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Open Innovation and Collaborative Networks

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Abstract: *This paper examines the transition from traditional closed-innovation models, where firms rely primarily on internal knowledge and resources, to open innovation paradigms that emphasize collaboration and external linkages. In highly competitive markets, the rapid pace of technological change has compelled organizations to complement internal research and development with external sources of knowledge through licensing, partnerships, and inter-firm collaboration. Open innovation projects, when effectively managed, can generate significant economic, social, and environmental benefits, although empirical evidence suggests that outcomes are not always aligned with expectations.*

The paper highlights the growing importance of collaborative innovation across sectors and organizations, driven by the need to address complex socio-economic challenges and foster sustainability. It also underscores the necessity of further research into how diverse combinations of knowledge - spanning universities, suppliers, and customers - can create complementarities or substitution effects that shape firms' exploration and exploitation strategies. By providing a comprehensive overview of the opportunities and limitations of open innovation, this paper contributes to a deeper understanding of how enterprises are adapting their innovation models in the 21st century.

Keywords: *Open Innovation; Closed Innovation; Collaboration; Knowledge Management; Technological Competence; Sustainability; Inter-firm; Agreements; Innovation Models; Competitive Advantage; Digital Age.*

1. Introduction

In the traditional innovation model, based on the closed-innovation paradigm, companies rely primarily on internal knowledge and skills for the development of new innovations. In this context, organizations invest in highly qualified human capital and in internal research-and-development processes to generate competitive advantages (Felin & Zenger, 2014).

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According to (Yun et al., 2018), this model requires a high control of organizational processes to protect internal intellectual property and avoid or strongly restrict the interactions and exchanges of resources and internal knowledge with agents outside the organization.

Given the intense competition in most markets today, companies are increasingly recognizing the necessity and advantages of regularly developing new products. Firms that introduce higher-quality products faster than their competitors usually earn higher economic returns (Datar et al., 1997). However, rapid changes in technology often force such firms to depend on external technological knowledge and skills in addition to internal technological resources. Many firms today are relying more extensively on external linkages to acquire new technological knowledge using strategies such as technology licensing and collaborative agreements. Inter-firm collaboration is an important vehicle for the creation of technological competencies (Schoenmakers & Duysters, 2006), and is a viable solution to the problem of resources and capabilities not always being available within a firm and difficult to obtain efficiently in the market (Das and Teng, 2000).

One of the biggest benefits in engaging in well-managed open innovation projects, is the positive impact in economic, social, and environmental sustainability (Rauter et al., 2018). However, despite the benefits, that can easily be found in the literature, according to a survey conducted by Accenture in 2015 (a consultancy company) about 50% of surveyed organizations, said that open innovation don't seem to be yielding as many new products or other benefits as they had hoped (Deichmann et al., 2017).

2. Convergence of Open Innovations and Collaborative Networks

The major motivation for open innovation (Dahlander & Gann, 2010; West & Bogers, 2014, 2017; Obradovic et al., 2021) is that it improves a firm's ability to generate knowledge spillovers (Griliches, 1979; Jaffe et al., 1993; Audretsch & Feldman, 1996; Griffith et al., 2006) and create new products internally and in collaboration with external partners (Cappelli et al., 2014; Bogers et al., 2018, 2019; Granstrand & Holgersson, 2020). In this context, we draw on West et al. (2014a,b) and Bogers et al. (2018) in defining open innovation as a concept that encompasses the novel challenges, norms and practices of innovation processes. Open innovation strategies increase the likelihood of knowledge complementarities, leading to faster and higher-quality innovation along with greater firm productivity (Hall et al., 2013 Audretsch & Belitski, 2020). It has become a "key innovation strategy" (Frenz & Ietto-Gillies, 2009; Hsieh et al., 2018; Kobarg et al., 2019) as small and large firm, start-ups and incumbents promote open collaborative activities, deepening and broadening the portfolio of activities with innovation partners (Roper et al., 2017; Audretsch et al., 2021).

Underlying the theoretical positioning of this strategy is the assumption that collaboration has a positive impact on innovation (Denicolai et al., 2016; Roper et al., 2017), which in practice results in the proposition that knowledge collaboration is often an 'objective in itself' (Del Giudice & Maggioni, 2014). The downside of collaboration includes resource redeployment and relocation, along with the use of time and effort (Stadler et al., 2022), in

addition to operational, technological, cognitive, cultural and regulatory barriers that limit open innovation.

The role of networks in fostering open innovation

When organizations collaborate, they aim to obtain more resources while achieving their goals and interests (Dias & Selan, 2022; Minson & Mueller, 2012; Tseng et al., 2020). Aiming to obtain more resources and working together with common interests makes organizations more innovative because with collaboration, different organizations can learn from each other (Demircioglu & Audretsch, 2020; Martínez-Costa et al., 2019; Tseng et al., 2020). Thus, collaboration has become highly relevant to innovation, particularly when there are agreements of goals, interests, and values across different organizations (Van der Voet & Steijn, 2021).

The concept of open innovation, initially defined by Chesbrough (2006) is relevant as cross-sectoral collaborative innovation can be understood as a sub-case of the open innovation model (Gallaud, 2013). Indeed, Gallaud defines collaborative innovation and its rationale as:

“an organization cooperates with other firms (suppliers, customers, competitors, and consultants) or other organizations (such as universities or public research organism) to develop or commercialize a new innovation. The organizations agree to pool their resources or to share information and knowledge to develop one project, at the end of the project, they keep independent from the legal point of view. The main goal of such collaborative innovation is to gain access to the partner’s knowledge and competences especially to tacit knowledge”.

Chesbrough & Brunswicker (2014) observed that knowledge created outside of a corporation’s boundaries, such as that created by and acquired from startups, has become increasingly important for increasing the pace of innovation. Disruption of major industries in recent years has been attributed to startups such as Airbnb and Uber that play a key role in accelerating innovation, an essential requirement for the survival of corporations. Startups are typically agile, adaptive and resilient because they are not restricted by established processes and administrative procedures (Schättgen & Mur, 2016; Weiblen & Chesbrough, 2015). This is especially apparent when considering how the practice of formal partnerships has significantly increased over the last ten years (Ringel, Taylor, & Zablit, 2016). In fact, disruptive innovations emerging from startups have long been considered a threat to the survival of corporations.

However, as of late, this threat is being turned into an opportunity by both startups and corporations, in addressing individual resource or knowledge gaps through collaborative partnerships (Schättgen & Mur, 2016). Neyens, Faems, & Sels (2010) found that collaborating corporations outperform those that do not initiate collaboration with external partners. Synergies resulting from such collaborations offer many advantages for both parties. Collaborations with startups primarily allow large corporations to detect, develop, and test new technologies with lower costs and less risk. These collaborations also promote engagement with creative fresh talent and exposure to new ideas. On the other hand,

startups are interested in profiting from the considerable resources a corporation has to offer, such as market knowledge and experience, networks, finance, the strong reputation of the corporation itself, and the chance to test their products to see how they would fit within the market (Weiblen & Chesbrough, 2015).

Governance, coordination and leadership in innovation networks

In today's complex, and unpredictable business landscape, if organizations want to achieve sustainable competitive advantages, they need to develop strategies that enable them to enhance performance and innovation to meet actual market needs and demands (Nuryakin, 2018; Ng & Law, 2015). Innovation and performance strongly depend on how an organization's top management drives and motivates the organization's employees to overcome barriers such as different geographic locations, time-zones, cultures, and functions (Hansen, 2009), as well as to have the capacity to acquire the necessary resources (human, technological) and to adopt an effective innovation model. For example, some authors argue that an organizational ambidextrous leadership style enhances the chances of gaining and holding sustainable competitive advantage. Such a style is essentially characterized by the exploitation of the present conditions in order to optimize the current business models operation and, at the same time, exploring the opportunities that contribute to redefining the business model by making decisions in a pioneering risky way (Lutfihak & Evrim, 2016; Lee et al., 2017).

However, most organizations do not contain, on their own, all the resources, such as brilliant minds, technologies, and know-how, just to name a few, necessary to be able to respond today's market complex and dynamic demands. In an attempt to overcome such constraints, organizations engage in collaborative or trade-off partnerships, whereby in interacting with other organizations or individuals such as business partners, customers, universities, scientific institutes, public institutions, and even inventors, they hope to find the best methods for supporting innovation and improving organizational performance. Such collaborative partnerships are essentially characterized by an exchange of ideas, resources, and technologies in a controlled environment-enhancing synergy. The aim of these partnerships is to provide organizations with benefits such as reduced innovation costs, faster innovative processes, increased differentiation, easier access to the market, creation of new revenues streams, more diverse R&D investments, and the sharing of innovation development risks (Ullrich et al., 2016).

Digital platforms and innovation intermediaries

Digital transformation (DT) has become a significant phenomenon in innovation studies (Kochetkov, 2023), management, sustainability, and information science. It reshapes the value creation pathways of organizations and industries (Vial, 2019) through digital and information communications technologies (ICTs). In the industry context, DT underlies the fourth industrial revolution, or Industry 4.0, and leads digital revolutions (Ghobakhloo, 2020). For businesses, DT drives business model innovations through digitization, and digitalization (Verhoef et al., 2021). This multidisciplinary interest in DT demands integration across disciplines and sectors (Nambisan et al., 2019). Examples of DT

powered by digital platforms such as Amazon, Microsoft, and Alibaba have demonstrated cross-sectoral potential in value creation (Gamidullaeva et al., 2021), described as “ecosystem building” (Freundt et al., 2023) or “ecosystem economy” (Atluri & Dietz, 2023; Jacobides, 2019). Thus, understanding DT is essential for strategic decision-making and exploring its impact on innovation landscapes (Kochetkov, 2023).

With the advance of digital and online systems, interactions also have become more multi-layered and differentiated. Thus, Kuenne et al. (2013) outline five levels of interaction in their review of ‘health 2.0 platforms’ going from: information; communication; consultation; through to cooperation; and, collaboration. In the healthcare systems that were studied, the collection, synthesis and exploitation of users' knowledge in these systems was becoming ever more important in the role and activity of innovation intermediaries. The growth of more open, networked and distributed innovation systems in combination with the growth of online platforms and digital technologies has therefore created further opportunities and new ways of undertaking intermediation over the last twenty years. Thus, new forms of relational market transactions has meant that older formal forms of market exchange, such as formal market research or trade shows, have been superseded (Perry, 1996) or at least overlain by more online, digital provision.

Industry 4.0, Open Innovation 2.0 and the development of innovation ecosystems

The fourth industrial revolution, rooted in Industry 4.0 (I4.0), has drawn attention to the innovation opportunities linked to enhanced data gathering and elaboration within an interconnected organization (Schwab, 2017). From this perspective, the emerging technological scenario has crucial implications for manufacturing firms and their ability to strengthen their competitive advantage through adequate I4.0 adoption and implementation dynamics (Frank et al., 2019), with positive consequences at a broader national level (Edquist et al., 2021).

Inter-organizational networks in high-tech industries

Inter-industry collaborative innovation involves cooperation between different industries, achieving technological, resource, and informational complementarity and synergy through cross-industry collaboration (Lee, 2001; Cooke & Uranga, 1997; Wang & Zhong, 2022). This type of cooperation not only brings new opportunities and resources to different industries but also effectively promotes innovation and enhances competitiveness (Van de Ven, 1993). As one of the key drivers of modern economic development, strategic emerging industries play an important role in shaping economic structure, driving technological progress, and leading future development directions (Van de Ven, 1993). Therefore, in-depth research on the innovation networks among strategic emerging industries has both theoretical value and practical implications for policy-makers and enterprise managers, aiding in promoting high-quality economic development.

Open innovation in SMEs

For small and medium-sized companies (SMEs), open innovation presents itself as a way for these companies to overcome certain dimensions resulting from their size, and thus be able to adapt and thrive in an increasingly competitive and turbulent environment.

Table 1. ANOVA analysis for the number of years of activity

Variable	Less than 3	Between 3 and 10	More than 10
Practices			
Outside-in	0.220	0.162	0.234
Inside-out	0.322	0.193	0.264
Coupled	0.167	0.292	0.151
Benefits			
Develop of innovative capacity	$<1 \times 10^{-3}$	$<1 \times 10^{-3}$	$<1 \times 10^{-3}$
Cost reduction	0.257	0.195	0.179
Diversification	0.388	0.372	0.310
Reduced time to market	0.128	0.250	0.239
Risk-sharing	0.167	0.122	0.225
Increased accept of innovation	0.199	0.125	0.171
Challenges			
Lack of resources	0.190	0.079	0.111
Lack of competencies	0.121	0.152	0.108
Diff. in integration knowledge	0.012	0.097	0.003
Loss of control	0.256	0.192	0.231
Cultural challenges	0.180	0.131	0.188

The source: <https://doi.org/10.3390/joitmc7030169>

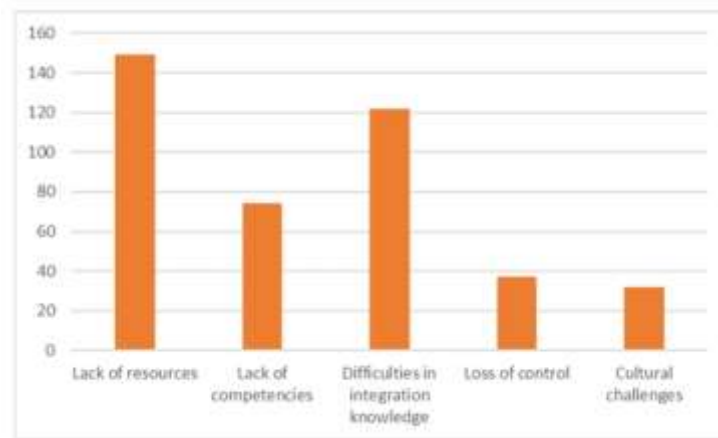
Table presents the result of applying analysis of variance (ANOVA) for the number of years of activity. Some significant differences emerged in the identification of the benefits associated with the development of the innovative capacity of organizations. SMEs with less than three years of activity favored the adoption of open innovation for the development of their innovative capacity. On the challenges, SMEs with more than 10 years of activity presented greater difficulties in integrating knowledge arising from open innovation; on the contrary, younger companies (i.e., with less than 3 years of activity) showed greater ease in incorporating this external knowledge.

Studies by Hossain (2015) show that SMEs are usually less bureaucratic and more risk-taking. Their flexibility, agility, and focus/niche strategy for a particular product or service allows them to innovate faster (Pierre & Fernandez, 2018). However, their small size means that these organizations have limited financial resources and use few structured and solidified innovation processes.

Despite the unequivocal benefits associated with the practices of innovation in SMEs, studies have also shown that these types of companies have greater difficulty in developing mechanisms capable of effectively implementing open innovation due to their size (Oumlil & Juiz, 2016; McPhillips, 2020). In these studies, it was emphasized that the greater flexibility and adaptability of these organizations did not compensate for the lack of resources and skills to develop a culture of permanent innovation. Faria et al. (2020) also confirmed this view by highlighting the difficulties of SMEs in absorbing and exploring scientific discoveries, which consequently made it difficult for them to integrate and monitor external knowledge in the internal innovation process. The loss of control was

another challenge highlighted by Rauter et al. (2019), while Aquilani et al. (2017) underlined the cultural barriers that emerged from the collaborative participation of a large number of diversified players.

Graph 1. Challenges of open innovation for SMEs.



The source: <https://doi.org/10.3390/joitmc7030169>

Graph shows the challenges posed by open-innovation practices in SMEs. A lack of resources was identified in a total of 149 responses (79.68%), and the difficulties in integrating knowledge from open-innovation processes in 122 responses (65.24%). On the opposite side, the loss of control and cultural barriers had a much smaller weight, and were less than 20%.

3. Conclusion

We are witnessing the emergence of a new paradigm in enterprises' activity – an open innovation model. The open innovation is a complete novelty in the concept of innovation and it stands for a cheaper and faster solution of problems in a global network compared with traditional methods. The 21st century has stimulated visible market changes, which made enterprises modify their innovation models.

There is growing interest in analyzing collaborative innovation because innovation is pursued through the cross-sectoral collaboration of different sectors and organizations. This interest is primarily justified by the (untested) assumptions that collaboration is conducive to innovation, that it is able to solve organizational and socio-economic problems, and that it can deal with grand challenges or wicked problems.

Further research could focus on understanding how different combinations of knowledge can generate complementarities and substitution effects. This research could further build on Bogers and West (2012) and Bogers et al. (2018) who emphasized that different ecosystem actors (universities, suppliers, customers) may have different effects on the exploration and exploitation behavior of firms.

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Otvorene inovacije i kolaborativne mreže

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Apstrakt: Ovaj rad istražuje tranziciju sa tradicionalnih modela zatvorene inovacije, u kojima se preduzeća oslanjaju prvenstveno na interne resurse i znanja, ka paradigmama otvorene inovacije koje naglašavaju saradnju i spoljne veze. U visoko konkurentnim tržištima, brz tempo tehnoloških promena primorava organizacije da interne istraživačko-razvojne kapacitete dopunjuju spoljnim izvorima znanja kroz licenciranje, partnerstva i međufirmarsku saradnju. Projekti otvorene inovacije, kada su dobro upravljani, mogu doneti značajne ekonomske, društvene i ekološke koristi, iako empirijski podaci pokazuju da rezultati nisu uvek u skladu sa očekivanjima. Studija ističe rastući značaj kolaborativne inovacije između različitih sektora i organizacija, motivisan potrebom da se odgovori na složene socio-ekonomske izazove i podstakne održivost. Takođe se naglašava potreba za daljim istraživanjima o tome kako različite kombinacije znanja - uključujući univerzitete, dobavljače i kupce - mogu stvoriti komplementarnosti ili supstitucione efekte koji oblikuju strategije preduzeća u oblasti istraživanja i eksploatacije. Pružanjem sveobuhvatnog pregleda mogućnosti i ograničenja otvorene inovacije, rad doprinosi dubljem razumevanju načina na koji preduzeća prilagođavaju svoje inovacione modele u 21. veku.

Ključne reči: Otvorena inovacija, Zatvorena inovacija, Saradnja, Upravljanje znanjem, Tehnološka kompetencija, Održivost, Međufirmarski sporazumi, Inovacijski modeli, Konkurentska prednost, Digitalno doba.