

FUTURES STUDIES AND SYSTEM DYNAMICS FOR SCENARIO BUILDING IN DIGITAL ENTREPRENEURSHIP: THE CASE OF PACHUCA, HIDALGO

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Abstract

Because digital entrepreneurship relies on a shifting network of actors, studying its components separately doesn't work. Tech, culture, economics, society, and government regulations all lock together; a single change in one area instantly forces the rest to adapt.

This study focuses on Pachuca, Hidalgo. The local landscape presents critical challenges, including a digital divide, limited internet connectivity, and public policies that fail to support technological growth. Since previous literature lacks holistic studies, this research fills that gap by mapping out the potential scenarios within the city's digital entrepreneurial ecosystem of Pachuca Hidalgo, Mexico.

Neither qualitative nor quantitative research traditions alone enable exploration of the system's behavior. System dynamics helps researchers track how different variables influence each other using nonlinear feedback loops. When analysts mix this approach with scenario planning, they can build realistic stories with quantitative coherence.

To achieve this, the study uses a step-by-step exploratory design broken into three research phases. 1) Codes and dimensions were identified with their respective co-occurrences. 2) A causal loop diagram was developed to model positive and negative relationships between system dimensions. 3) Two axes of uncertainty emerged from the diagram, forming the basis for five future scenarios of digital entrepreneurship.

The results indicate that the digital entrepreneurship system operates around two feedback nodes: growth factors, which concentrate five positive feedback loops; and barriers, which function as system stabilizers. Two uncertainty axes were identified, resulting in a four-quadrant matrix. An additional scenario was incorporated as a reference trajectory, yielding five future scenarios: trend, utopian, catastrophic, normative, and contrasting. Together, these scenarios serve as a practical instrument for entrepreneurs and decision-makers seeking to design anticipatory strategies that capitalize on the full potential of Pachuca's digital ecosystem.

Keywords

System Dynamics, Future Scenarios, Digital Entrepreneurship, Digital Entrepreneurial Ecosystem

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1 | Introduction

In recent decades, the digitalization of businesses and the use of virtual platforms repositioned digital entrepreneurship as a central element of e-commerce and the broader digital economy. The COVID-19 pandemic forced micro, small, and medium-sized enterprises (MSMEs) adopt websites, marketplaces, and social networks to survive and find new buyers so quickly (Béjar et al., 2022; Jajić et al., 2025). This digital shift changed the economy, meaning e-commerce now makes up about 6.4% of Mexico's Gross Domestic Product (INEGI, 2025). A 20% growth spike in 2024 anchored this economic footprint, driving total online sales to MXN 43.1 billion (AMVO, 2025). However, only 11.8% of Mexican internet users engage in online selling (INEGI, 2024a), suggesting that digital entrepreneurship growth remains poor.

Mungaray and González (2025) report that 40.8% of Mexican entrepreneurs possess only intermediate digital skills (including the use of digital sales platforms, websites, and Office software), a gap limiting digital entrepreneurship development nationwide. This matters economically, since MSMEs generate 43% of formal employment in Mexico (INEGI, 2024b), and socially, since closing this gap could strengthen the participation of women, youth, and disadvantaged communities in economic activities.

Only 57% of the urban population in Hidalgo has internet access, far below Mexico's national average of 79.8% (INEGI, 2024a; INEGI, 2024b; Ministry of Economy, 2025). Despite this low connectivity, the state's e-commerce grew 24.6% in 2024, beating the national average (AMVO, 2025). In Pachuca, the state capital, digital entrepreneurship holds significant potential for local economic development, but realizing this potential requires building digital competencies, not just adopting platforms. The digital divide and limited access to advanced skills training call for a prospective analysis to inform strategic decision-making that strengthens Pachuca's digital ecosystem.

In digital entrepreneurship, tech, economic, social, and legal factors constantly interact within a market driven by new algorithms (Liu et al., 2025; Troise et al., 2022). The actors within this system respond to diverse contexts and objectives, which makes relationships harder to map at the local level, where the digital connectivity divide, infrastructure limitations, gender barriers, and restricted access to digital skills add further layers of complexity (Khoo et al., 2024; Pigola et al., 2024).

Forecasting digital entrepreneurship in Pachuca is difficult. The system is shaped with multiple forces as technological advances and adoption, public policy development and application, and shifting consumer preferences. This study approaches this uncertainty prospectively through three phases: 1) a qualitative analysis phase that covers instrument design, data collection, and information analysis; 2) a system dynamics phase that translates dimensions into conceptual relationships; and 3) a scenario construction phase that maps thematic axes of uncertainty into future narratives.

2 | Theoretical Framework

Understanding digital entrepreneurship as a systemic phenomenon requires examining the theoretical axes that account for the dynamic behavior of the system over time. Three complementary approaches address this challenge from different angles: futures studies to explore possible trajectories, systems thinking to model complex interactions, and system dynamics to simulate their quantitative behavior. This research draws on all three to analyze the digital entrepreneurial ecosystem of Pachuca.

Future research is described as a structured process that involves the participation of different actors to develop medium- and long-term perspectives that converge in planned strategic decisions (Fathi et al. 2020). Gaston Berger (1957) introduced the term "foresight" to describe this work, which aims to build the future by combining past knowledge, current action, and a clear look at the environment. Bertrand Jouvenel (1964) added a key theoretical element: the future is

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a reality of multiple possibilities, constructible from the present. Both founded the French school, within which Michael Godet (2000) developed strategic foresight as an exploratory and normative approach to long-term thinking in organizational decision making.

The Anglo-Saxon school emerged from long term planning in operations research, evolving through technological forecasting into scenario planning. The RAND Corporation applied game theory and simulation models to create scenarios during the Cold War (Bradfield et al., 2005). Scenario planning allows organizations to explore probable, plausible, and alternative futures as a basis for structured decision-making (Chermack et al., 2001; Schwartz, 1997). Exhibit 1 summarizes the evolution of these schools of thought documented by Medina-Vásquez et al. (2014).

Exhibit 1. Epistemological Taxonomy of Prospective Studies.

Decades	Empirical-Predictive Approach	Humanistic-Prospective Approach	Systemic-Technological Approach
1940-1960	Long-range planning Futures research	<i>Prospective</i> Futurology	System analysis
1970-1980	Technological forecasting Scenario planning and reason for the study	<i>Prospective strategique</i> <i>Previsione umana e sociale</i>	System dynamics Visioning Technological watch Competitive intelligence
1990-2000	Technological forecasting Scenario planning	Foresight Forward-looking activities	Systems thinking Technology futures analysis Future-oriented technology analysis Horizon scanning

Note. Authors' elaboration based on Medina-Vásquez et al. (2014).

These theoretical schools naturally incorporate systems logic to model the complexity of the phenomena they analyze. In practice, digital entrepreneurs leverage technology to connect on online platforms, identify real time customer demands, and design specific solutions for the market (Nambisan et al., 2019). However, this business activity does not happen in a vacuum; political, social, and economic forces closely lock together to shape the entire environment. Because these forces constantly alter each other a shift in local regulations or social habits directly dictates economic survival studying any single element alone distorts the analysis and misreads how the whole system operates (Bejjani et al., 2023; Wurth et al., 2022).

The scientific literature approaches digital entrepreneurship from a systems perspective, distinguishing two traditions: soft systems, which interpret actor interactions qualitatively, and hard systems, which quantify relationships between variables in structured problems (Checkland, 1999; Sterman, 2002). Exhibit 2 presents a synthesis of eight representative studies on digital entrepreneurship from a systems perspective, following Jackson's (2016) classification; studies based on system dynamics are excluded, as the following section addresses them separately.

Exhibit 2. Representative Studies on Digital Entrepreneurship from a Systems Perspective.

Authors	Approach	Object of Study	Method	Contribution
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Nambisan et al. (2019)	Soft	Technology-enabled digital entrepreneurship	Theoretical and conceptual approach for the construction of an interpretative framework	Redefinition of digital technology boundaries, agents, and entrepreneurship processes through a systemic approach
Autio et al. (2018)	Soft	Digital affordances in entrepreneurship	Interdisciplinary theoretical-conceptual synthesis	Characterization of digital affordances as systemic mechanisms of emergence and evolution in technological entrepreneurial ecosystems
Elia, et al. (2020)	Soft	Digital entrepreneurship and collective intelligence ecosystem	Interpretative theoretical-conceptual synthesis	Definition of a new entrepreneurial paradigm enabled by digital technology
Bejjani et al. (2023)	Soft	Digital entrepreneurship ecosystems	Systematic review of the literature	Identification of key attributes to characterize digital ecosystems and develop their typology
Purbasari et al. (2023)	Hard	Architecture of entrepreneurship ecosystems	Social Network Analysis	Mapping of the digital innovation ecosystem structure using centrality and density metrics
Zhang et al. (2023)	Hard	Impact of digital technology on entrepreneurship	Econometrics and panel data	Quantification of digital technology in the entrepreneurial ecosystem and its interaction with other systemic elements
Pigola et al. (2024)	Hard	Impact of digital entrepreneurship ecosystems on sustainable development	Panel Data and Fuzzy Set Benchmarking	Roadmap for digital strategies targeting technological growth and inclusive socio-environmental benefits
Restrepo-Morales et al. (2024)	Hard	Barriers and drivers of digitalization in SMEs	Fuzzy Logic and Analytic Hierarchy Process	Assessment of digitalization barriers in SMEs and classification of inhibiting factors for strategic decision-making

Note. Authors' own elaboration.

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The soft systems studies in Exhibit 2 provide qualitative insight into the nature of digital entrepreneurship ecosystems, describing their elements, actors, and functioning; however, they do not project their future trajectories. Hard systems studies quantify relationships between actors but leave unexplored the alternative futures that may emerge from them. Neither approach alone captures the full complexity of the phenomenon, which justifies combining systemic modeling with prospective analysis.

Digital entrepreneurship operates through unpredictable, chain reaction relationships rather than simple, straight lines. In practice, entrepreneurs leverage software and online platforms to pin down shifting customer demands and design specific market solutions (Nambisan et al., 2019). Because a single adjustment in one area triggers unexpected consequences across others, studying these dimensions separately misrepresents the entire phenomenon. This fluid dynamic ultimately feeds into a digital ecosystem a flexible space that manages itself, expands naturally, and survives long term. Within this environment, actors collaborate organically by trading data and sharing resources or information to keep the collective network growing (Sahut et al., 2021). Its actors include network users who function as consumers or producers, as well as the digital platforms that mediate economic transactions (Song, 2019). Projecting future trajectories requires identifying critical uncertainties, a task for which scenario planning and system dynamics offer complementary tools.

System dynamics provides a methodology that connects systemic understanding of entrepreneurship with the prospective modeling of its behavior over time, using stock-and-flow diagrams and structural equations to represent variable interactions (Forrester, 1961). The methodology has been applied across a wide range of topics: strategic decision-making in companies (Yan et al., 2021), business network architecture (Telnov et al., 2024), artificial intelligence integration in emerging economies (Andrade & Gonçalves, 2021), crisis management in digital media (Caporuscio et al., 2023), and innovation in SMEs (Castillo et al., 2025).

Scenario planning and system dynamics articulate naturally. Scenario design defines possible futures and the critical uncertainties that may arise, while system dynamics provides quantitative coherence by verifying trajectories through causal modeling, offering a framework to validate the qualitative narratives of the scenarios (Kunc, 2024; Lane, 2000). Exhibit 3 presents representative studies that have applied system dynamics specifically to digital entrepreneurship, platform business models, and digital supply chains, documenting this articulation in scientific literature.

Exhibit 3. Representative Applications of System Dynamics in Digital Entrepreneurship.

Authors	Application Context	Results	Contribution
Bivona & Cosenz (2021)	Dynamic evaluation of business models on digital platforms	Critical turning points in the dynamics of growth and collapse of digital platforms	Systemic evaluation framework based on Dynamic Performance Management to validate digital platform business models
Cavallo et al. (2023)	Scaling of business models in startups through growth hacking strategies	Importance of business model consistency during scaling for the survival of digital startups	System dynamics as a simulation laboratory for accelerated growth scenarios in digital startups.

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Cosenz & Bivona (2021)	Design and experimentation of value creation strategies for business model innovation in SMEs	Development of strategies to capture SME complexity through the Dynamic Business Modeling approach	Combination of Business Model Canvas with system dynamics for SMEs
Ghadge et al. (2022)	Analysis of global supply chains facing the ripple effect of simultaneous long-term disruptions	Nonlinear effects of simultaneous disruptions are impossible to predict with static analysis; the impact varies by type of risk, combination, and affected node	System dynamics application to visualize and quantify risk propagation effects in digital supply chains under extreme scenarios
Kunc (2024)	Integration of a methodological framework combining system dynamics, scenario planning, and strategic management across sectors	Shared feedback and accumulation processes between system dynamics and future scenarios, facilitating their methodological articulation	Framework and taxonomy for applying system dynamics to create, support, and validate future scenarios.
Ranaei-Kordshouli & Maleki (2023)	Analysis of causal relationships between entrepreneurial motivations and institutions in the Iranian entrepreneurial ecosystem (2008–2018)	Greater impact of entrepreneurial freedom, technology transfer, and government effectiveness on the entrepreneurial motivation index	Systemic model identifying critical institutional factors for policy formulation under possible futures
Ruisi, et al. (2023)	Study of SMEs in crisis contexts and business model innovation to increase organizational resilience	Improved understanding of factor interdependence through dynamic modeling to simulate response scenarios before implementing structural changes	Dynamic Business Modeling as a prospective systemic tool for business model innovation and resilience building in digital SMEs
Li et al. (2024)	Analysis of B2B e-commerce platforms in the manufacturing industry	Reduced investment in value-added services early in the platform lifecycle, with moderate increases once users stabilize	System dynamics application to investigate investment and value-added service strategies in value chains

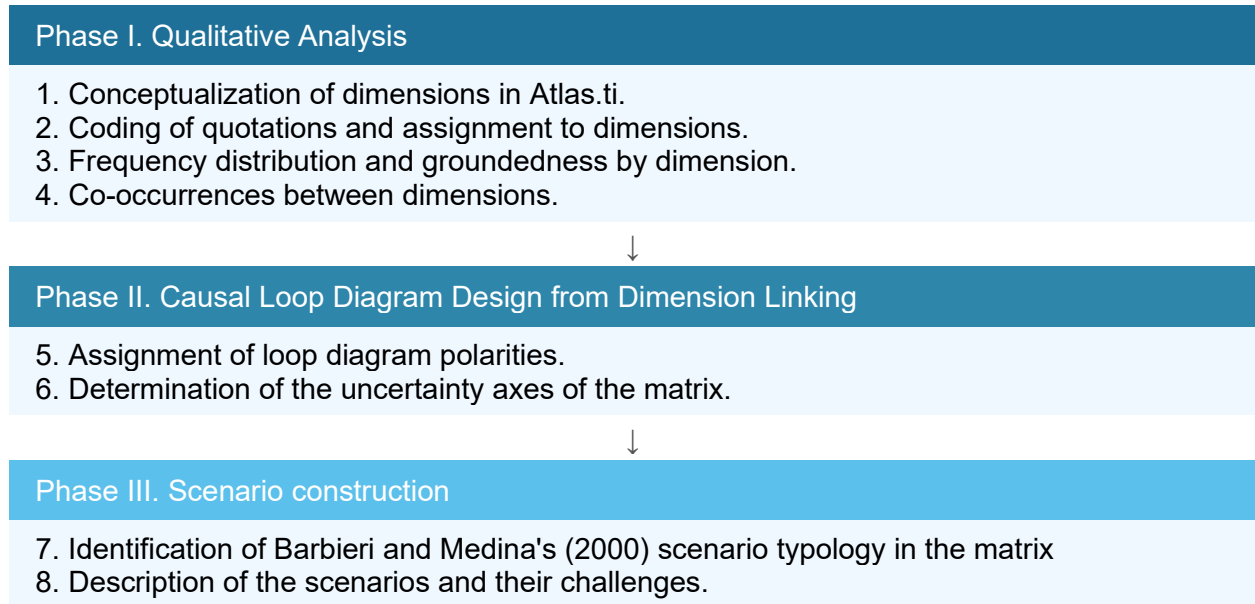
Note. Authors' own elaboration.

System dynamics can model the complex and evolving interactions of the digital entrepreneurial ecosystem, simulating how variable relationships produce different future trajectories. This study does not aim to describe the current state of digital entrepreneurship or

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prescribe specific solutions; it explores possible future trajectories by integrating actors' qualitative perceptions within a system dynamics framework. The approach provides entrepreneurs and decision makers with a tool to anticipate possible futures and design strategies that strengthen the local digital ecosystem.

Exhibit 4. Phases of the Methodological Process.



Note. Authors' own elaboration.

3 | Methodology

This research applied a mixed sequential exploratory approach (Creswell & Creswell, 2022), combined with the scenario planning methodology of Schoemaker (1995) and Schwartz (1997), structured into three progressive phases (Exhibit 4).

Phase I unfolded in three sequential steps. The first involved designing a semi structured interview instrument with eight questions covering the key thematic axes of the study (Exhibit 5): growth factors, barriers, opportunities, dominant shifts, key skills, emerging technologies, public policies, and trends. Experts in entrepreneurship and digital commerce validated the instrument. The sample followed intentional inclusion criteria: microbusinesses in Pachuca, Hidalgo, with a retail trade line and at least two years of online operations.

Exhibit 5. Definition and Description of Qualitative Analysis Dimensions.

Dimension	Description
Growth Factors	Elements such as technological, economic, social, and cultural factors can help boost the growth of digital entrepreneurship
Barriers	Elements that can restrict the growth of digital entrepreneurship (infrastructure, training, financing, regulations)
Opportunities	Consumer needs or preferences that could create profitable opportunities for digital ventures
Dominant Shifts	Shifts that could dominate the digital market in the future.

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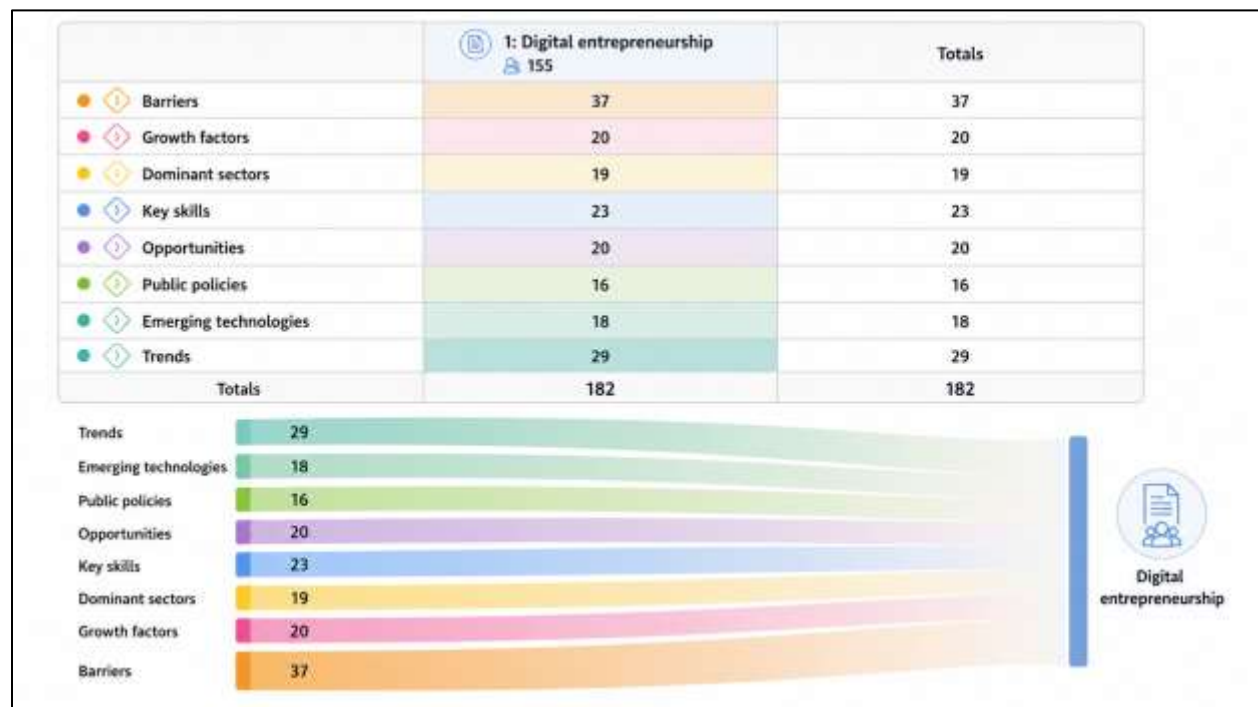
Key Skills	Competencies that could be essential for the success of digital businesses in the future
Emerging Technologies	New technologies that could impact or benefit digital entrepreneurship, like artificial intelligence, blockchain, and augmented reality
Public Policies	Programs or resources that could support digital entrepreneurship (financing, training, infrastructure) in the future
Trends	Changes in terms of technology, regulation, or market that will determine the behavior of digital entrepreneurship in the future

Note. Authors' own elaboration.

The second step involved data collection from April through May 2025; participants completed 52 online questionnaires and four face to face interviews with experts in business, marketing, digital commerce, and entrepreneurship.

The third step applied deductive coding to define dimensions and inductive coding to identify codes in Atlas.ti, producing 155 quotations and 182 codes (N=182) grouped into eight dimensions. These are presented in a code frequency cross-tabulation and a Sankey diagram showing their distribution (Exhibit 6). Testimonies are identified with the key ED (Digital Entrepreneur), followed by a consecutive number assigned during coding to preserve participant anonymity. The four dimensions with the highest quotation density are presented below, as they concentrate the most relevant findings for scenario construction.

Exhibit 6. Distribution of Quotation Frequencies by Thematic Dimension.



Note. Authors' own elaboration.

The barriers dimension yielded the highest number of quotations (37), with participants identifying regulatory, technological, and infrastructure obstacles to digital entrepreneurship growth:

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ED8: "Tax regulations are terrible, you can only deduct things that are digital, which doesn't leave much room to put invoices in, and you pay a lot."

ED13: "Many digital service providers don't fit the size of a small business."

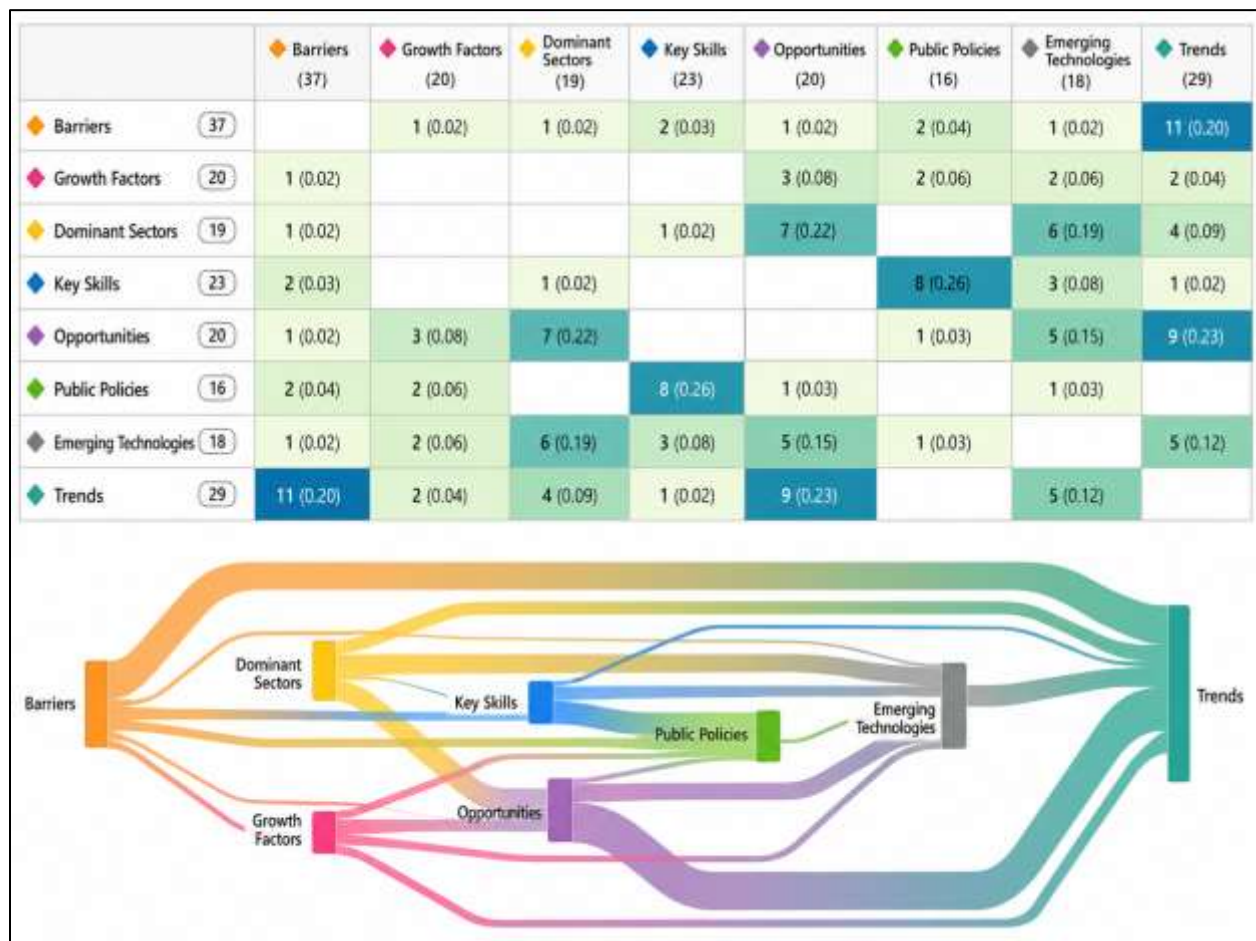
The trends dimension (29 quotations) concentrated on regulatory changes, technological advances, and national and international market transformations:

ED19: "We will see tougher new regulations against informality, more competition from big brands, and those who do not focus on constantly innovating will not be able to succeed."

ED17: "Platforms like Amazon and Mercado Libre will dominate digital commerce and monopolize the network; it will be impossible to compete against them from your website or online store, either you join them or you simply will not be visible."

Co-occurrence analysis between the eight dimensions identified association coefficients that reveal the most significant overlaps in the coded data (Exhibit 7).

Exhibit 7. Co-occurrence Analysis Between Qualitative Dimensions.



Note. Authors' own elaboration.

The opportunities dimension (20 quotations) concentrated on emerging niches linked to personalization, sustainability, and remote digital services:

ED10: "I think consumers are going to want more personalized products, even made-to-order."

ED16: "I think it will be more about services, because products are already widely accessible, so digital services like legal, tax, and accounting advice remotely will be in demand."

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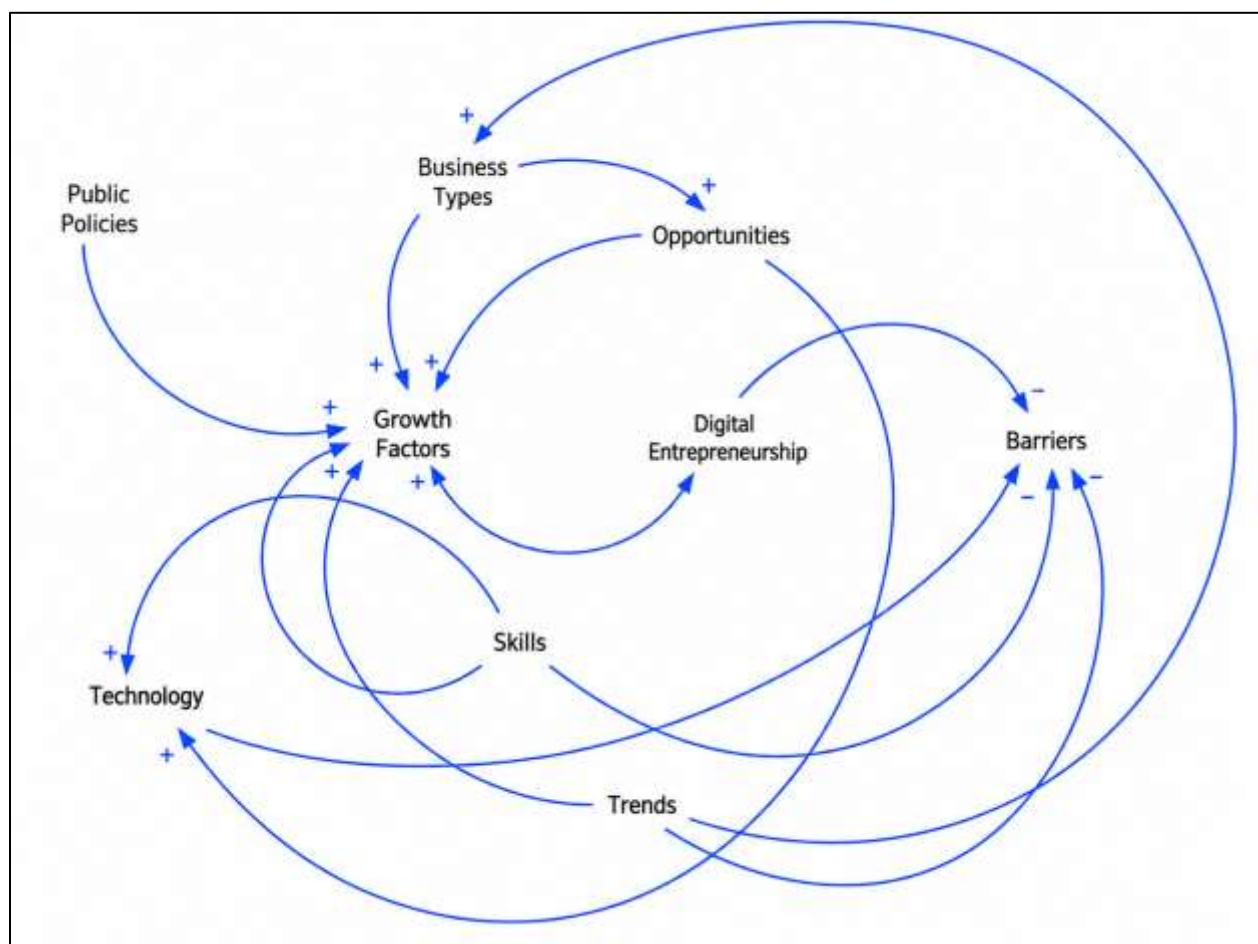
The public policy dimension (16 quotations) concentrated participants' demands for institutional support: free training in digital tools, social media marketing, tax advice, and certifications. Infrastructure access was another recurring theme, including proposals for technology parks, community centers, and expanded internet connectivity:

ED11: "A state platform to promote Hidalgo-based enterprises, with access to payment gateways, training, and outreach."

ED20: "Government-sponsored virtual fairs to promote crafts abroad. And legal protection against imitations."

In Phase II, the research modeled the interactions between the eight qualitative dimensions, whose predetermined elements can be organized and interrelated in positive or negative ways. Causal polarities were assigned based on the thematic content of each dimension and the researcher's interpretive judgment of the nature of relationships between variables, following Forrester's (1961) and Sterman's (2002) guidelines for causal loop diagram development. Using co-occurrence data from Atlas.ti, Vensim PLE translated these relationships into a causal loop diagram (Exhibit 8), with positive polarities reflecting amplifying influences on digital entrepreneurship potential (growth factors) and negative polarities identifying elements that reduce ecosystem potential (barriers).

Exhibit 8. Causal Loop Diagram of Digital Entrepreneurship Dimensions in Pachuca, Hidalgo.



Note. Authors' own elaboration.

Adoption of emerging technologies by digital entrepreneurs (x -axis).

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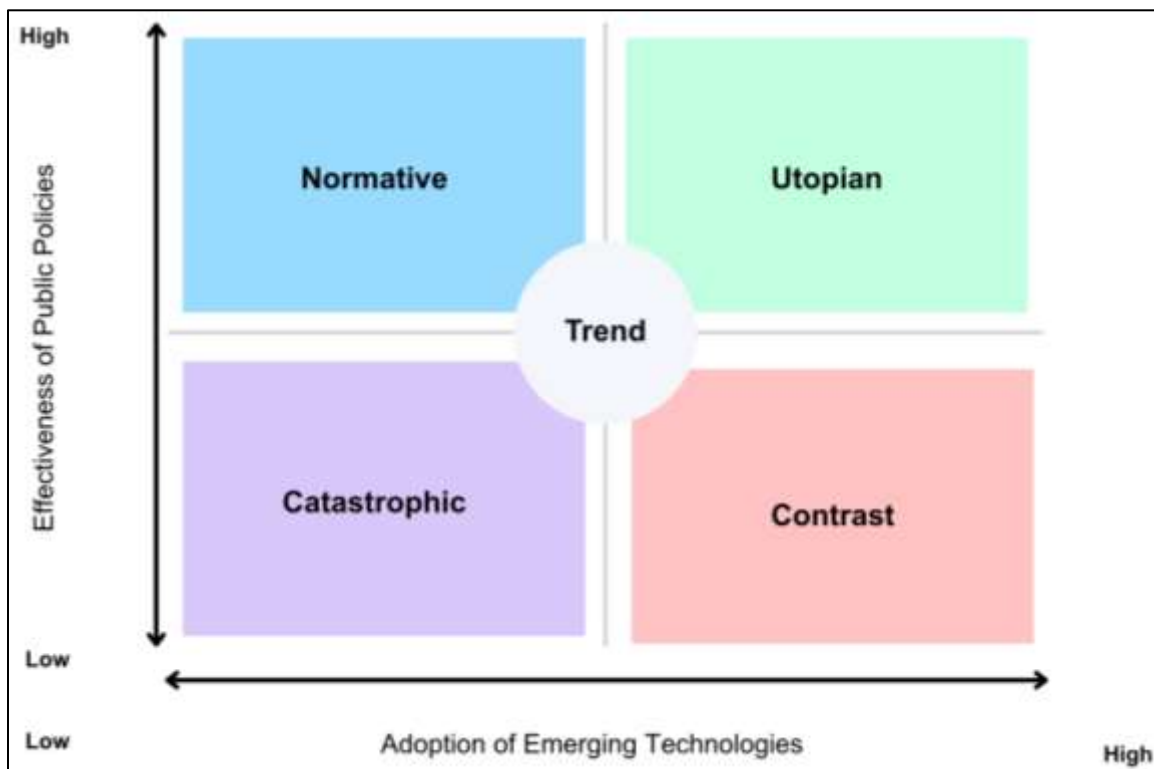
- High: entrepreneurs actively incorporate emerging technologies into their business models, activating positive feedback loops that expand ecosystem potential.
- Low: entrepreneurs rely on conventional methods with limited technological adoption, restricting the capacity of reinforcing loops and reproducing current conditions.

Effectiveness of public policies to support digital entrepreneurship (y-axis).

- High: public policies create favorable conditions through training, subsidies, and digital infrastructure, neutralizing structural barriers and strengthening ecosystem growth factors.
- Low: the absence of public policies reinforces structural barriers, limiting entrepreneurs' access to technological resources, digital infrastructure, and institutional support.

Scenario construction followed Barbieri and Medina's (2000) typology, which defines five scenario types based on their relationship with the current trajectory of the phenomenon and their degree of desirability. The combination of the extreme states of both axes produces four quadrants that, together with a trend scenario serving as a reference trajectory at the point of systemic equilibrium, configure the five future scenarios for digital entrepreneurship in Pachuca, Hidalgo (Exhibit 9).

Exhibit 9. Causal Loop Diagram of Digital Entrepreneurship Dimensions in Pachuca, Hidalgo.



Note. Authors' elaboration based on Schoemaker (1995) and Barbieri and Medina (2000).

4 | Results

From the matrix, five scenarios can be constructed for the digital entrepreneurial ecosystem of Pachuca, Hidalgo (Exhibit 10). Each scenario describes its specific configuration in terms of the

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uncertainty axes and identifies the central challenge facing the ecosystem, providing ecosystem actors with a basis for early strategic decision making.

Exhibit 10. Characterization of Future Scenarios for Digital Entrepreneurship in Pachuca, Hidalgo.

Scenario	Description	Central Challenge
Trend	Continuity of current conditions in Pachuca's digital entrepreneurial ecosystem: moderate technological adoption, sporadic public policies, and gradual growth without significant transformations (center of the matrix: moderate adoption + sporadic policies)	Overcome the structural inertia of the system before the technological gap becomes irreversible
Utopian	Ideal state of the digital entrepreneurial ecosystem: universal access to advanced technologies, unlimited institutional support, and elimination of identified systemic barriers (upper right quadrant: high adoption + very effective policies)	Develop the institutional capacity necessary to sustain support conditions
Catastrophic	Maximum deterioration of the ecosystem: insurmountable structural barriers, displacement of local enterprises by large platforms, and low technological adoption without effective public policies (lower left quadrant: low adoption + ineffective policies)	Reverse the absence of effective policies and low technological adoption that displaces local entrepreneurship in favor of large platforms
Normative	Desirable and achievable configuration exceeding the trend scenario through activated growth factors: effective public policies, access to digital training, and progressive adoption of emerging technologies (upper left quadrant: moderate adoption + effective policies)	Maintain the articulation between effective public policies and progressive technological adoption to sustain growth
Contrast	Extreme fragmentation of the digital entrepreneurial ecosystem due to technological hyper-adoption, absence of institutional support, competitive volatility, and collapse of sustainable trajectories (lower right quadrant: high adoption + ineffective policies)	Develop regulatory and institutional support mechanisms that contain the volatility and fragmentation of the entrepreneurial digital ecosystem

Note. Authors' elaboration based on Barbieri and Medina (2000).

The plausibility of the five scenarios is supported by convergent evidence in the literature. Galvez and Revinova (2025), who assess digital technology development across Latin America, conclude that a neutral trajectory of moderate growth without significant transformation is the most likely regional outcome, directly supporting the trend scenario. The catastrophic scenario draws on Restrepo-Morales et al. (2024), who document how structural barriers limit digitalization in SMEs, and Mungaray and González (2025), who identify the digital skills gap as a critical obstacle for Mexican entrepreneurs. The normative scenario follows Ranaei-Kordshouli and Maleki (2023), who show that institutional effectiveness and government support are the strongest drivers of

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entrepreneurial motivation, and Zhang et al. (2023), who demonstrate that policy support amplifies the impact of technology adoption on strategic flexibility. The utopian scenario builds on Elia et al. (2020), who describe the conditions under which collective intelligence and institutional support converge to eliminate systemic barriers in digital entrepreneurial ecosystems. The contrast scenario draws on Zhao and Weng (2024), who document how rapid technological adoption widens competitive gaps across contexts without policy intervention, and Soluk et al. (2021), who find that in the absence of institutional support, access to digital technologies alone does not sustain entrepreneurial activity in developing countries.

5 | Conclusion

This study proposed a methodological design articulated in three sequential phases. In Phase I, Atlas.ti qualitative analysis identified dimensions and co-occurrences. Phase II translated those conceptual relationships into a causal loop diagram developed in Vensim PLE, and Phase III articulated the resulting systemic structure with Barbieri and Medina's (2000) scenario typology and Schoemaker's (1995) uncertainty axes. This sequence, moving from qualitative data to structural model to prospective narrative, does not appear systematized in this form in the reviewed literature, representing a methodological contribution transferable to similar research contexts on entrepreneurial ecosystems under high uncertainty.

Digital entrepreneurship expands primarily because digital tools become more intuitive, lowering the barrier to entry for the general public. This shift actively pulls in individuals who currently face significant digital literacy gaps. As user friendly interfaces replace complex technical requirements, managing a digital storefront or trading on online platforms transitions from a specialized career into a normal household task. Consequently, even people with no technical background begin to navigate these tools out of economic necessity. This widespread integration goes beyond business metrics; it fundamentally restructures community habits, shifting how ordinary citizens earn money, purchase goods, and maintain social connections on a daily basis.

However, even though this transition has already begun, mapping its exact future remains a challenge. Because technology evolves rapidly and local infrastructure varies, the phenomenon can easily veer into several unexpected directions. Because local conditions and actors' behaviors constantly change, the entire process can easily veer down completely unexpected paths before reaching a final outcome. The scenarios in this study demonstrate that different combinations of current conditions produce different futures, demonstrating that specific factors will determine the success or failure of the digital entrepreneurial ecosystem. The normative scenario represents the most viable path for ecosystem strengthening, as it depends on achievable conditions: effective public policies and progressive technological adoption.

Three limitations may be considered when interpreting the findings of this study. First, the geographical scope is limited to Pachuca, Hidalgo; the scenarios should not be extended to other regional contexts, given their specific conditions. Second, the sample consisted exclusively of microbusinesses operating online, excluding other profiles that coexist in the digital entrepreneurial ecosystem. Third, the causal model served as a structural representation tool without executing simulations, which limits the quantitative verification of projected trajectories.

Three lines of future research follow from these findings. The first involves contrasting the central challenges of each scenario with specialized literature on digital entrepreneurship to enrich the empirical base of the projections. The second involves replicating the study in other Mexican urban contexts with similar digital divide characteristics to evaluate the applicability of the scenarios. The third involves running simulations on the causal model to quantify projected trajectories and improve scenario validation.

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