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Open Innovation and Innovative Performance of Pakistani SMEs: Moderated Mediation of Knowledge Management Capability and Innovative Climate

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Abstract

Drawing upon the organizational capabilities of knowledge management, the current study aims to examine the mediating role of knowledge management capability between open innovation and firm-level technological, structural, and entrepreneurial capabilities and the moderation role of innovation climate between open innovation and firm innovative performance. A questionnaire-based survey with a sample of 332 top managers of Pakistani SMEs across the service and manufacturing sectors was conducted. The study adopted partial least squares structural equation modeling (PLS-SEM) to estimate moderated mediation using the SmartPLS 3.0.

The results revealed that the organization structure contributes significantly, followed by ICTs and entrepreneurial orientation on SMEs' knowledge management capability. Mainly, the most robust knowledge management capability positively affects open innovation and mediates most significantly between open innovation and organization structure, followed by ICTs and entrepreneurial orientation. Finally, open innovation directly and through the moderation of innovative climate significantly impact SMEs' innovative performance.

The findings suggest that improving the knowledge management capability and innovative climate means the mechanisms of mediation and moderation through which entrepreneurial orientation, ICTs, and organization structure impact the open innovation, which, in turn, impact SMEs' innovative performance. For policymakers, an important message is that SMEs do not innovate individually but with customers, competitors, suppliers, and others.

The usefulness resides in advancing a comprehensive process of knowledge management capability and innovative climate, suggesting the mechanisms to transmit the effects of

entrepreneurial orientation, ICTs, and organization structure to open innovation, thereby to SME's innovative performance.

Keywords: knowledge management capability, open innovation, innovative performance, small and medium enterprises, information and communication technologies, organization structure.

1. Introduction

Today against the ongoing globalized wave of competition, innovation through the prism of knowledge capital is enriched with qualifying adjectives including open, disruptive, reversed, frugal, fractal, and others (Laperche, 2017). Notably, open innovation (OI), which is "the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and expand the markets for external use of innovation, respectively" (Chesbrough, 2006), is at the heart of SMEs business strategy (Lu et al., 2020). Specifically, through inbound and outbound types of openness, knowledge mechanisms of discovery, maintenance, and utilization can be executed either by internal leveraging outside-in knowledge or by external leveraging of inside-out knowledge, respectively (Lichtenthaler & Lichtenthaler, 2009). Therefore, technological, organizational, and commercial OI is an inevitable trajectory (Laperche, 2017) for SMEs, which constitute 90 percent businesses and more than 50 percent employment globally as well as contribute up to 40 percent of national income (GDP) in emerging economies including Pakistan (The World Bank, 2020, Baig, 2019).

Concerning their open innovation strategies, Bigliardi et al. (2020) provided that even though the accepting of OI is very important, however, SMEs accept in and outbound OI much less than multinationals do due to both internal and external structural constraints of resource, scale, skills, and capacity as well as an understanding of and reach to external knowledge and practice of intellectual asset management (Henttonen & Lehtimaki, 2017). Therefore, SMEs have to improve their knowledge management capability to dynamically manage their knowledge flows in due course by realigning and reconfiguring the mechanisms of knowledge search, maintenance and utilization within and across the firm boundaries (Lichtenthaler & Lichtenthaler, 2009).

Mainly, one of the agents that have increased SMEs' ability to utilizing greater distributed knowledge sources is the development of the internet, that has taken the knowledge availability and sharing capacities of previously firm-level networks of information communication technologies (ICTs) to the world wide web (Chesbrough & Bogers, 2014). Besides, SMEs require to constantly modify their knowledge capabilities, which dynamically grow evolutionarily to meet the changing world (Teece, 2007). Structural mechanisms permit these knowledge capabilities to be groomed in different firm-level units (Lichtenthaler & Lichtenthaler, 2009). Structural mechanisms denote dedicated organizational structures that support realignment and reconfiguration to facilitate the development of outside-in and inside-out ideas, respectively (Odriozola-Fernández et al., 2019).

Besides, firms with robust dynamic capabilities are strongly entrepreneurial (Teece, 2007). Dynamic capabilities facilitate in ensuring ever-changing capability, partly by serving to

form the environment. The dimension of dynamic capabilities that includes forming the environment is entrepreneurial. Accordingly, to advance dynamic capabilities for open innovation processes to effectively manage knowledge flows in due course (Lichtenthaler & Lichtenthaler, 2009), SMEs have to be in circumstances of being innovative, be proactive, and risk-takers (Ibarra-Cisneros & Hernandez-Perlines, 2019). These entrepreneurial SMEs, based upon their relational capabilities and resources (Dyer & Singh, 1998), portray their strategic entrepreneurial orientation (EO) of proactiveness, innovativeness, and risk-taking (Covin & Slevin, 1989) by using a wider variety of knowledge search strategies for instance suppliers, customers, universities, and competitors, and benefit from that in their OI results (Isichei et al., 2020).

Finally, OI process also needs to be facilitated by a firm-level innovative climate to overcome "Not Invented Here" (NIH) and "Not Shared Here" (NSH) syndromes that are deemed as significant obstacles to SMEs' acceptance of OI strategies to impact their innovation results (Del Giudice et al., 2018; Enkel et al., 2011; Najar & Dhaouadi, 2020).

Thus, the micro-foundations of dynamic capabilities including organizational structure, entrepreneurial orientation, ICTs, and innovative climate (Teece, 2007) have implications for open innovation, going from how persons share knowledge within and outside the firms to how firms manage knowledge flows in the innovation process (Dodgson et al., 2006; Sun et al., 2020; Shi et al., 2020). In other words, to effectively take advantage of outside knowledge coming from the OI model, an organization needs knowledge management capabilities to align outside-in, and inside-out knowledge flows with its innovative processes (Brunswicker & Vanhaverbeke, 2015). Thus, through the dynamic capability of knowledge management, SMEs can realign and reconfigure the knowledge capabilities by not only concentrating on external knowledge as such but also understand that open innovation is almost nothing but utilizing and improving internal knowledge capabilities also (Bogers et al., 2019). Therefore, knowledge management (KM) in SMEs' OI approach is becoming increasingly important (Agostini et al., 2020).

While early works mostly investigated OI adoption in large multinational companies, recent years have seen SMEs begin to open up their innovation processes (Bigliardi et al., 2020). Particularly, within the inter-organization contexts including open innovation, Agostini et al. (2020) provided that in quantitative articles, apart from the 'human side' of KM (Martinez-Conesa et al., 2017), both the innovative and organizational performance are associated with KM capabilities, strategy, and practices to uncover the particular dimensions, and processes connected with KM (Jiao et al., 2014). Notably, the scholars are looking to the growingly significant part performed by such ties as knowledge sources to fill out the internal gaps in knowledge to meet competitive pressures and improve firm innovation and overall performance (Bojica et al., 2018). Thus, paving the way to open KM's black box (Agostini et al., 2020).

To endorse this further, in recent empirical studies, the investigators evaluate the interaction of various preferences of KM with informal and formal open innovation outcomes (Scuotto et al., 2017), explore the relationships of antecedents of knowledge management (Explicit & Implicit) with technological innovation capabilities including open innovation (Yao et al., 2020), find the impact of entrepreneurial orientation and

knowledge acquisition with collaborative performance (Dung et al., 2020), investigate the linkages of entrepreneurial orientation with absorptive capacity and business performance (Ibarra-Cisneros & Hernandez-Perlines, 2019), draw the relationship between open innovation, knowledge management capability and dual innovation (Sun et al., 2020), and focus on open innovation and organizational ambidexterity relationship with the moderating impact of entrepreneurial orientation in an inter-organizational context (Nobakht et al., 2020). However, according to some researchers (Martinez-Conesa et al., 2017; Cillo et al., 2019), there are still limited studies that empirically address the relationship between KM capability and OI. Besides, empirical studies have started to check the moderating role of innovation climate on the association between its antecedents and outcomes at various analysis levels (Newman et al., 2020). Specifically, there is a need for further research on how HRM moderator-innovative climate affects the firms' disposal to open up their innovation processes (Kim & Ahn, 2020; Del Giudice et al., 2018; Popa et al., 2017).

Therefore, to address these issues in the context of small and medium-sized service and manufacturing enterprises of Pakistan, this study's objective is fourfold. First, the study examines the impact of organizational capabilities, i.e., entrepreneurial orientation, ICTs, and organization structure, on KM capability. Second, it analyses the impact of KM capability on OI. Third; it measures the mediation role of KM capability between KM factors and OI. Fourth, it examines OI's role in innovative performance by taking the innovative climate as a moderator. In other words, the study aims to answer the following two research questions:

- Does knowledge management capability mediate the relationship between organizational capabilities and open innovation within the context of small and medium-sized service and manufacturing enterprises of Pakistan?
- Does innovative climate moderate the relationship between open innovation and innovative performance within the context of small and medium-sized service and manufacturing enterprises of Pakistan?

The theoretical contribution of this research lies in three aspects. First, within the inter-organization context of open innovation, the current study validates the relationship among knowledge management capability, open innovation, and innovative performance, thus, furnishing the empirical evidence to resolve the key issue of knowledge management and innovation management research. Second, from the knowledge and capability-based perspectives, the current study forms the theoretical paths from knowledge management capability to open innovation, and further to innovative performance and suggests the mediating role of knowledge management capability in the relationship between open innovation and structural, technological, and entrepreneurial capabilities to uncover the specific strategy, elements, dimensions and mechanisms related to KM Third, from the perspective of the 'human side' of OI, this research proposes the moderating role of innovative climate in the relationship between open innovation and innovative performance.

Finally, the current study also advances the advantages will obtain and presents a new insight for the practitioners and policymakers to dynamically integrate cultural, structural, technological, and entrepreneurial organizational capabilities to strengthen further the open innovation and innovative performance link of service and manufacturing SMEs by improving the mediation and moderation role of knowledge management capability and innovative climate, respectively.

The paper is further structured as follows: Section two elaborates on the theoretical background, followed by the hypotheses development and conceptual framework of research. Section three explains the methodology used to conduct the research. Section four describes the results. Finally, section five concludes with discussion, implications, and limitations with further prospects for research.

2. Theoretical Background and Hypotheses Development

2.1 Theoretical Background

Although the innovation process models have been developing since Schumpeter's pioneering research (1934), innovation was confined to the one-dimensional commercialization of knowledge from inside the organization (Verreynne et al., 2020). However, theoretical foundations of resource-based theories (Barney, 1991; Grant, 1996), behavioral theory (Cyert & March, 1963), learning theory (Nonaka, Takeuchi & Umemoto, 1996), evolutionary theory (Nelson & Winter, 1982), absorptive capacities theory (Cohen & Levinthal, 1990), and dynamic capabilities theory (Teece, 2007) in their core strategic and theoretical elements of resources, routines, and capabilities signify the importance of knowledge and the systemic and complementary character of innovation furnish, partially, the grounds for the significance of OI (Dodgson et al., 2006). Particularly, appraisals of the innovation mechanism itself emphasize its highly interlinked and iterating character, augmented by vast extrinsic consolidation, with suppliers, customers, and other sources of knowledge-inferring that innovation appears as an element of a process of knowledge and technology across organizational boundaries (Dodgson et al., 2006; Martinez-Conesa et al., 2017; Verreynne et al., 2020). Therefore, under the firm's business model, OI recognizes knowledge flows in and out of the firm as a distributed innovation process to integrate organizational resources and capabilities externally with outside partners (Chesbrough & Bogers, 2014; Verreynne et al., 2020).

Mainly, for SMEs, outside-in, and inside-out purposive flows of knowledge are still more important to gain and sustain a competitive edge because they confront more extreme scarcity of resources (Henttonen & Lehtimaki, 2017). Consequently, as per the resource-based view (RBV) and its additions, such as the knowledge-based view (KBV), SMEs shape collaborative partnerships externally to obtain advantage from their innovative knowledge, expertise, and skills. Accordingly, OI enables SMEs to identify external knowledge and utilize internal knowledge to gain economic benefits from building knowledge resources to sustain competitive advantages (Popa et al., 2017).

Besides, according to socio-technological theory, social and technological perspectives shape a firm's capabilities for effective knowledge management (Gold et al., 2001). The social paradigm describes the knowledge transmitting bonds among the workforce ingrained in a firm's organizational culture and structure, which are accountable for

transferring tacit and informal knowledge. On the other hand, the technological paradigm describes the organizational information system dedicated to maintaining, storing, and analyzing knowledge. Accordingly, a firm's KM culture, structure, technology, and knowledge process to retain, transform, and transport knowledge constitute a firm's KM capabilities (Gold et al., 2001). Such KM capabilities as "preconditions" for effective knowledge management are central to OI model, showing how firms manage the outside-in and inside-out knowledge flows to improve the innovation mechanism and optimize the outside utilization of innovation (Martinez-Conesa et al., 2017).

Similarly, the resource-advantage theory specifically considers firms' entrepreneurial capabilities necessary for new startups to promote the utilization of new and current knowledge to find out new market niches for proactive, innovative offerings, which lead to market-based positioning of competitive edge and, thereby, superior performance (Hunt & Morgan, 1996; Wiklund & Shepherd, 2003).

Since dynamic capabilities are commonly rooted in entrepreneurial acts and show how dynamically the firm's knowledge capabilities may be configured or reconfigured to meet the business environment's requirements and exploit its opportunities (Teece, 2010). Therefore, Eisenhardt and Martin (2000), based upon dynamic capabilities, suggest that apart from the resources themselves, the firm's strategic processes are significant because they help transform resources into value-added strategies (Wiklund & Shepherd, 2003). Consequently, someone may probably better comprehend co-innovation prospects and strategic options by embedding the open innovation paradigm into dynamic capabilities (Bogers et al., 2019).

Thus, drawing on the organizational capabilities of knowledge management (Gold et al., 2001), the resource-advantage theory (Hunt and Morgan, 1996), and dynamic capabilities (Teece, 2007) for open innovation (Lichtenthaler & Lichtenthaler, 2009), as shown in Figure 1, the current study formulates and examines an integrated research model by taking into account the literature on the mediation role of knowledge management capability between open innovation and entrepreneurial orientation, ICTs, and organization structure, along with the moderation role of innovation climate in the relationship between OI and firm innovative performance. The structural relationships and the related hypotheses are depicted in Figure 1 and explained in the following subsections.

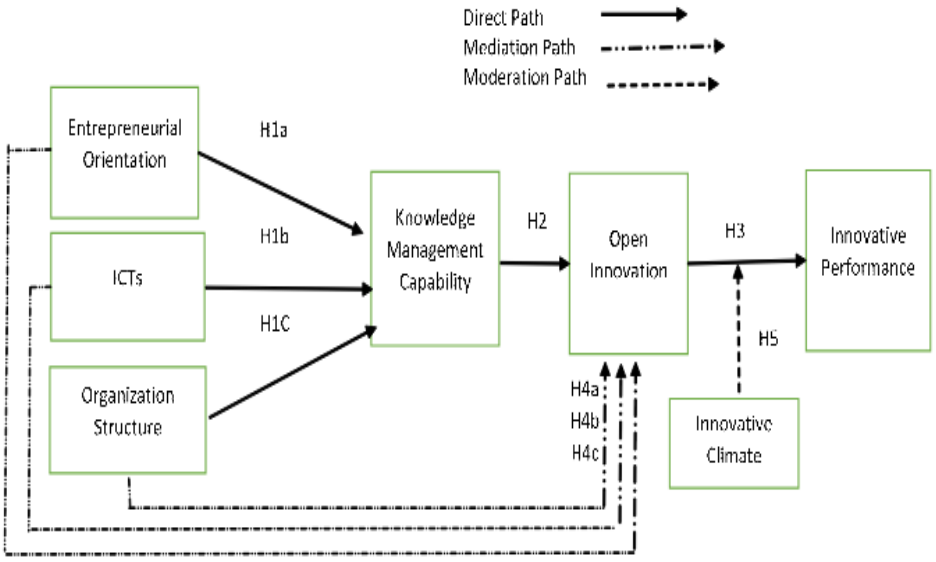

Figure 1: Research Framework

2.2 Hypotheses Development

2.2.1 Antecedents of KM Capability

As mentioned earlier, that organizations with dynamic capabilities are intensively entrepreneurial (Teece, 2007). The firm's entrepreneurial orientation originated from the strategic management literature (Covin & Slevin, 1989) to explain how a firm struggles to chase innovative market prospects and refurbish current operations (Grimmer, Miles & Grimmer, 2015). Its beliefs and values are very proactive towards innovative market prospects, accepting risk, open to innovative thoughts, and intensively supporting the innovation process (Cheng & Huizingh, 2014). Therefore, organizations with robust entrepreneurial orientation incline to consistently examine and watch their surroundings to recognize novel prospects to sustain their competitive edge (Covin & Miles, 1999; Lumpkin & Dess, 1996). Thus, in this background of the dynamic capability, the capability to combine and integrate resources, including knowledge, is a core ability (Kogut & Zander, 1992). Notably, within the context of open innovation, the integration of know-how within and across the firms (e.g., other enterprises, suppliers, customers, research institutions, universities, etc.) is essential. Therefore, due to such inclination to embrace innovative thoughts and continue to look for new technologies, entrepreneurial organizations, through outside-in knowledge strategies, may identify more significant external sources in more depth to advance their innovation activities for more innovative performance. Besides, due to the inclination to be more open to innovative thoughts, entrepreneurial organizations, through inside-out strategies of knowledge, are more ready to apply emerging methods, like shifting in-house innovations to outside partners. That is a different method to enhance organizational income. Finally, the entrepreneurial

orientation is associated with risk acceptance; this attitude may help handle some obstacles towards open innovation, such as combining diverse but identical knowledge flows among partners' alliances. Consequently, the current study hopes that with entrepreneurial orientation, firms can enhance their ability to manage knowledge internally and externally, which may positively impact open innovation (Cheng & Huizingh, 2014).

Accordingly, given the significance of entrepreneurship to innovative performance, entrepreneurial orientation (EO) may be a significant determinant towards how a firm is organized—one that increases the performance advantage of a firm's knowledge-based assets by paying concentration on the applying of these assets to explore and exploit market prospects (Wiklund & Shepherd, 2003). Therefore, within the context of SMEs, the recent empirical studies have found the positive and significant impact of entrepreneurial orientation on firms' knowledge management capability, including knowledge competence, knowledge acquisition, organizational ambidexterity, structural infrastructure capability (see, e.g., Wahyuni & Sara, 2020; Dung et al., 2020; Nobakht et al., 2020; Isichei et al., 2020). Thus, Based on the above discussion, the following hypothesis is formulated:

- **H_1a:** There is a positive relationship between entrepreneurial orientation and knowledge management capability.

There is an agreement in academic discourse that Knowledge Management (KM) as a bundle of practices correlated to the utilization of knowledge as an essential element to create more value. Besides, KM practices are backed by ICTs to enable firms to create, disseminate, modify, and utilize knowledge (Soto-Acosta & Cegarra-Navarro, 2016). ICTs, therefore, significantly facilitate the exchange of distributed roots of knowledge in OI process (Dodgson et al., 2006). Furthermore, through information and communication systems, technology mobilizes social capital to generate new knowledge and integrates previously fragmented information and knowledge. Therefore, ICTs can eliminate barriers to effective communication between different parts of the organization (Gold et al., 2001). Such a pattern should also enhance the development of internal knowledge management capabilities to generate a firm's innovativeness. Therefore, firms are increasingly relying on ICTs in several business operations to enhance their productivity and innovation through adequate knowledge flows (Santoro et al., 2018).

However, according to Bigliardi et al. (2020), even though it has been emphasized that ICT resources are significant for innovative performance, how ICT impacts outside search is not clear. In this regard, Martinez-Conesa et al. (2017) asserted that for effective communication and collaboration, firms should complement IT infrastructures with IT operations to enhance their KM capability to support purposive outside-in and inside-out flows knowledge within and across the firms' boundaries. In other words, organizations may use their IT capacity, which is applied to create knowledge management architectures, to integrate with outside partners, and then effectively leverage outside-in and inside-out knowledge flows. However, IT capacity only offers prospects to improve OI performance; therefore, organizations require the capabilities to acquire, integrate, convert and use knowledge resources to transform these prospects into profits (Wu et al., 2019). Therefore,

within the context of SMEs, the recent empirical studies have found the positive and significant impact of ICTs capacity on firms' knowledge management capabilities, including potential and realized absorptive capacities, explicit knowledge sharing, knowledge exploration, and knowledge management capabilities (Martinez-Conesa et al., 2017; Wu et al., 2019; Cillo et al., 2019; Yao et al., 2020). Thus, based on this discussion, the following hypothesis is formulated:

- **H_1b:** There is a positive relationship between ICTs and knowledge management capability.

According to the dynamic capabilities paradigm, the main element of growth is the firm capability to reconfigure and recombine its resources and structures as it grows in size and as technologies and markets evolve. This "orchestration" mechanism includes the alterations, extension, disinvestment, and regulating firm resources (Bogers et al., 2019). To effectively manage externally acquired knowledge and leverage technological architecture, the organizational structure must better access and integrate the acquired knowledge into the innovative organizational processes (Chiaroni et al., 2010; Gold et al., 2001). Therefore, effective knowledge sharing demands a flexible organizational structure in terms of open innovation' task forces or business units, multiple types of cross-functional teams having common goals as well as firm-level roles, e.g., champions leading the process of transforming from closed to OI (Chiaroni et al., 2010). Notably, regarding particular organizational structure features, a relatively lower degree of complexity, centralization, and formalization leads to effective knowledge sharing (Yao et al., 2020). Notably, in the context of implementing dynamic capabilities for developing innovativeness, SMEs should have informal, organic structures with a multi-skilled flexible workforce to be represented as an ambidextrous entity (Hermawati & Gunawan, 2020).

In contrast, when knowledge is placed at an organizational level with a high span of control, the complicated organizational hierarchy frequently blocks the knowledge-sharing mechanism (Grant, 1996). Therefore, within the context of SMEs, in contrast to Martinez-Conesa et al., 2017 and Kim & Ahn, 2020, the recent empirical studies have found the positive and significant impact of organizational structure on firms' knowledge management capability, including tacit knowledge sharing as well as on inbound, outbound OI activities, and business model innovation (Yao et al., 2020; Gentile-Ludecke et al., 2019; Hock-Doepgen et al., 2020).

Therefore, given this background, the study hypothesizes that:

- **H_1c**: There is a positive relationship between organizational structure and knowledge management capability.

2.2.2 Knowledge Management Capability and Open Innovation

Knowledge and innovation management are two research domains closely tied together (Natalicchio, Ardito, Savino & Albino, 2017) to explicate the knowledge-based approach to firm-level innovations and trends that have wide-ranging implications for knowledge management capabilities (Grant, 1996). Mainly, because OI drawing on both external and internal resources and exploit external and internal paths to market (Chesbrough, 2003), the role of capabilities and their associations to open innovation strategy is an essential current issue under the knowledge and capability-based perspectives of KM research (Agostini et al., 2020). Particularly, in comparison to vertically integrated R & D-based closed innovation model, in the OI, creative thoughts and knowledge existed in people and intellectual property (IP) flow openly either outside-in or inside-out to expedite internal innovation well as to develop the markets further to exploit innovation externally. Therefore, in the OI paradigm, the key element is the firm's capability to manage knowledge flows (Chesbrough & Bogers, 2014; Shi et al., 2020) internally and externally (Gold et al., 2001).

Particularly in SMEs' context, such knowledge management capability to search and utilize the knowledge delivered by associates and customers is essential because it permits them to convert creative thoughts from the environment into innovations. Thus, without such knowledge management capability, SMEs might not, in effect, realize the advantages of external sources of knowledge and ideas to develop further and launch innovative offerings (Santoro et al., 2018; Cillo et al., 2019). Therefore, within the context of SMEs, the recent empirical studies have found the positive and significant impact of knowledge management capabilities, including knowledge exploitation and exploration capabilities, cognitive and absorptive capacities, KM and KM capability, tacit and explicit knowledge sharing, and potential and realized absorptive capacities on open innovation (see, e.g., Cillo et al., 2019; Scuotto et al., 2017; Kim & Ahn, 2020; Martinez-Conesa et al., 2017; Yao et al., 2020; Wu et al., 2019). Therefore, given this background, the study hypothesizes that:

- **H_2**. There is a positive relationship between knowledge management capability and open innovation.

2.2.3 Open Innovation and Innovative Performance

Within the context of inter-organizational debates, OI is believed as the advantage received by organizations from capitalizing knowledge, technologies, and capabilities along with channels of other firms to the market to leverage on their internal knowledge and technology (Chesbrough, 2003, 2006). The knowledge flows beyond the firms' boundaries become complementary knowledge resources to be involved in the focal firm's exploitation and exploration activities (Nobakht et al., 2020) to improve radical and incremental innovative performance (Jugend et al., 2018). Therefore, in open innovation strategies, the capability to recognize, obtain, and exploit outside-in and inside-out knowledge flows are essential to innovation performance (Nobakht et al., 2020). Consequently, a significant improvement in OI has been a growing number of widespread empirical evidence of how OI impacts innovative performance, including organizational ambidexterity, radical and non-radical innovation, exploitation and exploration dual innovation, and new

product/service innovativeness, and new product/service success, (see, e.g., Nobakht et al., 2020; Jugend et al., 2018; Sun et al., 2020; Cheng & Huizingh, 2014).

Therefore, given this background, the study hypothesizes that:

- **H_3.** There is a positive relationship between open innovation and firm innovative performance.

2.2.4 Knowledge Management Capability as a Mediator

Open innovation can increase innovative thoughts; however, these thoughts cannot be productive without good knowledge management. The open innovation model demands effective knowledge management to facilitate outside-in and inside-out knowledge flows, which later integrate implicit and explicit knowledge and innovation in localization (Sun et al., 2020). Therefore, in the OI paradigm, innovation is created by approaching, exploiting, and assimilating flows of knowledge across the firm's boundaries (Chesbrough, 2017). According to dynamic capability theory, firms (e.g., SMEs particularly) need useful knowledge management capabilities that permit them to recognize and transform current and novel knowledge into innovative commercial offerings (Teece, 2010; Hock-Doepgen et al., 2020). These KM capabilities, as stated earlier, are those underlying firm-level cultural, structural, technological, and entrepreneurial capabilities, which as "preconditions" for effective knowledge management, are at the heart of the concept of OI, showing that how firms manage the buying and selling knowledge to increase innovative outcomes (Gold et al., 2001; Martinez-Conesa et al., 2017; Hock-Doepgen et al., 2020).

Therefore, within SMEs' context, the recent empirical studies (Yao et al., 2020; Sun et al., 2020) have explored the mediating role of knowledge sharing and knowledge management capability. For instance, the study of Yao et al. (2020) found that through the mediation of knowledge sharing tacit and explicit, knowledge-sharing culture and middle management possess the most significant impact on technological innovation capability, including open innovation, followed by the management system, IT support, and organizational structure, respectively. Similarly, Sun et al. (2020) found that knowledge management capability has a significant indirect impact between both inward and outward open innovation and exploration and exploitation-based dual innovation. Therefore, given this background, the study hypothesizes that:

- **H_4a-c:** Knowledge management capability mediates the positive relationship between open innovation and (a) entrepreneurial orientation, (b) ICTs, and (c) organizational structure.

2.2.5 Innovative Climate as a Moderator

Firms' move to OI has been led by a convergence of socio-economic and technological developments. However, against these environmental trends, many firms (especially SMEs) are still unwilling to unlock their innovation strategy with OI activities due to the workforce's resistance and absence of inner motivation (Chesbrough & Crowther, 2006; Popa et al., 2017). However, the current open innovation paradigm continues to be relevant in innovation model thinking. Therefore, considering the organizational culture as the main barrier to effective knowledge management (Gold et al., 2001), the current study argues that understanding of OI and its model (and therefore innovation mechanisms) must be

expanded by the human element of innovative climate (Del Giudice et al., 2018). As one of the core elements of innovative culture, an innovative climate nurtures enthusiasm and engagement, motivates others to accept risks under a sound environment, expedites learning, and stimulates thinking logically (Rao & Weintraub, 2013). Therefore, shaping culture is vital to a firm's capability to manage its knowledge more actively (Gold et al., 2001).

Besides, current empirical studies suggest that developing the right climate for innovation increases the innovativeness of SMEs. For instance, Kim and Ahn (2020) found that open innovation-friendly climate directly and with its antecedents, i.e., organizational flexibility and entrepreneurial orientation promotes open innovation activities. Similarly, Martinez-Conesa et al. (2017) established that commitment-based HRM practices contribute positively and significantly towards knowledge management capability to produce open innovation. Similarly, Popa et al. (2017) found that organizational factors, including commitment-based human resources practices, contribute positively towards innovation climate, affecting outbound and inbound OI. Finally, the recent study of Yao et al. (2020) found that knowledge sharing culture through knowledge sharing, tacit and explicit, has a significant indirect impact on firms' technological innovation capabilities, including open innovation.

For these reasons that an innovation climate can facilitate SME to search, assimilate, and utilize external knowledge to strengthen their innovative performance (Popa et al., 2017), the following final hypothesis is formulated:

- **H_5**: Innovative climate moderates the positive relationship between open innovation and innovative performance.

.3. Methodology

3.1. Sampling and Data Collection

With the world ranking of $44^{th\ and}$ 53^{rd} in disruptiveness and innovativeness, Pakistani firms embrace disruptive ideas to thrive innovatively (The Global World Competitive Report, 2019). Therefore, to empirically examine how Pakistani firms have embraced open innovation activities to create new offerings and enrich their existing ones, the current empirical research focuses on a sample of Pakistani SMEs across the service and manufacturing sectors. With more than 38 million small and medium enterprises, Pakistan's SME sector provides 80% employment to non-agriculture labor (Baig, 2019). However, to minimize cost and save time, a non-probabilistic based stratified type of survey methodology, the quota sampling technique was adopted (Toylan et al., 2020) to select the percentage-statistical sample from within a statistical population of 38 million SMEs. As a result, with 95% confidence, five percent-plus/minus-precision, 50 percent proportion of the population which has the attribute in question, and Z values of 1.96, the current research obtained a sample size of 385 service and manufacturing firms from the entire research population (Cochran, 1963). Besides, the participation rate for recently published papers related to SME's open innovation spanned from 24% to 67% (Lu et al., 2020; Liao et al., 2020). Thus, the current research sample has been doubled to 770 to obtain a better sample size following the targeted population.

Accordingly, by utilizing a survey-based questionnaire, data was gathered by Ph.D. scholar mostly from the senior executives (i.e., general managers and managers) engaged in general management, selling/marketing, production, and operation areas of manufacturing, services, and IT/Telecom sectors of SMEs. For data collection, list, and contact information of SMEs obtained from the Small and Medium Enterprises Authority of Pakistan. The survey was conducted from early January 2020 to the end of July 2020. Finally, the total number of submitted and utilizable survey forms was 332, which reported a 43% response rate, contributed 54%, and 46% by manufacturing and services/IT/telecom sectors.

Finally, by following the study of Liao et al. (2020), to examine the non-response bias, the current study checked the earliest with the latest submitted survey forms about the size, capital, and age of the SMEs; however, found no significant variations between them, suggesting the non-existence of the non-response bias issue.

3.2. Measuring Instrument

All the constructs employed in the survey instrument were measured using reliable and valid multi-item scales adapted from existing research (see Table 1). The respondents were advised to rate the statements using a 5-point scale (5-strongly agree, 4-agree, 3-neutral, 2-disagree, 1-strongly disagree). However, the first section of the questionnaire included statements concerning the firm's age, annual turnover, capital size, and sector type of sampled SMEs.

Table 1 presents the codes for each measurement scale used in the current study. However, to ensure adequate indicator reliability and validity, the current study retains only those items in the measurement model that showed acceptable factor loadings. For measuring SMEs' entrepreneurial orientation, a 9-items scale was adapted from Covin and Slevin (1989) that took their extent of innovation, risk-taking, and proactiveness. Similarly, a 9-items scale of firm innovative climate representing factors of collaboration, safety, and simplicity was adapted from Rao and Weintraub (2013). However, the item no. 2, 4, and 8 were dropped due to low factor loadings.

Moreover, a 6-items scale for measuring ICTs for operational support was adapted from Martinez-Conesa et al. (2017). Similarly, an 8-items scale measuring firm innovate performance in terms of marketing and introducing new incremental and radical products was adapted from Kotabe, Jiang and Murray (2014); however, items no. 1 to 5 were dropped due to low factor loadings. Accordingly, to measure the application of different KM practices across boundaries of the functional areas, a 9-items scale of knowledge management capability was adapted from Liao et al. (2011); however, due to high cross-loadings, the study eliminated the item no. 4, 6, 8, and 9 respectively. Besides, to measure the open innovation inclusive of inbound and outbound, a 10-items scale was adapted from Naqshbandi and Jasimuddin (2018); however, item no. 1 and 10 dropped due to low factor loadings. Finally, to measure organizational structure to have the flexibility for employees' interaction to create and share knowledge, 12 items scale was adapted from Gold et al. (2001); however, item no. 10 and 12 were eliminated due to low factor loadings.

Finally, the back-translation strategy was applied (Brislin, 1980; cited in Hassan & Ayub, 2019). Therefore, the survey statements were initially produced in English and then converted into the Urdu language. Subsequently, the research statements were converted

back into English to avoid the difference of the sense generated by language translation (Toylan et al., 2020).

3.3. Data Analysis

Early structural equation modeling (SEM) applications employed a covariance-based approach (CB-SEM), which demanded two rather complex steps. However, investigators now have the choice of applying the single-step variance-based PLS-SEM. Besides, rigorous research through PLS-SEM provides good choices to entrepreneurial researchers to produce innovative knowledge by simultaneously examines the relationships between multi-item latent variables. In PLS-SEM, the latent variables scores calculated based on total variance are referred to as composite variables. However, in CB-SEM, the latent variables are calculated based on common variance and are referred to as common factor variables. Notably, in the current study, mediation, and moderation integrated; therefore, it adopted composite-based SEM methods such as partial least squares (PLS-SEM) to estimate conditional process models. Thus, the statistical objective is to maximize the explained variance in one or more multi-item dependent constructs (Manley et al., 2020).

Implementation of PLS-SEM initially demands evaluating the measurement model applying confirmatory composite analysis to ensure that all benchmarks are reached or crossed; the investigator subsequently assesses the structural model. Accordantly, the current study initially discusses CCA and subsequently evaluate the structural model (Hair Jr et al., 2020).

4. Results

4.1 Measurement Model

Confirmatory composite analysis (CCA), an approach identical to CFA for CB-SEM, is the preferred way to examine the "model" (Hair et al., 2020). CCA for reflective constructs involves evaluating the item loadings, composite reliability, AVE, and discriminant validity (Hair et al., 2020). As shown in Table 1, most item loadings were over 0.708, and besides Cronbach's alpha, composite reliability is above the suggested benchmarks (Hair Jr et al., 2017). Besides, convergent validity is evaluated based on AVE, and as shown in Table 1, all variables surpass the benchmark of 0.50 (Hair & Sarstedt, 2019).

Table 1: Scales Reliability and Validity

Construct	Code	Loadings	α	CR	AVE
Entrepreneurial Orientation Covin and Slevin (1989)	EO1	0.748	0.912	0.928	0.591
	EO2	0.818			
	EO3	0.814			
	EO4	0.595			
	EO5:	0.743			
	EO6	0.791			
	EO7	0.779			
	EO8	0.813			
	EO9	0.792			
Innovative Climate Rao and Weintraub (2013)	IC1	0.835	0.929	0.944	0.737
	IC3	0.866			
	IC5	0.901			
	IC6:	0.761			
	IC7	0.860			
	IC9	0.919			
Information Communication Technologies for Operation Martinez-Conesa et al. (2017)	ICT1	0.851	0.902	0.924	0.671
	ICT2	0.830			
	ICT3	0.776			
	ICT4	0.842			
	ICT5	0.780			
	ICT6	0.832			
Innovate Performance Kotabe et al. (2017)	IP6	0.846	0.808	0.944	0.737
	IP7	0.809			
	IP8	0.891			
Knowledge Management Capability Liao et al. (2011)	KM1	0.883	0.889	0.919	0.695
	KM2	0.804			
	KM3	0.883			
	KM5	0.818			
	KM7	0.773			
Open Innovation Naqshbandi and Jasimuddin (2018)	OI2	0.828	0.896	0.918	0.585
	OI3	0.843			
	OI4	0.813			
	OI5	0.778			

	OI6	0.718			
	OI7	0.826			
	OI8	0.575			
	OI9	0.699			
Organization Structure Gold et al. (2001)	OS1	0.685	0.901	0.918	0.528
	OS2	0.725			
	OS3	0.654			
	OS4	0.745			
	OS5	0.679			
	OS6	0.775			
	OS7	0.763			
	OS8	0.749			
	OS9:	0.727			
	OS11	0.753			

Besides, as shown in Table 2, discriminant validity is supported initially by applying the Fornell and Larcker (1981) benchmark, demonstrating that all the reflective variables' correlations values are below than with their respective square root of the AVE scores.

Table 2: Discriminant validity for Reflective Constructs

	EO	ICTs	IC	IP	KM	OI	OS
EO	**0.769**						
ICTs	0.670	**0.819**					
IC	0.609	0.532	**0.859**				
IP	0.634	0.508	0.751	**0.850**			
KMC	0.745	0.780	0.644	0.683	**0.833**		
OI	0.732	0.735	0.827	0.784	0.790	**0.765**	
OS	0.700	0.786	0.650	0.684	0.793	0.759	**0.727**

Moreover, as depicted in Table 3, discriminant validity is also supported using the heterotrait-monotrait (HTMT) method; almost all ratios except one are below 0.90. The confidence intervals do not include zero or one (Henseler et al., 2015).

Table 3: Heterotrait-Monotrait Ratio (HTMT)

	EO	ICT	IC	IP	KMC	OI	OS
EO	-						
ICT	0.726 CI.95 [0.5890.819]						
IC	0.655 CI.95 [0.5250.774]	0.572 CI.95 [0.3970.731]					
IP	0.741 CI.95 [0.6290.825]	0.585 CI.95 [0.4680.683]	0.819 CI.95 [0.7290.885]				
KMC	0.823 CI.95 [0.6980.908]	0.859 CI.95 [0.7650.933]	0.703 CI.95 [0.5730.824]	0.810 CI.95 [0.7120.882]			
OI	0.805 CI.95 [0.7170.874]	0.810 CI.95 [0.7060.891]	0.903 CI.95 [0.8730.934]	0.906 CI.95 [0.8300.967]	0.880 CI.95 [0.8090.933]		
OS	0.769 CI.95 [0.6630.847]	0.854 CI.95 [0.7650.924]	0.698 CI.95 [0.5470.833]	0.809 CI.95 [0.7260.877]	0.872 CI.95 [0.8100.917]	0.834 CI.95 [0.7560.894]	-

4.2 Structural Model

Structural model evaluation involves evaluating multicollinearity, path coefficients, and significance, R^2 total variance explained in the endogenous constructs, exogenous construct f^2 effect sizes, and endogenous construct Q^2 (Hair et al., 2020). The structural model was initially evaluated for multicollinearity among variables. The results confirmed that multicollinearity does not affect the results; the VIF for almost all the concerned variables except one is below 3.30 (Kock, 2015). Further, the path coefficients and their statistical significance were evaluated, applying the PLS bootstrapping technique whereby 5,000 samples were applied to create bias-corrected confidence intervals for each coefficient (Merkle et al., 2020).

Hypotheses 1a-c that entrepreneurial orientation, ICTs, and organizational structure each is positively related to knowledge management capability were supported with positive path coefficients of 0.298 (p<.01), 0.318 (p<.01), and 0.334 (p<.01). The results also support hypothesis 2 because knowledge management capability is positively related to open innovation with a path coefficient of 0.790 (p<.01). Hypothesis 3 was supported because open innovation is positively related to innovative performance with a path coefficient of 0.553 (p < .01). Hypotheses 4a-c that knowledge management capability mediates the relationship between open innovation and entrepreneurial orientation, ICTs, and organizational structure, respectively, were supported with positive path coefficients of 0.235 (p<.01), 0.252 (p<.01), and 0.264 (p<.01). Finally, hypothesis 5 offers the idea that the innovative climate will interact with open innovation to bring positive and significant innovative performance changes. It was also supported with positive path coefficients of 0.097 (p< .01). The combined results from the path analysis are shown in Figure 2.

Figure 3 graphically represents the moderating conditions of the interaction term. As Figure 3 shows, when a firm is characterized by a high degree of innovative climate, raising the

amount of OI has a significant and positive impact on the pursuit of innovative performance.

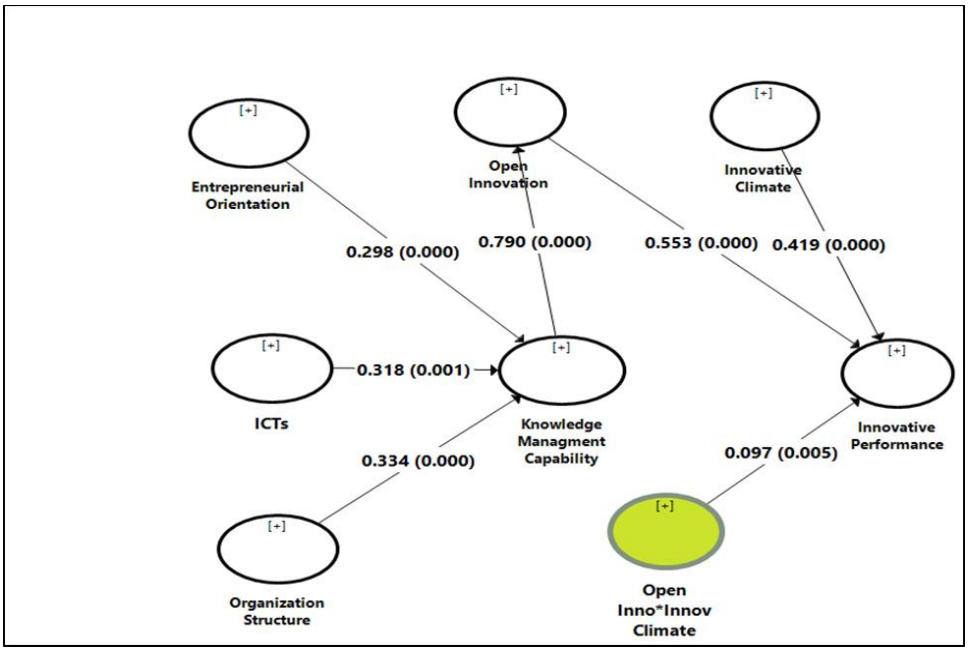

Figure 2: Structural Model

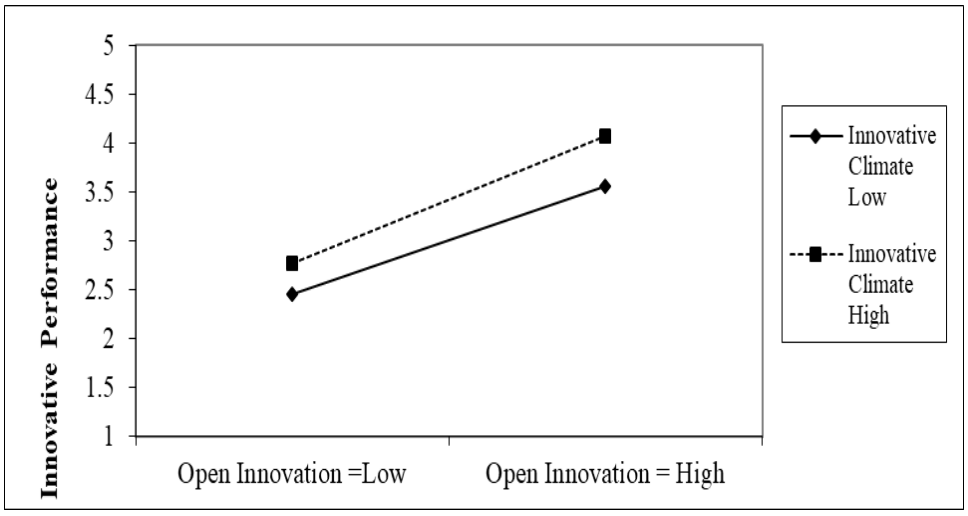

Figure 3: Moderating Effect of the Innovative Climate

The structural model analysis results supporting each hypothesis were statistically significant at the .01 level are shown in Table 4.

The subsequent step of structural model assessment includes explained variance. Knowledge management capability has an R^2 of 0.735. The open innovation has an R^2 of 0.625, and the R^2 for innovative performance is 0.660, thus establishing the explained variance as moderate and substantial of the structural model. Besides, each exogenous variable has an f^2 *effect* size, which assists in the R^2 findings of endogenous variables. Entrepreneurial orientation, ICTs, and organization structure each have an f^2 of 0.158, 0.135, and 0.138 on the knowledge management capability. Besides, knowledge management capability has an f^2 of 1.663 on open innovation. Besides, open innovation has an f^2 of 0.273 on innovative performance. Finally, innovative climate and interaction terms of open innovation with innovative climate each have an f^2 of 0.133 and 0.035 on innovative performance. The effect sizes are all positive and meaningful, ranging from quite large to small (Cohen, 1988).

Finally, model evaluation involves assessments for in-sample prediction. The initial stage is to look at the Q^2 metric for endogenous variables originating from the blindfolding technique. Any value above 0 furnishes a core sign that the model has in-sample predictive power (Hair et al., 2020). The Q^2 for knowledge management capability is 0.503, the Q^2 for open innovation is 0.357, and the Q^2 for innovative performance is 0.458. Thus, the model has excellent in-sample predictive power (Hair et al., 2020). Table 5 depicts the results of the in-sample predictive power of the structural model.

Table 4: Structural Model Path Analysis

Hyp	Paths	VIF	β	Mean	SD	t-value	P-value	95% CI		Supported
								LL	UL	
Direct Effects										
H_1a	EO -> KM	2.118	0.298	0.306	0.076	3.915	0.000	0.162	0.451	Yes
H_1b	ICTs->KM	2.821	0.318	0.314	0.099	3.206	0.001	0.133	0.520	Yes
H_1c	OS -> KM	3.049	0.334	0.329	0.084	3.966	0.000	0.161	0.489	Yes
H_2	KM -> OI	1.000	0.790	0.792	0.033	24.189	0.000	0.715	0.846	Yes
H_3	OI -> IP	3.288	0.553	0.547	0.066	8.337	0.000	0.422	0.681	Yes
	IC -> IP	3.878	0.419	0.423	0.054	7.819	0.000	0.305	0.516	Yes
Indirect Effects										
H_4a	EO->KM->OI		0.235	0.243	0.061	3.860	0.000	0.126	0.361	Yes
H_4b	ICTs ->KM-OI		0.252	0.249	0.080	3.130	0.002	0.103	0.417	Yes
H_4c	OS-> KM->OI		0.264	0.261	0.068	3.909	0.000	0.131	0.393	Yes
Moderating Effect (Two-Stage Approach)										
H_5	OI*IC -> IP		0.097	0.094	0.034	2.818	0.005	0.030	0.164	Yes

Table 5: The Predictive Power of the Structural Model

Construct	R^2	Q^2	f^2 (Effect Size)
IP	0.660-moderate	0.458-good	
KM	0.735-substantial	0.503-good	
OI	0.625-moderate	0.357-good	
EO->KM			0.158-moderate
ICTs->KM			0.135-small
OS->KM			0.138-small
KM->OI			1.663-high
OI->IP			0.273-moderate
IC->IP			0.133-small
OP*IC->IP			0.035-small

5. Discussion, Implications, Limitations, and Future Directions

5.1 Discussion

Drawing upon the organizational capabilities of knowledge management, the resource-advantage theory, and dynamic capabilities for open innovation, the current study in the context of Pakistani service and manufacturing SMEs offered and tested conditional process structural models that examine the mediation of knowledge management capability between open innovation and firm-level technological, structural and entrepreneurial capabilities along with moderation role of innovation climate between OI and firm innovative performance. The results revealed that among different impacts of firm-level antecedents of KM capability, the organization structure contributes most significantly, followed by ICTs and entrepreneurial orientation on the SMEs' knowledge management capability. The findings imply that KM capability positively affects OI; this relationship, being similar to Martinez-Conesa et al. (2017), also emerged as the strongest in the current structural model. The results also suggest that KM capability mediates most significantly between open innovation and organization structure, followed by ICTs and entrepreneurial orientation. Finally, the results suggest that open innovation directly and through the moderation of innovative climate significantly impact SME's ability to introduce and market incremental and radical offerings. Therefore, improving the dynamic capability of knowledge management and innovative climate means the mechanisms of mediation and moderation through which entrepreneurial orientation, ICTs, and organization structure impact open innovation and, in turn, impact firm innovative performance. Thus, improving the relevant dynamic capabilities supporting OI and innovative performance relationship means the screening of outwardly created knowledge, put mechanisms in place to commercialize innovative thoughts, and restructure the firm and develop its culture to integrate and use outside-in as well as inside-out flows of knowledge reflecting changing demands and opportunities (Bogers et al. 2019). In the broader sense, this is what in literature is known as a firm's knowledge management capability to manage a body of

knowledge in due course by restructuring actively and readjusting the mechanisms of knowledge search, maintenance, and use within and across its boundary (Lichtenthaler & Lichtenthaler, 2009).

These results are similar to prior research suggesting that within the context of open innovation, KM system based infrastructure as well as entrepreneurial capabilities, particularly technology, structure, culture, and entrepreneurial orientation, are connected to an SME' potential to apply the knowledge as a core element to add and create value inside and outside its boundaries (Dung et al., 2020; Wu and Hu, 2018; Gentile-Lüdecke et al., 2019; Jasimuddin & Naqshbandi, 2019; Martinez-Conesa et al., 2017; Soto-Acosta et al., 2018; Soto-Acosta & Cegarra-Navarro, 2016; Gold et al., 2001). In other words, in theory, and practice, the generation and application of knowledge resources, routines, and capabilities take center stage in explaining a firm's ability to effectively perceiving of the type and accessibility of outside-in knowledge resources, the capturing of inside-out ones, and restructuring both for determining its innovative performance (Dodgson et al., 2006).

5.2 Theoretical Implications

The first contribution is the finding that organization structure, ICTs, and entrepreneurial orientation have direct and positive relationships with knowledge management capability. This finding within the context of KM and strategic management research strengthens the recent ongoing investigation into and the advancement of the knowledge and capability-based perspectives in the OI paradigm (Agostini et al., 2020; Yao et al., 2020; Bogers et al., 2019). The empirical evidence shows that these three direct relationships combine to explain approximately 74% of the knowledge management capability variance. Besides, keeping in view the central role of KM in purposively managed knowledge flows in a distributed innovation process across organizational boundaries, the current study contributes by exploring knowledge management capability as a most significant variable having the highest effect size on open innovation that in turn has an important impact on the innovative behavior of the firms.

However, the current study believes that these direct relationships derived from theory seldom maintain in reality, completely comprehending the processes whereby variables affect one another demands exploring the mechanisms of moderated mediation (Sarstedt et al., 2020). Therefore, to uncover such mechanisms related to KM and 'human side' of OI, the current study further contributes by suggesting the mediation and moderation-based mechanisms of knowledge management capability and innovative climate, respectively, to transmit the effects of entrepreneurial orientation, ICTs, and organization structure to OI and, thereby to innovative organizational behavior (Agostini et al., 2020).

5.3 Managerial and Policy Implications

The findings of current research have implications for owners/authorities and policymakers of service and manufacturing SMEs. Notably, managers/owners may need to know if they want to introduce and market incremental and radical offerings to achieve and sustain competitive advantage; they need to use internal ideas as well as external ideas to promote their innovative activities. In other words, enterprising individuals need to open their borders and place more confidence in OI to discover and search for new collaborations and business connections. Therefore, managers/owners should take the OI phenomenon as critical for the innovation that can be radical, transformative, and disruptive to existing ways of doing things. It can be minor incremental measures in developing further what is

already being done: only making things somewhat better. These broad variations have the utmost importance for SMEs in defining OI's scope for launching incremental and radical innovative offerings to acquire and maintain a competitive edge (Dodgson et al., 2013).

Mainly, as combining outside-in knowledge may result in disruption and demand a cultural shift. Hence, SMEs seeking to profit from outside-in knowledge-generating from the OI approach must develop management capabilities and an innovative climate to adjust outside-in streams of knowledge with the intra-firm-level innovation activities. Mainly, OI success depends mostly on creating a climate that develops partnerships and controls the not-sold-here and not-invented-here syndromes (Bogers et al., 2019). Besides, to advance inside-out and outside-in open innovation activities to increase innovative performance, SMEs are expected to develop their knowledge management capability. For example, while SMEs use the outside-in process, internal and external KM mechanisms should thoroughly be developed for having been able to effectively utilize innovative thoughts from suppliers, customers, and different sources in collaboration with applying novel knowledge from own R&D activities in a manner to distribute to associates or legally authorize to them for commercialization to markets (Wu & Hu, 2018).

In developing such type of knowledge management capability, however, SMEs in an environment of primarily distributed valuable knowledge must pay particular attention in creating systems and entrepreneurial architectures including organization structure, ICTs, and EO to combine disparate pieces of knowledge in a useful way to introduce and market more innovative products and services. This 'systems architecture capability' and 'pro-entrepreneurship organizational architectures' are incredibly valuable in an open, innovative world (Bogers et al., 2019; Covin et al., 2020). Firms are therefore expected to be more innovative, proactive, and risk-takers as well as to be ready to invest in flexible structures and ICTs to build their dynamic KM capability that in turn, together with innovative climate, would enable them to connect and collaborate with other actors in inbound and outbound open innovation and, thereby generate superior, innovative performance.

Finally, in SMEs and entrepreneurship policy and framework, a more comprehensive view currently needs to consider where innovation takes place and the environment necessary for supporting it beyond the R & D investments. Thus, innovation by no means merely technology and knowledge; it is equally developing a group of novel offerings with new marketing methods in all economic sectors and a shift in organizing and practicing enterprises and work organization and external collaborations. Generally, SMEs least participate in alliances for innovative projects. Therefore, the current study's findings suggest upgrading their dynamic capability of knowledge management by building their structural, technological, and entrepreneurial capabilities. This dynamic knowledge management capability would embed SMEs in knowledge flows to acquire the creative thoughts they need for innovation and their marketplaces. In conclusion, an important message is that SMEs do not innovate individually but with customers, competitors, suppliers, research institutions, universities, and others (OECD, 2020).

5.4 Limitations and Recommendation for Future Research

Though there are possible advantages from the current study, it faces certain research limitations that warrant future research. First, due to the cross-sectional research design, the current study cannot certainly infer directionality and or causation, e.g., it cannot tell that improvement in knowledge management capability can impact open innovation. So, there would need to carry out longitudinal research to check that changes in one variable initially can bring changes in another variable subsequently. Second, the current study suggests that future studies may use objective data, particularly in estimating the innovative performance free from participants' perception. Third, firm-level data was collected with perceptual measures from the critical respondent per firm; therefore, the data might be affected by common method variance. However, there was no possibility of common method bias. The lower managerial personnel completed 37 percent of the survey forms; therefore, such a diverse set of data can improve the variables of interest's explanatory powers.

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