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Innovation Eco-Embeddedness, Breakthrough Innovation, and Performance of Non-Core Firms: A Mediation Moderation Study

Mohamed Shawesh *, Kolawole Iyiola and Ahmad Alzubi

Department of Business Administration, Institute of Graduate Research and Studies, University of Mediterranean Karpasia, 33010 Mersin, Northern Cyprus, Turkey
* Correspondence: mohamedshaesh.akun@gmail.com

Abstract: In today's rapidly evolving business landscape, non-core firms face increasing pressure to innovate while adhering to sustainable practices. Non-core firms are organizations that operate in peripheral or less central positions within an ecosystem, having limited access to critical resources but playing essential supportive roles in innovation processes. Innovation eco-embeddedness, which integrates ecological considerations into innovation processes, is becoming a critical factor for enhancing innovation performance. However, the dynamics between eco-embeddedness, breakthrough innovation, and innovation performance, especially under varying levels of ecological legitimacy and technology turbulence, remain under examination. This study aims to investigate the relationships between innovation eco-embeddedness, breakthrough innovation, and innovation performance in non-core firms. Additionally, it examines the moderating effects of ecological legitimacy and technology turbulence on these relationships. This study developed and tested seven hypotheses using a conceptual framework based on innovation ecosystem theory, breakthrough innovation theory, and institutional theory. We collected data from a diverse sample of non-core firms and used structural equation modeling to analyze the direct, mediating, and moderating effects. The findings reveal a positive relationship between innovation eco-embeddedness and both breakthrough innovation and innovation performance. Breakthrough innovation also directly enhances innovation performance and mediates the relationship between eco-embeddedness and performance. Ecological legitimacy significantly moderates the impact of eco-embeddedness on breakthrough innovation, while technology turbulence intensifies the mediated relationship between eco-embeddedness and innovation performance when both moderating factors are high. This study provides valuable perceptions for managers and policymakers in non-core firms, highlighting the importance of embedding ecological considerations in innovation processes.

Keywords: non-core Turkish manufacturing firms; breakthrough innovation theory; institutional theory; innovation performance; ecological legitimacy; technology turbulence

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1. Introduction

In recent years, the concept of "ecosystems" has become a popular framework to describe the competitive environment in which firms operate. Ecosystems are groups of hierarchically independent but interdependent heterogeneous members working collaboratively to create a value proposition 018 [1,2]. A survey by Accenture in January 2018, involving 1252 leaders from firms earning over USD 1 billion across 13 sectors, revealed that 60% were interested in building ecosystems to transform their businesses or navigate disruptions [3]. By establishing ecosystems, core organizations can accumulate resources from other ecological members to co-create value and facilitate industry transformation. For instance, companies like Google, Apple, and IBM have established ecosystems that bring together several participants, enabling disruptive breakthroughs and creating new consumer values and market benefits [4]. An innovation ecosystem is characterized by the collaboration and interdependence of various stakeholders working together to nurture innovation. Participants in such an ecosystem can access additional or complementary resources such as technologies, assets, and markets, which benefit their growth by embedding themselves into the system and engaging in collaborative efforts to enhance their capabilities [5]. Consequently, firms are increasingly adopting various innovation collaboration strategies with external entities as a competitive strategy, thereby increasing the number of players in the innovation ecosystem [6]. Moreover, non-core firms build systems to create services and products, enhancing mutual benefits and boosting the value of ecosystems [3]. Non-core firms refer to organizations that operate in peripheral or less central positions within an ecosystem, having limited access to critical resources but playing essential supportive roles in innovation processes [3]. This approach improves their sustainability and competitiveness while achieving better performance [7–9].

Research on innovation ecosystems is still in its growing stages, with the existing literature primarily consisting of case studies that investigate how core firms facilitate the construction of ecosystems and co-create value to gain a competitive edge. Previous studies have shown that embedded firms occupying non-core positions within an innovation ecosystem differ significantly in their resource scanning and acquisition strategies, as well as their strategic decision-making processes [10]. Organizations venturing into a market allocate resources to breakthrough innovation (BI), which can replace outdated product lines with new and improved products of superior ecological value [11]. Breakthrough innovation is considered a potent catalyst for accelerated growth [12]. It allows firms to leverage new technologies to provide higher consumer benefits by improving existing products [13,14]. Hence, non-core organizations must nurture breakthrough innovation to transform ecological benefits into improved firm performance.

The institutional theory posits that business operations are deeply embedded in specific institutional environments, and that support from external institutions is crucial in establishing a strong foundation for firms' growth and longevity [15]. It is important to establish pathways that enable non-core organizations to utilize breakthrough innovation to assimilate and apply ecological knowledge and inputs, leveraging ecological legitimacy to circumvent the "new entry defect" [16] and ensure growth and longevity. Moreover, numerous studies have claimed that business models are highly contingent on the external environment [17,18]. This study considers technological turbulence, defined as the perceived speed of technological advancements during the development of new products [19], as a contingency factor that non-core firms can leverage.

This study aims to examine the relationships between innovation eco-embeddedness, breakthrough innovation, and innovation performance in non-core firms. Specifically, it examines the moderating roles of ecological legitimacy and technological turbulence in these relationships. This study seeks to provide a comprehensive understanding of how non-core firms can leverage their innovation ecosystems and achieve breakthrough innovations in a rapidly changing technological and environmental landscape. To achieve these objectives, this study will address the following research questions:

1. What is the relationship between innovation eco-embeddedness and innovation performance in non-core firms?
2. How does breakthrough innovation mediate the relationship between innovation eco-embeddedness and innovation performance?
3. How do ecological legitimacy and technological turbulence moderate relationships?

By addressing these research questions, this study aims to contribute to the theoretical advancement of innovation ecosystem theory, breakthrough innovation theory, and institutional theory. Figure 1 constructs a moderated mediation model to examine the influence of innovation eco-embeddedness on the innovation performance (IP) of non-core organizations in the Turkish manufacturing industry.

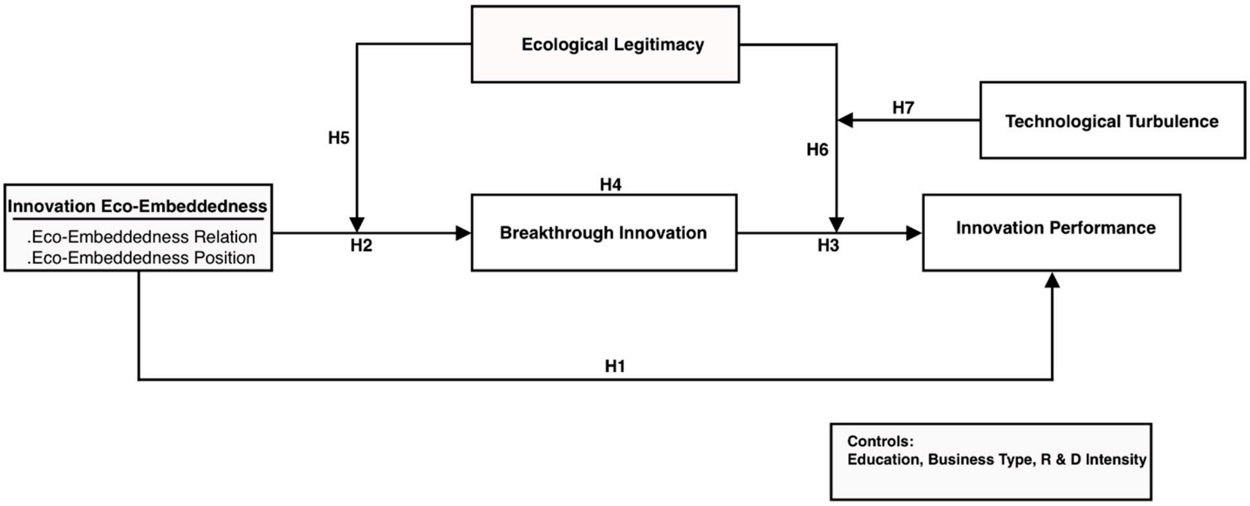

Figure 1. Conceptual model.

The remainder of this paper is structured as follows: The literature review presents a comprehensive review of the theoretical foundations and empirical studies related to innovation ecosystem theory, breakthrough innovation theory, and institutional theory. It also integrates these theories to form the study's hypotheses. The research methodology outlines the research design, sample selection, data collection methods, and measurement of the variables. It also describes the statistical techniques used for data analysis and hypothesis testing. The results present the study's findings and the interpretation of the data. The discussion offers a detailed analysis of the findings from the existing literature. It emphasizes the study's theoretical and practical implications and offers recommendations for managers and policymakers. The conclusion summarizes the key findings, contributions, and limitations of the study, as well as suggestions for future research.

2. Theoretical Background and Hypotheses Development

2.1. Underpinning Theory

The concept of ecosystems is instrumental in understanding process-oriented phenomena that involve the utilization and recycling of environmental resources to maintain a system in a state far from equilibrium. At equilibrium, members may perish, and organizations may face bankruptcy [20]. The theory of innovation ecosystems emphasizes participants' critical role as fundamental components within the ecosystem, which is crucial for achieving value co-creation [21]. This theory helps to elucidate how interconnected actors within an innovation ecosystem collaborate and interact to foster innovation and sustain the system.

Breakthrough innovation theory has gained prominence due to its focus on technological innovation, transformation, and globalization [22–24]. One study [25] describes breakthrough innovation as "game-changing," and [26] characterizes it as a "foundational" invention. This type of innovation has the potential to significantly alter technological trajectories and drive the development of new markets and customer bases [27]. The theory provides a framework for understanding how breakthrough innovations can impact firms and industries.

According to institutional theory [15], firms operate within a distinct institutional environment, with external institutional support playing a crucial role in establishing a robust foundation for long-term success. This theory highlights the importance of the broader institutional context in shaping firm behavior and performance, emphasizing how external pressures and supports influence organizational practices.

This study combines three different types of theory: innovation ecosystem theory, breakthrough innovation theory, and institutional theory. The goal is to generate new ideas about how innovation eco-embedding improves the performance of non-core businesses, especially in an emerging economy. This theoretical integration provides a comprehensive framework to examine the interplay between innovation, institutional support, and performance outcomes.

2.2. Innovation Eco-Embeddedness

Innovation eco-embeddedness refers to the integration of non-core firms into a cooperative and open innovation ecosystem, which comprises various participants working towards collaborative innovation. This integration involves developing mutually beneficial collaborations that facilitate resource sharing and leverage the advantages of ecosystem members) [5]. In this study, innovation eco-embeddedness is defined as the engagement of ecological non-core firms within an open and collaborative innovation ecosystem [3]. This engagement allows firms to operate within a favorable ecological niche for steady growth and form beneficial ecological partnerships, thereby gaining access to a wide range of innovation resources and achieving synergistic interdependence [28,29].

The authors of [3] propose a classification of innovation eco-embeddedness into two key dimensions, based on the nature of interactions and the specific ecosystem location. Within innovative partnerships, the eco-embeddedness relationship refers to the complementary connections between non-core firms and other partners. It encompasses the capabilities and resource availability of ecological collaborative firms. A non-core firm holds the eco-embeddedness position in the network, reflecting the diverse range of resources and opportunities available to the organization. The authors of [3] further argue that examining these two dimensions provides a more comprehensive understanding of the capabilities and impact of innovation eco-embeddedness behavior among non-core firms. Consequently, this study measures innovation eco-embeddedness as a unified construct, incorporating both dimensions to assess its influence on firm performance.

While innovation eco-embeddedness allows non-core firms to access a variety of resources and enter collaborative innovation, the character of the innovation resulting from such ecosystems is important. There are two forms of disruptive innovation that are often discussed in the literature: radical innovation and breakthrough innovation.

According to [30], radical innovation involves fundamental changes in technology and markets, often leading to the creation of entirely new industries. This implies that radical innovation involves the complete dismantling of current technologies, thereby rendering previous products obsolete. It also fosters the emergence of new industries. On the other hand, breakthrough innovation involves a drastic change in technological trajectories and market structures, without necessarily opening up new industries. According to [26], breakthrough innovation is usually based on the prevailing technologies and develops new applications or market opportunities.

While the shift from feature phones to smartphones is a breakthrough innovation, offering significant improvement in existing technology without the birth of a new industry, radical innovations are much deeper changes, enabling new industries to develop, such as when e-commerce was ushered in by the invention of the internet.

When non-core firms engage in eco-embeddedness, they often encounter discontinuous or breakthrough innovations. These companies, on the periphery of ecosystems, generally cannot drive radical innovation themselves; still, they can use ecosystem partnerships to realize breakthrough innovations that will significantly improve their competitive advantage in existing markets. Understanding this distinction can provide a better understanding of the strategic approaches non-core firms must make to leverage their eco-embeddedness for innovation performance.

2.3. Innovation Eco-Embeddedness and IP

Strategic alliances between firms facilitate relationships that enable embedded enterprises to access technologies and knowledge from other network participants [31]. Such inter-firm networks offer flexible and efficient access to resources interconnected with other firms or industries [32,33]. Research on organizational network positions indicates that firms can acquire and utilize a broader range of resources through their social network affiliations [34]. These embeddedness networks enhance knowledge acquisition and information sharing, although these studies primarily focus on core firms. For non-core firms, a greater number of firms filling an ecological niche translates to more beneficial network positions from an eco-embeddedness perspective. This is due to the increased diversity and number of external resources available to the firm [3]. Essential and hard-to-replicate resources are critical for maintaining a competitive edge.

Non-core firms with a higher level of eco-embeddedness can access extensive technological and innovation knowledge, including diverse resources provided by ecological partners. Such benefits enhance internal resources and contribute to the creation of new knowledge and ideas, thereby supporting internal R&D and innovation activities [35]. Consequently, a higher eco-embeddedness position aids non-core firms in achieving relevant innovative outcomes [36,37]. Ecological partners who share a common value system and technological expertise reduce knowledge gaps among members engaged in ecological collaboration. A higher eco-embeddedness position helps companies obtain important inputs, but non-core organizations may not be able to use these inputs if the partners' skills and resources do not complement each other [38]. Strong relationships and collaborative innovation with complementors enhance resource capabilities and assist non-core enterprises in more effectively integrating complementary and internal resources [6]. So, the eco-embeddedness relationship helps non-core organizations create new multimodal dimensions and improve the absorption and transfer of innovation, which leads to better innovation performance [3,38]. Based on the aforementioned discussion, the following hypothesis is posited:

H1. *Innovation eco-embeddedness positively influences IP in non-core organizations.*

2.4. Innovation Eco-Embeddedness and Breakthrough Innovation

Manufacturing firms are increasingly focusing on responding to market opportunities by integrating technologies and external knowledge to drive innovation, despite the lack of extensive examination of the direct link between innovation eco-embeddedness and BI [39,40]. Previous studies have also highlighted the challenges organizations face in fostering breakthrough innovation internally [30,41]. This difficulty is often due to the need to combine diverse new forms of knowledge to drive innovation [9]. Therefore, breakthrough innovation often requires a broad spectrum of external knowledge inputs, suggesting that firms engaging with various focal organizations are more likely to succeed in achieving breakthrough innovations. According to ecological perspective and innovation ecosystem theory, a firm's position within a network has a significant impact on its ability to access innovative resources [37]. A favorable eco-embeddedness position, characterized by proximity to the center of the ecosystem, enhances a firm's stability and [3,42].

By fostering connections with a diverse range of ecological partners, non-core firms can effectively develop and nurture breakthrough innovations. Furthermore, eco-embeddedness enhances a firm's knowledge search and storage capabilities, broadening its awareness of technological advancements and customer demand trends [3]. Exposure to emerging technologies and new knowledge is crucial for breakthrough innovation [24,40,43]. While homogeneous resources can expedite knowledge acquisition, they may also lead to redundancy and inefficiencies in novelty [3]. In contrast, the eco-embeddedness relationship promotes access to heterogeneous resources through complementary ties, which are more conducive to fostering innovation. Such heterogeneous resources help to address knowledge deficiencies and meet the innovation requirements of ecological partners [44]. Thus, eco-embeddedness facilitates the acquisition and reconfiguration of resources, enhancing the potential for breakthrough innovation. Based on the above discussion, the following hypothesis is proposed:

H2. *Innovation eco-embeddedness positively influences breakthrough innovation in non-core organizations.*

2.5. Breakthrough Innovation and Innovation Performance

The significance of innovation in achieving and sustaining a competitive advantage is well-established in the literature [45,46]. Innovation is a strategic process that enables firms to leverage their capabilities and assets to achieve desired performance outcomes [47]. This process involves the generation and acceptance of new ideas, methods, services, or products [48,49]. Breakthrough innovations have been categorized into two distinct types [35]. Technological innovation enhances value creation by improving processes and products [50]. Market innovation involves entering new markets and targeting new customer segments rather than focusing solely on existing market niches [51]. This approach expands market reach and drives growth by exploring new opportunities.

Although the existing literature has not extensively examined the impact of breakthrough innovation on innovation performance, within non-core firms in ecological partnerships specifically, relevant studies provide insights into this relationship. The authors of [35] found that both technological and market innovations positively affect performance. Additionally, cross-national research indicates that market orientation has a favorable impact on organizational performance. Further, exploratory learning, idea generation, iterative problem-solving, and the development of innovation models contribute to enhanced innovation and faster commercialization [52]. Building on these perceptions and extending the existing literature, the following hypothesis is proposed:

H3. *Breakthrough innovation positively influences IP in non-core firms.*

2.6. The Intervening Role of Breakthrough Innovation

Eco-embeddedness allows firms to expand their access to resources and enhance collaboration within ecological systems [3]. The ability of firms to translate external inputs gained through eco-embedding into performance outcomes largely depends on the development of breakthrough innovation. By exploring various technological and market domains, firms can understand patterns of technological transformation and anticipate future market needs. This knowledge enables firms to utilize innovative techniques to identify and examine new markets, thereby reshaping their core strengths and competitive edges. Breakthrough innovation plays a crucial role in mediating the relationship between eco-embeddedness and innovation performance.

Firms with high eco-embeddedness positions have access to diverse and non-redundant resources, which can facilitate the development of breakthrough innovations [3,53]. This access supports the creation of adaptive strategies and a better understanding of stakeholder requirements and environmental dynamics, ultimately leading to enhanced innovation performance. A higher level of eco-embeddedness provides non-core firms with a greater variety of unique and non-redundant resources [54,55]. This resource availability is crucial for the development of breakthrough innovations and adaptive strategies. The insights gained from a diverse resource pool and comprehensive external information help firms to effectively manage uncertainties and respond to market fluctuations. This capacity for adaptation and resource management is vital for achieving high innovation performance [3,56–58]. Based on the discussion, is the following hypothesis is posited:

H4. *The relationship between eco-embeddedness and innovation performance is mediated by breakthrough innovation.*

2.7. Ecological Legitimacy as a Moderator

The perception of a firm's actions and values as appropriate and aligned with social and institutional standards is known as ecological legitimacy [59]. It involves external evaluations that determine a firm's acceptance and recognition within its institutional environment. As a key element of institutional theory, ecological legitimacy enables firms to access external resources and gain support from stakeholders [60]. Ecological legitimacy can influence the effectiveness of eco-embeddedness and the success of resource utilization within an innovation ecosystem. According to [2], the impact of eco-embeddedness on resource accessibility and innovation effectiveness is determined by non-core firms' recognition and alignment with ecological values and public perceptions.

If a non-core firm's innovation does not advance or complement the ecosystem's objectives and fails to gain recognition from collaborators, it may not receive support [3]. A lack of ecological legitimacy can lead to resistance from the ecosystem and the potential loss of partnership status [2,3,29]. Achieving ecological legitimacy can enhance the effectiveness of resource utilization and capability improvement, including breakthrough innovation [24,40,51]. Firms with high levels of ecological legitimacy are better positioned to satisfy evolving consumer expectations and improve performance. Based on this discussion, the following hypotheses are proposed:

H5. *The relationship between innovation eco-embeddedness and breakthrough innovation is moderated by ecological legitimacy. That is, the higher the level of ecological legitimacy, the stronger the influence of innovation eco-embeddedness and breakthrough innovation.*

H6. *The relationship between breakthrough innovation and IP is moderated by ecological legitimacy. That is, the higher the level of ecological legitimacy, the stronger the influence of innovation eco-embeddedness on IP.*

2.8. The Joint Conditional Role of Technological Turbulence and Ecological Legitimacy

Performance-related outcomes in non-core firms often depend on multiple, complementary external factors [3,17,51,61]. Non-core firms face unique challenges, such as a the "liability of newness" and limited resources compared to core firms, which affect their ability to nurture innovation effectively [2,62]. Both technological turbulence and ecological legitimacy play significant roles in moderating the impact of innovation breakthroughs on performance [63]. Technological turbulence refers to the pace of technological advancements and their potential impact on firms [64]. Non-core firms must adapt to rapid technological changes to develop and enhance their innovation capabilities. Unlike core firms, which are typically more attuned to technological advancements, non-core firms must actively upgrade their network capabilities and leverage emerging technologies to maintain competitive advantage [65]. Ecological legitimacy is crucial for non-core firms as it influences their ability to access resources and gain support from stakeholders [60]. It enables firms to integrate into ecosystems, expand their resource streams, and gain insights into consumer demands and regulations [2,3]. However, lower levels of technological turbulence may constrain the effectiveness of ecological legitimacy for innovation performance.

Ecological legitimacy and technological turbulence work together to moderate the relationship between breakthrough innovation and innovation performance. High ecological legitimacy enables firms to access a variety of resources and support, while high technological turbulence fosters the emergence of advanced technologies that improve access to external knowledge. The combination of both factors strengthens the impact of breakthrough innovation on performance [17,66]. For instance, technologies like big data analytics enable firms to process external intelligence more effectively [67,68]. Leveraging ecological legitimacy allows non-core firms to collaborate and innovate more effectively. Simultaneously, technology turbulence provides access to advanced technologies that mitigate uncertainties and investment risks. The synergistic effect of high ecological legitimacy and technological turbulence results in improved innovation performance. Based on the above discussion, the following hypothesis is proposed:

H7. *The indirect relationship between eco-embeddedness in IP through BI is strongest when both ecological legitimacy and technological turbulence are high.*

3. Methodology

3.1. Research Context

Turkey is considered an emerging market economy and is frequently categorized as a newly industrialized country. The growth of Turkish industry can be attributed to several factors, including its favorable geopolitical position and government incentives aimed at attracting local and foreign investors. In total, 84% of Turkey's overall production comes from the manufacturing sector, including food production, basic metals, textiles, rubber and plastics, chemicals and chemical products, clothing, and electrical equipment [69]. However, approximately 75% of Turkey's total imports are intermediate goods, suggesting an enormous reliance on foreign inputs in the country's domestic production [70]. In part, this can be attributed to the increasing integration and globalization of the global value chain in recent years. The entrance of foreign-owned enterprises and major multinational corporations has further increased the importation of intermediate goods within the industrial sector [71].

Another possible explanation is that the required inputs are not domestically produced, or that local firms lack certain required expertise and technologies, making import dependency a defining attribute of the Turkish economy [70]. Since Turkish firms cannot innovate autonomously, dealing with the ever-changing competitive environment is challenging based on their capabilities and resources. As a result, Turkish firms are attempting to create different innovation strategies with external corporations and expanding the number of partnerships inside the innovation ecosystem to obtain competitive strategies. This makes the Turkish manufacturing industry an interesting research context for our study. Moreover, it is essential to understand how and under what conditions innovation-eco embeddedness promotes innovation performance in such an important industry.

3.2. Research Design, Sampling, and Data Collection

This study uses a quantitative research approach by employing a cross-sectional research design. Specifically, questionnaires were used to collect data. Non-core Turkish manufacturing firms within ecosystems listed in the Trade Register Gazette of Turkey were selected for the sample (TOBB, 2023). The primary attributes of the non-core firms surveyed by this study include relatively limited capacity for independent innovation and resource constraints and are embedded into ecosystems to acquire information, capabilities, and resources that can provide collaborative innovation and complementary advantage. The survey participants were middle and senior-level managers who possess a deep understanding of the operations and innovation performance of the firms, to ensure that the survey results accurately reflected the actual conditions of the firms.

To ensure the questionnaires' accuracy before formal distribution, we conducted an in-depth interview with 50 middle and senior-level managers of non-core firms who deeply understand corporate information in the manufacturing industry within several ecosystems. The interviews aimed to ensure that the language and the clearness of the questionnaires aligned with the realities of the firms. Based on the feedback, a number of the items on the questionnaires were modified for better comprehension. We employed the purposive sampling method to enhance the efficacy of the sample. Following the procedures in [3] to ensure the samples were representative of the subjects intended, two screening questions were asked: "Are you a non-core firm?" and "Are you operating within an ecosystem primarily controlled by a platform?" In addition, the "R and D intensity" in the demographic information was included to assess the level of technological research and development and product and service innovation among the subjects included in the sample. The majority of the surveyed firms were actively engaged in innovation, making the sample representative of such characteristics. To enhance the diversity of the sample, this included a wide range of innovation ecosystems, considering various "business types" (see Table 1).

Table 1. Demographic characteristics.

	Category	Frequency	Percentage (%)
Gender	Male	407	89.69
	Female	49	10.31
Education			
	Bachelor's	289	63.38
	Master's	144	31.58
	PhD	23	5.04
Business Type			
	Chemicals and petrochemicals	12	2.63
	Plastics and rubber	47	10.31
	Electrical and electronics	58	12.72
	Medical and pharmaceutical	66	14.47
	Wood and furniture	47	10.31
	Building materials	84	18.42
	Food and beverages	43	9.43
	Textiles and apparel	99	21.71
R and D intensity			
	<3%	18	3.95
	3–6%	104	22.81
	6–10%	224	49.12
	11–15%	75	16.45
	Over 15%	35	7.67

The data collection occurred from 8 March 2023 to 4 July 2023. In total, 886 questionnaires were sent out via e-mail and on-site survey. In total, 474 responses were recovered, and due to incompleteness, 18 responses were discarded, resulting in a response rate of 51.47%. The demographic characteristics of the participants are displayed in Table 1. In terms of gender, the majority, 407 (89.69%), were male, and 49 (10.31) were female. In terms of education, the majority, 289 (63.38%), had a bachelor's degree, while 144 (31.58%) had a master's degree and 23 (5.04%) had a doctoral degree. The business types were represented by the following numbers: textiles and apparel, 99 (21.71%), building materials, 84 (18.42%), medical and pharmaceutical, 66 (14.47%), electrical and electronics, 58 (12.72%), plastics and rubber, 47 (10.31%), food and beverages, 43 (9.43%), and chemical and petroleum, 12 (2.63%). In terms of R and D intensity, the majority of the surveyed firms, 224 (49.12%), had 6–10%, 104 (22.81%) had 3–6%, 75 (16.45%) had 11–15%, over 35 (7.67%) had over 15%, and 18 (3.95%) had less than 3%.

3.3. Survey Instruments

This study utilized well-validated scales from the existing literature to measure the research variables. Since Turkish firms were surveyed by this study, the back-translation approach established by Brislin (1970) [72] was utilized to help ensure the quality and reliability of the translation.

Innovation eco-embeddedness was measured through items adopted from [44,73–75]: 5 items for eco-embeddedness relation and 5 items for eco-embeddedness position. The respondents were asked to rate the extent to which their non-core firms were embedded into cooperative and open innovative ecosystems with the objective of collaborative innovation.

Breakthrough innovation was measured through 6 items adopted from [76,77].

Ecological legitimacy was measured through 4 items adopted from [59,77] and revised by [3]. Respondents were asked to rate the extent to which their firm activities aligned with societal expectations within innovation ecosystems and earned acceptance and recognition from various ecological collaborators.

Technology turbulence was measured through 4 items [78].

Innovation performance was measured through 4 items from [79,80]. The items assess the market and financial aspects of innovation. The specific items used to measure each construct in the study are detailed in Appendix A, Table A1.

4. Data Analysis and Results

SPSS 27 and AMOS 26 were used to analyze the data collected. Cronbach's alpha was used to determine the reliability of the measurement items. Confirmatory factor analysis (CFA) was used to examine the validity of the model; convergent and discriminant validity were computed, and various goodness-of-fit indices were provided for the research model. Pearson correlation coefficients were computed among the study's constructs.

For hypothesis testing, we utilized Hayes's PROCESS macro, and for regression modeling, we computed the mean scores of the items for each variable. To determine the statistical significance of each regression coefficient, we employed the Bootstrapping technique with a bias-corrected percentile. Through the use of a confidence interval (CI) of 95% and a total of 5000 resamples, the direct, mediating, and moderating effects of the conceptual hypotheses were examined. CI that excludes zero implies the existence of a statistically significant effect.

4.1. Non-Response Bias

The assessment of non-response bias was conducted for early and late responses using Armstrong and Overton's methods (1977). Early and late responses were compared by taking into consideration the independent variable and the moderators. We then compared early and late responses of the dependent variable and the mediator. We found no evidence of non-response bias in the current study after conducting an independent t-test to compare early and late responses. Hence, it was demonstrated that non-response bias is not a concern in the current study.

4.2. Common Method Bias (CMB)

Since this study adopts a cross-sectional research method, CMB is a potential issue that arises when a respondent consistently responds to items in a particular manner across various measures, which can lead to erroneous relationships among constructs. To address the issue of CMB, we adopted various ex ante and ex post remedies. The ex ante remedies included several procedural measures, such as measures involved in data collection, using unambiguous sentences, selecting well-validated measurement items from the existing literature, ensuring respondents' complete anonymity, organizing the questionnaire into different sections, and refraining from questions that covered multiple issues at once.

Regarding ex post remedies, we conducted several widely used statistical procedures. All the measurement items were loaded into a common latent factor in AMOS. It was found that there was no statistically significant difference ($p > 0.05$) between the model's standardized regression weight with and without common latent factors. Further, we followed [81]'s marker variable technique, which requires the selection of a variable that has no theoretical connection with the constructs under investigation. To this end, "personal adventure shopping" (a theoretically unrelated construct to the main variables of interest) was incorporated into the questionnaire. This marker variable was assessed using three specific items: "Shopping is a thrill to me", "I find shopping stimulating", and "To me, shopping is an adventure". According to [81], if the marker variable is discovered to have a significant correlation with the constructs under examination, it indicates that the respondents tended to answer the survey items in a particular manner across multiple measures, which can lead to erroneous relationships among the constructs. The results revealed that the marker variable had a non-significant correlation (i.e., <0.08) with the main variables of interest. In addition, we conducted Harman's single-factor test. This involved extracting five factors that had eigenvalues greater than 1. The results revealed that the first factor accounted for 33.16%, which is below the recommended threshold of 50%. Based on the ex ante and ex post remedies employed by the current study, it can be said that CMB is unlikely to have been an issue in this study.

4.3. Measurement Model

As illustrated in Table 2 and Figure 2, for each item, the standardized factor loadings were all statistically significant at the 1% level, offering evidence of convergent validity. The results revealed that these loadings were between 0.693 and 0.935, which were above the recommended minimum threshold of 0.6 [82]. Additionally, the Cronbach's α (0.879 to 0.936) and composite reliability (0.854 to 0.943) for each variable were above the recommended benchmark of 0.7 [83]. In addition, the AVE values (0.539 to 0.788) for all the constructs were above 0.5 [84], offering evidence that the measurement items are consistent and reliable.

Table 2. Assessment of reliability and validity.

Construct		Indicator	Cronbach's Alpha	Factor Loading	T Value	CR	AVE
Innovation-eco embeddedness							
	Eco-embeddedness relation		0.895			0.889	0.618
		ECR1		0.793			
		ECR2		0.870	17.726 ***		
		ECR3		0.810	15.870 ***		
		ECR4		0.723	16.115 ***		
		ECR5		0.710	14.422 ***		
	Eco-embeddedness position					0.854	0.539
		ECP1	0.879	0.693			
		ECP2		0.743	18.867 ***		
		ECP3		0.778	18.963 ***		
		ECP4		0.743	16.409 ***		
		ECP5		0.704	20.529 ***		
Breakthrough innovation			0.926			0.943	0.734
		BI1		0.782			
		BI2		0.760	21.950 ***		
		BI3		0.847	27.754 ***		
		BI4		0.935	36.847 ***		
		BI5		0.868	29.552 ***		
		BI6		0.932	35.990 ***		
Ecological legitimacy			0.928			0.931	0.771
		EL1		0.784			
		EL2		0.922	30.401 ***		
		EL3		0.906	29.245 ***		
		EL4		0.894	28.114 ***		

Table 2. *Cont.*

Construct	Indicator	Cronbach's Alpha	Factor Loading	T Value	CR	AVE
Technology turbulence		0.936			0.937	0.788
	TT1		0.935			
	TT2		0.923	24.456 ***		
	TT3		0.878	22.666 ***		
	TT4		0.809	20.774 ***		
Innovation performance		0.901			0.896	0.685
	IP1		0.896			
	IP2		0.881	24.707 ***		
	IP3		0.753	19.239 ***		
	IP4		0.770	19.943 ***		

Note: ECR = eco-embeddedness relation, ECP = eco-embeddedness position, BI = breakthrough innovation; EC = ecological legitimacy, TT = technology turbulence, IP = innovation performance, *** = significant at 0.001 level, CR = composite reliability, AVE = average variance extracted.

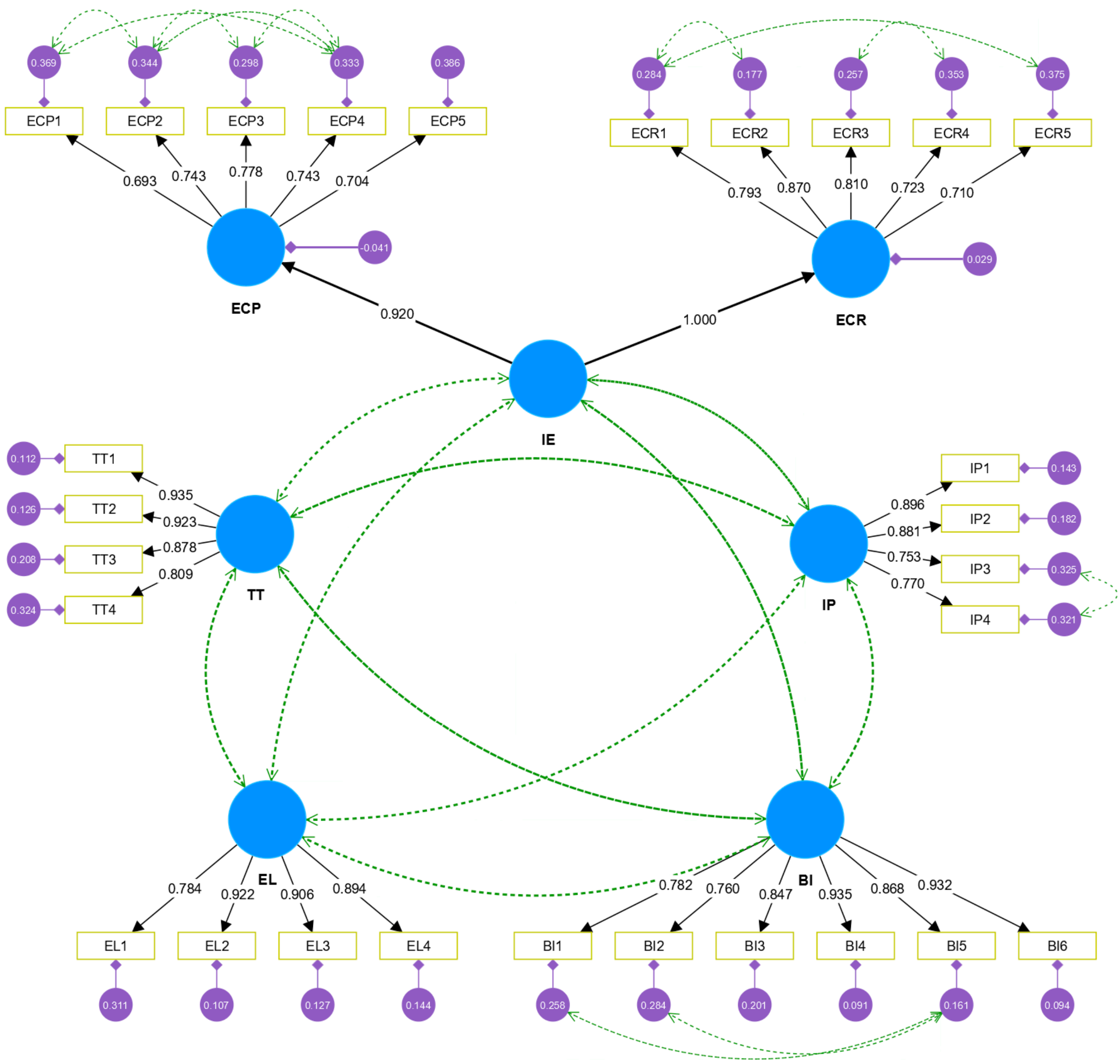

Figure 2. CFA results.

Furthermore, as recommended by [84], we checked whether the square root of the AVEs for each construct exceeded the surrounding correlations. As shown in Table 3, the square root of all the AVEs was greater than the nearby correlations, offering support for the discriminant validity.

Table 3. Discriminant validity.

	Mean	SD	ECR	ECP	BI	EL	TT	IP	Edu	BT	R and D Intensity
ECR	3.793	0.727	**(0.785)**								
ECP	3.788	0.711	0.656 **	**(0.734)**							
BI	3.770	0.735	0.385 **	0.336 **	**(0.857)**						
EL	2.491	0.625	0.376 **	0.367 **	0.302 **	**(0.878)**					
TT	2.229	0.606	0.366 **	0.354 **	0.376 **	0.380 **	**(0.888)**				
IP	3.955	0.770	0.380 **	0.423 **	0.367 **	0.215 **	0.258 **	**(0.827)**			
Edu	2.120	1.099	0.022 **	0.058 **	0.079 **	0.107 **	0.084 **	0.105 **	-		
BT	4.430	2.146	0.154 **	0.062 **	0.092 **	0.132 **	0.117 **	0.067 **	0.037 **	-	
R and D intensity	2.850	0.757	0.200 **	0.118 **	0.205 **	0.163 **	0.133 **	0.227 **	0.294 **	0.208 **	-

Note: M = mean, SD = standard deviation, ** indicates significance at 0.01. Bold values on the diagonal represent the square root of the Average Variance Extracted (AVE). For discriminant validity, these values should be higher than the correlations (off-diagonal values) between constructs.

To assess the reliability and validity of the multi-item measures in this study, we employed confirmatory factor analysis (CFA) with maximum likelihood estimation. As recommended by [85], the model fit was evaluated using approximate fit heuristics. Specifically, absolute fit statistics such as χ^2/df, RMSEA, AGFI, and GFI, incremental fits such as RFI, CFI, IFI, NFI, and TLI, and parsimony fit such as PGFI, PCFI, and PNFI were used to assess the model fit. Accordingly, as illustrated in Table 4, the results obtained from the CFA show acceptable model fit, with χ^2/df = 2.237, RMSEA = 0.052, and AGFI = 0.874 and GFI = 0.898, RFI = 0.924, CFI = 0.962, IFI = 0.963, NFI = 0.934, and TLI = 0.957, and parsimony fit, with results such as PGFI = 0.724, PCFI = 0.833, and PNFI = 0.808.

Table 4. Model fit summary.

Parameters	χ^2/df	TLI	CFI	RFI	NFI	IFI	AGFI	GFI	RMSEA
One-factor model	8.552	0.518	0.499	0.534	0.546	0.562	0.486	0.532	0.197
Two-factor model	5.449	0.607	0.619	0.626	0.609	0.629	0.572	0.599	0.139
Three-factor model	4.007	0.738	0.752	0.769	0.772	0.786	0.692	0.704	0.128
Five-factor model (adopted conceptual model)	2.237	0.957	0.962	0.924	0.934	0.963	0.874	0.898	0.052
Seven-factor model	3.119	0.852	0.866	0.850	0.877	0.889	0.802	0.784	0.102

Moreover, as depicted in Table 5, the adopted conceptual model satisfies the goodness-of-fit metrics compared to the alternative models. The adopted model, being a second-order measurement, is worth noting. According to [86,87], it has been demonstrated that in cases in which the theoretical foundations are robust, a second-order measurement can be adopted that provides a more interpretable and parsimonious model compared to other alternative models. As can be seen in Table 5, the five-factor model (innovation eco-embeddedness, breakthrough innovation, ecological legitimacy, technology turbulence, and innovation performance) provided a superior fit compared to the alternative models.

Table 5. Summary of model fit (adopted model).

Fit Metrics	Limits	Obtained Results
Absolute fit		
χ^2/df	<3	731.628/327 =2.237
RMSEA	>0.08	0.052
GFI	>0.8	0.898
AGFI	>0.8	0.874
Incremental fit		
RFI	>0.9	0.924
IFI	>0.9	0.963
CFI	>0.9	0.962
NFI	>0.9	0.934
TLI	>0.9	0.957
Parsimony fit		
PGFI	>0.5	0.724
PCFI	>0.5	0.833
PNFI	>0.5	0.808

Note: RMSEA = Root Mean Square Error of Approximation, GFI = Goodness of Fit Index, AGFI = Adjusted Goodness-of-Fit Index, RFI = Relative Fit Index, IFI = Incremental Fit Index, CFI = Comparative Fit Index, NFI = Normed-Fit Index, TLI = Tucker–Lewis Index, PGFI = Parsimony Goodness-of-Fit Index, PCFI = Parsimony Normed-Fit Index, PNFI = Parsimony Normed-Fit Index.

4.4. Hypotheses Testing: Mediation Model

To test hypotheses H1, H2, and H3 and the mediation (H4), Model 4 from Hayes (2022) [88], PROCESS macro, was used. The results of the mediation model are illustrated in Table 6.

Table 6. Hypothesis testing: direct and mediating effects.

	Innovation Performance				**Breakthrough Innovation (H2)**				**Innovation Performance**			
	Step 1				**Step 2**				**Step 3**			
	β	**SE**	**t**	***p***	**β**	**SE**	**t**	***p***	**β**	**SE**	**t**	***p***
Constant	1.610	0.207	7.799	0.000	2.252	0.179	12.617	0.000				
IE **(H1)**	0.364	0.050	7.317	0.000	0.401	0.046	8.646	0.000				
BI **(H3)**									0.256	0.047	5.472	0.000
R^2	0.226				0.141							
F	66.148				74.751							
df1	2.000				1.000							
df2	453.000				454.000							
Total Effect		Total Effect	SE	t	p	LL	UP					
		0.467	0.048	9.809	0.000	0.373	0.560					
Direct Effect		Direct Effect										
IE-IP		0.364	0.050	7.317	0.000	0.266	0.462					
Indirect effect (H4) via bootstrap (Mediation validation)						**Boot SE**	**Boot LL**	**Boot UP**				
IE-BI-IP						0.032	0.046	0.173				

Bootstrap resample: 5000.

In step 1 in Table 6, it was discovered that innovation eco-embeddedness positively influences innovation performance (β = 0.364, t = 7.317, $p < 0.001$), which validates H1. In step 2 in Table 6, it was found that innovation eco-embeddedness positively influences breakthrough innovation (β = 0.401, t = 8.646, $p < 0.001$), in support of H2. In step 3 in Table 6, breakthrough innovation was found to positively influence innovation performance (β = 0.256, t = 5.472, $p < 0.001$), which validates H3.

To determine the mediation role of breakthrough innovation, it was crucial to verify whether the indirect effect is significant. Additionally, it was also checked whether breakthrough innovation is a full or partial mediator of the innovation eco-embeddedness–innovation performance relationship. Based on 5000 bootstrap resamples, when breakthrough innovation was included as a mediator in the link between innovation eco-embeddedness and innovation performance (i.e., IE-BI-IP), the direct effect remained significant. As illustrated in Table 6, the bootstrap results for the bias-corrected percentile validate the mediating effect ($\beta_{\text{indirect effect}}$ = 0.102, SE = 0.032, CI [0.046, 0.173]). The CI excludes zero. Hence, H4 was validated and it was implied that breakthrough innovation partially mediated the relationship between innovation eco-embeddedness and IP.

4.5. Hypotheses Testing: Moderation Model

We employed Model 70 from [88], PROCESS macro, to examine the moderated mediation model. To prevent multi-collinearity issues, the constructs were mean-centered to create the interaction terms. As a result, three interaction terms were generated: (a) innovation-eco-embeddedness × ecological legitimacy, (b) innovation breakthrough × technological turbulence, and (c) innovation breakthrough × ecological legitimacy × technology turbulence. Additionally, education, business type, and R and D intensity were included as covariates in the moderated mediation model. The results of the moderated mediation model are presented in Table 7.

Table 7. Moderated mediation analyses.

Moderated Regression Analysis Results (PROCESS Model = 70) **Bootstrap CI 95%**							
	Coeff	**SE**	**t**	***p***	**LLCI**	**UPCI**	R^2
Step 1: mediator construct model	Outcome: Breakthrough Innovation						
Constant	1.922	0.153	11.568	0.000	1.783	2.402	0.194
Co: Education	−0.026	0.026	−1.014	0.311	−0.078	0.023	
Co: Business Type	0.005	0.013	0.007	0.963	−0.027	0.027	
Co: R and D intensity	0.094	0.039	2.221	0.021	0.014	0.173	
Innovation Eco-Embeddedness	0.361	0.042	7.226	0.000	0.330	0.643	
Ecological Legitimacy	0.195	0.041	3.114	0.019	0.153	0.379	
Interaction: H5 Innovation Eco-Embeddedness X Ecological Legitimacy	0.057	0.031	1.262	0.059	−0.104	0.058	
Step 2: dependent construct model	Dependent: Innovation Performance						
Constant	1.324	0.189	6.996	0.000	1.109	1.779	0.165
Co: Education	−0.019	0.020	−0.889	0.446	−0.039	0.069	
Co: Business Type	0.010	0.016	0.014	0.997	−0.009	0.072	
Co: R and D Intensity	0.016	0.018	0.750	0.953	−0.011	0.025	
Innovation Eco-Embeddedness	0.309	0.048	6.461	0.000	0.265	0.526	
Breakthrough Innovation	0.239	0.045	4.992	0.009	0.127	0.242	
Ecological Legitimacy	0.149	0.040	2.781	0.015	0.105	0.285	
Technology Turbulence	0.101	0.039	2.114	0.043	0.074	0.149	
Interaction: H6 Breakthrough Innovation X Ecological Legitimacy	0.202	0.044	4.229	0.012	0.134	0.239	
Breakthrough Innovation X Technology Turbulence	0.099	0.039	2.285	0.036	0.055	0.149	
Ecological Legitimacy X Technology Turbulence	−0.152	0.040	−2.623	0.014	−0.295	0.037	
Three-way interaction: H7 Breakthrough Innovation X Ecological Legitimacy X Technology Turbulence	0.142	0.040	2.624	0.034	0.086	0.184	
Conditional effect of innovation breakthrough on innovation performance							
Ecological legitimacy (−1SD)	0.184	0.039	4.482	0.029	0.316	0.498	
Ecological legitimacy (+1SD)	0.391	0.045	7.261	0.017	0.150	0.306	
Index of moderated mediation							
		Boot SE			**Boot LLCI**	**Boot ULCI**	
		0.035			0.067	0.115	

Note: n = 456; Co = control variables; bootstrap resample = 5000; LLCI = lower level; UPCI = upper level = upper level.

In step 1 in Table 7, innovation-eco-embeddedness positively influenced breakthrough innovation ($\beta_{IE\text{-}BI}$ = 0.361, SE = 0.042, p < 0.001, CI [0.330, 0.643]), but ecological legitimacy did not moderate this relationship ($\beta_{EL*IE\text{-}BI}$ = 0.184, SE = 0.035, p > 0.05, CI [−0.104, 0.058]), indicating that ecological legitimacy did not moderate the innovation eco-embeddedness–innovation breakthrough relationship. Thus, rejecting H5.

In step 2 in Table 7, breakthrough innovation positively influenced innovation performance ($\beta_{BI\text{-}IP}$ = 0.239, SE = 0.045, p < 0.01, CI [0.127, 0.242]), and ecological legitimacy moderated this relationship ($\beta_{EL*BI\text{-}IP}$ = 0.202, SE = 0.044, p < 0.05, CI [0.134, 0.239]). To gain a deeper understanding of the moderating effect, interaction plots were created using simple slope analysis at +1SD (i.e., one standard deviation above the mean) and −1SD (i.e., one standard deviation below the mean). The simple slope test revealed that at a higher level of ecological legitimacy ($\beta_{simple\ slope}$ = 0.391, SE = 0.045, p < 0.05, CI [0.316, 0.498]), the impact of breakthrough innovation on innovation performance is stronger, while at a lower level of ecological legitimacy ($\beta_{simple\ slope}$ = 0.184, SE = 0.039, p < 0.05, CI [0.150, 0.306]), the positive impact of breakthrough innovation on innovation performance is weaker. This supported H6. The graphical representation of the interaction is illustrated in Figure 3.

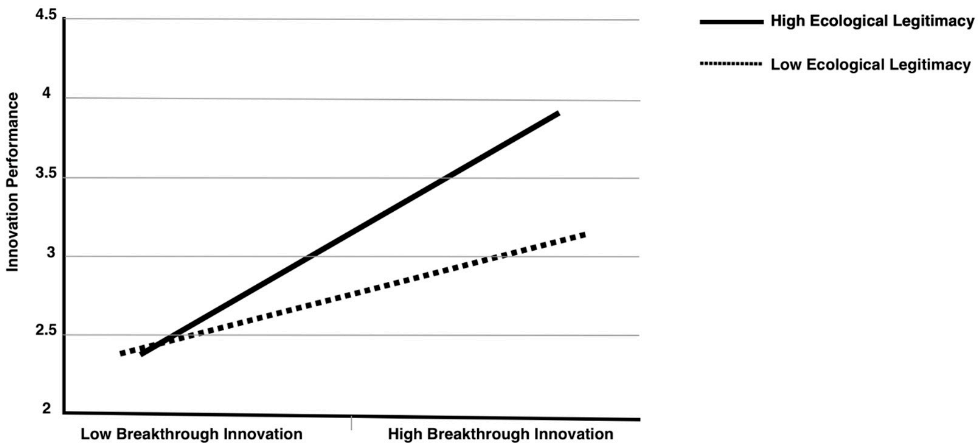

Figure 3. The interaction of breakthrough innovation and ecological legitimacy on innovation performance.

Furthermore, H7 proposes that the indirect impact of innovation eco-embeddedness on IP via breakthrough innovation is stronger when ecological legitimacy and technological turbulence are high. Nevertheless, in step 2 in Table 7, the regression coefficient of the interaction (i.e., three-way interaction) (breakthrough innovation x ecological legitimacy x technology turbulence) was significant and positive ($\beta_{BI\ X\ EL\ X\ TT}$ = 0.142, t = 2.624, p < 0.05, (Boot LLCI = 0.086, Boot LLUP = 0.184)). To explore this moderated mediation effect, we used simple slope analysis to examine the moderating effects at +1SD (i.e., one standard deviation above and below the mediator (breakthrough innovation)) and the two moderator constructs (ecological legitimacy and technology turbulence). Figure 3 depicts the visualization of the three-way interaction. Figure 4 demonstrates that innovation performance increases substantially only at a higher level of ecological legitimacy and technological turbulence, supporting H7. In addition, the simple slope differences were examined, as demonstrated in Table 8. The results revealed that when technology turbulence and ecological legitimacy are high, breakthrough innovation more significantly enhances the advancement of innovation performance, further supporting H7. However, in comparison with low technology turbulence, the effect is stronger and more significant with a high level of technology turbulence, while the effect is insignificant irrespective of the levels of ecology legitimacy.

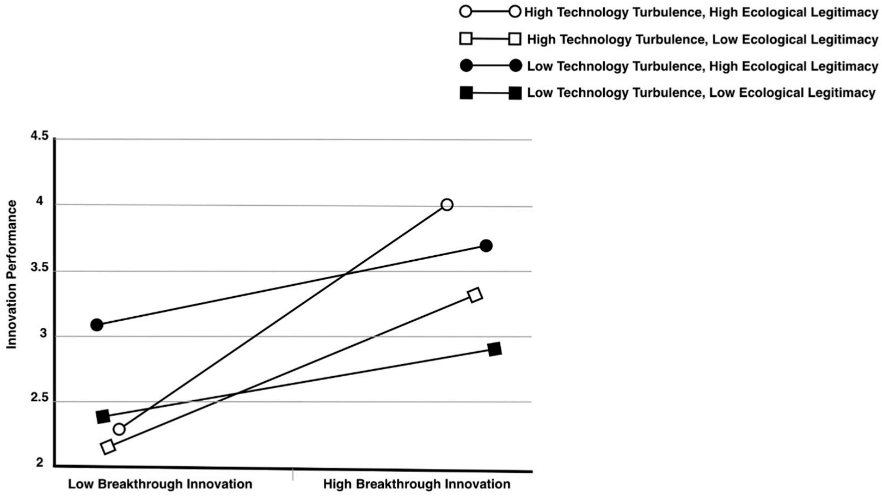

Figure 4. Three-way interaction between breakthrough innovation, technology turbulence, and ecological legitimacy.

Table 8. Simple slope test.

Innovation Performance		
	Slope	**T**
(a) High technology turbulence, high ecological legitimacy	1.104	4.001 ***
(b) High technology turbulence, low ecological legitimacy	1.001	3.199 **
(c) Low technology turbulence, high ecological legitimacy	0.410	1.290
(d) Low technology turbulence, low ecological legitimacy	0.120	0.689
Slope Differences		
(a) and (b)	1.321	3.113 ***
(a) and (c)	1.061	2.984 **
(a) and (d)	0.998	2.006 **
(b) and (c)	−0.580	−1.999 *
(c) and (d)	−0.661	−2.001 *
(c) and (d)	0.240	0.883

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$.

5. Discussion

This study used a sample from the Turkish manufacturing industry to look at how innovation eco-embeddedness affects IP in non-core firms. This was accomplished by combining ecosystem theory, innovation ecosystem theory, and institutional theory. The study also examined how innovation eco-embeddedness influences IP through breakthrough innovation, as well as the moderating roles of ecological legitimacy and technological turbulence.

The findings confirm that innovation eco-embeddedness positively affects innovation performance. This validates previous research [3] and reinforces the notion that non-core companies within ecosystems gain from collaborative relationships that facilitate the sharing and utilization of new information, thereby enhancing their performance [38,89]. Network members contribute organization-specific resources and complementary knowledge, which improves overall network performance and benefits embedded firms by reinforcing their innovation performance [90].

Innovation eco-embeddedness positively influences breakthrough innovation. Firms engaged in strategic alliances with other key organizations gain access to diverse forms of knowledge necessary for developing breakthrough innovations [43,91]. Participation in ecosystems allows non-core firms to leverage complementary assets and foster innovation through the combination of new knowledge inputs [92]. Breakthrough innovation, in turn, positively impacts innovation performance [40], suggesting that firms making significant strides in developing new technologies and methods enhance their performance by providing superior customer value compared to existing products and services. Breakthrough innovation partially mediates the relationship between innovation eco-embeddedness and IP. This finding underscores that breakthrough innovations, which arise from the integration of diverse knowledge components, are crucial for future development [93–95]. While complementary and diverse resources obtained through ecosystems provide direct support for innovation, they also indirectly enhance IP by promoting breakthrough innovation. Effective eco-embeddedness and communication with ecosystem partners allow firms to optimally use resources and overcome constraints, thus boosting innovation success and performance.

The results do not support the idea that ecological legitimacy moderates the relationship between eco-embeddedness and breakthrough innovation. However, ecological legitimacy significantly moderates the relationship between breakthrough innovation and IP. Higher ecological legitimacy makes it easier to access important resources and information, like what customers want and what the law states [2,3]. This makes the impact of breakthrough innovations on IP stronger. Firms with high ecological legitimacy are better positioned to adapt to ecosystem rules and effectively utilize resources, which enhances their innovation performance. The indirect relationship between innovation eco-embeddedness and IP through breakthrough innovation is strongest when both ecological legitimacy and technological turbulence are high. In a technologically turbulent environment, firms must adapt to rapid changes by engaging with innovation networks [96,97]. Non-core firms with high ecological legitimacy are better able to acquire the necessary resources and technological innovations, which helps to improve innovation performance in such environments.

6. Conclusions

6.1. Theoretical Contribution

This study introduces and empirically tests a novel integrated theoretical model combining ecosystem theory, breakthrough innovation theory, and institutional theory. Previous research predominantly focused on core organizations, portraying non-core firms as secondary participants within ecosystems and emphasizing central firms' role in leveraging their bargaining power by attracting more players [2,3,98,99]. In contrast, this research, based on the work in [3], highlights the importance of embedding non-core enterprises in favorable ecosystems. Our findings demonstrate that innovation eco-embeddedness significantly enhances the innovation performance of non-core firms in the Turkish manufacturing sector. This contribution enriches both the innovation ecosystem literature and ecosystem theory by emphasizing the role of non-core firms. Previous studies [3] have identified the performance implications of eco-embeddedness in non-core firms, but they have not thoroughly examined the specific relationship between eco-embeddedness and breakthrough innovation.

This research bridges this gap by examining how innovation eco-embeddedness influences breakthrough innovation and how breakthrough innovation, in turn, affects innovation performance. This study enhances comprehension of these connections and contributes to the co-creation literature by demonstrating that breakthrough innovation serves as a link between environmental embedding and the effectiveness of innovations. This finding advances breakthrough innovation theory and clarifies the mechanisms through which eco-embeddedness impacts performance. Institutional theory asserts that the institutional environment deeply influences organizational processes. This study expands on this theory by incorporating ecological legitimacy and technological turbulence into the theoretical model. Prior research has shown that firms in an ecosystem face institutional constraints and technological uncertainties [2,100]. Our findings reveal that ecological legitimacy enhances the impact of breakthrough innovation on innovation performance, illustrating the importance of legitimacy for non-core firms seeking to improve their performance. This research introduces a three-way interaction model, demonstrating that the mediating effect of breakthrough innovation is stronger when both technological turbulence and ecological legitimacy are high. By identifying technology turbulence as a crucial contingency, this study extends the current literature by showing how different conditions affect the relationship between innovation eco-embeddedness and innovation performance. This nuanced understanding provides new insights into how non-core firms can leverage technology turbulence and ecological legitimacy to enhance their innovation performance.

6.2. Practical Implications

Firstly, the positive relationship between innovation eco-embeddedness and innovation performance suggests that firms should prioritize embedding their innovation processes within the broader ecological context. This involves building strong relationships with various stakeholders, including suppliers, customers, regulatory bodies, and research institutions, to create a supportive innovation ecosystem. Firms can establish partnerships and collaborations that facilitate the sharing of resources, knowledge, and expertise, which can, in turn, drive innovation. Additionally, by positioning themselves as integral parts of the ecological system, firms can gain access to critical resources and support, further enhancing their innovation capabilities.

Non-core firms should also establish innovation cooperation with complementary organizations and strengthen their alliances to maintain the overall ecological balance. This mutual enhancement enables efficient resource reorganization and integration, resulting in unique value co-creation and growth-driven collaboration. Non-core firms should prioritize nurturing breakthrough innovation by leveraging their ecosystem embedding. By seeking and obtaining necessary resources within the ecosystem, non-core enterprises can focus on externally responsive innovation, such as identifying market gaps and customer needs in order to create new services and products that capture stronger performance benefits. This strategic focus on breakthrough innovation can significantly enhance competitive advantage and overall performance for these enterprises.

Third, this study discovered that the effect of breakthrough innovation on innovation performance depends on the degree of ecological legitimacy. Breakthrough innovation is a strategic tool for firms that enables successful breakthrough inventions to improve performance and gain competitive advantage [23,101]. Hence, managers of embedded firms in ecosystems should learn from eco-partners to gain knowledge and information to nurture breakthrough inventions to improve innovation performance. Managers of non-core organizations must strive to achieve ecological legitimacy to obtain increased support. The current research findings highlight the key role of the external institution environment in ecosystems. Non-core firms embedded in ecosystems should align with ecological norms and principles and comply with ecosystem regulations and guidelines. Additionally, they should continually strengthen ecological legitimacy to gain recognition and support from eco-members such as complementors, focal organizations, and suppliers. By adopting this approach, non-core companies can effectively uphold harmonious partnerships, thereby safeguarding the alignment of objectives and interests among collaborating entities.

Fourth, high levels of ecological legitimacy and technology turbulence strengthen the indirect effect of innovation eco-embeddedness on innovation performance through breakthrough innovation. Therefore, managers of non-core firms should understand that neither ecological legitimacy nor technology turbulence necessarily enhance the positive effect of eco-embeddedness on innovation performance through breakthrough innovation under all conditions. The findings of this research suggest that the indirect effect is the strongest when ecological legitimacy and technology turbulence are high. Hence, managers should pay appropriate attention to these interaction effects. For non-core firms, the innovation performance outcomes they seek and the environmental conditions they confront should be thoroughly identified during the innovation process to select suitable ecosystems or eco-partners from which to learn. Finally, non-core enterprises need to use acquired resources and collaborative eco-partnerships to upgrade capabilities for product innovation, particularly in highly turbulent technical conditions. Based on this, for the managers of non-core firms embedded in ecosystems seeking to improve their innovation performance, it is helpful to pursue this goal by achieving ecological legitimacy under high levels of technology turbulence.

6.3. Limitations

This research has some limitations, which may provide insights for future research. The collected data were from the Turkish manufacturing sector. However, it is important to note that conditions such as institutional and economic factors may vary across different industries and countries. Further investigations covering more industries and countries may yield a better understanding. Further, this study measures breakthrough innovation as a unified construct. According to [102], breakthrough innovation mostly requires time to fully reflect on performance-related outcomes. Further, longitudinal research is required to deepen the understanding of breakthrough innovation in embedded firms in ecosystems. Moreover, examining the two dimensions of breakthrough innovation separately could also provide a deeper understanding of our conceptual model. Sustainable business model innovation can also be introduced into the current model as a mechanism [103].

Furthermore, the majority of the existing studies on ecosystem embeddedness are mainly focused on core firms [3]. Finally, research on the innovation ecosystem from a non-core perspective is still in its early stages; more studies are required to enrich the ecosystem literature from a non-core perspective.

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Informed Consent Statement: All participants in this study provided their informed consent.

Data Availability Statement: Data related to this study can be requested from the corresponding author, Mohamed Shawesh.

Conflicts of Interest: The authors report no conflicts of interest.

Appendix A

Table A1. Measurement items.

Variables/Iteams	Source
Eco-embeddedness position	[44,73–75]
Our firm has established cooperation with many ecological partners	
Our firm has acquired many kinds of resources in cooperation with ecological partners	
Our firm has launched many new products in cooperation with ecological partners	
Our firm and ecological partners carry out innovative cooperation in various modes (such as technology licensing and cooperative R&D)	
The innovation cooperation between our firm and ecological partners is relatively frequent.	
Eco-embeddedness relation	
The business types of our firm and of our ecological partner are similar and in the same industry field	
The knowledge, technology, and resources of the ecological partner have high availability for our firm	
The combination of our resource capabilities and those of our ecological partner helps improve our firm’s performance	
The combination of our resource capabilities and those of our ecological partner helps improve the performance of the ecological partner	
Our company has established a high level of cooperation and trust with our ecological partners	

Table A1. *Cont.*

Variables/Iteams	Source
Breakthrough innovation	[76,77]
Our product is highly innovative, replacing an inferior alternative	
Our product incorporates a radically new technological knowledge	
High-quality technical innovations were introduced during the development of this product	
The application of our product is totally different from those of our main competitors' products	
Our process has been greatly improved	
We have made a major adjustment in our market positioning	
Ecological legitimacy	[3,59,77]
Our new product or service meets the expectations of ecological stakeholders	
Our business activities are in line with the regulations and guidelines of the ecosystem	
Our business activities conform to the values and business philosophy of the ecosystem	
Our corporate image and products and services are highly valued and widely acceptable by ecological partners	
Technological turbulence	[78]
The technology is changing rapidly	
Technological changes provide big opportunities	
A large number of new products have been made possible through technological breakthroughs	
Technological developments are rather major	
Innovation performance	[79,80]
After becoming embedded in the ecosystem, our business revenue increased significantly	
After becoming embedded in the innovation ecosystem, the cost of our products or services fell significantly	
After becoming embedded in the ecosystem, our firm entered new markets	
After becoming embedded in the ecosystem, our firm increased its market share in the industry	

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