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A mediated moderated analysis of knowledge management and stakeholder relationships between open innovation and performance of entrepreneurial firms

Omar Ali Kanaan^a, Malek Alsoud^b, Muzaffar Asad^{c*}, Mohammad A. Ta'Amnha^d and Shaker Al-Qudah^e

^aBusiness Administration department - Assistant professor, Applied Science Private University, Amman, Jordan

^bDepartment of E-Marketing and Digital Communication, Al-Ahlyya Amman University, Amman, Jordan

^cProfessor of Entrepreneurship, Business School, Tecnológico de Monterrey, Mexico

^dManagement Sciences Department, Business School, German Jordanian University, Amman, Jordan

^eBusiness Administration, Faculty of Business, Applied Science Private University, Jordan

ABSTRACT

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Even though entrepreneurial firms make substantial contributions to both domestic and global economies and innovations, there is disagreement in the literature regarding how open innovation affects these firms' ability to succeed. The current research is an attempt to address the gaps by analyzing the intricacies and dynamics of entrepreneurial firms' involvement in Open Innovation. Furthermore, the impact on performance is examined from a knowledge perspective. In Jordanian context, this study analyzed the link between stakeholder interactions, knowledge management, open innovation, and the performance of entrepreneurial firms. The findings demonstrated that open innovation activities are statistically significant to the overall performance of entrepreneurial firms. However, since it has an unintentional detrimental effect over the performance of entrepreneurial firms in Jordan, the moderating effect of stakeholder relations and the mediation effect of knowledge management has been analyzed. The moderating role of stakeholder relationships has been proven statistically which enriched the theoretical foundations of RBV and contingency theory by adding stakeholders' theory into the combination of the two theories, at the end limitations and guidelines for future research along with practical implications are emphasized.

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1. Introduction

Globalization has led to faster technological advancements, more intense competition, and shorter product life cycles (Liñán, Paul and Fayolle 2020). Entrepreneurial firms now must revise their business plans and create fresh ideas for advertising campaigns because of the magnitude of the changes (Ta'Amnha et al., 2023). To stay competitive, entrepreneurial businesses must always grow faster than their competitors based on information (Khan, et al. 2021). Currently, internal knowledge development cannot be relied upon exclusively (Asif, Asad & Kashif et al., 2021). Nevertheless, enterprises be open to suggestions and information from outside sources to obtain a competitive edge and promote expansion (Qalati et al., 2022) yet the understanding of dynamic innovation patterns and criteria through cycles of both open and closed innovations through knowledge remained unexplored (Tjahjadi, et al. 2020, Yun, et al. 2022, Asad, Asif and Sulaiman, et al. 2023). Therefore, to overcome common resource constraints, especially about knowledge resources, entrepreneurial firms have been turning to Open Innovation (OI) methods (Brunswick & Vanhaverbake, 2015; Grimsdottir & Edvardsson, 2018; Cillo et al., 2019; Marco, Martelli & Minin, 2020; Surya et al., 2021; Ta'Amnha et al., 2023; Asad, Asif & Sulaiman et al., 2023). Compared to large industrial level firms, entrepreneurial firms participate in OI less frequently, but their instructional roles in OI are difficult

* Corresponding author

E-mail address muzaffar.asad@tec.mx (M. Asad)

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to ignore (Barrett, Dooley & Bogue 2021; Asad, Aledeinat et al., 2024). Nonetheless, there is an abundance of studies over the link between open innovation and performance, but the findings are contradictory (Iqbal & Suzianti, 2021; Strazzullo et al., 2022). Since entrepreneurial firms are often unable to commercialize innovative goods and services (Stephan, Andries and Daoou 2019), open innovation practices are more important for them during the commercialization phase of the innovation process than they are at the beginning (Elia, Petruzzelli & Urbinati, 2020; Chandler & Krajcsák, 2021). When considered in the context of entrepreneurial firms, pertinent aspects and dynamics need to be carefully examined to have a comprehensive understanding of the currently ambiguous open innovation-performance link (Srisathan, Ketkaew & Naruetharadhol, 2020). When conflicting empirical findings arise, innovation scholars often suggest examining the intervening elements producing inconsistent results (Baron & Kenny, 1986).

This study aims to achieve that based on concepts related to mediating role of knowledge management and moderating role of stakeholder relations, as majority of the studies have taken knowledge management as independent construct (Akram, Goraya, Malik, & Aljarallah, 2018; Alzghoul, Elrehail, Emeagwali, & AlShboul, 2018; Wang & Xu, 2018; Soto-Acosta, Popa, & Martinez-Conesa, 2018; Ferraris, Mazzoleni, Devalle, & Couturier, 2019) and hardly the researchers examined knowledge management as mediator (Ayoub, Abdallah & Suifan 2017; Shabbir & Gardezi 2020) hence, mediating role of knowledge management between open innovation and performance has received limited attention by the scholars in the context of Arab world especially Jordan. When Chesbrough and Appleyard (2007) first introduced the concept of OI as a strategy, they focused on the ways in which a range of external actors could engage in knowledge-based activities that foster creative processes. External links amongst members of innovation eco-systems and information sharing amongst organizations follow (Singh, Gupta et al., 2021). Activities based on knowledge management are the primary factors influencing performance because of OI (Asad, Asif & Sulaiman et al., 2023).

In contrast to that, the success of collaborative open innovation now depends on involving stakeholders in the creation of knowledge-based value (Allam & Ahmad, 2013; Rong et al., 2015; Pererva et al., 2021). The result indicates that knowledge- and stakeholder-relationship structures play a critical role in determining the overall effects of open innovation on performance, especially when it comes to entrepreneurial firms in the developing countries where they lack resources. Stakeholder relations and knowledge management are the two variables at the capricious level that were carefully chosen for this investigation. Here is a thorough explanation. In order to overcome their accountability of “smallness” (Grey, 2006; Greene, Brush, & Brown, 2015) and other challenges (Bowen, Morara & Mureithi, 2009; Agwu & Emeti, 2014; Gamage, et al., 2020; Pererva et al., 2021), as well as to increase competitiveness and organizational performance (Kmieciak and Michna 2018, Orlando, Franca & Ortiz, 2018; Prasanna et al., 2019), it first clarified the openness of innovation procedures and activities by entrepreneurial firms. The second factor i.e., stakeholders’ relations has been the significance of these businesses and their overwhelming numerical domination in the local, provincial, and national economies (Inwinkl, Josefsson & Wallman 2015; Ardito et al., 2020; Choudhury & Pattnaik 2020).

Entrepreneurial firms currently comprise most businesses and account for a significant portion of employment in the developing countries like Jordan (Mahawrah & Shehabat, 2016; Altarawneh & Altarawneh, 2017, Migdadi et al., 2017; Okour, Chong & Asmawi, 2019). Entrepreneurial firms are considered as key drivers of economic development, particularly in terms of advancing the economy (Asad, Kashif & Sheikh et al., 2021; Qalati et al., 2022; Asad, Aledeinat et al., 2024). For our study, it is more important that entrepreneurial firms have grown into important sources of invention and innovation (Audretsch & Belitski, 2023). Therefore, encouraging open innovation in start-up businesses remains a top priority for policy. Initiatives to support economic development at the district, provincial, and global levels (Darroch & McNaughton, 2002; Chen & Huang, 2009; Leckel, Veilleux & Dana, 2020; Freixanet et al., 2021). Major corporations possess the necessary resources, but entrepreneurial businesses are more vulnerable when they depend only on organizational and management skills in creative endeavours that aren't supposed to fail repeatedly (Asad, Aledeinat et al., 2024). As such, taking part in open innovation initiatives can help entrepreneurial firms overcome the limitations of resources (Cillo et al., 2019; Leckel, Veilleux & Dana, 2020). Most studies have focused on multinational corporations (MNCs) (Villar, Alegre & Pla-Barber, 2014; Ferraris, Santoro & Dezi 2017) and larger enterprises, leaving little to no empirical findings on entrepreneurial firms.

Hence it would be right to claim that there needs to be some informative gap-filling with the addition of additional variables to complete the explanations because the OI-performance link is inconsistently discussed in the literature. Furthermore, it is unknown that how open innovation (OI) will affect the advancement or hindrance of active stakeholder knowledge feedback (Inwinkl, Josefsson & Wallman 2015), or knowledge management (Hammami et al., 2021), or how it will function as a mediator between open innovation and performance. Another important objective of this study is to enrich the understandings of the relationships among OI activities, knowledge management, and performance as they pertain to entrepreneurial firms by examining the moderating effect of stakeholders’ relationships. Research has shown that creative businesses are more inventive when their employees wear a variety of ties rather than just one kind. Particular attention should be given to the relationships that entrepreneurial firms have with various external stakeholders (Lee & Sukoco, 2007; Pererva, et al., 2021).

Within the sections that follow, the works of literature relevant to the key concepts and the involved constructs are reviewed. The creation of hypotheses is based on this part researchers’ findings. After that, we discuss the approach that has been used to conduct the empirical study in detail, and then there are sections on the outcomes and its linkage with prior literature. In the final part of the paper, we present an integrated final thought along with several implications.

2. Literature Review and Research Framework Development

Entrepreneurial businesses have fewer resources available to them and have less access to outside resources, technology, and expertise. As a result, compared to larger corporations, research on OI in entrepreneurial firms is more complex. To get beyond resource constraints and knowledge limitations, entrepreneurial firms utilize networking and methods for acquiring knowledge more frequently than larger organizations do overall.

2.1 Performance of Entrepreneurial firms

Because entrepreneurial firms typically maintain informal records, measuring performance is especially critical (Asad, Majali, et al., 2023; Asad & Kashif, 2021). As a result, the evaluation of the success of entrepreneurial businesses in developing nations is established over the perceptual measures of managers and owners with respect to increase in revenue, assets, sales, and staff (Shin, Kim & Jeong, 2018; Mardani et al., 2018; Khan et al., 2021; Satar et al., 2023; Alkhuzaie et al., 2024).

Performance of entrepreneurial firms is not a uni-dimensional construct, with the main components being market share, profitability, increase in assets, and employment growth. Measurements that give owners and managers access to new or innovative information should be looked at as a key management tool for entrepreneurial firms (Ibarra et al., 2020; Hayaiean, Hesarzadeh & Abbaszadeh, 2021; Hock-Doegen et al., 2021).

Additionally, facilitating easier access to financing is one of the ways that the Jordanian government and industry established a comprehensive analysis of the elements that would boost the sector's competitiveness for entrepreneurial firms (Mikalef, Pateli & Wetering, 2020; Asad, Asif & Khan et al., 2022). Like this, a low-performance trap prevents many start-up companies from growing past a certain point and from graduating to larger businesses (Qalati et al., 2022). For the same reason, growth in investments, sales, and profitability may also be sluggish or even stagnant (Zafar et al., 2022). Furthermore, a lack of understanding about entrepreneurial firms may prevent them from gaining additional benefits.

Furthermore, knowledge sharing is a significant issue (Kucharska & Bedford, 2019; Le & Lei, 2019; Setini et al., 2020) that has been noted in the literature however, the same regarding performance of entrepreneurial firms has received comparatively less attention from researchers (Liu, Chen & Tsai, 2005; Lam et al., 2021). The primary cause of Jordanian entrepreneurial firms' lack of competitiveness with developed country entrepreneurial firms is their emphasis on building relationships with stakeholders rather than competing with them.

According to Khan, et al. (2021), entrepreneurial firms in developing nations operate in an environment that is comparatively more turbulent, which makes knowledge management and stakeholder concerns even more important. Thus, one important tactic to improve the performance of entrepreneurial firms could be to apply open innovation through knowledge management through stakeholder relationships.

2.2 Open Innovation

Because of the ever-evolving business landscape and growing complexity of technology (Asif, Asad & Bhutta et al., 2021; Damer et al., 2021; Fadhel et al., 2022), entrepreneurial firms in developing countries must take the lead in open innovation (Vrgovic et al., 2012; Zia, 2020). Developing new product based on market information and external knowledge that can be obtained from external sources, is termed as open innovation (Krajcsák, 2019; Jeong et al., 2020).

Despite their potential to give businesses the chance to acquire complementary knowledge, open innovation—which is readily acquired through collaboration of industry and academia, is lacking in developing nations (Tariq, Badir and Chonglertham, Green innovation and performance: moderation analyses from Thailand 2019). For businesses to achieve the competitive edge needed to achieve high performance, open innovation is essential (Tariq, Ehsan, et al., 2022). Here, open innovation fosters the creation of new knowledge, which enhances performance (Tariq, Badir et al., 2017; Zhao, 2023). Businesses can better serve their customers, thanks to open innovation, which has an impact on overall performance (Rauter et al., 2019).

But for entrepreneurially oriented businesses to perform well, it might be preferable to achieve open innovation, which would enhance knowledge management (Wong, 2005; Santoro et al., 2018). This is because inefficiencies are the primary causes of time and money waste, which are burdensome for entrepreneurial businesses that already have limited resources (Won & Park, 2018).

2.3 Knowledge Management

Research has demonstrated that knowledge management may improve innovation performance (Zhao, 2023). The open innovation strategy highlighted latent advantages of gaining outside information (Wong, 2005; Usai et al., 2018). Scholars have explored the topics of knowledge management, knowledge transfer from sources like buyers and sellers, and creative methods for learning about external networks (Scarbrough, 2003; Shahzad et al., 2020).

In the context of knowledge flow, which is defined as an interchange of knowledge contained within and beyond the boundary and range of organizations, accessing outside knowledge is referred to as “knowledge influx” (Shehzad et al., 2023). When it

comes to the inside-out information-sharing process, companies outsource the information, whereas in the opposite process, they are the ones who gather and handle the information that they receive (Kmieciak & Michna, 2018; Liu & Lee 2015).

As we've studied knowledge management, we've considered the sharing of knowledge about entrepreneurial businesses (Khaliq et al., 2014). Proactive OI activities by the focus entrepreneurial firms encourage knowledge transfers from external stakeholders to entrepreneurial firms (Long & Fahey, 2000; Martínez-Cañas, Sáez-Martínez & Ruiz-Palomino, 2012). Knowledge management is more often associated with OI practices for knowledge dissemination than it is with playing a central role in the relationship between entrepreneurial firms and OI (Mehrez 2019). Although innovative openness has been shown to positively impact an enterprise's ability to use outside expertise (i.e., external knowledge) and its ability to absorb information (Obeidat et al., 2016), though it is not the case for knowledge management.

Since OI has a great deal of potential for entrepreneurial firms, this field of study has been growing and diversifying (Sabri & Odeh, 2019). The literature is primarily produced by conducting methodical research along the lines of thematic categories, which include cooperation as well as networking (Salehi, et al. 2022), managerial challenges (Agwu & Emeti, 2014), and absorptive capacities (Usai et al., 2018).

Numerous studies have examined creativity and performance in relation to these issues using the concept of openness (Lambrechts et al., 2017; Liao, Fu & Liu, 2020). In addition to allowing for concurrent large investments in research and development, openness during the invention process can provide entrepreneurial firms with improved availability of contemporary technology and lab facilities (Majali et al., 2022). Tasks related to external research and development have a positive effect on Jordanian entrepreneurial firms' innovation performance (Altarawneh & Altarawneh, 2017). As a result, a range of OI initiatives concurrently raise an organization's output (Ovuakporie et al., 2021).

Nevertheless, given the erratic outcomes of the relationship between open innovation and performance mentioned above, additional research over the impact of open innovation on performance of entrepreneurial firms need to be explained. As opposed to the main intra-company flow of knowledge, open innovation (OI) involves “purposeful inflows and outflows of knowledge”, or two-way information flows (Wang & Xu, 2018). The primary goals of OI Knowledge sourcing, knowledge flow, and value co-creation are examples of strategies.

In this way, an ambivalent pattern of knowledge transfer becomes a real performance enhancer enabled by OI. Failure to receive information may therefore still happen even if the focus firm actively shares its own information in swap for outside knowledge as part of OI (Zhao, 2023). Whatever success entrepreneurial businesses have, as major players in open innovation, sharing their knowledge in relation to value co-creation through stakeholder-engaged knowledge networking is unimportant and irrelevant. The more crucial thing to think about is how much entrepreneurial firms' knowledge-sharing initiatives ultimately promote stakeholder knowledge management (Seuring & Gold, 2013).

2.4 Moderating Role of Stakeholder Relations between Open Innovation and Knowledge Management

Another factor influencing the unpredictable relation between OI and performance, including information management is the calibre of relationships with stakeholders (Ansong, 2017). Research has shown that interactions with external stakeholders are crucial for open innovation (OI) to transpire in entrepreneurial firms (Inwinkl, Josefsson & Wallman, 2015). Stakeholder theory can be a useful tool for these firms to understand their stakeholders' interactions during OI initiatives (Liu, Lei & Buttner, 2020).

Due to their greater degree of dynamic nature, ability to adjust to changes in the external environment, and potential for radical innovation, entrepreneurial firms may be more innovative than larger corporations (Freeman, Dmytriiev & Phillips, 2021). Moreover, there is a positive link between performance of entrepreneurial firms, innovativeness, and strategic alliances (Ng, Kee and Ramayah 2020). The possibility of entrepreneurial firms benefiting from open innovation (OI) is increased when they have relationships with external sources that enable reciprocal knowledge exchange because of their increasing age (Asad, Aledeinat et al., 2024).

The utilization of outside resources and expertise, lower R&D expenses and failure rates, risk distribution, and quicker time-to-market are a few of the knowledge-oriented advantages of stakeholder collaboration that have been demonstrated to help entrepreneurial enterprises (Baah et al., 2021). Entrepreneurial firms benefit from convergent transfer of knowledge that is continuously provided by exclusively secure connections to stakeholders (Singh, Giudice et al., 2022). This keeps the firms away from costly knowledge exploration that may limit new opportunities.

Collaboration is essential for entrepreneurial firms because these companies primarily rely on the expertise of other companies for their innovation (Baah, Jin & Tang, 2020). Likewise, entrepreneurial firms are prone to form networks beyond their firms with other entrepreneurial firms or with academia (Fischer et al., 2021). Entrepreneurial businesses must learn from their suppliers and customers to innovate and create new products based on market information (Haiyun et al., 2021).

Hence, Universities and business partners are significant entities that positively support open innovation (Huggins, Prokop & Thompson, 2020). The mutual trust and open sincere dialogues between entrepreneurial firms and their stakeholders may enhance the impact of absorption capacity on information exchange (Bertello et al., 2021). This could then bring us to raise

the argument that the degree of positive interactions between stakeholders and entrepreneurial firms can affect the positive relation between OI activities and knowledge management. When viewed as a whole, the arguments and considerations made in the previous sections about the connections between OI, knowledge management, cooperative linkages with stakeholders, and performance of entrepreneurial firms make sense.

Researchers that studied knowledge management and open innovation as a mediator claiming that open innovation plays a crucial influence over performance of entrepreneurial firms. Most researchers have also viewed open innovation to mediate the relationship, hence, the diversified relationship between open innovation and the performance of entrepreneurial firms has got scarce or limited attention by the scholars especially in emerging economies like Jordan. There are also a lot of gaps in the body of knowledge about performance of entrepreneurial firms, as evidenced by the lack of research on the significance of knowledge management, particularly for these businesses that operate in developing nations.

Furthermore, there has been little evidence of the moderating role of stakeholders in open innovation and knowledge management. Consequently, considering the theoretical foundations of RBV along with the support of contingency theory to support the moderating influence of stakeholders' relationship between OI and knowledge management, the following framework has been developed for empirical analysis (Fig. 1).

3. Research Methodology

Jordan's economy now ranks among the highest proportion of SMEs due to a remarkable surge in the number of entrepreneurial firms. Among the various suggestions put forth to increase the potential of entrepreneurial firms to expand and become large enterprises, innovation has drawn a lot of attention. Every developing nation has faced a range of challenges in their pursuit of positive externalities.

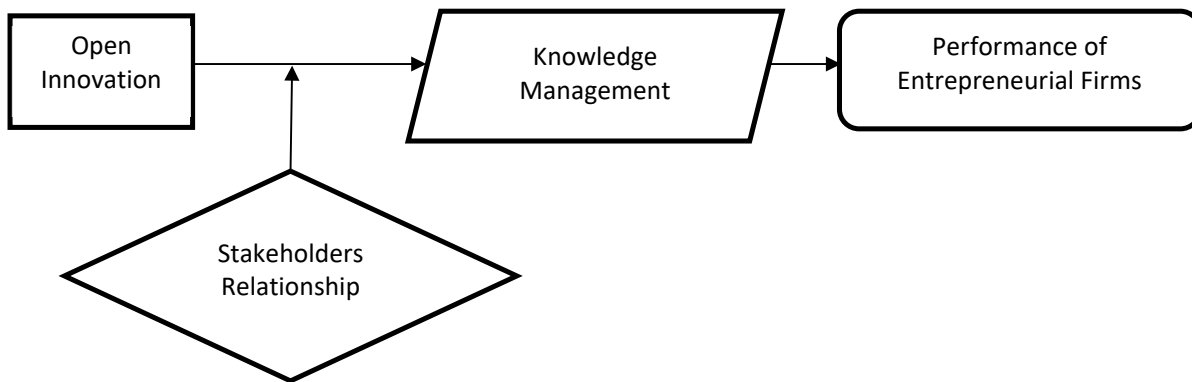


Fig. 1. Research Framework

The primary concern in Jordan about start-up businesses is their growth and development into major corporations. As a result, a primary study was conducted using the data from the previous researchers' study and the reviewed literature to measure the performance of entrepreneurial firms. An adopted questionnaire was used for data collection to test the research framework. For this study, we selected Aman City and its surrounding areas' entrepreneurial firms in the manufacturing and service sectors. Research instrument was divided into multiple sections covering background information, and four variables which are; OI, stakeholder relations, knowledge management, and performance of entrepreneurial firms. Four items were selected from Asad et al. (2023) to gauge open innovation. Similarly, nine items covering the frequently used items for the measurement of the performance of the entrepreneurial firms were taken from Asad et al. (2024). These items were used to assess the performance of entrepreneurial firms. The eight items used to gauge the relationships between stakeholders came from Ansong (2017). Lastly, Ta'Amnha et al. (2023) have used this method to measure the knowledge management of the firms that serve as mediators. The questionnaire was attached in both Arabic and English in case the respondents did not speak Arabic. To increase the response rate, the respondents were promised a summary of the findings. The questionnaire's pre-test sought out possible areas for development. The items have been measured using a seven-point Likert scale as is being used to measure perceptions of the respondents in the developing countries (Riphah, et al., 2022; Sulaiman & Asad, 2023; Xie et al., 2023). The respondents, who were contacted by phone and in-person visits, provided direct answers to the questionnaire. Managers responded to open innovation items and owners and top management graded items pertaining to knowledge management, stakeholder relationships, and performance levels. In their respective fields of expertise, each survey participant was well-respected and well-known. Only the entrepreneurial businesses with the highest percentage of SMEs and entrepreneurial firms were selected from Jordan's largest representative city.

4. Findings and Discussions

Software called SPSS 25.0 was used to screen the data initially to compute the descriptive and to confirm the normality of the data which was hardly required as partial least square is a nonparametric test; however, Smart PLS 3 was used to test the external model and hypothesis.

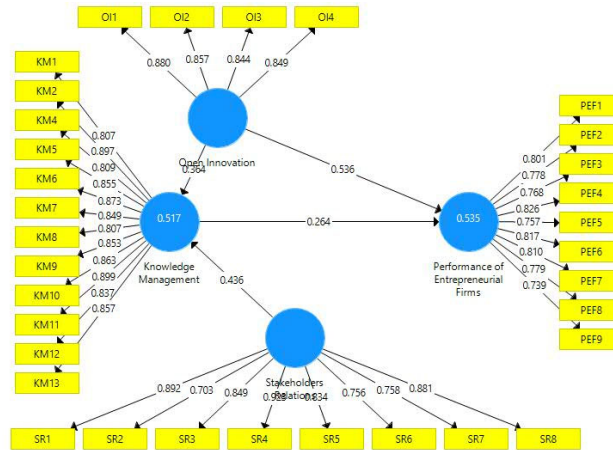


Fig. 1. Measurement Model

4.1 Outer Loadings

This study first determined each outer loading to pinpoint the problems with outer loadings. Table 1 thus displays the outer loading indications based on their specific values between the lower bound of 0.703 and the higher bound of 0.923.

Table 1
Outer Loadings

Outer Loadings	Knowledge Management	Open Innovation	Performance of Entrepreneurial Firms	Stakeholders Relations
KM1	0.807			
KM10	0.863			
KM11	0.899			
KM12	0.837			
KM13	0.857			
KM2	0.897			
KM4	0.809			
KM5	0.855			
KM6	0.873			
KM7	0.849			
KM8	0.807			
KM9	0.853			
OI1		0.880		
OI2		0.857		
OI3		0.844		
OI4		0.849		
PEF1			0.801	
PEF2			0.778	
PEF3			0.768	
PEF4			0.826	
PEF5			0.757	
PEF6			0.817	
PEF7			0.810	
PEF8			0.779	
PEF9			0.739	
SR1				0.892
SR2				0.703
SR3				0.849
SR4				0.923
SR5				0.834
SR6				0.756
SR7				0.758
SR8				0.881

Because of this, the outer loading item findings that are displayed above guarantee that each item is included in the model and that all the variable values related to knowledge management, open innovation, entrepreneurial firm performance, and stakeholder relations are higher than the 0.7 threshold (Hair, Ringle, & Sarstedt, 2013).

4.2 Construct Reliability and Validity

To ensure the construct's reliability and validity, researchers analysed Cronbach's Alpha, Composite reliability, and Average Variance Extracted (AVE) for knowledge management, open innovation, performance of entrepreneurial firms, and stakeholder relations. Henseler, Ringle, and Sarstedt (2015) identified that Cronbach's Alpha value greater than threshold level of 0.7 ensures that the instrument holds significant reliability, and calculated value of composite reliability if exceeds 0.6 shows that the instrument is valid, but a higher than 0.7 value is preferred. Furthermore, AVE calculated value of 0.5 and above ensures that the instrument holds convergent validity. Table 2 shows the results.

Table 2
Construct Reliability and Validity

Variables	Cronbach's Alpha	Composite Reliability	Average Variance Extracted (AVE)
Knowledge Management	0.965	0.969	0.724
Open Innovation	0.880	0.918	0.736
Performance of Entrepreneurial Firms	0.923	0.936	0.619
Stakeholders Relations	0.933	0.945	0.685

The calculated values of 0.965, 0.880, 0.923, and 0.933 for knowledge management, open innovation, entrepreneurial firm performance, and stakeholder relations, respectively, were obtained from Cronbach's Alpha analysis of all variables. In a similar vein, the values of 0.969, 0.918, 0.936, and 0.945 represented the composite reliability for knowledge management, open innovation, entrepreneurial firm performance, and stakeholder relations. Furthermore, the average variance extracted was found to be 0.724, 0.736, 0.619, and 0.685 for stakeholder relations, performance of entrepreneurial firms, open innovation, and knowledge management.

4.3 Discriminant Validity by Fornell-Larcker Criterion

The performance of entrepreneurial firms, stakeholder relations, open innovation, and knowledge management have all had their discriminant validity analysis analysed. The study also confirmed that one latent variable differs from the other latent variable, as per discriminant validity. According to Hair, Black, Babin, Anderson, and Tatham (2010), the most effective method for assessing discriminant validity is to use the Fornell-Larcker criterion. Table 3 lists all the measured values for each variable.

Table 3
Discriminant Validity by Fornell-Larcker Criterion

Variables	Knowledge Management	Open Innovation	Performance of Entrepreneurial Firms	Stakeholders Relations
Knowledge Management	0.851			
Open Innovation	0.631	0.858		
Performance of Entrepreneurial Firms	0.602	0.702	0.787	
Stakeholders Relations	0.659	0.613	0.548	0.828

As a result, it has been determined that all the constructs in the structural model that have results in discriminant validity according to the Fornell-Larcker criterion above are both valid and dependable.

4.4 Discriminant Validity by Heterotrait- Monotrait Ratio

A key idea in structural modelling is discriminant validity, which demonstrates how one latent variable differs from the other (Henseler, Ringle and Sarste 2015). Similarly, discriminant validity can be assessed and the average correlation between the indicators and variables can be measured using the Heterotrait-Monotrait Ratio of correlation; if the construct value of HTMT is less than 0.90, discriminant validity between two variables has been assessed (Ab Hamid, Sami and Sidek. 2017). Table 4 lists the discriminant validity by HTMT criterion for each of the following variables: stakeholder relations, open innovation, performance of entrepreneurial firms, and knowledge management.

Table 4
Discriminant Validity by Heterotrait- Monotrait Ratio

Variables	Knowledge Management	Open Innovation	Performance of Entrepreneurial Firms	Stakeholders Relations
Knowledge Management				
Open Innovation	0.680			
Performance of Entrepreneurial Firms	0.629	0.770		
Stakeholders Relations	0.687	0.675	0.585	

As a result, the analysis above demonstrates the discriminant validity using the Heterotrait-Monotrait ratio, which looks at the validity and reliability of each construct value.

4.5 Direct Effects

In order to test the direct relationships, the study utilized structural equation modelling. Table 5 explains the calculated values for path coefficients for the direct effects of open innovation over performance, which indicates a significant impact.

Table 5
Path Coefficient Direct Effects

Path Coefficients	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Open Innovation → Performance of Entrepreneurial Firms	0.707	0.715	0.050	14.06	0.000

The path coefficient of direct effects results above indicate a significant correlation ($\beta=0.707$, $t=14.06$, $p=0.000$) between open innovation and entrepreneurial firm performance. This clarifies that open innovation improves the performance of entrepreneurial firms because open innovation and entrepreneurial firms both are dependent upon the preferences of the consumers. Thus, open innovation significantly improves the performance of entrepreneurial firms.

4.5 Mediating Effects

After ensuring that the direct relationship between open innovation and entrepreneurial firms is confirmed, knowledge management was introduced in the model to check its mediating impact between open innovation and performance of entrepreneurial firms. Initially the direct impact of open innovation over knowledge management and then direct impact of knowledge management was seen on performance of entrepreneurial firms. Therefore, the researchers looked at the mediation effects of knowledge management using indirect effects. Table 6 mentions the findings for the mediating effect of knowledge management.

Table 6
Mediating Effects

Path Coefficients	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Open Innovation→Knowledge Management	0.631	0.634	0.084	7.546	0.000
Knowledge Management→Performance of Entrepreneurial Firms	0.264	0.266	0.118	2.242	0.025
Open Innovation→Knowledge Management→Performance of Entrepreneurial Firms	0.167	0.168	0.079	2.112	0.035

Before confirming the mediating impact, the direct impacts are reported. The analysis demonstrates that open innovation holds a significant impact on knowledge management ($\beta=0.631$, $t=7.546$, $p=0.000$), and that knowledge management holds a significant impact over performance of entrepreneurial firms ($\beta=0.264$, $t=2.242$, $p=0.025$). Likewise, there is a noteworthy mediating impact of knowledge management between open innovation and performance of entrepreneurial firms ($\beta=0.167$, $t=2.112$, $p=0.035$).

4.7 Moderating Effects

After ensuring that the direct and indirect impacts are significant, in order to address the inconsistencies in the literature, stakeholders' relations were introduced in the research model. Initially the direct impact of stakeholders' relations was analysed and afterwards, the interaction term was introduced to check the moderating impact of stakeholders' relations. Table 7 illustrates the results of direct and moderating impact of stakeholders relations.

Table 7
Moderating Effects

Path Coefficients	Original Sample (O)	Sample Mean (M)	Standard Deviation (STDEV)	T Statistics (O/STDEV)	P Values
Stakeholders Relations→ Knowledge Management	0.381	0.42	0.157	2.432	0.015
Moderating Effect 1→Knowledge Management	0.551	0.237	0.18	3.061	0.004

Initially the direct effect of stakeholders relations was analysed over knowledge management which was found to be significant ($\beta=0.381$, $t=2.432$, $p=0.015$). Afterwards the interaction term was introduced which calculated the moderating role of stakeholders relations between open innovation and knowledge management. The results of the moderating effects of

stakeholders relations were found to be significant ($\beta=0.551$, $t=3.061$, $p=0.004$). This shows that stakeholders' relations are an important factor which can significantly influence the impact of open innovation on knowledge management.

4.8 Construct Cross-validated Redundancy

For the purpose of confirming the predictive relevance, construct cross-validated redundancy was analysed. To investigate the cross-validated redundancy of the construct, we blindfolded a process. Similarly, the endogenous latent variable's Q^2 was determined by the analysis using the Stone-Geisser test. Asad, Asif, Bakar, and Altaf (2021) also used the same test to calculate predictive relevance and identified that if the measured value of Q^2 is above zero, the model holds significant predictive relevance. Table 8 mentions the results of the Stone-Geisser test for both the variables which are knowledge management and performance of entrepreneurial firms.

Table 8

Construct Cross-validated Redundancy

	SSO	SSE	$Q^2(=1-SSE/SSO)$
Knowledge Management	1200	755.775	0.370
Performance of Entrepreneurial Firms	900	613.791	0.318

After ensuring that the overall model is statistically significant and holds sufficient predictive relevance, the results of the research are discussed below and are linked with the findings of the previous studies and the detailed discussion is made in the next section.

5 Conclusions, Implications, Limitations and Future Directions

This paper intended to advance our comprehension of the important role that OI plays in entrepreneurial firms by looking at links between eight distinct OI activities inverse information exchange, stakeholder interactions, and success of entrepreneurial firms. All things considered, by extending dynamic knowledge and participating in inter-organizational networking activities, entrepreneurial firms can act as platforms (orchestrators) for collaborative co-creation of shared values between all stakeholders, despite their resource limitations. These findings are consistent with an integrative perspective.

5.1 Theoretical Implications

This research attempted to close the knowledge gap by emphasizing the need to consider mediating and moderating factors when analysing OI's effect on entrepreneurial firms' performance from a theoretical perspective. Academics are starting to realize that open innovation might not be the solution to performance issues facing entrepreneurial firms. Because theoretical construction is complex and empirical tests have lag effects, researchers need to look for additional intervening elements to support the empirical development of the OI-performance relationship.

The research enriched the literature by providing empirical evidence supporting the existence of the impact of open innovation over performance of entrepreneurial firms on a spatially contextualized level. The notion of an economic frontier is also raised in this study, which expands the possible scope of investigation for open innovation and the relationship between the performance of entrepreneurial firms. Still, this is a small body of constructed research due to the prevalence of quantitative methods and research from developed nations in the literature (Ullah, et al. 2021, Fischer, et al. 2021).

The research and analysis examined production and utility entrepreneurial firms observed in the rapidly expanding Jordanian economic chart, thereby broadening the geographic range covered by practical studies. Because diverse economies reflect heterogeneous circumstances that may enable or impede knowledge as well as network-based business operations, contextualizing an existing body of research can be beneficial. This is especially true regarding entrepreneurial firms (Ferraris, Mazzoleni, et al. 2019). A shift like this in the canon of literature might stimulate more creative thinking in theory, especially considering the new circumstances.

The stakeholder component of relationships adds significantly and holds a significant impact on the overall relationship between open innovation and knowledge management. This specific research showed that an OI can effectively promote reverse-knowledge distributing among stakeholders instead of just sharing information in a way that can be "imagined" by any associated organization. This dispels the myth that a focal entrepreneurial firm will instantly receive feedback information based on the knowledge that is sent and received once it implements open innovation (OI).

This picture may convey the false impression that stakeholder information exchange increased because of the focal firm's implementation of open innovation (Jimenez-Jimenez, Martínez-Costa and Rodriguez 2019). This might be a better representation of the knowledge-related activities that entrepreneurial firms carry out. They use a highly networked environment when implementing OI.

Knowledge derived from addressed stakeholders and central firms sharing knowledge, along with the supportive impact of stakeholder relations, generally confirms the encouraged exchange of knowledge (Irfan, et al. 2022). This supports the idea that OI practices could form a continuous, multidimensional knowledge network for sustained performance that goes beyond the personal aspirations and expectations of the central entrepreneurial firm (Martinez-Costa, Jimenez-Jimenez and Rabeih 2019). In keeping with this logic, we propose a unique notion of knowledge flow for upcoming research, indicating that directed knowledge flow should take the OI-knowledge-performance nexus into account.

5.2 Practical Implications

This research offers managers with helpful insights into the relationships between innovation, outside information, and inflow-performance in entrepreneurial firms, all from an entirely empirical perspective. Our study sheds light on how SME managers manage relationships with stakeholders when engaging in open innovation. In working with different partners in innovation eco-systems, specificity and dynamic action are especially important. It also broadens the assumptions surrounding a standardized manner of contact with stakeholders.

Therefore, during OI by the entrepreneurial firms, we advise managers to develop customized relationship-management strategies and necessary procedures for various stakeholders on the flow of knowledge both internally and externally. Utilizing a variety of role descriptions, individual and opponent orientation, and interacting techniques is essential. Hence, the entrepreneurial firm-based inter-organizational knowledge activities in the middle of OI should be set up methodically in an integrative innovation ecosystem where a variety of information is present. Understanding the knowledge structure more thoroughly and clearly is made possible by the recognition and analysis of knowledge actions.

This is a novel conclusion: the amount of incoming information modifies such a relationship in a negligible way. OI is obviously and statistically irrelevant when assessing the real performance of an entrepreneurial firm. These findings incentivize managers to prioritize the use and integration of knowledge within current business and innovation frameworks, as entrepreneurial firms have the capacity to increase the amount of incoming information from innovation transparency and foster more robust relationships between diverse stakeholders. This needs to be done to gain from outside information flows and creative openness.

5.3 Limitations and Future Directions

Despite its limitations, this study may present chances for additional study in the future. Because this analysis was according to a small sample of Jordanian entrepreneurial firms, its conclusions are probably country specific. To make more comprehensive generalizations, more research on OI in entrepreneurial firms in less developed nations is required, even though a study with this narrow focus might be beneficial in the way it was intended. Comparative research across multiple countries is the next research opportunity to better understand the cultural concerns inherent in OI practices.

Conducting research on the correlation between cultural innovation and different situations is imperative. Comparative studies for OI-SME performance research should be beneficial because they may lead to the integration of entangled, frequently contradictory findings in meta-research to produce a comprehensive and contrasting understanding that can be used by professionals and academics.

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