

The role of ICT, intrapreneurship and collaborative management networks in innovation and business competitiveness

El papel de las TIC, intraemprendimiento y redes de gestión colaborativa en la innovación y la competitividad empresarial

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Abstract: this research analyzes the relationship between intrapreneurship culture, management collaboration networks, and information and communication technologies on innovation performance, as well as their direct and indirect effects on business performance and competitiveness. Using data collected from a questionnaire applied on MSMEs in the state of Aguascalientes in the Mexico's trade sector, the study tests fifteen hypotheses across three models, each examining the impact of a causal variable on innovation performance through a quantitative analysis using structural equation modeling. The results indicate significant associations between these factors and highlight the role of innovation in enhancing business outcomes. Additionally, the study considers the profound effects of the COVID-19 pandemic, which has exacerbated existing vulnerabilities in Latin American and Caribbean economies, affecting key sectors such as commerce, tourism, and transportation. The conclusions emphasize the varying impact of direct and indirect effects of causal variables (intrapreneurship culture, management collaboration networks, and information and communication technologies) on the mediator variables (intrapreneurship culture, management collaboration performance and competitiveness). Across all models, a positive and significant relationship is confirmed between innovation performance and both business performance and competitiveness. However, a stronger association is found between the causal variables and business performance and competitiveness in dynamic environments.

Keywords: innovation, intrapreneurship, business network, ICT, firm performance.

Resumen: esta investigación analiza la relación entre la cultura de intraemprendimiento, las redes de colaboración en la gestión y las tecnologías de la información y comunicación en el desempeño innovador, así como sus efectos directos e indirectos en el desempeño y la competitividad empresarial. Utilizando datos recolectados a través de una encuesta aplicada a mipymes en el estado de Aguascalientes del sector comercial en México, el estudio evalúa quince hipótesis en tres modelos, cada uno examinando el impacto de una variable causal sobre el desempeño innovador mediante un análisis cuantitativo a través de ecuaciones estructurales. Los resultados indican asociaciones significativas entre estos factores y destacan el papel de la innovación en la mejora de los resultados empresariales. Adicionalmente, el estudio considera los efectos profundos de la pandemia de COVID-19, que ha exacerbado vulnerabilidades existentes en las economías de América Latina y el Caribe, afectando sectores clave como el comercio, el turismo y el transporte. Las conclusiones subrayan el impacto variable de los fectos directos e indirectos de las variables causales (cultura de intraemprendimiento, redes de colaboración en la gestión y tecnologías de la información y comunicación) sobre la variables mediadora (desempeño innovador) y las variables de resultado (desempeño y competitividad empresarial). En todos los modelos, se confirma una asociación más fuerte entre las variables causales y el desempeño y competitividad empresarial. Con base en estos hallazgos, el estudio propone recomendaciones estratégicas para las empresas que buscan mejorar su desempeño y competitividad en entornos dinámicos.

Palabras clave: innovación, intraemprendimiento, colaboración empresarial, TIC, desempeño empresarial.

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Introduction

The COVID-19 pandemic has profoundly reshaped life worldwide since it first emerged in Wuhan, China, at the end of 2019, exerting an unprecedented impact on the health, economic, and financial systems of countries across all income levels (Sotgiu and Dobler, 2020). The economic crisis triggered by the coronavirus (COVID-19) has significantly affected Latin American and Caribbean nations, exposing long-standing vulnerabilities in their productive and business structures (CEPAL, 2020). Moreover, the Economic Commission for Latin America and the Caribbean, in its most recent Special Report on COVID-19 published in June 2020, estimates that 34.2% of formal employment and 24.6% of GDP in the region come from sectors severely impacted by the pandemic (e.g., commerce, tourism, transportation, cultural industries, goods repair, hotels and restaurants, fashion, and automobiles). In contrast, less than one-fifth of employment and GDP are generated in sectors only moderately affected (e.g., agriculture, livestock, fisheries, food production, medical supplies and equipment, pharmaceuticals, telecommunications, and packaging) (CEPAL, 2020). Economic diversification and the implementation of appropriate policies were essential to strengthen economic resilience during and after this crisis (Sotgiu and Dobler, 2024).

In this evolving situation, innovation has become increasingly crucial, as today it is essential for businesses to navigate the challenges that have forced many companies to be out of the market. Therefore, the adoption of effective business strategies is a determining factor in improving organizational performance in a competitive and ever-changing environment. According to various studies, companies that develop and implement well-structured strategies, based on a comprehensive analysis of the market and their internal capabilities, not only increase profitability but also adapt to fluctuations in the economic environment (Porter, 2020). In particular, the diversification of strategies that consider both innovation and

sustainability has become a key axis for longterm success (Grant, 2021). Additionally, the continuous evaluation of these strategies allows for adjustments in operational and administrative tactics, contributing to greater efficiency and effectiveness in decision-making processes (Johnson *et al.*, 2022). These approaches not only optimize financial performance but also strengthen business competitiveness on a global scale (Barney, 2023).

Ongoing innovation is crucial for a company to stay competitive and maintain its position in the market. It involves the introduction of new products, services, or ideas that are recognized as novel by others, playing a vital role in the company's continued success and growth (Farida and Setiawan, 2022). A company's competitiveness lies on three fundamental strategic pillars: competitive performance (output), organizational resources (input), and the processes and management capabilities that enable these resources to flourish and be utilized effectively (Kang and Na, 2020).

Accordingly, the aim of the research is to explore the relationship between intrapreneurship culture, management collaboration networks, and information and communication technologies (ICT) with innovation performance, along with the direct and indirect impacts of these variables on business performance and competitiveness. The paper is organized into four key sections: first, a theoretical framework outlining the development of the research hypotheses; second, a detailed explanation of the research methodology; third, an analysis of the results; and finally, a discussion of the findings and the conclusions drawn.

The goal is to deliver scientifically grounded insights that elucidate potential shifts in business innovation and its interplay with diverse business strategies, aiming to drive positive outcomes in both performance and competitiveness. Consequently, this research aims to provide a strategic guide with business recommendations designed to bolster the resilience, growth, and sustainability of companies in today's rapidly changing and highly volatile environment.

Theoretical development/research hypothesis

In this section, we establish the theoretical foundation that underpins the research model, outlining the key theory and the focus of the research. We detail the conceptualization of each variable and highlight the empirical evidence supporting the proposed relationships presented in each research hypothesis.

The resource-based view (RBV) posits that resources and capabilities are valuable when they enable an organization to seize opportunities and mitigate threats. While the RBV has been widely applied, recent analyses highlight its limitations and suggest its evolution into a more comprehensive theory by integrating elements from stakeholder theory. These elements include (a) incorporating normative aspects or framework, (b) recalibrating the idea of sustainability, (c) viewing people beyond resources, and (d) allotting more room for cooperative behaviors (Freeman *et al.*, 2021).

Despite extensive research on the RBV and its application in enhancing business performance and competitiveness, there remains a gap in understanding how specific resources-such as intrapreneurship culture, management collaboration networks, and information and communication technologies (ICTs)-can be strategically developed and integrated to maximize their impact on innovation performance, particularly in the context of micro, small, and medium-sized enterprises (MSMEs). This empirical gap becomes even more pronounced in dynamic and uncertain environments, such as those shaped by the COVID-19 pandemic, where resilience and adaptability emerge as critical organizational capabilities. By focusing on MSMEs in the state of Aguascalientes in the Mexican trade sector, this study addresses this gap by exploring not only the direct and indirect effects of these resources on innovation performance but also their role in fostering business resilience and sustained competitiveness in times of crisis.

Innovation

Innovative initia tives are fundamental in influencing the performance of companies and, on a larger scale, shaping the dynamics of the entire economy. The significance of innovating business processes lies in its ability to act as a bridge that converts the advantages of external collaboration into measurable innovation results. Companies should approach business process innovation not merely as a functional requirement but as a strategic asset essential for transforming external insights into market success. By simultaneously prioritizing external partnerships and refining internal processes, organizations can effectively manage the challenges of today's dynamic business landscape. This approach fosters sustainable growth, strengthens competitive positioning, and drives improvements in both product innovation and operational performance (Yu et al., 2024).

Business model innovation can pertain both to companies already established in the market with a solid position and to emerging entities by developing new business models in the form of start-ups. In this context, modifications to the business model are represented as a growth with gradual improvements or with transformative innovations. It is important to underline that the extent of innovation within the business model is determined by the specific needs of the enterprise. Identifying these needs accurately becomes a key element for achieving success in the context of value creation (Otola and Grabowska, 2020).

Intrapreneurship culture and innovation performance

Executives are tasked with fostering employees' intrapreneurial involvement by encouraging and empowering them to actively participate in their organization's entrepreneurial initiatives (Sánchez-Vidal *et al.*, 2024). The involvement of employees in intrapreneurial projects at the organizational level depends significantly on how well their individual attributes

align with the organizational environment in which they operate (Niemann *et al.*, 2022).

An investigation about the rationality in intrapreneurship and innovation outputs promotes that intrapreneurship is crucial for successful innovation outputs. This body of research reveals that cognitive styles of intrapreneurs plays a significant role in the innovation outputs (Marques et al., 2021). It is anticipated that the presence of intrapreneurship within the organization in the context of innovation will drive growth and profitability, ultimately enhancing the company's overall performance. This implies that the effectiveness of a company in achieving its objectives can be also evaluated through its innovation orientation (Aina and Solikin, 2020). These authors mention that intrapreneurship encompasses four key sub-dimensions: innovativeness, risk-taking, proactiveness, and competitive aggressiveness. These elements positively influence a company's financial performance and competitiveness in the market.

Once the background for intrapreneurship culture and innovation performance, business performance and business competitiveness have been established, the hypothesis one, hypothesis one "a" and hypothesis one "b" are presented:

H₁: The level of intrapreneurship culture in companies positively and significantly influences their levels of innovation performance.

H_{1a}: The level of intrapreneurship culture in companies positively and significantly influences their levels of business performance.

H_{1b}: The level of intrapreneurship culture in companies positively and significantly influences their levels of business competitiveness.

Gestión de colaboración de redes y Management collaboration network and innovation performance

Collaboration can foster close interactions among project partners and promote the exchange of information, which in turn drives the development of innovations (Klijn *et al.*, 2024). A study conducted in Mexico by ÁlvarezAros *et al.* (2022) confirmed a positive and significant relationship between the horizontal collaboration of open innovation (institutions of education, government and competitors) with financial performance of the firms. Keung and Shen (2017) confirmed in the case of China that the establishment of effective project networks by contractors could benefit their business competitiveness.

Based on these arguments, our study tests the following hypothesis, hypothesis two "a" and hypothesis two "b", about the association of management collaboration networks with innovation performance, business performance and business competitiveness levels:

H₂: The level of management collaboration networks positively and significantly influences their levels of innovation performance.

 H_{2a} : The level of management collaboration networks positively and significantly influences their levels of business performance.

 H_{2b} : The level of management collaboration networks positively and significantly influences their levels of business competitiveness.

Information and communication technologies and innovation performance

Information and Communication Technologies (ICT) are tools implemented in organizations to transmit information and enhance communication to compete in the context of the information and communication environment (Ab Wahab et al., 2020). Lecerf and Omrani (2020) examines the effects of innovation on small and medium-sized enterprise (SME) internationalization and the direct and moderating impacts of information and knowledge circulation during information technology adoption. The results suggest that developing innovation, while increasing the level of information technology, can improve internationalization.

In a study conducted on Indonesian companies, Widjaja *et al.* (2020) reveal that there was a positive and meaningful relationship between information and communication technology and business performance. Saleem *et al.* (2020) confirmed in another study that the effects of ICT projects are not limited to social and economic development but are also classified as mixed developments in terms of strategic, managerial, informational, operational, transactional, organizational, infrastructure and transformational nature.

Once the arguments were presented, the study tests the following hypothesis three, hypothesis three "a" and hypothesis three "b", about the relationship of information and communication technologies with innovation performance, business performance and business competitiveness levels:

H₃: The level of Information and Communication Technologies positively and significantly influences their levels of innovation performance.

H_{3a}: The level of Information and Communication Technologies positively and significantly influences their levels of business performance.

 $H_{_{3b}}$: The level of Information and Communication Technologies positively and significantly influences their levels of business competitiveness.

Innovation performance and business performance

Business performance (BP) is directly related to the scope of the organizational objectives proposed (Morales, 2020). The idea that open innovation positively influences business performance is widely supported by empirical research and is broadly acknowledged within both industry and academia (Carmona-Lavado *et al.*, 2023; Figueira *et al.*, 2023; Haddoud *et al.*, 2023). The creation of innovative products and services enhances efficiency, generates greater earnings and expands market presence (Sahoo *et al.*, 2024).

A study conducted by Febrianti and Herbert (2022), aimed to understand the influence of business analysis and innovation performance in improving the BP of small and medium enterprises. The results in this study confirmed that business analysis and innovation performance have a high influence on business performance. This relationship shows that the variables of business analysis ability and innovation are important factors for MSMEs to improve their BP.

Thus, the role of business analysis skills and innovation has a high influence in building BP. Based on these arguments about the association of innovation performance business with the business performance levels, this study tests the following hypothesis four:

H₄: The level of innovation performance positively and significantly influences their levels of business performance.

Innovation performance and business competitiveness

In the era of globalization, where competitiveness poses significant challenges for developed economies, innovation emerges as a crucial factor in leveraging growth opportunities and developing effective employment creation strategies to ensure success in the global market (Hajighasemi *et al.*, 2022). Innovation is an ongoing governance process that offers transformative approaches to enhancing stakeholder experiences (Sørensen and Balsby, 2021).

Structural innovation, encompassing both process and institutional innovation, plays a transformative role in enhancing the competitiveness of a destination (Zhou *et al.*, 2024). In a study, it was demonstrated that innovation in service systems, characterized by idea generation, service creation, and commercialization, strengthens the competitiveness of firms. This suggests that the processes of idea generation, service creation, and commercialization are crucial for achieving higher levels of competitiveness within organizations (Ekom *et al.*, 2023).

The study tests the following hypothesis five, based on the idea that it is about the association of innovation performance with business competitiveness levels.

 H_5 : The level of innovation performance positively and significantly influences their levels of business competitiveness.

Once all the theoretical framework is developed to present the research hypothesis, Table 1 contains the structure of concepts and relation papers that stand our model of investigation.

Table 1

Research hypothesis (indirect effects) and supporting author(s)

Indirect effects Hypothesis	Support Author(s)
H1: The level of intrapreneurship culture in companies positively and significantly influences their levels of innovation performance.	Marques et al. (2021)
H2: The level of management collaboration networks positively and significantly influences their levels of innovation performance.	Klijn <i>et al.</i> (2024)
H3: The level of information and communication technologies positively and significantly influences their levels of innovation performance.	Lecerf and Omrani (2020)
H4: The level of innovation performance positively and significantly influences their levels of business performance.	Febrianti and Herbert (2022)
H5: The level of innovation performance positively and significantly influences their levels of business competitiveness.	Ekom <i>et al.</i> (2023)

This study also tests the indirect effects of the analyzed variables on competitiveness and business performance, excluding the innovation performance variable as a mediator. To achieve this, three different models have been developed (see Figures 1, 2, and 3). Consequently, additional hypotheses have been formulated to assess the direct effects, as outlined in Table 2.

Table 2

Research hypothesis (direct effects) and supporting author(s)

Hypotheses - direct effects	Support Author(s)	
H_{la} : The level of intrapreneurship culture in companies positively and significantly influences their levels of business performance.	Aina and Solikin (2020).	
H_{lb} : The level of intrapreneurship culture in companies positively and significantly influences their levels of business competitiveness.		
H_{2a} : The level of management collaboration networks positively and significantly influences their levels of business performance.	d significantly Álvarez-Aros <i>et al.</i> (2022); d significantly Keung and Shen (2017).	
H_{2b} . The level of management collaboration networks positively and significantly influences their levels of business competitiveness.		
H _{3a} : The level of information and communication technologies positively and significantly influences their levels of business performance.	ation technologies positively and signifi- formance.Widjaja et al. (2020); Saleem et al. (2020)ation technologies positively and signifi- npetitiveness.ation technologies positively and signifi- al. (2020)	
H ₃₀ : The level of information and communication technologies positively and significantly influences their levels of business competitiveness.		

Materials and methods

This study adopts a scientific approach that integrates both fundamental and practi-

cal methodologies to achieve its objectives. Its aim is to produce relevant and accurate data to enhance comprehension, validate findings, refine concepts, or apply knowledge effectively through a systematic scientific process (Creswell and Creswell, 2021).

The data collection process was carried out in three main phases. Initially, the questionnaire was developed using validated scales (Likert scale of five points), followed by a pilot test to assess and ensure data reliability. In the subsequent phases, two key analyses were performed: the first focused on evaluating the reliability and validity of the instrument, which are critical indicators of the quality and precision of measurement tools (Hair et al., 2020). The second phase involved the application of Structural Equation Modeling (SEM), a method thet allows for the simultaneous analysis of multiple dependent relationships, making it highly appropriate for this study (Kline, 2023). The analysis adopts a quantitative design, gathering data from a questionnaire to MSMEs in the state of Aguascalientes in the Mexico's trade sector to examine or validate hypotheses through statistical methods grounded in numerical evaluation. This methodology encompasses both descriptive and correlational aspects.

The sample used in this study consists of 200 MSMEs located in the state of Aguascalientes, Mexico. Within the state, commercial activities represent the largest portion of the tertiary sector—accounting for roughly 40% of all economic units—and contribute significantly to the region's GDP, according to the latest data from INEGI (2024), as reported in the Statistical Directory of Economic Units (DENUE, 2024). There are 2,276 MSMEs engaged in wholesale trade, representing the total universe from which the sample was drawn.

SEM guidelines suggest at least 10 observations per observed variable, and Hair *et al.* (2021) recommend a minimum of 200 observations or over 100 observations overall. In this study, six variables were analyzed across three models, indicating that a minimum of 60 questionnaires would meet the basic threshold. However, Kline (2023) points out that while simpler SEM models may be estimated with fewer than 100 observations, more complex models require larger samples for robust estima-

tion. Consequently, a total of 200 observations were chosen to exceed the minimal requirement and ensure reliable model fit. This sample size aligns with recognized SEM standards and provides a strong foundation for accurate and dependable statistical outcomes, particularly for the more involved models examined in this research.

The development of the data collection followed a systematic and rigorous process. It began with the selection of measurement scales for all the constructs that had already been validated and previously utilized in similar studies. Subsequently, a pilot test was conducted on a random sample of 10 companies and 5 experts to identify the appropriateness of the conceptualization of the variables, the language used in the questions, and the structure of the questionnaire. As a result, minor adjustments were made to the descriptions of certain concepts. The instrument measures the six variables: i. Innovation performance, ii. Intrapreneurship culture; iii. Management collaboration networks; iv. Information and communication technologies; v. Business performance; vi. Business competitiveness. Table 3 below presents the structure of the questionary including the variables, their dimensions, and the total items.

To ensure the reliability of the collected data, reliability and validity tests were performed, as these provide the essential language of measurement and constitute key quality indices for questionnaires (Batista-Foguet et al., 2004). Various procedures exist to measure the reliability of a scale, with the main indices being Cronbach's alpha coefficient, the Composite Reliability Index (CRI), and the Average Variance Extracted (AVE). One of the best methods for estimating reliability is the use of the ordinal alpha method, especially when analyzing polytomous data obtained from a Likert scale. Therefore, scale developers and researchers should resort to this approach to obtain more accurate reliability estimates (Idaka et al., 2020).

Cronbach's alpha coefficient is the most widely used reliability indicator in Social Sciences (Zumbo and Rupp, 2004). The Composite Reliability Index (CRI) serves as another reliability measure, interpreted in a manner similar to Cronbach's alpha but taking into account the relationships between the extracted constructs. Additionally, the Average Variance Extracted (AVE) is frequently reported, as it reflects the proportion of variance exp-

lained by a factor relative to the total variance attributed to measurement error for that factor (Hair, 2021).

As shown in Table 4, the values obtained for all three indices are adequate, confirming both the proper interrelation among the items of each construct and the accurate measurement of the constructs.

Table 3

Structure of the data collection instrument

Variable	Dimensions	Elements
	Product innovation	
Innovation performance	Process innovation	12
	Management Innovation	
	Coworker independence	
	Risk tolerance	
Intrapreneurship culture	Compensation and incentives	22
	Teamwork	_
	Management support	
	Government collaboration	
Management cellshanding action descente	Commercial integration	- 13
Management collaboration networks	Technological collaboration	
	Interinstitutional networks	
Information and Communication Technologies	Technological capacity	- 7
	Decision making integration	
Business Performance	Internal Processes	
	Open systems	12
	Rational Goals	
	Human relations	
	Financial performance	
Business Competitiveness	Cost reduction	18
	Technology approach	

Table 4

Summary of reliability and validity indices

Variables and dimensions	Cronbach's alpha	Extracted mean variation (AVE)	Compound Reliabi- lity (CRI)	p-values
Business Performance				
Internal processes	0.800	0.718	0.883	0.000
Open systems	0.844	0.763	0.906	0.000
Rational goals	0.921	0.864	0.950	0.000
Human relations	0.794	0.705	0.877	0.000

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Variables and dimensions	Cronbach's alpha	Extracted mean variation (AVE)	Compound Reliabi- lity (CRI)	p-values
	Competitive	eness		
Financial performance	0.917	0.700	0.933	0.000
Cost reduction	0.935	0.740	0.944	0.000
Technology approach	0.962	0.840	0.927	0.000
	Innovatio	on		
Product innovation	0.937	0.843	0.955	0.000
Process innovation	0.952	0.874	0.965	0.000
Management innovation	0.963	0.931	0.976	0.000
	Management Collabor	ative Networks		
Government collaboration	0.941	0.895	0.962	0.000
Commercial integration	0.926	0.819	0.948	0.000
Interinstitutional networks	0.960	0.926	0.974	0.000
Technological collaboration	0.766	0.681	0.864	0.000
Entrepreneurship				
Coworker independence	0.776	0.530	0.845	0.000
Risk tolerance	0.867	0.715	0.909	0.000
Compensation and incentives	0.832	0.665	0.888	0.000
Teamwork	0.893	0.702	0.921	0.000
Management support	0.853	0.693	0.900	0.000
Information and communication technologies				
Technological capacity	0.921	0.828	0.951	0.000
Decision making integration	0.882	0.810	0 927	0.000

Results and discussion

The SEM analysis estimated three MIMIC models, with innovation performance serving as the mediator variable between business performance and competitive performance. Model 1 assesses the relationship between intrapreneurship culture and innovation performance, along with its direct and indirect effects on business competitiveness and performance. Model 2 evaluates the relationship between management collaboration networks and innovation performance, as well as their direct and indirect impacts on business competitiveness and performance. Model 3 explores the relationship between Information and Communication Technologies (ICT) and innovation performance and similarly examines their direct and indirect effects on business competitiveness and performance.

Figures 1, 2, and 3 illustrate these models using path analysis, accounting for potential covariance of error among variables. Table 5 provides a summary of the results and goodness-of-fit tests for each model. Furthermore, we assessed the indirect relationships in each model using the SEM data, identifying the percentage of influence for each, as shown in Table 4. Overall, Models 1, 2, and 3 demonstrate acceptable fits for the dataset. The Chi-squared statistic (χ^2) for each model is within acceptable ranges, measuring 23.37, 24.4, and 39.7, respectively, and effectively accounting for the potential variances and covariances in the dataset.

Table 5

Results of SEM models

Model 1	Comments = 200	
Intrapreneurship culture	← Innovation performance	
	+0.2616 (±0.07) ***	
	← Enterprise Performance	
	+0.3188 (±0.06) ***	
	← Business Competitiveness	
	+0.4219 (±0.06) ***	
	← Enterprise Performance	
Innovation Devlormon co	+0.2738 (±0.06) ***	
milovation renormance	← Business Competitiveness	
	+0.2373 (±0.06) ***	
Model 2	Comments = 200	
	← Innovation performance	
	+0.1550 (±0.07) **	
	← Enterprise Performance	
Management collaboration networks	+0.2746 (±0.06) ***	
	← Business Competitiveness	
	+0.4213 (±0.06) ***	
	← Enterprise Performance	
	+0.3232 (±0.06) ***	
Innovation performance	← Business Competitiveness	
	+0.2891 (±0.06) ***	
Model 3	Comments = 200	
	← Innovation performance	
	+0.2442 (±0.07) ***	
	← Enterprise Performance	
Information and Communication Technologies	+0.0757 (±0.07) *	
	← Business Competitiveness	
	+0.2473 (±0.07) ***	
	← Enterprise Performance	
	+0.3415 (±0.07) ***	
Innovation performance	← Business Competitiveness	
	+0.2885 (±0.07) ***	



SEM Model 1

Figure 1



Note. Elaboration using STATA's SEM Builder application.

Model 1 tests the intrapreneurship culture in relation to innovation performance and the direct and indirect effects with business performance and business competitiveness (hypotheses 1, 1a, 1b, 4-1 and 5-1). The sign direction of the lambda coefficients (Λ) of intrapreneurship culture with innovation performance is positive and significant (Λ =+0.2616, p<0.01) as the hypothesis 1 arguments, and the coefficients for the association of innovation performance with business performance and business competitiveness as the hypotheses 4-1 and 5-1 arguments are also positive and significant (Λ =+0.2738, p<0.01 and Λ =+0.2373, p<0.01). The coefficients for the direct effect of intrapreneurship culture on business performance and business competitiveness are also positive and significant as the hypotheses 1a and 1b arguments $(\Lambda = +0.3188, p < 0.01 \text{ and } \Lambda = +0.4219, p < 0.01).$

The interpretation with the results of Model 1 is that for every standard deviation increase in intrapreneurship culture, innovation performance, business performance and business competitiveness increase on average 26.0, 31.0 and 42.0 percent, respectively. These findings confirm the existing arguments in the literature about positive association of intrapreneurship culture on innovation, business, and business competitiveness. In the same way, for every standard deviation increase in innovation performance, business performance and business competitiveness increase on average 27.0 and 23.0 percent, respectively.





Note. Own elaboration using STATA's SEM Builder application.

The literature shows that management collaboration networks also influence innovation performance and direct and indirect effects on business performance and business competitiveness. Model 2 addresses this question and tests hypotheses 2, 2a, 2b, 4, and 5 for the association between these variables. The results show a lambda coefficient of management collaboration networks and innovation performance $(\Lambda = +0,1550, p < 0.05)$ as indicated by hypothesis 2, and the coefficients for the association of innovation performance with business performance and business competitiveness as mentioned in hypotheses 4 and 5, as they are positive and significant (Λ = +0.3232, p<0.01 and Λ =+0,2891, p<0.01). The coefficients for the direct effect of management collaboration networks on business performance and business competitiveness are also positive and significant as the arguments of hypotheses 2a and 2b (Λ=+0,2746, p<0.01 and Λ=+0,4213, p<0.01).

The interpretation of the Model 2 results shows that for each standard deviation, the

increase in managerial collaboration networks, innovation performance, business performance and business competitiveness increased by approximately 15.0%; 27.0% and 42.0%, respectively. These findings confirm the existing arguments in the literature about the positive association of management collaboration networks in terms of innovation, and business competitiveness. In addition, for each increase in the standard deviation in innovation performance, business performance and business competitiveness increase on average by 32.0% and 28.0% respectively.





Note. Elaboration using STATA's SEM Builder application.

In the context of Information and Communication Technologies, the literature points out that this variable tends to positively influence innovation performance and it has direct and indirect effects with business performance and business competitiveness (hypotheses 3, 3a, 3b, 4-3 and 5-3). The sign direction of the lambda coefficients of Information and Communication Technologies with innovation performance is positive and significant (Λ =+0.2442, p<0.1) as the hypothesis 3 arguments, and the coefficients for the association of innovation performance with business performance and business competitiveness as the hypotheses 4 and 5 arguments are also positive and significant (Λ =+0.3415, p<0.01 and Λ =+0.2885, p<0.01). The coefficients for the direct effect of Information and Communication Technologies on business performance and business competitiveness are also positive and significant as the hypotheses 3a and 3b arguments (Λ =+0.0757, p<0.01 and Λ =+0.2473, p<0.1).

The interpretation of Model 3 as the results shows, is that for every standard deviation increase in information and communication technologies, innovation performance, business performance and business competitiveness increase on average 24.0, 0.7 and 24.0 percent, respectively. These findings confirm the existing arguments in the literature about positive association of Information and Communication Technologies on innovation, business, and business competitiveness. Also, for every standard deviation increase in innovation performance, business performance and business competitiveness increase on average 32.0 and 28.0 percent, respectively (Table 6).

Table 6

Results of direct and indirect effects of SEM models

Number of observations 200			
Relationships	Direct	Indirect	Total
Model	11		
Intrapreneurship culture -> Business performance	0.32 (82%)	0.07 (18%)	0.39
Intrapreneurship culture -> Business competitiveness	0.42 (87%)	0.06 (13%)	0.48
Model 2			
Management Collaboration Network -> Business performance	0.27 (84%)	0.05 (16%)	0.32
Management Collaboration Network -> Business competitiveness	0.42 (90%)	0.046 (10%)	0.466
Model 3			
Information and Communication Technologies -> Business performance	0.08 (0.0001%)	0.08 (99.9%)	0.16
Information and Communication Technologies -> Business competitiveness	0.25 (78%)	0.07 (22%)	0.32

In summary, the main conclusions of models 1, 2 and 3 are the followings. In model 1, the strongest relationship occurs between the intrapreneurship culture and business competitiveness, followed by its relationship with business performance. The strongest direct effect of innovation performance is on business performance, while the weakest relationship in this model is between innovation performance and business competitiveness. However, all relationships are positive and statistically significant. In model 2, the strongest relationship is between management collaboration networks and business performance, with the direct relationship between innovative performance and business competitiveness being the most positive and significant. The weakest relationship is between management collaboration networks and innovation performance, although all relationships in this model remain positive and significant, as supported by the literature. Model 3 reveals positive relationships between all variables, but with different levels of significance. The weakest association is between information and communications technologies and business performance, while the strongest relationship is

between innovation performance and business performance.

As part of the discussions, the results obtained through structural equation modeling (SEM) provide empirical evidence supporting the relationship between internal and external organizational factors (intrapreneurship culture, managerial collaboration networks and information and communication technologies) and competitive and business performance, mediated by innovation.

The results of this research provide valuable information on the mechanisms that influence business performance through innovation. First, the mediating role of innovation outcomes highlights the importance of fostering an intra-corporate culture within organizations. This aligns with recent studies, such as Sanchez et al. (2024) and Niemann et al. (2020), which emphasize the need to empower employees to actively contribute to business initiatives and ensure alignment between individual attributes and the organizational environment. These results suggest that a strong intra-corporate culture not only improves innovation performance, but also amplifies competitive and business outcomes.

The influence of management collaboration networks on innovation performance and business competitiveness is aligned with the conclusions of Klijn *et al.* (2024) and Álvarez-Aros *et al.* (2022). Both studies highlight the role of collaboration – whether horizontal, with external partners such as governments and educational institutions, or internal, through effective project networks – in driving innovation and financial performance. This reinforces the idea that strategic partnerships are indispensable to foster innovative capabilities and achieve sustainable competitiveness.

As for the role of Information and Communication Technologies (ICT), the studies of Widjaja et al. (2020) and Saleem et al. (2020), confirmed the multifaceted impacts of ICT on business performance, ranging from strategic and management benefits to operational and transformational development. The results also support the assertion of Lecerf and Omrani (2020) that increasing ICT adoption, while fostering innovation, contributes significantly to organizational internationalization and competitiveness. In this study, ICT emerged as a key factor for innovation performance, allowing companies to navigate and thrive in dynamic and information-rich environments. The indirect but notable impact of technological tools on competitiveness points to their ability to nurture agile and adaptable business ecosystems that can respond quickly to changing external pressures. These findings reinforce the interconnected nature of the intra-enterprise, collaborative and technological dimensions in the conduct of organizational performance, highlighting intrapreneurship as a strategic pillar, collaborative networks as conduits for resource sharing and ICT as a catalyst for operational efficiency and market responsiveness.

Table 7 summarizes the results of each hypothesis, highlighting the significant coefficients.

The analysis shows conclusive results for all indicators of the three models. The results of model 1 indicate that the lambda coefficients for each relationship between the variables were as expected. The intra-entrepreneurial culture shows a positive association with innovation results, but also shows a strong direct effect with business performance and business competitiveness; likewise, innovation performance has a positive and significant impact on business performance and business competitiveness. Therefore, hypotheses 1, 1b, 1c, 4-1 and 5-1 are confirmed. The results of Model 2 show that management collaboration networks have a positive influence on innovation performance, as well as a direct effect on business performance and business competitiveness and an indirect effect through innovation performance on business performance and business competitiveness. Therefore, hypotheses 2, 2b, 2c, 4-2 and 5-2 are confirmed. These results corroborate the existing literature and studies. The results of model 3 show that information and communication technologies have a positive impact on innovation performance and also have a positive association on business performance and business competitiveness. The performance of innovation also shows a direct positive effect on the performance of companies and the competitiveness of companies. This is an expected result that confirms that information and communication technologies increase innovation performance, business performance and business competitiveness. Therefore, hypotheses 3, 3b, 3c, 4-3 and 5-3 are confirmed.

Table 7

Summary of the results

Model 1	Association variables / Hypothesis
	Innovation performance ← H1 confirmed
	+, significant
Intrapreneurial culture	Commercial performance \leftarrow H _{1a} confirmed
intrapreneurial culture	+, significant
	Business competitiveness \leftarrow H _{1b} confirmed
	+, significant
	Business performance \leftarrow H _{4.1} confirmed
	+, significant
Innovation Performance	Business competitiveness \leftarrow H _{5.1} confirmed
	+, significant
Model 2	Association Variables
	Innovation performance \leftarrow H ₂ confirmed
	+, significant
	Commercial performance \leftarrow H _{2a} confirmed
Management Collaboration Networks	+, significant
	Business competitiveness \leftarrow H _{2b} confirmed
	+, significant
	Business performance \leftarrow H ₄₂ confirmed
	+, significant
Innovation Performance	Business competitiveness \leftarrow H ₅₂ confirmed
	+, significant
Model 3	Association Variables
	Innovation performance \leftarrow H ₃ confirmed
	+, significant
Information and communication technologies	Commercial performance \leftarrow H _{3a} confirmed
	+, significant
	Business competitiveness \leftarrow H _{3b} confirmed
	+, significant
	Business performance \leftarrow H _{4,3} confirmed
	+, significant
Innovation Performance	Business competitiveness \leftarrow H _{5.3} confirmed
	+, significant

Conclusions

The main contribution of this research is to analyze the relationship between intraprneurship culture, management collaboration networks and information and communication technologies with innovative performance, as well as the direct and indirect effects of these variables on business performance and competitiveness through three models, one for each

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causal variable. This study was carried out in MSMEs in the commercial sector of a developing country, specifically Mexico. Fifteen hypotheses were tested in the three models, analyzing the association between intrapreneurial culture, managerial collaboration networks and ICT with innovative performance, as well as the relationship between innovative performance and business performance and competitiveness. In addition, the direct effects of intra-corporate culture, management collaboration networks and ICTs on business performance and competitiveness were examined.

It is important to highlight several conclusions on the variable impact, comparing the direct and indirect effects of the causal variables (intra-corporate culture, management collaboration networks and information and communication technologies) on the mediating variable (performance in innovation) as well as the outcome variables (business performance and business competitiveness). In all three models, the results confirmed a positive and significant relationship between innovation performance and business performance and competitiveness. However, there is a stronger association between intrapreneurship culture, managerial collaboration networks, information and communication technologies, and business performance and competitiveness.

Therefore, the main conclusion of this research revolves around the following strategic recommendations for companies with the aim of improving both their performance and their competitiveness. These recommendations fall into three key areas: fostering an intra-corporate culture, improving collaboration through management networks, and leveraging information and communication technologies. Based on the analysis and evidence presented below, a list of practical considerations drawn from these findings is presented:

The culture of intrapreneurship promotes autonomy, tolerance, compensation, teamwork

and support for management. To improve the performance and competitiveness of companies, strategic decisions and actions should allow employees the freedom to make decisions, take charge of new projects and freely express their opinions. Tolerance can be emphasized by allowing an organizational philosophy that encourages employees to accept risk and view organizational change as an opportunity. A strong compensation strategy is key to creating a workplace culture that encourages engagement and motivation, encouraging employees to undertake new projects that improve company performance. This can be achieved through a compensation plan that includes financial rewards, public recognition, and support for education and professional development. Teamwork can be strengthened by implementing a flexible organizational structure by management support. Our findings suggest that an intrapreneurship culture can only thrive in a supportive environment that values and invests in employee development, fostering innovation, performance, and competitiveness within the organization.

Management collaboration networks focus on customers, suppliers, competitors, government entities, technology intermediaries, industry associations, financing organizations, higher education institutions and technical colleges. Our findings indicate that while the implementation of management collaboration networks positively impacts innovation performance, it has an even stronger direct effect on business performance and competitiveness. Management collaboration networks should therefore be leveraged as a strategic tool to deliver direct improvements in business performance by improving the quality and efficiency of internal processes, increasing customer satisfaction, accelerating adaptation to market needs, managing corporate image, expanding market share, increasing profitability and productivity, motivating employees, and reducing turnover and absenteeism. In addition, companies that systematically participate in management collaboration networks tend to achieve better financial performance, cost reduction, and more effective technology deployment.

Information and communication technologies (ICTs) have a low direct impact on the performance of companies. However, its role in promoting innovation results is important, as ICT strengthens business performance and competitiveness. For this reason, information technology strategies related to processes, systems and organizational communication (particularly with customers, suppliers and competitors) should focus on product innovation, innovative processes and management systems innovation. This approach is critical to achieving the best possible outcomes for the organization.

Looking ahead, future analyzes will deepen collaboration networks and information and communication technologies in each facet of intraentrepreneurship, with the aim of formulating strategic proposals that serve as a basis for organizational decision-making. These proposals will not only focus on improving business performance and competitiveness, but will also highlight how a business mindset can stimulate disruptive innovation; how collaborative links can facilitate robust knowledge sharing and resource sharing; and how ICT can be harnessed to increase operational efficiency. By conducting in-depth research on these dimensions, the research will generate viable insights for academics and practitioners, potentially revealing new ways for exploring how these interconnected factors can further shape long-term organizational success and resilience in evolving market environments.

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