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The Effect of Technology and Open Innovation on Women-Owned Small and Medium Enterprises in Pakistan

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Abstract

Technological adaption and innovative activities foster small and medium enterprises (SMEs) growth, especially women-owned SMEs in Pakistan, However, the impact of technological adaption and innovative activities on SMEs growth in the context of Pakistan has been examined by very researchers. This study aims to identify the effect of technology and open innovation policies on the growth of women-owned SMEs and the present trends and management challenges for successful full implementation of open innovation. The study considered a sample of 693 women enterprises located in different cities in Pakistan. Open innovation is measured through eight innovative practices, reflecting the exploration and exploitation of technology in SMEs. Study findings revealed that women enterprises were involved in several open innovation policies during the last five years. Moreover, the study indicated no significant differences between manufacturing and service SMEs regarding open innovation practices; however, women enterprises are more impressively engaged in open innovation practices. Findings also reveal that women-owned SMEs follow open innovation, mainly for market-related intentions, to compete with competitors and meet customers' demands. Thus, it is suggested that government policy relating to thriving SMEs owned by women should be innovation-oriented. The study contributes to the theoretical and practical implications. Further, the study is helpful for SMEs, researchers, practitioners, and decision-makers.

Keywords: Open Innovation, SMEs, Technology, Trends, and Motives, Management Challenges

JEL Classification Code: O12, M53, I21

1. Introduction

Small and medium-sized enterprises (SME) play a vital role in the national economy by creating job opportunities and promoting industrial development and innovation (OECD, 2017). To gain and retain a competitive edge in the industry, many SMEs rely on their innovative capacity (Parida et al., 2012). The evolution of Internet technologies has enabled SMEs to compete successfully and competently in both local and international markets. But in terms of adopting open innovation strategies, a majority of them are facing challenges. A small company may find it challenging to access up-to-date knowledge of current systems and procedures (Lee et al., 2010). These limitations can prevent business people from competing and doing well. Studies recommend opening the innovation phase to address these challenges and boost the market efficiency of SMEs (Parida et al., 2012). This means a change from a closed trading paradigm to an open innovation model (Chesbrough, 2003).

The SME sector has a lot of potential for growth in the coming years with respect to job creation, entrepreneurial spirit, and innovation. However, the sector has always struggled due to the burden of challenges. Countries are mostly developing open innovation policies in SMEs, and their confidence in SMEs is rising (Khan et al., 2006).

The women-owned SMEs are the backbone of Pakistan's economy, contributing to the gross domestic

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product, job generation, and export growth. In Pakistan, factors like low access to finance, lack of family support, unfavorable social structure, educational issues, lack of access to market networks, low technical know-how, security issues, and low participation in economic activities act as hurdles in making women financially strong and independent (Khalid et al., 2020a). Moreover, Pakistan stands near the bottom of women's participation in the workforce. This lack of participation is at the root of many of the demographic and economic constraints that Pakistan faces. Besides, most businesses are family businesses. The number of women involved in the ownership, management, and direction of family businesses has not been impressive. Women's presence has been sometimes described as "invisible", without influence in decision-making, and women's efforts are not always properly recognized and rewarded in terms of job titles and salaries. To develop SMEs, access to finance is an essential factor that contributes to the country's economic growth (Jianguo & Qamruzzaman, 2017).

Chesbrough (2003) identified that open innovation has gained a growing interest in research sciences and has been studied to date mainly in multinational companies based on comprehensive discussions and case studies. Some other studies say that in small organizations, open innovation still occurs. One of the strongest arguments in favor of small companies being more innovative is that they have the ability to act quickly and decisively, particularly in terms of executing new ideas (Henkel, 2006). A central part of the innovation process concerns the way firms go about organizing a search for new ideas that have commercial potential. New models of innovation have suggested that many innovative firms have changed the way they search for new ideas, adopting open search strategies that involve the use of a wide range of external actors and sources to help them achieve and sustain innovation (Laursen & Salter, 2006; Lestari et al., 2020). Lichtenthaler (2009) conducted open innovation empirical research. He concentrated on large and medium enterprises in Austria, Germany, and Switzerland as there were no studies of small businesses and service industries.

This research is the first explanatory research to assess the degree to which women-owned SMEs have applied open innovation practices and whether there is a trend towards growing acceptance overtime of the model of open innovation. The disparities among SMEs and manufacturing and service firms are created and checked. Moreover, this study represents the incentive of women-owned SMEs to involve in innovation and the management challenges to adopting open innovation. As far as the researchers are aware, this study is the first to study the effects of technology and open innovation on women-owned SMEs.

2. Literature Review

2.1. Concept of Open Innovation

In the 21st century, technical and scientific research and development (R&D) has steadily modified the way it is conceived, sponsored, and performed. The conventional "closed" innovation model, in which most R&D is carried out in-house and innovative goods are produced in isolation and secrecy behind the tightly guarded laboratory of the organization, is now commonly accepted as being inherently impractical and an evolving "open innovation paradigm" is now taking its place (Gassmann et al., 2010).

Open innovation is a commonly used concept spanning multiple aspects. Most recently, the definition of open innovation has been modified as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model (Vu, 2020). The key concept underlying the open innovation concept is that firms are naturally designed in such a way that their operations affect and are affected by other entities in the business environment. Some benefits of open innovation adoption include improving firm's learning effectiveness in absorbing external knowledge; providing access to complementary knowledge residing in innovation partners and grant access to intangible tacit knowledge and know-how; exploitation of economies of scale and scope in both research and development, enhancing the distribution of risks among the partnering firms. Lichtenthaler (2008) stated that in addition to acquiring external technology, firms have started to actively commercialize technological knowledge, which represents the opposite type of technology transactions. The strong interactions with a firm's environment contrast the traditional closed approaches to innovation. Therefore, this new paradigm has been termed open innovation.

Open innovation was initially described as 'intent usage.' Information inflows and outflows to boost internal innovation, and widen the opportunities for external application of innovation". This description was further established and explained the 'divided method of invention depending on intent. Regulated information transfer through organizational borders" Model of modern creativity It has changed from locked "in-house" R&D to a mix of both internal and External channels of innovations, technology and other forms of intelligence This could encourage businesses to innovate. Much of your attention in the field Innovation literature has been paid to the inbound information method. Inflows to drive internal innovation, with less attention given to Outbound Information Outflow Method.

According to Clausen and Pohjola (2009), involvement in different open innovation activities by using inflows and outflows of knowledge becomes the important premise for a successful business. Open innovation is not an entirely new paradigm; it essentially and profoundly builds and draws on many long-standing core study topics and theoretical structures, including Schumpeter's view of the entrepreneur as an innovator and an agent of transformation, stressing the significance of the 'creative destruction' mechanism (Schumpeter, 1912), the importance of corporate R&D to economic growth (Chesbrough et al., 2006).

2.2. Open Innovation and Small and Medium-sized Enterprises (SMEs)

SMEs play a vital role in national economies by generating employment opportunities and are important contributors to value creation and innovation. Not only in the developing world, but even in developed economies, the rate of creativity tends to increase. How they will encourage effective creativity is the main question confronting multiple small medium-sized firms. Innovation in small and medium-sized businesses can be (more) productive and competitive, but this is not the case in many SMEs. Most SMEs aren't at least imaginative. Researchers defined core obstacles for SME innovation in answer to this issue, including the challenge of human capital (skills and skills) and small-scale learning to increase innovation speed and decrease costs; the challenge of research and development (R&D) and the discovery of new emerging technologies; the challenge of macro-technologies; the challenge of national policies and regulations (Gassmann, 2006). SMEs face the inherent tension of depending on external partners to complement their internal innovation activities while having limited resources to manage such open innovation processes. Open innovation guidelines will better address these problems if used correctly. In general, the practice of open innovation successfully relies on different factors. These factors are grouped into nine themes: 1) relational aspects, 2) the people involved in the process, governance, facilitators, provision of resources, strategy, process management, leadership, and culture (Durst & Ståhle, 2013).

In a study, Sadat and Nasrat (2020) examined the practice of open innovation by Small and Medium-sized Enterprises (SMEs) in the food industry. They adopted a multiple case study approach and conducted in-depth semi-structured interviews with four food SMEs in the Flanders region of Belgium. The results of the analysis showed that food SMEs practice open innovation mostly through inbound open innovation activities rather than outbound, mainly due to lack of sufficient resources. Food SMEs typically lack sufficient financial capital, technology, and human capital. Within inbound open innovation activities, collaboration with organizations is found to be a key element for food SMEs' internal development and innovation of new products. D'Angelo and Baroncelli (2020) building on the open innovation framework examined the R&D inbound model of SMEs. Specifically, they focused on the impact of different horizontal R&D collaborations on product innovation and innovation performance. Their analysis showed that collaborating with different horizontal R&D partners brings to different innovation outcomes. In particular, R&D collaboration with universities has a positive impact on product innovation, but not on innovation performance. Whereas, R&D collaboration with research centers and other private companies has a positive impact on both product innovation and innovation performance.

Small and medium-sized companies are seeking open innovation mostly for market-related purposes, such as satisfying consumer needs or keeping up with rivals. Their most significant problems apply to operational and cultural concerns as a result of expanded foreign interactions. (Lakhani et al., 2007). Considering the inbound open innovation, i.e., the outside-in process, SMEs are most likely to use external partnerships so they can concentrate on specializing in internal competence. Open innovation has been described as the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively (Chesbrough et al., 2006). SMEs turn to Open Innovation to find a solution to a problem they cannot solve for various reasons. Open Innovation allows SMEs to rely on experts to solve their problems (Chesbrough & Bogers, 2014). Since SMEs often have limited resources at their disposal, open innovation allows them to collaborate with external partners and the wider community to develop new products and services. This approach can be also used to foster prudent innovation (significant cost reduction, focus on core functionalities and optimized performance level), contributing to innovation and market performance of SMEs (Qamruzzaman & Jianguo, 2019).

With the advent of new patterns of development and the increase in the number of consumers with socially conscious buying actions, businesses are introducing new business models focused on developments that enable them to compete in the ecological and/or sustainable market segments. For this cause, creativity is of considerable significance in the sense of market practices aimed at developing goods and environmental and economic processes. Large numbers of businesses have proposed incorporating creativity to generate economic and environmental benefit at the same time.

This process builds on diverse networks of collaborators and potential stakeholders, collaborating together across transparent innovation frameworks of inbound and outbound activities, to solve the complexities of innovation.

2.3. Technology Exploitation and Technology Exploration

Few researchers Chesbrough and Vanhaverbeke (2018) declared that the outflow and inflow of information regarding intellectual property (IP, hereafter) is important in open innovation. A company that owns rights in a patent, know-how, or other IP assets, but cannot or does not want to be involved in the manufacturing of products, could benefit from the licensing out of such IP assets by relying on the better manufacturing capacity, wider distribution outlets, greater local knowledge and management expertise of another company (the licensee)(Gassmann, 2006). The Out-licensing helps to take advantage of the IP as they discover profitable, external routes to the market for other businesses with different business models.

To be successful, a licensing arrangement should benefit all the parties involved. By acquiring rights to a patent, a licensee can create new products, services, and market opportunities for themselves, reduce costs to acquire new technologies, without having to develop their own, save time getting a new product to market, and gain a competitive advantage over rivals, especially if their license is exclusive (Le & Nguyen, 2020). Businesses must continually adopt new technologies to remain profitable, innovative, and competitive in today's global market. Many companies are choosing to achieve these goals by collaborating with others through licensing programs, outsourcing, joint ventures, acquisitions, or other strategic partnerships. Each of these affiliations almost always requires the inbound or outbound licensing of intellectual property (Lichtenthaler, 2008).

Another approach is to build on existing staff initiatives and skills, even if you do not work in the internal R&D department, to take advantage of internal experience. Various case studies show that informal working contacts with other organizations' personnel are essential to understanding the manufacturing and selling of new products (Khalid et al., 2020b). Many businesses own extensive IP portfolios that include patents, patentable inventions, know-how, and copyrights, as well as trade secrets, trademarks, and domain names. The most common reason companies license IP is that outbound licensing can be a useful and simple way to monetize underutilized technology. However, there are many other potential advantages to licensing out IP that may be less evident. Van Dijk and Van Den Ende (2002) and Sundgren et al. (2005) stated that in light of the recent economic crisis, many industrial firms attempt to capture additional value from their technologies by means of open innovation strategies. Besides acquiring external technology, many firms therefore increasingly try to license their own technology to other firms either exclusively or in addition to its application in their own products.

Technology-exploration refers to practices that enable firms to acquire new knowledge and technologies from outside through customer involvement, external networking, external participation, outsourcing R&D, and the inward licensing of IP. The ultimate goal of technology exploration is to develop innovative services based on new information and communication technologies. The traditional service development starts with the user requirements to create new services. Technology Exploration starts from new available technologies and invites users to create ideas for innovative services (Van de Vrande et al., 2009).

Innovation literature stresses the importance of opening the innovation process to internal and external innovators. The question of what determines the integration of these types of innovators in the innovation process remains open. Neyer et al. (2009) used a sociotechnical systems perspective to address a number of challenges with respect to this matter: an organization deploying different innovation practices to open the innovation process might not be aware which types of innovators are de facto integrated into its innovation process. Alternatively, an organization targeting the integration of a particular type of innovator might not use the suitable innovation practices to integrate the knowledge of this type of innovator. They proposed that a combined analysis of innovation practices and underlying social interactions is needed to decide about the integration of a particular type of innovator in the innovation process. Being aware of these interrelations will allow organizations to act more consciously when opening their innovation processes (Neyer et al., 2009). Idea collection should provide an important link between creativity and innovation. Ideas sit at the nexus between creativity and innovation, the point where one research stream has traditionally ended, and the other began (Gilson and Litchfield, 2017). Chesbrough and Bogers (2014) defined open innovation as a distributed innovation process based on purposively managed knowledge flows across organizational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organization's business model. Open innovation is a multifaceted phenomenon that demands understanding across various perspectives and levels of analysis. In respect of determinants, processes, and outcomes of open innovation, examining the emerging perspectives within the organization, outside the organization, between organizations or in the broader context of industries is useful. Networking in open innovation can be horizontal, vertical, or a combination of these and the corresponding network profile has a significant role in innovation performance. After the initial inventions by users, business models help to further advance the relevant

products and processes by capturing some good knowledge from the public, by attracting capital, scaling the innovations, and thereby creating an economically sustainable business or industry. Different revenue streams can be activated to create an architecture of activities through which value is created, captured, and distributed in a manner specific to open business models, that is, leaving profitable niches for others.

Gomes-Casseres (1997) concluded that either of the two coalition tactics were practiced by small businesses. They prefer to use partnerships to achieve economies of size and reach when the corporations are tiny compared to their competitors and their market; they resist alliances when they are big in relative terms. This conduct is compatible with the use of partnerships among major companies. The paper also examined the sources of benefit for a small business that is operating in a scale-intensive market leveraging a constellation of allies. Its revenues rely on a mixture of the community-based benefits created by the constellation and the proportion of such profits that the organization will gain from from the group. In this respect, small businesses experience real dangers when their negotiating power within their constellation is poor.

To keep an eye on potential opportunities, enterprises can invest in start-ups and other companies (Keil et al., 2002). The literature on innovation networks reveals little of to what extent different types of knowledge are exchanged and combined by collaborating firms to foster innovation (Sammarra & Biggiero, 2008). Based on field research in the aerospace industrial cluster of Rome, Sammara and Biggiero (2008) investigated the exchange of technological, market, and managerial knowledge. Using social network analysis, the paper shows that the three types of knowledge are unevenly distributed and exchanged, thus revealing that the process of exchange is knowledge-specific. Further, it is found that in most collaborative relationships, partners exchange technological knowledge together with market and managerial knowledge, emphasizing the complex nature of the innovation process which requires access to and recombination of diverse knowledge. This phenomenon concerns not only large companies but also small-to-medium enterprises.

To acquire external expertise, businesses can also outsource R&D activities. The belief that companies do not carry out all R&D activities on their own is because they have to draw on external expertise that can be approved or purchased. In the innovation process, technological service providers have also become more relevant, for example, engineering firms and high-tech organizations (Prencipe, 2000). Brusoni and Prencipe (2001) building on previous research on multi-technology firms and products argued that firms know more about technology than they apply in their own production. They proposed two major dimensions according to which firms should adjust their knowledge and production boundaries, namely systemic interdependencies across components and uneven rate of change across components' underlying knowledge bases. They analyzed the implications of this less-than-perfect overlap between knowledge and production boundaries for the management of firms' external relationships.

Scuotto et al. (2017) increasing investments in information and communication technologies (ICTs), knowledge exchange, and sharing help SMEs tackle the current global and dynamic environment. Given that much of the useful knowledge resides outside the enterprises' boundaries, these technological tools foster the gathering of big data and information. Although both the academic and the trade literature have widely acknowledged the need to foster the development of more innovative products, little empirical research has examined the cognitive processes underlying the creation of these novel product concepts (Dahl & Moreau, 2002). Vossen (1998) & Sivadas and Dwyer (2000) noted that SMEs could benefit from external networks. SMEs must innovate consistently to remain competitive, but on the other hand, innovation is risky and expensive. Many SMEs are forming alliances to quicken the pace of and reduce risks associated with innovation. Public policy can effectively increase collaboration for innovation among firms, entrepreneurs, research institutions, and the public sector in a way that is easily accessible and beneficial for SMEs. Considering cognitive barriers and constrained resources and capabilities for applying open innovation in SMEs with unrestricted scope, a local approach offers advantages to facilitating open innovation (Leckel et al., 2020). After exploring how to identify and operationalize open innovation, the current section introduces some preliminary recommendations on the effect of open innovation on SMEs owned by women, the gaps between industries and categories, and what reasons and management challenges can be faced.

3. Research Methodology

This study examines the reasons, trends, and management problems of women-owned SMEs regarding open innovation. Based on exploratory research, the survey was conducted in computerized interviews with 500 respondents were from women-owned SMEs. NVivo and Lisrel software were used for analyzing the qualitative information; further, data was collected from five cities of Pakistan - Lahore, Karachi, Islamabad, Rawalpindi, and Multan. The processing of data took three weeks. For data reliability, only long-standing respondents and companies that systematically innovate were chosen. Therefore, the survey began by using screening questions within the survey. Using screening questions within a survey has become standard practice across the market research industry. Screening questions are the first

questions that a respondent is exposed to in a survey. These questions determine whether respondents have the appropriate demographic or psychographic criteria that would make them eligible to participate in a research study. First, the screening question stated that if their business has produced at least one innovation in the last three years. Second, the survey investigated if the businesses of the respondents had formulated a plan for innovation. Third, respondents were expected to serve for at least five years in their current employment. The screening ensured that respondents represented SMEs with systemic innovation initiatives and judged how innovation processes have changed over the last five years.

The survey was stratified into two groups (10–99 workers and 100–599 staff) throughout the manufacturing and service industries. The database of Chambers of Commerce, Pakistan was the source of the sample. Interviewees specifically demanded innovation managers, i.e., small corporations, research and development, general managers, administrators, or new business growth management personnel. A total of 2450 respondents, of which 1050 (42%) were prepared to give interviews were contacted. A total of 693 respondents went through the screening step, which is a final sampling rate of 28%. Table 1 indicates the distribution of these respondents across groups and sectors.

Table 1: Demographic Profile of Samples

	No. of employee		
	10–99 personnel	**100–499 personnel**	
Manufacturing Food and beverages	50	28	
Chemicals, rubber, and plastics	70	46	
Machinery and equipment	40	50	
Other manufacturers	44	53	
	204	177	381
Services IT	38	14	
Business services	70	44	
Other services	96	50	
Services IT	204	108	312
	408	285	693
	38	14	

4. Results and Discussion

Table 2 demonstrates the effect of open innovation activities on women-owned SMEs. The last three columns offer a summary of the success of these innovative SMEs in Pakistan. The table shows how many SMEs in the past five years have undergone a rise, stabilization, or decrease in the usage of technology exploitation and technology discovery in different areas. The contribution of SMEs to innovation has increased thanks to changes in the way innovation takes place in the economy. These findings show that not only do MNEs carrying open innovation but also a large section of SMEs carry out open innovation.

Table 3 shows the incidence and perceived trends in open innovation. Trend estimates have been averaged for easy presentation. The Mann-Whitney U test is used to compare differences between two independent groups when the dependent variable is either ordinal or continuous, but not normally distributed. Table 3 states that non-parametric Mann-Whitney testing was less acceptable since most dependent variables were in breach of the required normal distribution. Hence, we performed a multivariate analysis. Multivariate analysis of variance (MANOVA) is a procedure for comparing multivariate sample means.

Table 2: Incidence and Perceived Trends in Open Innovation Practices (*n* = 693)

	Incidence	**Perceived trends**		
		Increase %	**Stable %**	**Decrease %**
Technology exploitation				
Venturing	23	10	90	1
Outward IP licensing	14	3	88	1
Worker Involvement	74	37	46	1
Technology exploration				
Customer involvement	88	32	67	1
External networking	87	45	79	2
External participation	47	25	94	2
Outsourcing R&D	41	30	60	3

As a multivariate procedure, it is used when there are two or more dependent variables and is often followed by significance tests involving individual dependent variables separately. In processing, technology exploration, i.e., services also participate in research and development outsourcing, and inland IP licensing seems to have a slightly greater emphasis. By comparison, service firms do a better job (22% versus 32%, $p < 0.05$).

Table 4 reveals significant variations as regards perceived patterns. All values in the respondent's column are (much) more prominent, with a workforce of 100–499 staff. In particular, medium-sized companies are more active in open innovation. This finding contrast with Lichtenthaler and Lichtenthaler (2009) and Lichtenthaler (2008) who concluded that company size did not significantly influence technology exploration, although it affected technology usage. In conclusion, medium-sized companies are more likely than small enterprises to apply and embrace open innovation.

Table 5 compares the clusters based on the extent of implementation of open innovation practices over the past five years so as to examine the variations between clusters further. As for sectors, the manufacturing firms comprise 74 percent of respondents in cluster 1. For clusters 2 and 3 respectively the percentages are 70 and 62. The Kruskal–Wallis test by ranks is a non-parametric method for testing whether samples originate from the same distribution. It is used for comparing two or more independent samples of equal or different sample sizes. It extends the Mann–Whitney U test, which is used for comparing only two groups. A test of Kruskal – Wallis indicates the importance of these variations at po0,05 (Kruskal – Wallis w2 1/2 7,3, df 1/2). 72% of Cluster 1 respondents are medium-sized businesses and for clusters 2 and 3 respondents the percentage of medium-sized businesses are 48% and 36%, respectively. Again, there are substantial variations, now at po0.001 (Kruskal – Wallis w2 1⁄4 23.1, df 1⁄4 2. As such, Cluster 1 (open innovators) findings show that open innovation is embraced as firms expand in size. Cluster 3 includes several small businesses with small open innovation application, but most companies often include consumers in the process of innovation. Cluster 2 includes SMEs who participate in open innovation activities that do not entail major investment such as worker engagement and external networking. Cluster 1 (medium-sized businesses) respondents embrace open innovation activities that typically require significant investment, including venturing, exterior involvement, IP licensing, and R&D outsourcing.

Table 6 indicates that the most important reason for almost all open innovation activities carried out by SMEs is market-related. For most respondents, innovation is considered a way of upgrading the products and fulfilling consumer demand leading to improved growth, improved monetary results, or a higher market share. Market-based motivation is crucial in driving firm engagement (37%), involvement in other firms (44%), and participation of consumers in the innovation phase (74%). Many SMEs feel that a wide range of methods must satisfy customers' changing demands and prevent rivals or new entrants from overtaking the company. Power, concentration, cost, and capability motives are less widely stated.

Table 3: Incidence of and Perceived Trends in Open Innovation Practices between Industries

	Incidence Manufacturing (*n* = 381) (%)	**Services (*n* = 312) (%)**	**Mann-Whitney Z(U)**	**Manufacturing (*n* = 381) (%)**	**Services (*n* = 312)**	**Mann-Whitney Z(U)**
Technology exploitation						
Venturing	22	32	2.35[4]	0.08	0.14	2.01[2]
Outward IP licensing	10	7	1.15	0.03	0.02	0.1
Worker Involvement	86	85	0.6	0.38	0.38	0.2
Technology exploration						
Customer involvement	88	87	0.7	0.32	0.38	1.2
External networking	86	85	0.5	0.22	0.24	0.38
External participation	39	44	1.15	0.12	0.13	0.26
Outsourcing R & D	50	34	4.0	0.21	0.11	2.5
Inward IP licensing	28	18	3.1	0.04	0.03	0.5

Table 7 demonstrates the key management and organizational problems for SMEs when embracing open innovation. The critical barriers to innovation as listed by the respondents are venture production (56%), external involvement (58%), and R&D outsourcing (50%). The most evident obstacles for businesses when implementing open innovation practices arise i.e., 35 percent, when two or more companies operate together, involvement in other companies (75 percent), and the engagement of external parties and consumers. Such open innovation involves collaboration among various organizations or personnel, similar to a joint venture. These inter-organizational interactions also lead to difficulties in separating duties and responsibilities, balancing creativity, handling everyday tasks, and issues in communication within and between organizations. Another barrier is the availability of time and money. This is a barrier to virtually all forms of open innovation practices; however, as shown in Table 8 the relatively low scores for the time and money variable indicate that this is not a primary obstacle to open innovation practices. The issues associated with administration arise more often in the form of the joint venture (34%), participation in other companies (22%), external partners (18%), and, in particular, collaboration with governmental or other non-profit organizations. Also, as government subsidies and assistance are provided to the company, the administrative burden is prominent.

Table 4: Incidence of and Perceived Trends in Open Innovation Practices between Size Classes

	10-99 personnel (*n* = 408) (%)	**100–499 personnel (*n* = 285) (%)**	**Mann–Whitney Z(U)**	**10–99 personnel (*n* = 408)**	**100–499 personnel (*n* = 285)**	**Mann–Whitney Z(U)**
Technology exploitation						
Venturing	26	30	1.2	0.9	0.11	1.1
Outward IP licensing	5	12	3.3**	0.02	0.03	1.2
Worker Involvement	90	92	1.6	0.34	0.44	2.4*
Technology exploration						
Customer involvement	87	88	1.06	0.26	0.45	4.2**
External networking	84	85	0.3	0.22	0.28	3.1*
External participation	34	34	4.2**	0.11	0.16	2.1[4]
Outsourcing R&D	32	54	4.1**	0.11	0.22	2.2[4]
Inward IP licensing	24	48	3.7**	0.16	0.06	2.1[4]

Table 5: The Perceived Trend in Open Innovation Practices across Three Clusters

	Cluster1 (*n* = 144)	**Cluster2 (*n* = 430)**	**Cluster3 (*n* = 70)**	**Kruskal-Wallis w^2 (df = 2)**
Technology exploitation Venturing	0.27	0.21	0.0.2	6.2
Outward IP licensing	0.21	0.06	0.02	28.0**
Worker involvement	0.43	0.33	0.05	30.1**
Technology exploration Customer involvement	0.62	0.30	0.03	30.3**
External networking	0.49	0.24	0.03	13.5*
External participation	0.43	0.12	0.04	12.6*
Outsourcing R&D	0.41	0.14	0.05	4.4
Inward IP licensing	0.27	0.04	0.02	44.4**

Table 6. Motives to Adopt Open Innovation Practices

Category	Venturing (*n* = 76) (%)	Technology exploitation	Customer involvement (*n* = 273) (%)	Technology exploration		
		Worker involvement (*n* = 264) (%)		External networking (*n* = 243) (%)	External participation (*n* = 91) (%)	Outsourcing R&D (*n* = 111) (%)
Control	2	8	2	2	4	4
Focus	6	–	–	2	6	5
Innovation process	20	–	20	26	20	11
Knowledge	6	–	8	30	10	40
Costs	10	–	5	5	15	10
Capacity	2	–	10	6	10	8
Market	4	10	44	20	25	12
Utilization	–	20	–	–	–	–
Policy	–	12	–	–	–	–
Motivation	–	40	–	–	–	–
Other	21	10	11	9	10	10
Total	100	100	100	100	100	100

Table 7: Hampering Factors when Adopting Open Innovation Practices

Category	Venturing (*n* = 45) (%)	Technology exploitation	Customer involvement (*n* = 90) (%)	Technology exploration		
		Worker involvement (*n* = 90) (%)		External networking (*n* = 91) (%)	External participation (*n* = 40) (%)	Outsourcing R&D (*n* = 60) (%)
Administration	20	–	–	8	10	20
Finance	15	–	–	9	–	5
Knowledge	10	–	–	–	8	–
Marketing	20	–	–	–	12	–
Organization/ culture	23	–	35	45	66	35
Resources	8	20	15	8	–	15
IPR	–	–	5	6	–	–
Quality of partners	–	–	–	20	–	19
Adoption	–	–	18	–	–	–
Demand		–	20	–	–	–
Competences		30	–	–	–	–
Commitment		38	–	–	–	–
Idea management		12	–	–	–	–
Other	5	–	7	2	4	6
Total	100	100	100	100	100	100

5. Discussion and Conclusions

New technological systems emerge when strong cores of complementary knowledge consolidate and feed an array of coherent applications and implementations. External networking to obtain new or novel information is a key open innovation activity among women-owned SMEs in Pakistan. Only a minority of respondents are interested in external and inward IP licenses, venture operations, and external involvement. Informal and unstructured activities that do not require significant investment such as customer engagement and outside networking are the most common open innovation practices. In comparison, IP licensing, venture, and external collaboration require financial commitment, formalized contracts, and a structured risk management strategy. This result is consistent with previous innovation research in small and medium-sized companies (Van de Vrande et al., 2009; Lee et al., 2010; Nieto & Santamaría, 2010; Battistella et al., 2015).

One of the survey's key purposes was to know whether SMEs are gradually practicing open innovation in the last five years. The respondents unequivocally sense a rise in the spread of open innovation and popularity. It is not surprising that SMEs play an increasingly important role in innovation. In reality, SMEs frequently lack capital for in-house production and promotion of new goods and are thus more inclined or compelled to partner with other organizations. Manufacturing companies are more involved in the outsourcing of R&D and IP licensing. Open innovation is as relevant for service companies as for manufacturing businesses, and open innovation activities must not be restricted to women-owned SMEs that have formal R&D operations. The results are consistent with the findings of Lichtenthaler and Lichtenthaler (2009) and Yunitarini and Santoso (2018).

Three clusters of women-owned SMEs were disclosed, grouping organizations into groups with common open practices for innovation. In comparison, we observed major variations between size groups in the adaptation of open innovation methods. Medium-sized businesses, more often than small-sized enterprises, participate in and embrace open innovation. These businesses have the size and resources needed for open innovation activities compared to small companies. The survey findings also show that open innovation exists in small companies and is gradually embraced, but the adaptation rate for open innovation activities for medium-sized firms is increasing compared to small-sized firms. Business services are more active open innovators than manufacturers. They are more engaged in informal relative to formal practices than manufacturers. Open innovation is associated with the adoption of a service business model in manufacturing firms. Moreover, service SMEs are more inclined to use inbound practices due to reasons associated with firm size, industry, and knowledge intensity in the market, whereas the decision about which sub-practice to adopt seems to be strongly influenced by the type of actor, the firm's vulnerability, and internal managerial skills, and the existence of complementarities

The findings show that market-related goals (to increase profits, market share, and continue growing) are the primary reason for embracing open innovation activities in SMEs. This finding is in line with Gans and Stern (2003), who suggested that competitive interaction between start-up innovators and established firms depends on the presence or absence of a market for ideas. By focusing on the operating requirements, efficiency, and institutions associated with markets for ideas, this framework holds several implications for the management of high-technology entrepreneurial firms.

Management and organizational barriers to open innovation are very complicated; however, as women-owned SMEs work with external partners, the key obstacle of open innovation in SMEs lies in the organizational culture. Khalid et al. (2020a) stated that factors like low access to finance, lack of family support, unfavorable social structure, educational issues, lack of access to the market network, low technical know-how, and security issues, and low participation in economic activities act as hurdles in making women financially strong and independent in case of Pakistan.

Limitations: First, the study cannot claim that the survey data capture the entire area of exploitation and discovery of external technology, considering the limited data. Second, while the study has a wide sample of women-owned SMEs, certain types of companies might still be ignored. However, the sample represents a wide variety of creative SMEs, which go beyond previous studies on open innovation. For future study, open innovation in wider reach should become more comprehensive, and small companies and businesses in the services sectors should also be captured. Also, quantitative methods should be used to research open innovation. There are many innovation indicators, but this research used a few of them; hence further studies must consider those indicators.

The present survey also does not explore the relationship between small and large companies in open innovation. Therefore, the need for open innovation should be based on future research on cultural, institutional, and decision-making gaps among companies of different sizes and industries. A final recommendation is to analyze in greater depth the causes and challenges of open innovation. This study found that the key cause SMEs to participate in open innovation was business considerations. This indicates that SMEs are inspired to draw on their internal expertise and pursue new business routes. Future research must pay greater attention to the purposeful outflow of information, namely, technical manipulation.

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