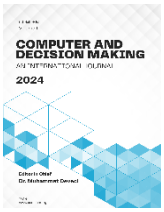
Computer and Decision Making

An International Journal

www.comdem.org
eISSN: 3008-1416



Evaluating Barriers to Implementation of Open Innovation in SMEs: A Case Study in Ordu Province

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ARTICLE INFO

Article history:
Received 24 October 2024
Received in revised form 21 November 2024
Accepted 5 February 2025
Available online 13 February 2025

Keywords:

Open Innovation; Factors Affecting Open Innovation; Multi-Criteria Decision Analysis

ABSTRACT

Approaches such as innovation, innovation management, open innovation, and utilization of technology have become critical for almost all businesses to stay ahead of the competition in today's globalized corporate environment. Non-enterprise innovation applications, often known as open innovation in enterprises, are integrated by embedding them into internal systems. The production of innovative ideas in collaboration with non-enterprise partners can be classified as open innovation practices within small and medium-sized businesses (SMEs). As a result, they are critical components in assisting organizations, such as offering a competitive advantage to SMEs, cost reduction, improving customer service quality, and responding to market needs on time. Yet, SMEs have a number of challenges when it comes to open innovation applications. The elimination of these barriers and problems will also increase the agility of SMEs. In this context, the barriers to open innovation implementation in SMEs were investigated, and the criteria that prevent open innovation were identified. The weight coefficients representing the importance levels of the criteria were calculated using the Interval Valued Intuitionistic Fuzzy Ranking Comparison (RANCOM) technique. According to the findings, the most critical barrier in the fulfilment of open innovation was " inadequacy or lack of management support."

1. Introduction

Due to increased rivalry, organizations today are looking for new ways to stay in the game and extend their lifespan, which is one of their most significant aims in the competitive environments in which they operate. Businesses must innovate to survive in ever-changing competitive settings. Innovations that can be used to products, services, processes, organizations, and marketing help businesses differentiate themselves and establish market leadership in the countries with which they are linked [1].

Open innovation is an innovation approach that can be used in product, service, process, organization, and marketing. Open innovation is an innovation process that manages the flow of

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https://doi.org/10.59543/comdem.v2i.11151

interest between businesses through monetary and non-monetary means according to each business's management model. The flow of information can take the shape of an interest entry into the company, an interest exits from the company, or a two-way movement of interest.

Open innovation is described as the systematic discovery, retention, and use of knowledge within and beyond an organization's borders during the innovation process [2]. Another definition of open innovation is how a company leverages innovation information from external partners (customers, competitors, institutions, etc.) or from outside by licensing it and bypassing institutional barriers [3].

According to West and Lakhani [4], to capitalize on innovative opportunities, a wide range of internal and external resources must be systematically sought out and adopted, consciously integrated with solid capacity and resources, and extensively utilized through multiple channels. The main reason businesses engage in open innovation is to lower the risk and expense of innovation. The necessity for a high level of ability, competence, and originality in the innovation process drives organizations to adopt open innovation approaches [5].

It has been argued that the open innovation process can be classified in three ways. The first of these is the outside-in approach. The outside-in approach integrates information from suppliers, consumers, and other external sources, while also expanding the company's knowledge base for use in innovation processes. The second is an inside-out transfer. In the inside-out approach, the company takes a pioneering approach by releasing the information it has developed to the market. It licenses and commercializes the information and technology it develops. This generates a profit. The third option is the combination process. In the combined procedure, the previous two components are used jointly [6].

Memiş and Korucuk [7] stated that, for businesses to be successful, they must always provide new value to their customers. It is claimed that creativity and open innovation techniques are critical for firms seeking to provide fresh value to their customers.

Companies cooperate to profit from external sources of knowledge for a variety of reasons, including lowering the cost of technical development, easing market access, leveraging economies of scale, and saving time in new product development. Furthermore, open innovation eliminates market entry barriers caused by factors such as technology and expertise. On the other hand, open innovation is not a miraculous method. It also has certain disadvantages. Companies that invest in open innovation confront risks and challenges that hinder them from reaping the benefits of open innovation efforts. According to Akın [8], risks include loss of information, high coordination costs, loss of control, loss of trust, protection of intellectual property rights, difficulty in finding the right partner, failure to balance open innovation with operational activities, insufficient time, and limited financing.

In the open system approach, the organization's boundaries are clear and distinct from the environment, and information flows freely between the organization and its surroundings. However, in open innovation networks, it is difficult to identify the system's boundaries since they are ambiguous, which broadens the functions of the boundary units and allows them to spread to other units. Open innovation is concerned with the direction, kind, and conditions of information flowing into and/or out of the organization in order to innovate or profit from inventive outputs [9]. Based on these points, the barriers to open innovation in SMEs are significant, and the relevant concept, which also addresses critical issues such as technology management, R&D applications, competition, and cost advantage, is one that should be carefully considered.

The study examined the issues that impede the deployment of open innovation in Ordu province. Its goal was to identify the issues impeding the deployment of open innovation and prioritize the relevant aspects using the Interval Valued Intuitionistic Fuzzy Ranking Comparison (IVIF-RANCOM)

technique. The next section included a review of the literature on the concept of open innovation and the barriers to it. The third section then provided explanations of the IVIF-RANCOM technique, which was used as the study's methodology. In the fourth section, the IVIF-RANCOM findings and the decision-making problem component were given. Finally, the study's conclusions were presented in the last section.

2. Literature

Many national and international research on open innovation practices and barriers were found in the comprehensive literature review. These studies are summarized below.

- Chesbrough and Crowther [10] examined 12 American companies that were recognized as early adopters of open innovation in the consumer-packaged products, chemicals, inks, coatings, and aerospace sectors.
- Terwiesch and Xu [11] focused on innovation competitions, open innovation and multi-dimensional problem solving in their study.
- Ili et al. [12] observed that open innovation was more efficient in attempting to improve R&D efficiency for automotive corporations than a closed innovation strategy.
- Huizingh [13] stated that open innovation is a useful idea for many companies and circumstances, eventually settling into the realm of innovation management.
- Xiaobao et al. [14] investigated the open innovation framework, business characteristics, network openness, and network information among SMEs in a developing country.
- Seyfettinoğlu and Taşdoğan [15] studied the impact of open innovation on the performance of food and beverage companies in Türkiye.
- Asswad et al. [16] studied how open innovation can help overcome barriers to long-term business model innovation.
- Aquilani et al. [17] presented a theoretical framework for overcoming cultural barriers in open innovation processes using intermediaries.
- Calof et al. [18] employed forecasting and forecasting networks to address open innovation challenges in their study.
- The organizational innovation priorities and innovation targets of Turkish logistics companies were comparatively investigated by Erdal and Korucuk [19].
- Özbebek Tunç and Zincir [20] investigated open innovation using organizational theories and related subjects in their research. For this purpose, it was analyzed within the context of inter-organizational relationships, which evaluate the organization alongside other organizations.
- Akın [8] studied open innovation in Turkey in his study and emphasized the limited developments.
- Dubouloz et al. [21] addressed the barriers they encountered using the open innovation strategy in small and medium-sized businesses (incoming, outgoing, and combined).
- Sikandar and Kohar [22] conducted a systematic literature review on open innovation in small and medium-sized businesses.
- Aytekin et al. [23] evaluated the global innovation efficiency of EU member and candidate countries using DEA and EATWIOS.
- Memiş and Korucuk [24] identified the hidden barriers to innovation in tea businesses operating in Giresun.

- Süslü and Atmalı [25] identified the relations between open innovation and competitive advantage through a systematic literature review.

Few studies have been conducted on the barriers and effective factors influencing the adoption of open innovation, according to the comprehensive review of the literature. The fact that this study examines and ranks the barriers to open innovation sets it apart from others. Furthermore, considering the approach employed, this study will contribute to the field, the city in which it is carried out, and the literature.

3. Methodology

In this study, the IVIF-RANCOM technique will be utilized to assess the importance of the criteria. RANCOM produces weight values by comparing criteria's pairwise importance rankings. RANCOM was chosen for this study because it may be used without requiring experts unfamiliar with MCDA approaches to get to know the technique and because of its understandable structure. On the other hand, because the problem under study had unclear information, it was decided to employ the RANCOM technique defined by IVIF. The next subsections will provide basic IVIF information, followed by descriptions of the IVIF-RANCOM application process.

3.1. Interval Valued Intuitionistic Fuzzy Sets

IFS, an extension/generalization of fuzzy sets, was first presented by Atanassov in 1983 [26]. IFS takes the level of uncertainty in membership and non-membership into account. In 1986, Atanassov and Gargov expanded IFS to IVIFS. An interval membership function with membership and non-membership values defines an IVIFS. Many decision-making methods have been expanded under IVIFSs [27–30]. In this study, we presented a new extension of RANCOM, namely IVIF-RANCOM. To begin with, however, it is helpful to explain IVIFSs.

Assume that X is the non-empty set. A is the IFS in the universe of discourse, where $A = \{\langle x, \mu_A(x), \nu_A(x)\rangle | x \epsilon X\}$, $\mu_A(x): X \to [0,1]$, $\nu_A(x): X \to [0,1]$. $\mu_A(x)$ denotes the degree of membership, while $\nu_A(x)$ is the degree of non-membership. Also, $\pi_A(x) = 1 - \mu_A(x) - \nu_A(x)$; $\pi_A(x): X \to [0,1]$ indicates the degree of hesitation or uncertainty.

In the universe of discourse, $\tilde{A} = \{\langle x, \tilde{\mu}_{\tilde{A}}(x), \tilde{\nu}_{\tilde{A}}(x)\rangle | x \epsilon X\}$ is an IVIFS, where $\tilde{\mu}_{\tilde{A}}(x) = \left[\mu_{\tilde{A}}^L, \mu_{\tilde{A}}^U\right] \subset [0,1]$ and $\tilde{\nu}_{\tilde{A}}(x) = \left[\nu_{\tilde{A}}^L, \nu_{\tilde{A}}^U\right] \subset [0,1]$. Here, $\tilde{\mu}_A(x)$ is the interval-valued membership function ($\tilde{\mu}_A(x)$) and $\tilde{\nu}_A(x)$ denotes the interval-valued non-membership function. Also, the conditions for the hesitating degrees A and B must be met. Also, $\pi_{\tilde{A}}^L = 1 - \mu_{\tilde{A}}^U - \nu_{\tilde{A}}^U$ and $\pi_{\tilde{A}}^U = 1 - \mu_{\tilde{A}}^L - \nu_{\tilde{A}}^L$ are the lower and upper bounds of the hesitation degree, respectively. In this context, the representation of $\tilde{A}$ including lower and upper end points can be written as $\tilde{A} = \left[\mu_{\tilde{A}}^L, \mu_{\tilde{A}}^U\right], \left[\nu_{\tilde{A}}^L, \nu_{\tilde{A}}^U\right], \left[\pi_{\tilde{A}}^L, \pi_{\tilde{A}}^U\right]$.

Let $\delta = \{\delta_1, \dots, \delta_n\}$ be a set of IVIF numbers, where $j = 1, \dots, n$, $\delta_1 = [a_1, b_1], [c_1, d_1]$, $\delta_n = [a_n, b_n], [c_n, d_n]$. Here, a_n is the lower bound of the membership degree, b_n denotes the upper bound of the membership degree, c_n represents the lower bound of the non-membership degree, and d_n depicts the upper bound of the non-membership degree. Eq.s (1-6) define the basic operations, the score function ($S(\delta_1)$), the accuracy function ($H(\delta_1)$), and the IVIF weighted aggregation (IVIFWA) operator regarding IVIF numbers (IVIFNs), where $\lambda > 0$, $\lambda^k > 0$, $k = 1, \dots, r$, $j = 1, \dots, n$ [30–33].

$$\delta_1 \oplus \delta_2 = \left(\begin{bmatrix} a_1 + a_2 - a_1 a_2, \\ b_1 + b_2 - b_1 b_2 \end{bmatrix}, \begin{bmatrix} c_1 c_2, \\ d_1 d_2 \end{bmatrix}\right) \quad (1)$$

$$\delta_1 \otimes \delta_2 = \left(\begin{bmatrix} a_1 a_2, \\ b_1 b_2 \end{bmatrix}, \begin{bmatrix} c_1 + c_2 - c_1 c_2, \\ d_1 + d_2 - d_1 d_2 \end{bmatrix}\right) \quad (2)$$

$$\lambda\delta_1 = \left(\left[1-(1-a_1)^{\lambda}\right], \left[1-(1-b_1)^{\lambda}\right], \left[{c_1}^{\lambda}\right], \left[{d_1}^{\lambda}\right]\right) \quad (3)$$

$$\tilde{A}^{\lambda} = \left({a_1}^{\lambda}, {b_1}^{\lambda}, \left[1-(1-c_1)^{\lambda}\right], \left[1-(1-d_1)^{\lambda}\right]\right) \quad (4)$$

$$S(\delta_1) = \left(a_1 + b_1 + (1-c_1) + (1-d_1) + a_1 \times b_1 - \sqrt{(1-c_1) \times (1-d_1)}\right)/4 \quad (5)$$

$$H(\delta_1) = a_1 + c_1 + b_1 + d_1 \quad (6)$$

$$IVIFWA_j = \left(\begin{bmatrix} 1 - \prod_{j=1}^{n}(1-a_1)^{\lambda_k}, \\ 1 - \prod_{j=1}^{n}(1-b_1)^{\lambda_k} \end{bmatrix}, \begin{bmatrix} \prod_{j=1}^{n}(c_1)^{\lambda_k}, \\ \prod_{j=1}^{n}(d_1)^{\lambda_k} \end{bmatrix}\right) \quad (7)$$

3.1. IVIF-RANCOM

Criteria are standards or norms that are considered while solving problems. However, it is often not acceptable for the criteria to be equally important in solving the problem. To represent the relative importance of the criteria in the problem-solving process, a procedure known as weighting is carried out. In this context, subjective and objective weighting techniques are applied. If the subjective technique is used in the weighting process, the evaluators' judgments must be received effectively, accurately, and consistently for the results to be valid and reliable.

RANCOM can be used by evaluators or experts with limited expertise in multi-criteria decision-making, can be easily and quickly implemented, is repeatable, intuitive, and delivers consistent ranking analysis. This study will propose a new RANCOM extension, IVIF-RANCOM, for dealing with uncertain information. IVIF-RANCOM can be implemented by following the steps outlined below [34].

Step 1. Determining criteria and experts: Criteria and experts are determined. In this context, $C_1, \ldots, C_n$ denotes criteria, while $E_1, \ldots, E_r$ depicts experts.

Step 2. Evaluating criteria: Criteria are evaluated by experts based on their importance. Table 1 lists the linguistic terms employed in this study [35]. As a result, $\iota_{jk} = [a_{jk}, b_{jk}], [c_{jk}, d_{jk}]$ represents the importance of criterion j.

Table 1
The linguistic terms and corresponding IVIFNs

Codes	Linguistic Terms	IVIFNs			
		a	*b*	*c*	*d*
AV	Absolutely Very Importance	0.99	1.00	0.00	0.00
EH	Extremely High Importance	0.90	0.95	0.01	0.04
VH	Very High Importance	0.80	0.85	0.05	0.10
H	High Importance	0.70	0.75	0.15	0.20
MH	Medium High Importance	0.60	0.65	0.25	0.30
M	Medium Importance	0.50	0.55	0.35	0.40
ML	Medium Low Importance	0.40	0.45	0.45	0.45
L	Low Importance	0.30	0.35	0.55	0.60
VL	Very Low Importance	0.20	0.25	0.65	0.70
EL	Extremely Low Importance	0.10	0.15	0.75	0.80
AL	Absolutely Low Importance	0.00	0.00	0.99	1.00

Step 3. Determining experts' weights: The weight coefficients of each expert (λ_k) are determined, where $\sum_{k=1}^{r} \lambda_k = 1$, and $0 \leq \lambda_k \leq 1$. In this study, we consider all expert evaluations equally important.

Step 4: Integrating expert evaluations: The integrated IVIF significance values of criteria are obtained using the IVIFWA operator given in Eq. (7).

Step 5. Calculating crisp significance values of criteria: The crisp significance value of ι_j is obtained via Eq. (5).

Step 6. Determining ranking orders: The ranking order of each criterion (ζ_j) is determined based on $S(\iota_j)$ values. The criteria are ordered from largest to smallest based on their $S(\iota_j)$ values. The criterion with the highest score is first in the ranking.

Step 7. Creating the ranking comparison matrix: The ranking comparison matrix $P = [p_{gj}]_{n\times n}$ is constructed via Eq. (8), where $g, j = 1, \dots, n$.

$$p_{gj} = \begin{cases} 1 & , \quad if\ \zeta_g < \zeta_j \\ 0.5 & , \quad if\ \zeta_g = \zeta_j \\ 0 & , \quad if\ \zeta_g > \zeta_j \end{cases} \tag{8}$$

Step 8. Building the horizontal vector: The horizontal vector of the summed criteria weights (ξ_j) is formed using Eq. (9).

$$\xi_j = \sum_{g=1}^{n} p_{jg} \tag{9}$$

Step 9. Determining the weight coefficients: The weight coefficient of each criterion is computed by applying Eq. (10).

$$w_j = \frac{\xi_j}{\sum_{j=1}^{n} \xi_j} \tag{10}$$

where $0 \le w_j \le 1$ and $\sum_{j=1}^{n} w_j = 1$.

3. Results

This study aims to evaluate the importance of the barriers to open innovation adoption in SMEs from Ordu province. For this purpose, nine barriers were determined through literature and experts' opinions. The determined barriers were accepted as decision criteria, and it was aimed to find their weight values using the IVIF-RANCOM technique. While determining the criteria, expert opinions and the studies of Savitskaya et al. [36], Hossain [37], Oduro [38] and Mu and Wang [39] were employed. The criteria considered in the problem are presented in Table 2.

Table 2
The list of criteria

Codes	Criteria
C1	Project Partner Finding and Trust Barrier
C2	High Transaction Cost
C3	Lack and Inadequacy of Management Support
C4	Administrative and Legal Obligations
C5	Lack of Technical Knowledge
C6	Lack of Market Knowledge
C7	Imbalance Between Independence and Integration
C8	Strategic Dimension Barriers (Resource and Strategy Alignment Barrier)
C9	Other Barriers (Lack of Information, Personnel Incompatibility, etc.)

Seven experts with extensive experience and knowledge of this subject were consulted to determine the weight values of the criteria. In the industry, experts hold the roles of operations officer (E5), manager (E6), engineer (E1), engineer (E2), quality management system manager (E3),

assistant consultant (E4). and chief (E7). Using the linguistic terms listed in Table 1, the experts evaluated the criteria's levels of importance. Table 3 displays these evaluations.

Table 3

Evaluations of experts regarding the importance of criteria

Experts	C1	C2	C3	C4	C5	C6	C7	C8	C9
E1	H	VH	M	MH	EH	ML	L	VL	EL
E2	L	ML	EH	EL	VL	ML	MH	H	VH
E3	EH	EH	VH	VH	EH	EH	EH	EH	EH
E4	L	H	EH	VH	M	M	VH	H	MH
E5	VH	EH	H	ML	MH	M	L	VL	EL
E6	L	VL	H	EL	MH	M	ML	VH	EH
E7	EL	VL	L	EH	VH	H	MH	M	ML

The evaluations of the experts were transformed to equivalent IVIFNs. Moreover, the expert evaluations were integrated via Eq. (7). These values are shown in Table 4.

Table 4

Evaluations of experts regarding the importance of criteria

	C1				C2				C3			
	a	b	c	d	a	b	c	d	a	b	c	d
E1	0.70	0.75	0.15	0.20	0.80	0.85	0.05	0.10	0.50	0.55	0.35	0.40
E2	0.30	0.35	0.55	0.60	0.40	0.45	0.45	0.45	0.90	0.95	0.01	0.04
E3	0.90	0.95	0.01	0.04	0.90	0.95	0.01	0.04	0.80	0.85	0.05	0.10
E4	0.30	0.35	0.55	0.60	0.70	0.75	0.15	0.20	0.90	0.95	0.01	0.04
E5	0.80	0.85	0.05	0.10	0.90	0.95	0.01	0.04	0.70	0.75	0.15	0.20
E6	0.30	0.35	0.55	0.60	0.20	0.25	0.65	0.70	0.70	0.75	0.15	0.20
E7	0.10	0.15	0.75	0.80	0.20	0.25	0.65	0.70	0.30	0.35	0.55	0.60
ι_j	0.59	0.67	0.19	0.28	0.70	0.78	0.11	0.18	0.75	0.82	0.08	0.15
	C4				**C5**				**C6**			
	a	b	c	d	a	b	c	d	a	b	c	d
E1	0.60	0.65	0.25	0.30	0.90	0.95	0.01	0.04	0.40	0.45	0.45	0.45
E2	0.10	0.15	0.75	0.80	0.20	0.25	0.65	0.70	0.40	0.45	0.45	0.45
E3	0.80	0.85	0.05	0.10	0.90	0.95	0.01	0.04	0.90	0.95	0.01	0.04
E4	0.80	0.85	0.05	0.10	0.50	0.55	0.35	0.40	0.50	0.55	0.35	0.40
E5	0.40	0.45	0.45	0.45	0.60	0.65	0.25	0.30	0.50	0.55	0.35	0.40
E6	0.10	0.15	0.75	0.80	0.60	0.65	0.25	0.30	0.50	0.55	0.35	0.40
E7	0.90	0.95	0.01	0.04	0.80	0.85	0.05	0.10	0.70	0.75	0.15	0.20
ι_j	0.64	0.71	0.15	0.23	0.72	0.79	0.10	0.17	0.61	0.68	0.20	0.27
	C7				**C8**				**C9**			
	a	b	c	d	a	b	c	d	a	b	c	d
E1	0.30	0.35	0.55	0.60	0.20	0.25	0.65	0.70	0.10	0.15	0.75	0.80
E2	0.60	0.65	0.25	0.30	0.70	0.75	0.15	0.20	0.80	0.85	0.05	0.10
E3	0.90	0.95	0.01	0.04	0.90	0.95	0.01	0.04	0.90	0.95	0.01	0.04
E4	0.80	0.85	0.05	0.10	0.70	0.75	0.15	0.20	0.60	0.65	0.25	0.30
E5	0.30	0.35	0.55	0.60	0.20	0.25	0.65	0.70	0.10	0.15	0.75	0.80
E6	0.40	0.45	0.45	0.45	0.80	0.85	0.05	0.10	0.90	0.95	0.01	0.04
E7	0.60	0.65	0.25	0.30	0.50	0.55	0.35	0.40	0.40	0.45	0.45	0.45
ι_j	0.63	0.70	0.17	0.25	0.66	0.73	0.15	0.23	0.67	0.76	0.12	0.20

Table 5 displays the criteria's significant values, weights, and importance rankings.

Table 5

Final results

ζ_j	9	3	1	6	2	8	7	5	4		
$S(\iota_j)$	0.61	0.72	0.77	0.66	0.74	0.62	0.64	0.67	0.70		
p_{gj}	C1	C2	C3	C4	C5	C6	C7	C8	C8	ξ_j	w_j
C1	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.50	0.0123
C2	1.00	0.50	0.00	1.00	0.00	1.00	1.00	1.00	1.00	6.50	0.1605
C3	1.00	1.00	0.50	1.00	1.00	1.00	1.00	1.00	1.00	8.50	0.2099
C4	1.00	0.00	0.00	0.50	0.00	1.00	1.00	0.00	0.00	3.50	0.0864
C5	1.00	1.00	0.00	1.00	0.50	1.00	1.00	1.00	1.00	7.50	0.1852
C6	1.00	0.00	0.00	0.00	0.00	0.50	0.00	0.00	0.00	1.50	0.0370
C7	1.00	0.00	0.00	0.00	0.00	1.00	0.50	0.00	0.00	2.50	0.0617
C8	1.00	0.00	0.00	1.00	0.00	1.00	1.00	0.50	0.00	4.50	0.1111
C9	1.00	0.00	0.00	1.00	0.00	1.00	1.00	1.00	0.50	5.50	0.1358

The study found that "lack and inadequacy of management support" is the most important barrier limiting SMEs from implementing open innovation. Adopting and supporting new policies by management has a positive impact on employees. The same arguments can be made about the acceptance and use of open innovation. However, insufficient managerial support will impede the implementation of open innovation. The second key factor is "high transaction cost." For businesses, providing and successfully employing financial resources is vital to their survival. Insufficient financial resources will prevent open innovation from being adopted.

4. Conclusions

SMEs' open innovation applications are crucial for cost savings and competitive advantage. Open innovation applications for SMEs improve company performance while improving customer value. At the same time, open innovation aids in the process of simplifying corporate operations and expanding into new markets, or, in other words, achieving the company's strategic objectives through the collaborations it encourages.

Market performance will rise, and open innovation will be promoted by SMEs' increased market orientation and innovation-focused operations. Through open innovation initiatives, SMEs will make the required efforts to satisfy customer needs, wants, and expectations, increasing the firm's value. According to the study's findings, SMEs can attain a number of competitive dimensions by prioritizing manufacturing and service dimensions in terms of open innovation and the development of new marketing strategies.

However, there are various challenges to implementing open innovation in SMEs, and these issues must be addressed to preserve the company's existence. Related concerns include a lack of trust when choosing a project partner, management perspective, a lack of market/information, and high transaction costs, all of which are critical difficulties for SMEs to address.

The effectiveness of open innovation processes depends on SMEs' managers creating an environment that is more democratic, open to inquiry, and supportive of the free flow of innovative ideas. Effective use of open innovation approaches requires a supportive and collaborative company culture. Raising awareness of open innovation, especially among SMEs, is a major duty of commercial institutions and organizations. Without a doubt, one way to ensure effectiveness and efficiency in SMEs is through creative endeavors and, consequently, open innovation. It can be argued that by embracing the open innovation strategy and removing the barriers that stand in their way, SMEs can succeed and, consequently, turn a profit in terms of time and money.

In this regard, the study investigated the barriers that SMEs encounter when implementing open innovation. The findings can be used as a guide not only by SMEs but also by other businesses and others interested in subjects such as innovation and open innovation. At the same time, the study might be considered critical in building a model for open innovation. It is anticipated that this study will serve as a guide for further research by scholars seeking solutions to other problems.

Author Contributions

Conceptualization, S.K. and A.A.; methodology, A.A.; software, A.A.; validation, A.A.; formal analysis, S.K.; investigation, S.K.; resources, S.K.; data curation, S.K.; writing—original draft preparation, S.K and A.A.; writing—review and editing, S.K. and A.A; visualization, A.A. All authors have read and agreed to the published version of the manuscript.

Funding
This research received no external funding.

Data Availability Statement
Data supporting reported results can be found in the study.

Conflicts of Interest
The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgement
This study is a revised and expanded version of the study titled "Kobilerde Açık İnovasyonun Gerçekleştirilmesinin Önündeki Engeller: Ordu İlinde Bir Uygulama (Barriers to Implementation of Open Innovation in SMEs: A Case Study in Ordu Province)" which was presented as a full-text oral presentation at the V. International Scientific Conference of Economics and Management Researchers, Baku, 2023.

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