

Designing a Model for Creating a Successful Innovation Ecosystem in the Promotion of Small Businesses

Mojtaba Esfandiar ¹, Bita Tabrizian ^{2*}, Mohammad Mehdi Movahedi ³

¹ Ph.D. student, Department of Management, Roudehen Branch, Islamic Azad University, Roudehen, Iran

² Assistant Professor, Department of Management, Roudehen Branch, Islamic Azad University, Roudehen, Iran

³ Associate Professor, Department of Management, Firoozkooh Branch, Islamic Azad University, Firoozkooh, Iran

Abstract

This study aims to develop a conceptual model for a successful innovation ecosystem to enhance small and medium-sized enterprises (SMEs). A review of existing literature reveals the absence of a unified structure in innovation ecosystem models, necessitating a locally adapted framework. The research was conducted in two phases. In the first phase, 15 experts participated in a fuzzy Delphi process to identify key factors, resulting in a framework with four main indicators (structure and relationships, actors, performance, and outcomes) and 30 sub-indicators. In the second phase, DEMATEL was used for classification, ANP for prioritization, and ISM and structural path modeling for data analysis. The model structures the ecosystem into five levels, highlighting innovation tools and artifacts as the most influential factors. Empirical testing among SMEs confirmed the model's reliability and validity using Cronbach's alpha, composite reliability, and AVE, validating the significance of direct and indirect relationships within the ecosystem.

Keywords: Ecosystem, Innovation, Innovation Ecosystem, Small and Medium-sized Enterprises (SMEs)

1- Introduction

Innovation is perceived as a production-oriented process, and it is assumed that innovation is a key factor in gaining economic advantage (Trischler et al., 2020). In recent years, interest in the concept of "ecosystem" has significantly grown, and extensive research has been conducted on what ecosystems are and how they function (Zhi & Wang, 2021). The concept of the "innovation ecosystem" has gained attention since the mid-2000s as a framework for business development and the emergence of new industries (Arnal et al., 2020). By developing an innovation ecosystem,

* Corresponding Author

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companies can expand their core products, services, or business infrastructure and use them to improve their performance (Beltagui et al., 2020).

The origin of the "innovation ecosystem" concept may be closely related to the ideas of the "business ecosystem" and the "innovation system." However, it is essential to note that innovation is a necessity within a business ecosystem, where customer needs are met through interaction, collaboration, and competition. Therefore, the primary characteristic of any ecosystem is co-evolution (Arnal et al., 2020). Fukuda and Watanabe (2012) argue that the concept of an "innovation ecosystem" reflects that innovation occurs through interactive networks at various levels, encompassing a wide and complex range of stakeholders from both public and private sectors. Unlike biological ecosystems, an innovation ecosystem includes economic models that demonstrate the complex relationships between actors or institutions, whose primary and practical goal is the development of technology and innovation (Ghazi Nouri et al., 2020).

Understanding how such ecosystems can reduce innovation barriers is crucial for managers and policymakers (Nolia & Rosalia, 2020). Broader ecosystem approaches are shaped by the interaction of "actors," including companies and institutions that provide knowledge and resources and regulate the "rules" (Fijo et al., 2012). The innovation ecosystem is formed by the interaction of key players and the participation of institutions and stakeholders (Dedhaire et al., 2018). Additionally, this concept is applicable at the international level, and achieving sustainable development goals globally requires significant innovations in various fields. Multinational companies can contribute to these goals by fostering innovation, synchronizing research and development, and with the maturity of innovation ecosystems (Nylund et al., 2021).

In recent years, the concept of innovation ecosystems has gained widespread attention, offering new perspectives for innovative activities (Thomas & Autio, 2014). However, from a knowledge standpoint, related theories are still in their early stages of development, and there is no consensus among researchers on this subject (Sperland, 2021). As such, developing innovation ecosystems can enhance innovative performance and lead to improved organizational outcomes (Anja et al., 2020). Today, with an increased emphasis on sustainable development and the dynamic nature of innovation ecosystem components, and given that all institutions within an innovation ecosystem must collaborate and coordinate as a unified body to drive countries toward innovation, science, and technology, the innovation ecosystem presents a promising approach to improving innovation and addressing issues related to inter-organizational collaboration in joint innovation efforts for sustainability. This approach strengthens the flow, integration, and allocation of innovative resources and knowledge within the ecosystem (Yin et al., 2020).

However, analyses of Iran's knowledge-based economy reveal that all knowledge-based ecosystems in Iran suffer from significant and widespread weaknesses compared to other countries, with the innovation and entrepreneurship ecosystems being the weakest (Entezari, 2019). Despite the fact that Iran ranks 62nd among 132 countries according to the latest reports and has dropped nine places compared to the previous year, there is still a significant gap between Iran and leading countries in the region and Asia. To bridge this gap and transition from a resource-based economy to an innovation-based one, the first step is to provide accurate theoretical knowledge and a suitable model of the innovation ecosystem.

In summary, the innovation ecosystem differs from other concepts due to the dynamic nature of the development process, which includes co-evolution, self-organization, upstream and downstream activities, adaptation, and an entrepreneurial culture. The most important characteristics of an innovation ecosystem include co-evolution, dynamic internal interaction, self-organization, adaptation, self-regulation, an entrepreneurial culture, micro and macro flows, knowledge flow, learning, historical context, customer demand, and dynamic communication (Gobble, 2014). Additionally, analyzing and understanding an innovation ecosystem requires considering key features, such as the lifecycle of the ecosystem.

A literature review reveals that no comprehensive research on innovation ecosystems has been conducted in Iran. Moreover, existing international studies have generally not examined all the dimensions and components of innovation ecosystems simultaneously. Most studies have focused on specific industries, regions, or case studies (e.g., for universities), or they have merely identified actors or analyzed the structure of ecosystems. As a result, the lack of a comprehensive model of the innovation ecosystem that considers all dimensions—such as actors, performance, structure, types of relationships and interactions, outcomes, and consequences across various levels—is evident. Such a model could be a unified framework for future studies in different sectors and fields.

This research aims to identify and prioritize the factors influencing a thriving innovation ecosystem in promoting small businesses, ultimately developing a conceptual model to address these needs.

2- Literature Review

In the current market, where survival in the industry and achieving success is difficult, companies tend to create new products and improve previous methods. Innovation involves the creation, development, and implementation of new ideas, either in the form of improvements in existing products, processes, or strategies, which ultimately lead to commercial success and market leadership, creating value for stakeholders and contributing to economic growth and improved living standards (Katz, 2006). Innovation can occur in any form and start at any point in the process or be driven by various actors. For instance, many new products may emerge from entrepreneurs or ordinary individuals, or innovations may result from universities and their courses (Mohammadi et al., 2018). Innovation can be defined as new ideas, advancements, or solutions that can be implemented and turned into useful outputs. Therefore, not all creative ideas become innovations, but only those that are feasible and beneficial (Darst et al., 2013). Innovation is essential for survival and growth in the market, creating value, and enhancing competitiveness, which is beneficial for economic entities and, ultimately, for the whole society (Darst et al., 2013).

Today, the innovation ecosystem is considered a prominent type of environment that, through its creation or nurturing, can lead to broader perspectives (Mohammadi et al., 2018). Merkan and Goktas defined the innovation ecosystem as follows: the innovation ecosystem consists of economic factors, economic relations, as well as non-economic sectors such as technology, institutions, sociocultural interactions, and culture. This definition shows that an innovation ecosystem is composed of a network or various systems (Merkan et al., 2010).

The innovation ecosystem refers to the external elements—individuals, organizations, institutions—that influence or hinder an entrepreneur's decision to engage in entrepreneurship or their chances of success in launching an entrepreneurial business. The innovation ecosystem creates an environment that encourages entrepreneurial efforts (Forfas et al., 2009). In other words, the innovation ecosystem refers to networks or clusters of entrepreneurs, inventors, companies, universities, research laboratories, government agencies, and other institutions and resources to achieve a new process or develop a product (De Wolf et al., 2014; Fallah et al., 2021).

An ecosystem refers to organisms' complexity and interaction with the environment. The concept of an innovation ecosystem often expresses that innovation occurs through interactive networks at various levels. This network includes a wide range of stakeholders in both the public and private sectors. As part of the innovation ecosystem, all stakeholders are broadly connected in the innovation process, and their behavior improves the ecosystem's efficiency (Oksanen & Hautamaki, 2014).

The innovation ecosystem is a dynamic system of internal relationships between institutions and individuals necessary for moving toward economic and technological development. This ecosystem encompasses a range of actors, including academic, industrial, foundation, scientific, and economic organizations, and the government at all levels (Zarinjouy et al., 2020).

The literature on ecosystems presents various conceptualizations, reflecting the diversity of scholars' research traditions and theoretical backgrounds. The business ecosystem perspective reflects research on the dynamics of ecosystems and the relationships between suppliers, complementors, customers, and the focal firm (Edner & Kapoor, 2010). The multi-actor network perspective expands and stems from the view of the business ecosystem.

The assumption that relationships between a wide range of actors and intermediaries can indirectly affect the innovative behavior of a focal firm demonstrates the involvement of all institutions in the innovation environment. For example, local and national governments, communities, and policymakers are actors who control public resources. The multi-actor perspective aligns with the "ecosystem as structure" view. Adner's (2017) perspective suggests that we should focus more on the role of regulators, influencers, and institutions to understand companies' actions. We adopt Adner's (2017) view and define ecosystems as "the alignment structure of a multilateral set of partners who need to interact for a focal value proposition to materialize." We chose this view because it starts with the company's value proposition, examines the relevant capabilities, and describes the alignment of diverse ecosystem actors. Thus, it does not limit analyses to the actors and activities directly related to the focal company. Instead, it extends the analytical boundaries to the complex network of various ecosystem actors and influencers.

Previous research on innovation has examined similar multi-faceted collaboration models, such as open innovation (Chesbrough, 2003), innovation clusters (Porter, 1998; Nozari & Aliahmadi, 2023), value networks (Lee & Walley, 2002), and triple or even quadruple helix models (Carayannis & Campbell, 2009).

A standard view is that innovation ecosystems bring a new perspective to evaluating companies' positions within the relevant value system and their benefits. However, unlike the terms mentioned

earlier, such as value networks (Lee & Walley, 2002), clusters (Porter, 1998; Fallah & Nozari, 2021), and many others like innovation systems (Freeman, 1987), regional innovation systems (Asheim & Coenen, 2005), the use of "ecosystem" may imply different organizational performance implications. The justification for an ecological event or action depends on determining insufficient factors for explaining organizational actions like managerial decision-making processes. Therefore, the behavioral aspects of the business environment and the role of institutions must be incorporated into our understanding of innovation ecosystems as a collaboration perspective. In his final study, Moore (1993) noted, "The biological metaphor does not apply to commerce. Unlike biological communities, business communities are social systems. And social systems are made up of real individuals who make decisions."

3- Research Background

Jo Hyun Kim and colleagues (2022) made significant contributions to existing studies by combining the dynamic capability perspective with the innovation ecosystem approach. They consider key capabilities related to the ecosystem crucial for current players, especially core firms, to fully manage the innovation ecosystem, particularly when facing technological innovations. They also mention that despite discontinuities, they have developed an innovation ecosystem framework that redefines and specifies the framework of actors, activities, and artifacts proposed by Grandstrand and Holgersson (2020) through literature review of dynamic capabilities and innovation ecosystem research, as well as a case study of two leading automotive companies. They conclude that in the era of disruptive innovation, ecosystem actors consisting of current core firms, component providers, and complementors are extensively linked beyond existing industry boundaries (e.g., automotive innovation ecosystem).

Bronzwick and colleagues (2013) examined the organizational capabilities needed to manage open innovation in small and medium-sized enterprises (SMEs) based on a case study in a software company. The results indicate that SMEs need to adopt a management system with six dimensions—open strategy, company structure, inter-company network structure, support, and open culture—to achieve an open innovation approach.

A study by Sisodia and colleagues (2013) titled "Internal Open Innovation for Performance Enhancement: Enablers and Opportunities" aimed to identify the key factors that internal open innovation can enable and how it improves performance in the business-to-business context. The study collected data from managers in 204 high-tech businesses and related data on company performance and resilience. Results show that the ability to create relationships between companies in a knowledge-rich environment enhances the effectiveness of internal open innovation for achieving financial performance. Companies with strong relational capabilities and an approach are more successful.

Popa and colleagues (2017) explored empirical literature related to assessing the impact of organizational backgrounds and open innovation climates and their effects on the performance of SMEs. Their research revealed that organizational factors such as human resource commitment-based practices positively influence the innovation climate and that the innovation climate supports innovation methods (inward-outward and outward-inward processes).

Avallone and colleagues (2019), in a study titled "Open Innovation in SMEs: Identified Potential and Absorptive Capacity for Intra-Organizational Learning in Collaboration with Universities," showed that SMEs recognize the need to collaborate with universities due to various barriers to innovation development. Their research investigated the collaboration between SMEs and universities in an open innovation environment in Mexico. Results indicated that a collaborative outcome is the discovery of a continuous learning process when new knowledge resources are discovered through universities. However, until internal and external R&D units continue this relationship, the commercialization benefits may be realized in the future.

Yasmin Kamal Khan and colleagues (2019) in their paper titled "Innovation Ecosystem in SMEs" state that open innovation is more beneficial in the commercialization phase compared to the product development phase for SMEs. At the same time, SMEs, due to limited budgets for technology, need to be more cautious regarding intellectual property (IP).

Mohammadi (2018) conducted a study titled "Identifying Key Actors in the Development of the Innovation Ecosystem." The research method was a mixed-method approach (quantitative-qualitative). The findings showed that six main actors are crucial in the development of the innovation ecosystem: accelerators, coordinators, providers of human and physical infrastructure, leading users, venture capitalists, and leading experts. Organizations such as the Business Development Holding, Research and Technology Company, National Iranian Oil Research Institute, Iranian Polymer and Petrochemical Institute, Sharif University of Technology Chemical Engineering Department, Iran and Tehran Chemical Engineering Research Institute, and Amir Kabir University are considered providers of human and physical infrastructure. The Innovation and Prosperity Fund is considered a venture capitalist.

Babaei Farsani and colleagues (2018) in their study titled "Designing an Open Innovation Model in SMEs Using Grounded Theory (Case Study: Food Industries of Chaharmahal and Bakhtiari Province)" concluded that SMEs active in the food industry possess characteristics that define their identity. These companies are characterized by high decision-making speed, flexibility, greater innovation, job creation, focus on cost minimization, fewer managerial layers, lack of hierarchy, and the use of diverse informational resources. These companies are categorized as low-tech industries and strongly support research and development, creating unique opportunities for the food industry through modern research.

In a case study by Mehrali and colleagues (2019) in the sesame industry of Yazd Province, they investigated the impact of open business on open innovation. The findings suggest that as organizations open up their business, they can leverage external ideas, technologies, and methods to advance their innovations and improve their ability to attract ideas, thereby increasing open innovation within these organizations.

In a paper by Dabag Afrouz, Bafandeh Zende, and Pasban (2020), they aimed to create an innovation ecosystem in the health sector of Tabriz using a system dynamics approach. The subsystems considered include financial capital, consumers of innovation products, university R&D sectors, industry R&D sectors, infrastructure and regulations, and the government. Through library research, structured interviews, and expert consultations, they identified the relationships between these subsystems and presented causal diagrams and state-flow diagrams. Policy analysis

indicated that improving government regulations, reducing bureaucracy, and increasing the percentage of profit dedicated to R&D have the most significant impact on spreading innovation in the health sector. Improved international relations ranked second, and material and non-material incentives ranked fourth.

This summary presents key studies on innovation ecosystems. It highlights research on integrating dynamic capabilities with innovation ecosystems, open innovation in SMEs, and the impact of organizational and environmental factors on innovation performance. Key findings include the importance of organizational capabilities, collaboration with universities, and the role of regulatory improvements in fostering innovation.

Table 1: Research Background

Author(s)	Year	Title	Key Findings
Jo Hyun Kim et al.	2022	Dynamic Capabilities and Innovation Ecosystems	Key capabilities for managing innovation ecosystems are essential. Frameworks redefine actors, activities, and artifacts. Ecosystem actors include core firms, component providers, and complementors.
Bronzwick et al.	2013	Organizational Capabilities for Managing Open Innovation in SMEs	SMEs need a management system with six dimensions to achieve open innovation: strategy, company structure, network structure, support, and open culture.
Sisodia et al.	2013	Internal Open Innovation for Performance Enhancement: Enablers and Opportunities	Internal open innovation effectiveness increases with strong relational capabilities and a knowledge-rich environment.
Popa et al.	2017	Impact of Organizational Backgrounds and Open Innovation Climate on SME Performance	Organizational factors positively influence the innovation climate, which supports innovation methods and improves performance.
Avallone et al.	2019	Open Innovation in SMEs: Potential and Absorptive Capacity for Intra-Organizational Learning with Universities	SMEs recognize the need to collaborate with universities for innovation development. Continuous learning from universities leads to potential commercialization benefits.

4- Methodology

- This research is applied in nature, as its results are useful for enhancing the capabilities of small and medium-sized enterprises (SMEs).
- From a philosophical perspective, this research is explanatory, as it aims to provide evidence on factors influencing the advancement of SMEs.
- The research adopts a deductive approach.
- The research strategy is quantitative.
- From a knowledge goal perspective, this research is descriptive-exploratory.
- Temporally, this research is cross-sectional, as it provides a snapshot of perspectives regarding the enhancement of SMEs at a particular moment.

- Data collection methods are based on expert opinions using Delphi method and theoretical framework, and a questionnaire was designed. The collected data will be analyzed to provide insights into enhancing SME performance, particularly from the perspective of academic experts from Islamic Azad University. The study's statistical population consists of experts (managers and deputies) in knowledge-based companies, science and technology parks, and growth centers in Tehran. To this end, opinions from 15 experts from these companies were gathered. Notably, selected managers had significant work experience, management experience, and management education. For the t-test analysis, the sample size was 65 (managers, deputies, and experienced experts in each company), but two were unavailable during the research, so the total sample size was 63. Considering a 5% margin of error, a final sample of 54 was selected.

5- Data Analysis

Model Testing Using Structural Equation Modeling (SEM)

The purpose of this analysis is to evaluate the conceptual model of the research and to ensure the existence or non-existence of causal relationships among the research variables, as well as to assess the fit of the observed data with the conceptual model. The research model was tested using Structural Equation Modeling (SEM). The results of the model test are reflected in the diagram.

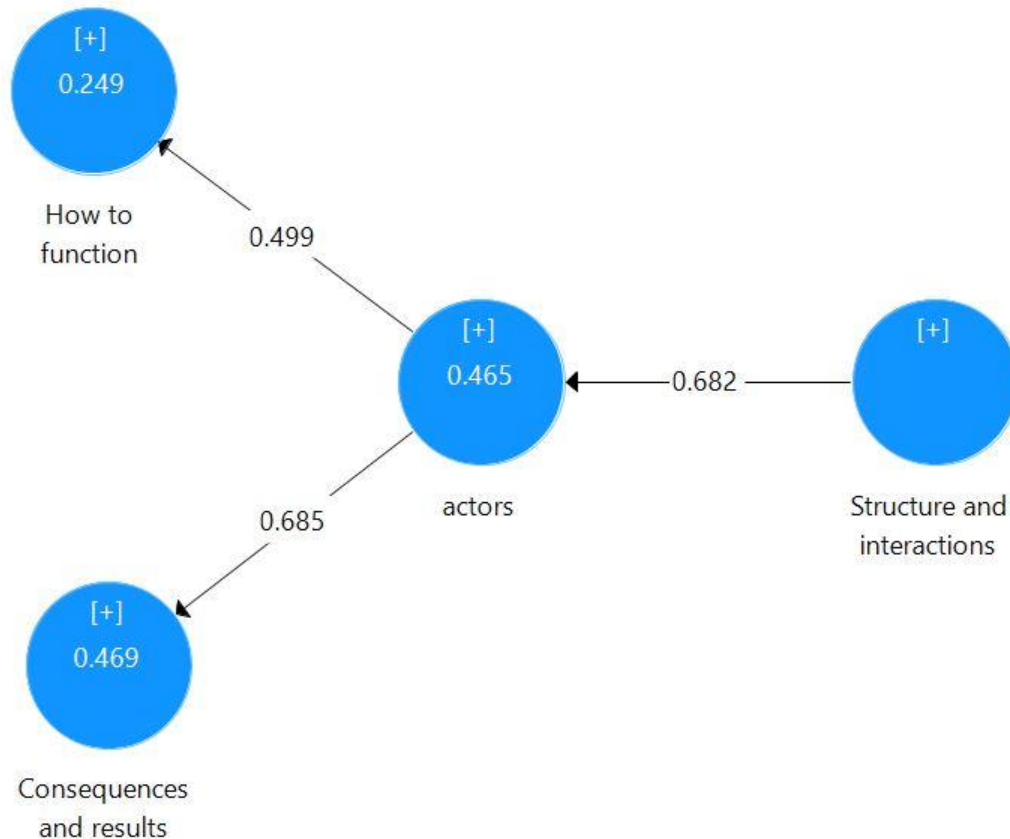


Figure 1: Measurement of the Overall Model in Standard State

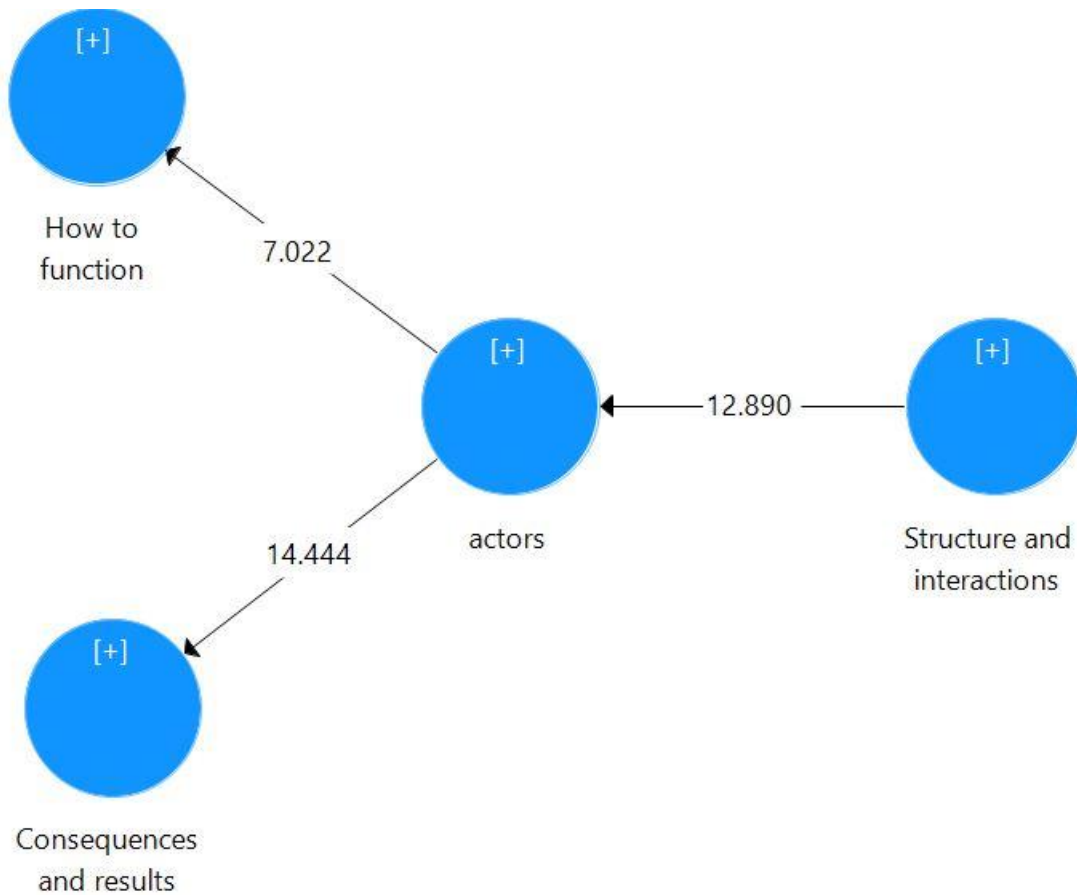


Figure 2: Measurement of the Overall Model in Significant State

Reliability and Validity Assessment

To assess reliability, Cronbach's alpha and composite reliability were used. Convergent validity was employed to evaluate validity. The Goodness of Fit (GOF) index was utilized to measure model fit.

Explanation:

- **Cronbach's Alpha:** This measure is used to assess the internal consistency or reliability of a set of scale or test items. A higher Cronbach's alpha value indicates better reliability.
- **Composite Reliability:** This is an alternative measure of reliability, which assesses the overall consistency of a set of indicators measuring a latent construct.
- **Convergent Validity:** This refers to the degree to which multiple measures of the same construct are related. It ensures that indicators of a construct are strongly correlated.
- **Goodness of Fit (GOF) Index:** This index evaluates how well the model fits the data. It provides an overall measure of how well the proposed model matches the observed data.

Table 2: Reliability and Validity of External Models

Variable	CR	AVE	MSV	Fornell-Larcker Matrix			
				1	2	3	4
Performance	0.787	0.552	0.193	0.743			
Outcomes and Results	0.844	0.644	0.478	0.342	0.803		
Actors	0.918	0.651	0.423	0.331	0.47	0.807	
Structure and Interactions	0.885	0.720	0.478	0.44	0.692	0.65	0.849

Reliability and Validity

- A Cronbach's alpha value higher than 0.70 indicates acceptable reliability.
- A CR value above 0.70 for each construct signifies adequate internal consistency for the measurement model.
- An AVE value greater than 0.50 indicates acceptable convergent validity.
- Considering the thresholds of 0.10, 0.25, and 0.36 for weak, moderate, and strong GOF (Goodness of Fit), a GOF value of 0.62 indicates a strong model fit.

Fuzzy Inference System

After designing and refining the conceptual model with experts, we proceed to the final phase of the work, where the ANFIS (Adaptive Neuro-Fuzzy Inference System) model is developed and tested using the responses from the internal organizational questionnaire. Fuzzy inference systems can model qualitative aspects of human knowledge without the need for precise and complex quantitative analyses. This section focuses on the design of the mathematical model, including the steps and requirements for the Adaptive Neuro-Fuzzy Inference System (ANFIS) based on the conceptual model.

To predict the conceptual model, we first design a sub-FIS (Fuzzy Inference System) and a general FIS. Then, by training them, we develop a sub-ANFIS and a general ANFIS model. MATLAB R2017a software was used for implementing this mathematical model. Initially, a sub-FIS was designed for each dimension of the model, and based on this, a general FIS was created. Data from 54 respondents were used, with responses from 40 experts (about 80% of all respondents) used for training the sub-FIS and FIS models, and the remaining 14 responses used as test data for the sub-ANFIS and general ANFIS models.

There are two methods for designing fuzzy inference rules in MATLAB software:

1. Network Partitioning
2. Reduced Clustering

In the first method, which we use, it is possible to generate Sugeno-type fuzzy inference systems with the option to select the number and type of membership functions. To reduce model complexity, two membership functions are considered for each component. Gaussian membership functions are selected for the model inputs. The number of rules in the model depends on the

number of components and the number of membership functions specified. For example, the number of rules for the first dimension with four components is 8 (i.e., 2^3). The second method, which uses reduced clustering, has fewer rules, and we have less control over them. As mentioned, we have sub-FIS and sub-ANFIS models for each dimension of the conceptual model. This section will address each of these.

Table 3: Concept of Parameters Used in the First Dimension Model

Component/ Dimension
1-1: Performance
1-2: Outcomes and Results
1-3: Actors
1-4: Structure and Interactions

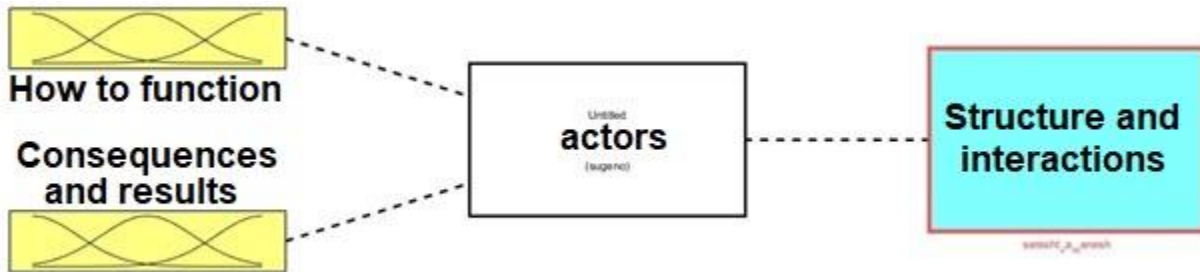


Figure 3: sub-FIS

As mentioned earlier, the expert questionnaire within the organization was designed with the perspective that users provide input on each sub-model (i.e., components) as well as feedback on its output (i.e., overall opinion on each dimension). These data are used for training and evaluating the models. The structure of the sub-ANFIS model for this dimension is shown in Figure (4).

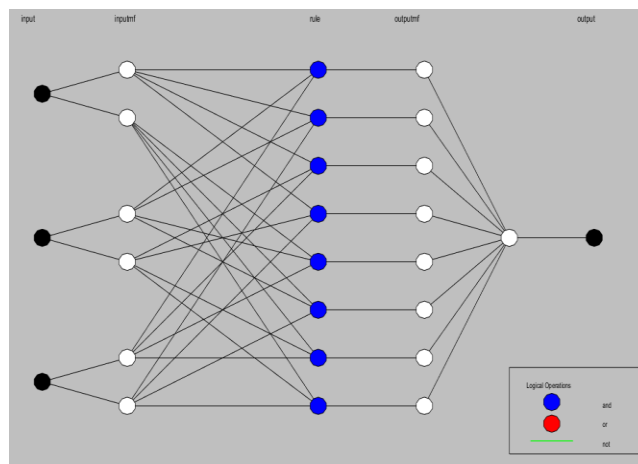


Figure 4: sub-ANFIS of the research model

Using the training data, the ANFIS system was trained using a grid partitioning method, and the following inference rules were obtained:

- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf1) and (input4 is in 4mf1) and (input5 is in 5mf1), then (output is out1mf1).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf1) and (input4 is in 4mf1) and (input5 is in 5mf2), then (output is out1mf2).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf1) and (input4 is in 4mf2) and (input5 is in 5mf1), then (output is out1mf3).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf1) and (input4 is in 4mf2) and (input5 is in 5mf2), then (output is out1mf4).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf2) and (input4 is in 4mf1) and (input5 is in 5mf1), then (output is out1mf5).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf2) and (input4 is in 4mf1) and (input5 is in 5mf2), then (output is out1mf6).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf2) and (input4 is in 4mf2) and (input5 is in 5mf1), then (output is out1mf7).
- If (input1 is in 1mf1) and (input2 is in 2mf1) and (input3 is in 3mf2) and (input4 is in 4mf2) and (input5 is in 5mf2), then (output is out1mf8).

As seen, the number of rules is equal to 8 (2^3). These inference rules map various combinations of the three inputs to one output of the subsystem, which is the characteristic or personality. Different combinations of component states can result in different outputs. If, in the modeling phase, instead of considering two membership functions per component, we had considered three membership functions for each component, the number of rules would increase to 27 (3^3), making the system much more complex.

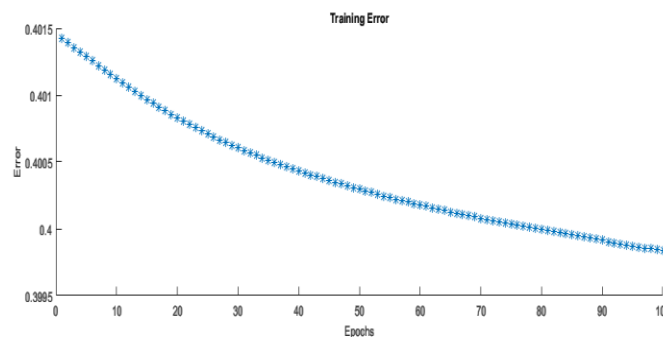


Figure 5: shows the model's training process, which aims to reduce the error between its output and the training data.

Figure (5) illustrates the model's training process. This process aims to reduce the error between the model's output and the actual output from the data. As the number of training iterations increases, the error decreases. After several training cycles, the error stabilizes. For this model, the error rate is 0.39 (after two training cycles with a length 100).

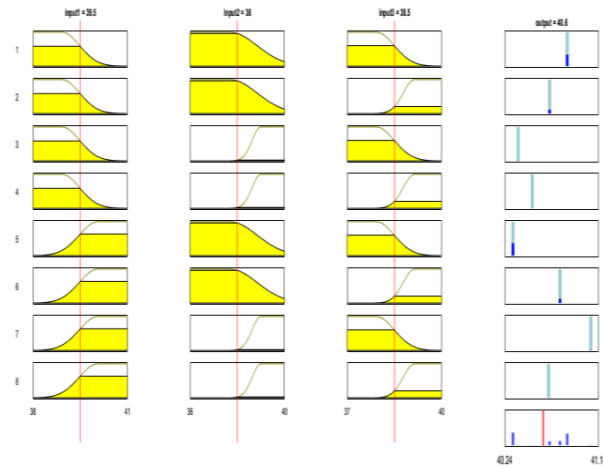


Figure 6: shows the representation of the dimension model's rules.

In Figure (6), by adjusting the input values within the range of minimum (zero) and maximum (100), you can observe the effect of each input on the output separately for each of the 8 inference rules (a row represents each rule).

6- Conclusion

An ecosystem is a region where organisms interact with each other and their surrounding environment. Ecosystems consist of living and non-living components and natural forces, all interacting and constantly changing. One organism's behavior influences others' behavior and impacts the ecosystem's environment. Consequently, the ecosystem's fate and survival depend on all its members' behavior (Kusia & Engler, 2011). Innovation ecosystems describe various entities' collaborative efforts to achieve innovation. Suppliers provide key elements and technologies in such ecosystems, while different organizations offer complementary goods and services. Customers generate demand and share their capabilities within the system. In a systemic context, organizations gain a competitive advantage by understanding the value and transparency of the products and services provided to customers (Fernández-Cueira, 2018). In the world of learning and innovative organizations, no organization can independently provide the resources needed for its development and commercialization. To achieve value, they must rely on active players in the ecosystem (Talmar et al., 2018). The diversity of elements and actors involved in an innovation ecosystem, the variety of roles, interdependencies, and the breadth of interactions make managing innovation ecosystems highly challenging. It continues to be a research question for academics and a practical challenge for those involved in innovation systems (Valkokari et al., 2016). The purpose of this article was to design a conceptual model of the factors influencing the innovation ecosystem for the enhancement of small and medium-sized enterprises (SMEs). Based on the findings, it can be concluded that the innovation ecosystem of SMEs is built upon the companies' internal capabilities, which are reflected in innovation tools (Granstrand & Holgersson, 2020).

When examining the definitions of innovation ecosystems, it is emphasized that most definitions neglect the role of actors as a key dimension of the ecosystem and innovation, even though bringing actors together within the ecosystem is based on the development of new products or services. Actors collaborate by understanding the needs for products, services, and technologies to create value together. Rabezska et al. (2019) and Hodges et al. (2007) identify innovation tools as the main drivers of ecosystems. These researchers believe that initial efforts in an innovation ecosystem are based on innovation tools, and gradually, as other dimensions join, a core ecosystem is formed. According to the results, the innovation ecosystem framework is structured around four indicators (actors, structure and interaction relationships, performance, and outcomes) and 36 sub-indicators. This article also aimed to integrate the results of previous research in a new and practical manner, providing a comprehensive model as a guide for innovation practitioners, policymakers, and others. It identified gaps in existing studies, such as insufficient attention to the impact of international and global market environments on innovation ecosystems, the role of culture as the foundation for the formation of an ecosystem, and the pivotal role of entrepreneurial universities and university-based entrepreneurial activities in innovation ecosystems. In support of this, it should be noted that in recent decades, universities have moved toward the third generation, playing a more entrepreneurial role and engaging more closely with industry. This generation of universities focuses on entrepreneurship and solving societal problems through systematic, scientific approaches in collaboration with industry (Mahdi, 2014, as cited by Shafiee & Safaieh, 2020). Sidrat and Frikha (2018) also emphasized the role of leadership in innovation ecosystems.

Management Recommendations

Based on the findings of this study, the following managerial recommendations are proposed to enhance the effectiveness of innovation ecosystems, particularly for small and medium-sized enterprises (SMEs):

1. **Foster Collaboration Among Ecosystem Actors:** Encouraging strong partnerships and collaborations between different actors within the ecosystem, such as suppliers, customers, and complementary service providers, can lead to more effective innovation. Organizations should actively seek opportunities for collaboration to leverage each other's strengths and capabilities.
2. **Leverage Innovation Tools and Capabilities:** SMEs should focus on developing and utilizing innovative tools and technologies that can enhance their competitive advantage. Investing in research and development, as well as in advanced tools, can drive innovation and improve their position within the ecosystem.
3. **Enhance Understanding of Market Needs:** Organizations should strive to gain a deeper understanding of market demands and customer needs. This involves gathering feedback from customers and analyzing market trends to ensure that their innovations align with current and future demands.
4. **Promote Transparent Communication:** Clear and transparent communication about products, services, and capabilities can help build trust and strengthen relationships within the ecosystem. Organizations should focus on improving transparency to enhance their competitive position and foster better collaboration.
5. **Adapt to Evolving Ecosystem Dynamics:** Managers should remain agile and adaptable to changes within the innovation ecosystem. This involves staying informed about

technological advancements, market shifts, and emerging trends to adjust strategies and maintain relevance.

6. **Encourage Continuous Learning and Development:** Investing in continuous learning and development for employees can drive innovation and improve organizational performance. Training programs and knowledge-sharing initiatives can enhance the skills and capabilities necessary for thriving in a dynamic ecosystem.
7. **Engage with International Markets:** SMEs should explore opportunities for international collaboration and expansion to broaden their market reach. Engaging with global markets can provide new avenues for innovation and access to a wider range of resources and expertise.
8. **Strengthen the Role of Leadership:** Effective leadership is crucial for guiding organizations through the complexities of innovation ecosystems. Leaders should focus on fostering a culture of innovation, encouraging collaboration, and providing strategic direction to navigate ecosystem challenges.

By implementing these recommendations, organizations can better position themselves within their innovation ecosystems, enhance their competitive advantage, and drive sustainable growth and development.

Research Limitations

Despite the valuable insights gained from this study on the innovation ecosystem, several limitations should be acknowledged.

1. **Data Availability:** The research primarily relied on internal data and expert opinions, which may limit the generalizability of the findings to other contexts or industries. Access to more diverse data sources, including international perspectives, could enhance the robustness of the conclusions.
2. **Scope of Analysis:** The focus was on small and medium-sized enterprises (SMEs), which may not fully capture the dynamics of innovation ecosystems in larger organizations or multinational companies. Future research could explore how different types and sizes of organizations interact within innovation ecosystems.
3. **Complexity of Ecosystems:** Innovation ecosystems are inherently complex, with numerous actors, relationships, and external factors at play. This study simplified some aspects to create a manageable conceptual model, potentially overlooking certain nuanced interactions, such as the influence of cultural, regulatory, or geopolitical factors.
4. **Evolving Nature of Ecosystems:** Innovation ecosystems are continuously evolving, influenced by rapid technological advancements and market shifts. The results of this study are based on current conditions and may not fully account for future changes in the ecosystem landscape.
5. **Limited Focus on Global Markets:** While the study recognized the importance of international markets, it did not extensively examine the role of global competition, international collaborations, or market-specific regulations that could significantly impact innovation ecosystems.

6. **Cultural Influence:** Cultural factors were identified as a key element in shaping ecosystems, but due to the scope of the study, an in-depth exploration of how culture influences innovation ecosystems was not fully addressed.

Addressing these limitations in future research could provide a more comprehensive understanding of the innovation ecosystems and the factors that drive their success.

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