15 companies, which, while sufficient for a mixed-method exploratory design, may not fully represent the diversity of MEs across other provinces or sectors in Panama. Future studies should expand the sample to increase generalizability.
2. **Qualitative Data:** Although rich and insightful, the qualitative data relied on self-reported interviews with managers and owners. This introduces potential bias, as responses may reflect aspirational views rather than actual practices. Triangulating these findings with observational data or internal documentation would enhance validity.

3. **Lack of Longitudinal Data:** The study did not include longitudinal data to assess how innovation capabilities evolve over time. Since innovation is a dynamic process, a follow-up or panel study would allow researchers to capture progress and emerging trends more accurately.
4. **Feasibility of the Roadmap:** Although the strategic roadmap is grounded in empirical evidence and best practices, its implementation feasibility was not tested in the field. Future research could pilot specific components of the roadmap to evaluate their real-world impact on innovation outcomes.

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