Equipping Small-and-Medium-Scale Companies (SMSC) Through Open Innovation: A Refined Proof of Concept and OI Redesign for Strategic Implementation

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Abstract This study presents a novel approach to Open Innovation (OI) as it applies to small-and-medium-scale companies (SMSCs) suffering from multilayer constraints to benefit from such a collective tech value creation model. Building on the decades-long practice of OI, the chapter looked into the model's evolution, development, and application constraints for the SMSCs and presented a refined concept note that meets the dynamic business and tech environment. Based on this, an OI model that encompasses different stakeholders is designed. The proposed IO model that applies to the SMSCs is built on the Consortium model principles that enable ease of entry and exit for each of the stakeholders, keeping members' best interest for the common good.

Introduction

The basic idea of Open Innovation is to get a group of companies, each with low-to-moderate stakes, to all work on developing and operating shared technological solutions. The notion of Open Innovation arose from the need for a long-term strategy, reflecting the need for internal research activity and innovation. With the shared values, risk, and cost-saving features of such a technological business model, businesses can take advantage of such a collective innovation hub. It is evident that OI can promote SMSCs' competitive advantage and enable the company's longevity;

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This external approach only will succeed if industrial education raises the internal perception of the SMCs for collaborative Technology Innovation.

Existing research in the field, for the most part: (1) Does not identify which forms of open innovation models are best suited for small-and-medium-scale companies; (2) Does not recognize that certain cutting-edge technologies may be available to enable and support open innovation models for small- and-medium-scale companies unlocking new forms of business operation and collaborative value creation for the common good; (3) do not have a design for a self-enforcing incentive mechanism to incent stakeholder participants in the open innovation hubs; and (4) do not clearly address the role of government in facilitating such collective research and development for the SMSCs.

Open Innovation: Evolution and Practice

Open Innovation has become a hot topic in economics, engineering, sociology, research and technology, anthropology, and other fields (Huizingh, 2011). As discussed by Chesbrough (2012), Open Innovation, OI has a significant effect on the dynamic and competitive environment we live in, not limited to big companies. The notion has the potential to define companies' long-term survival and gain competitive advantages through a collaborative setting. In an open innovation setting, companies will benefit from shared values through access to partnerships in research, development, technology, new business, and whatever in a collaborative environment at a shared cost and risk. Since the term Open Innovation was coined in 2003 by Chesbrough in his book, the concept has vastly expanded. Besides, the notion is adopted and customized increasingly across industries. This practice of collaborative setting has been in place in some high-tech companies where these companies have been using the concepts of sharing costs and risks.

Chesbrough (2012) states the differences between open and closed Innovation and the two kinds of open Innovation: (a) outside-in, where the company opens its innovation process to whatever outside inputs can be used, and (b) inside-out, when the company spills its unused ideas or developed techs to outside users for their businesses. Even today, the process is improving, and we can still see many big companies in the closed innovation model, where the patents are unused, not marketed, and becoming obsolete, which will not happen, or very few of them in the open innovation model.

The OI notion, as it applies to small- and large-scale companies, comes with a variation in the impact level given the scale effect. Kirschbaum (2005) described an open innovation inside a large company. Robert Kirschbaum was the former VP of Innovation at DSM, a Dutch company in the high-performance materials, health, and nutrition sector with annual revenue of over 8 billion euros, DSM-Bright Science. Brighter living. TM. (n.d.). The article presents the transformation of DSM to a multi-specialty company focused on applying the former areas to customers' products in a business-to-business market. The company was facing the early stages

of opening the innovation department since the 1990s when the New Business Development department was created to bridge the research areas with potential applications. After the success of this endeavor, DSM realized the many opportunities that culminated in another business group in 2001 called DSM Venturing & Business Development, where around 50 people were focused on the "Open Innovation" process. It clearly shows the commitment of DSM to keep ahead of the competition by the alignment of R&D to Innovation, facilitated by the priority given through the new venturing and business unit. In the Business Development Model, the process presented shows the maturation from R&D to Innovation is made through the personas: (a) Intrapreneur—bringing good ideas to viable projects and (b) Professionals—bringing the projects to business.

Vanhaverbeke et al. (2012) discussed the importance of open Innovation for small-and-medium-scale companies in attaining a competitive advantage. With a trade-off between protectionist international trade policies and an open economic setting with an appetite for international companies, local SMCCs are prone to harsh market conditions that drain their financial resources due to the competition from foreign low-cost companies. This justifies the need for collaborative value co-creation that fosters innovation and adds to the competitive advantage through shared costs and risk of the open innovation model. Accordingly, Vanhaverbeke et al. (2012) introduced the OI approach for SMCCs which is unique to companies of a similar scale of operation, unlike the big ones, which are far more resourceful in multiple aspects.

Open Innovation Adoption Constraints for SMSCs

Concerning the absorptive capacity of companies, companies' lack of internal knowledge to enable external interaction and capacity to absorb technologies beyond their products—Syndrome of Not Invented and resistance to change to a new model (Cohen & Levinthal, 1990; Katz & Allen, 1982). In small-scale companies, research and development expenditures tend to limit innovation capabilities with significant evidence of correlation, Acs and Audretsch (1990). innovation and small firms, they were already following the path to link internal research to company innovation.

Besides, regardless of a company's OI partnership, such developments in a collaborative setting can come with high-end solutions that call for tech readiness and the company's capabilities in implementing such technologies. In this regard, Pimentel and Albino (2010) to evidence from SMSCs in Brazil reflecting on the lack of Knowledge Management (KM) capacity as one of the constraints in internal business innovations and tech adoption and implementation. This is important because, with efficient knowledge management, SMCCs can easily and quickly retain their core capacity and knowledge in a steady manner as they catch up with or follow the industry dynamics. In this regard, it is recommended that companies have a minimum technological structure to handle open Innovation. Hence, such

preparedness can be harnessed through internal and external strategies to equip companies with a human capital investment that involves training for OI. Amati et al. (2020) presented the Pirelli project conducted in 2010 about Technology Road mapping Management (TRM) and built a process to link the TRM to Research, Technology, and Innovation Management system. Here, the Technology Road mapping Management shows an additional dimension to increase the complexity on the SMSCs' shoulders.

Studies show that SMSC's usage of Intellectual Property, IP, reflects lesser licensing and innovation results than big enterprises due to the lack of innovation and the complexity and cost of IP. Nikzad (2014) reflected on this by taking the case of the Canadian government's role in addressing the under-usage of IP and that the government should promote and create awareness while building IP capacity inside the SMSCs through education and cost reduction in IP for these companies. In 2017, the Canadian government launched a program (Innovation and Skills Plan) to incentivize SMSCs to foster their development and innovation. This program reflected more than two billion CAD (Cad$ 1.2 billion for the Strategic Innovation Fund and Cad$ 900 million for the Innovation Superclusters Initiative) to sectors considered priorities like advanced manufacturing, agri-food, clean tech, digital technology, health/biosciences, clean resources, transportation, and infrastructure. As of 2022, the funds available are Cad$ 750 million for a 5-year plan with five cluster areas: digital technology, protein Industries, advanced manufacturing, scale AI and ocean, and Global innovation clusters (n.d.). Visiting the Advanced Manufacturing cluster, Sector, I. (n.d.). The tech themes are related to the Internet of Things, machine learning, cybersecurity, and additive manufacturing (3D printing), with a total fund of Cad$ 427 million. The process is made of a call for specified title projects for groups of companies (consortiums) with certain characteristics for attending the contest for the funds.

In a digital world with cutting-edge technologies that promise operational efficiency for SMSCs, such companies also suffer from privacy and security issues that add extra layers of constraints for innovative value co-creation through Open Innovation (Turi, 2020; Turi & Li, 2021). Hasani et al. (2023) showed a model for SMSCs to overcome their difficulties in digital security. This important study also raises the weakness of the SMCs in IT, Engineering, and analysis for holistic development for medium and long-term competitiveness.

Here, the resilience and competitiveness of small companies lay on the long-term strategies, values, and policies of the company equipped with relevant technologies as it defines the positioning of the company in an industry, Gunasekaran et al. (2011). However, this is evidently a challenge for companies of this scale to stay ahead of the competition and time.

Due to these and other layers of complications, OI practices among small-and-medium-scale companies are very low, aggravated by within-group competition elements, resource constraints, human capital, and awareness issues for companies of this level who struggle to sustain their business or penetrate a market. This points out the importance of education in the industry as part of the government's role, which will be detailed later in this chapter.

Open Innovation: Value-Add

Gassmann et al. (2010) showed an interesting perspective for the next trend in OI by pointing out the openness trend from an absolute era of secrets and undisclosed information in companies to a more shared and disclosed information in the pre-competitive moment and more restricted way in a business moment. That is a trend in outsourced R&D in a collaborative and open innovation way. Also, the increasing need for resources imposes a natural trend for the shared costs and risks intrinsic to Open Innovation. Adding to that, there is a trend of more strategic development to be conducted in an open innovation model as different players can also assess it before the decision of adoption/insertion in the company. Another trend is the increase of low-tech sectors adopting the OI model, like the high-tech sectors. More and more daily companies will integrate themselves with the outside through Open Innovation. It is also shown that the number of SMSC adherence to this new model configuring a trend and strongly recommend for any size company decision. This can be understood as improving new technology and a new business road instead of only following the cost reduction path. Other trends identified in this regard are the change from standalone to alliances, fear of disclosing the past, to happiness of sharing the future. In this last category, changing the mindset from protecting the past IP to a tradable business and opportunity was another one.

Similarly, Qian and Haynes (2013) evaluated the efficacy of the US Small Business Innovation Programme, SBIR, in enabling SMSCs to high technology entrepreneurship. Beyond the SBIR, which is mostly focused on facilitating technological commercialization, the main conclusion is that the program also adds the entrepreneur stimulus by interconnecting with other programs and agencies that support this activity on SMCs. Additionally, they pointed out the need to address human capital investment on board to the SMCs policy under SBIR.

Companies that are part of a collective innovation hub can excel at internally developed tech solutions and product developments in a co-shared space at stake (Kohli et al., 2023; Turi et al., 2017). Yet, there is a risk of de-risking Innovation when managers try to reduce general risks in the innovation process, de-railing high-risk of hidden disruptive tech before all the others, Drakeman and Oraiopoulos (2020). To overcome this natural managerial flaw of keeping strategic vision linked to the present business of their products, they analyzed the ambiguity between the R&T&I department, designed to build the new tech, and the departments of product development and operations management, much concerned with keeping the current success of the company. This can be a healthy debate when someone over all departments forces some middle balance risk mitigation position on new high-tech content products. When disruptive technologies emerge in the market without going through the company innovation process, it is too late for laggard companies to catch up and win a competitive advantage being in a learning and/or adoption phase.

OI initiatives can potentially add value in RT&I functionalities of knowledge management, IT resources, project management, technology road mapping, and IP commercial exploitation for member SMSCs through a collaborative setting. To foster this:

- SMSC RT&I policy design, outsourcing opportunities through an SMSC's direct governance should be in place as part of such a collective initiative.
- More work is needed on the new tech risk-aversion behavior of SMSCs in a bid to neutralize the risk of staying at the same level as competitors; Tech-risk aversion is a common mistake in SMSCs for a couple of reasons: Internal fight for funds, misunderstanding the concept of the risk between business activities and RT&I, which search for the high-risk disruptive technology before anyone else.

A Refined Open Innovation Model Development for SMSCs

Based on the in-depth reviews and synthesis made on the studies around the open innovation models and the analysis presented above, we propose a refined OI model that applies to SMSCs.

Smaller firms need to link the company's innovation to internal research, and this internal RT&I and readiness will guard the functions necessary to perform the research in the open model. When it comes to larger firms, such companies hold internally built and structured strategic research, technology, and innovation and were able to fast adopt OI in its early stage. Hence, the OI approach must differ for SMSCs as they need to possess the capabilities, resources, and organization for RT&I. The proposed strategy under this condition is an open innovation model association for the SMSCs with a membership fee, aligned with some funds and strategy from the government for tech development.

The proposed model observes a semi-centralized framework with the government's leading role in open innovation initiatives for SMSCs. This is due to the government's economic growth facilitation nature and the need for an uplifting power and structure on the side of SMSCs which hold a spartan organization most suitable for operations and short-term cash flow.

To set the first move, we shall define the kind of relationship the players could hold:

1. Association: An association is a group of people or companies united for common purposes and interests. The members are independent of each other. One important purpose is to address the lobby's thoughts to lawmakers and public policies.[1]
2. A consortium is a group of two or more people or companies working together to reach common goals in a timeframe project. Each member is independent of

[1] National Industry Organizations (n.d.).

the others in business operations, but they have a contract agreement governing their relationships, duties, rights, and penalties. One advantage of this model is that it is easy for any company to join or leave after the foundation of the Consortium.[2]

3. A cooperative is a special group where the members own the cooperative and cooperate to promote mutual, social, cultural, and economic benefits to the members and society. Members of the Cooperative contribute to the capital of the cooperative and benefit from the profits it may have.[3]

Here, the proposed OI model is built on the Consortium model, which means that no center or place will be built priorly and has a project duration mindset renewed by the continuous interest of the members. Once the Consortium keeps the members' interest high, it exists, and when that interest ends, the closure will be in effect.

If we think of this consortium model as a kind of franchise under government control that enables different companies from different sectors, we may create a reference source for the development of the technology of interest.

The key players in the SMSCs Open Innovation Model are:

- Government in charge of fostering strategic long-term technological areas. The government's role is in the technical strategy for the region or the technology on the map. This can create a path for drawing attention and interest from the industrial community for each technology in the plan. The attraction and interest of the companies can be set through the subsidies for the Consortium and some tax relief for the companies that prove commitment by pouring funds into the innovation system. This could be an easy model to replicate anywhere in Canada and in any subject technology area, like a franchise. Here, we augment the Health Impact Fund model that will incentivize members to innovate by delinking the cost of innovation from the cost of technology and thus compensating SMSCs based on their propensity to innovate.[4] As this goes down to the ground, in terms of the role played by the government, implementation of this initiative will consider the (1) creation of SMSC-steered government programs and funds (for example, by taking advantage of the pre-existing US and Canadian government programs); (2) Awareness creation about the public funds available to the SMSCs to the OI members.
- Industries to steer the group, to drive innovation, keep the knowledge alive, and innovate to meet the intense market competition in a dynamic business and tech environment. Note that in an international setting of such Oi that allows foreign company memberships, member companies can also have a strategic interest in the subject investigated by the Consortium in addition to the financial incentives.

[2] Kenton (2022).

[3] CLUSA (2019).

[4] See the Health Impact Fund designed to delink the price of drugs from the cost of innovation by creating complementary incentives that cover the latter through health impact rewards at https://healthimpactfund.org/en/ Page Accessed on July 25, 2023.

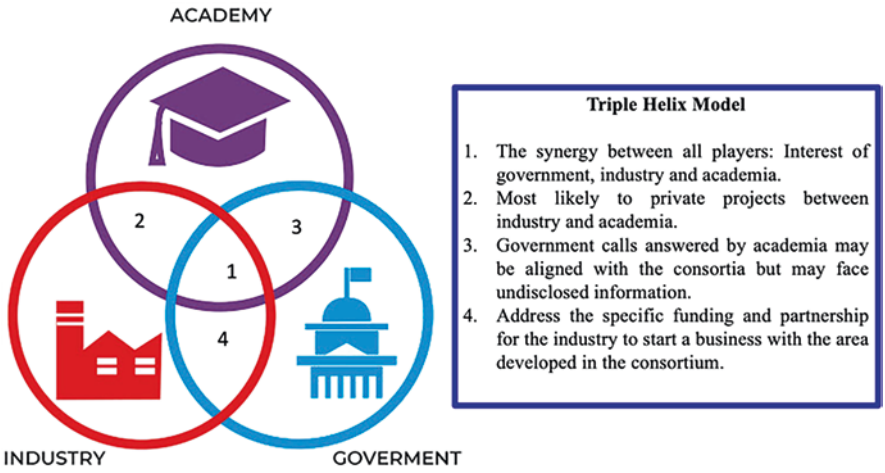

Fig. 1 Triple Helix for the consortium open innovation model. Source: Authors' development

- A collective OI hub leader (for example, a University or research institution that serves as an innovation fuel overseeing the OI, be in charge of developing disruptive and high-end tech solutions for the member companies and training OI hub members.

The model described above is based on the triple helix model of Innovation, which integrates the government, industry, and academia, and it may be expanded to the quadruple helix by including civil society and to the quintuple helix by incorporating sustainability and environment. Figure 1 shows the concept herein described.

Conclusion

The open innovation model presented in this chapter is state of the art about collaboration, risk, and cost-sharing. This will come with high efficiency and effectiveness in doing more research with less amount of funds per capita, enabling technological advancements and adoption for companies through a collective innovation hub. By leveraging this capacity of the OI model, the chapter explored application strategies and developed a novel, refined OI model that applies to small-and-medium-scale companies. The work presented here is a proof of concept, and further development and implementation strategies for the SMSCs OI model are underway as part of our future work.

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