



An Analysis of Open Innovation Determinants: the Case Study of Singapore based Family owned Enterprises

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Abstract Family businesses play an important role in the growth of global economy, and while they are arguably perceived as a conservative form of organization with high risk aversion and reluctance to change, counterintuitive empirical evidence show that they are most effective in ideation and commercialization of innovation projects. In the current business environment of rapid change in work patterns, fast adoption of enabling technologies for seamless collaborations across industry and geography, along with intense competition and high uncertainty, enterprises have no choice but to maximize returns on innovation investments. Therefore, they are increasingly dependent on an ecosystem-based approach to innovation management, which has shown greater likelihood to create radical innovations and enable profit generation.

The objective of this paper is to analyse determinants of open innovation practices in family-owned enterprises in consideration of the joint effect of in-company enablers and external factors. Drawing on a sample of 33 Singapore based family-owned firms, our findings confirmed the key drivers such as family and business culture, access to external funds, government supported initiatives, market dynamics, partnership, network, family capital, and external network. Managerial implications about the necessity to leverage both environmental determinants and internal innovation capabilities to foster novel business ideas are also highlighted in the conclusion of the paper.

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Un análisis de los factores determinantes de la innovación: el estudio de caso de las empresas familiares con sede en Singapur

Resumen Las empresas familiares desempeñan un papel importante en el crecimiento de la economía global, y aunque posiblemente se las perciba como una forma conservadora de organización con alta aversión al riesgo la evidencia empírica muestra que son más efectivas creando y comercializando proyectos de innovación. En el entorno empresarial actual de cambio rápido en los patrones de trabajo, la adopción rápida de tecnologías habilitadoras para colaboraciones fluidas en toda la industria y la geografía, junto con la intensa competencia y la alta incertidumbre, las empresas no tienen más remedio que maximizar los rendimientos de las inversiones en innovación. Por lo tanto, dependen cada vez más de un enfoque basado en el ecosistema para la gestión de la innovación, que ha demostrado una mayor probabilidad de crear innovaciones radicales y permitir la generación de ganancias. El objetivo de esta investigación es analizar los determinantes de las prácticas de innovación en las empresas familiares en consideración del efecto conjunto de los facilitadores internos y los factores externos. Basándose en una muestra de 33 empresas familiares con sede en Singapur, nuestros hallazgos confirmaron los impulsores clave como la cultura familiar y empresarial, el acceso a fondos externos, las iniciativas respaldadas por el gobierno, la dinámica del mercado, la asociación, la red, el capital familiar y la red externa. Las implicaciones gerenciales sobre la necesidad de aprovechar los determinantes ambientales y las capacidades de innovación interna para fomentar nuevas ideas de negocio también se destacan en la conclusión del artículo.

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Introduction

Traditionally, family businesses around the world have often been perceived as less innovative compared to their non-family owned counterparts due to their apparent risk aversion and reluctance to change [(Gaskell, 2018), (Marín, Hernández, del Valle, & Castillo. M., 2016)]. This is however open to debate and, in fact, counterintuitive empirical evidence in recent years show that family enterprises are the most innovative organizations among all. They are not only the ones securing the greatest number of patents and new products, but are also most effective in ideation and commercialization of these innovation projects (Duran, Kammerlander, van Essen, & Zellweger, 2015).

Innovation is not a new phenomenon. Arguably, as written by Fagerberg & Mowery (2006), innovation “is as old as mankind itself”. Inherently, human beings have the tendency to think and develop new and better ways to do things and to experiment in practice and, as such, research in business innovation have proliferated in recent years, with a steep spike in publications in the early 2000s [(De Massis, Sharma, Chua, & Chrisman, 2012), (Gunday, Ulusoy, Kilic, & Alpan, 2011), (Fagerberg & Mowery, 2006)]. The acute competition among firms registered since the turn of the century, the rapid growth of internet and its contribution to globalization and technological advancement, have in fact brought about greater attention on innovation practices, and the ability to create newness is nowadays regarded as a fundamental area in corporate strategy and the main provider of competitive edge (Lopez-Fernandez, Serrano-Bedia, & Gómez-López, 2015).

It is in fact a broadly recognized paradigm that innovation plays the pivotal role of enabling firms to pursue the threefold objective of top-line growth, bottom-line growth, and business sustainability in the long run [(BFI@SMU; UOB, 2015), (Forsman & Temel, 2011), (Fuetsch & Sues-Reyes, 2017)]. Therefore its contribution to a firm’s survival and growth is without doubt.

As a general definition, innovation essentially refers to the inherent ability of firms to withstand competition through the identification of novel and better ways to acquire and execute tasks related with products, processes, systems, structures, services, and marketing methods (Calantone, Cavusgil, & Zhao, 2002).

However, while the creation of novel ideas, products, and services was oftentimes viewed in the past as an exclusive result of internal activities such as in-house R&D, there is an increasing volume of studies that recognizes the critical contribution of environmental/ external elements as well (Wynarczyk, Piperopoulos, & Mcadam, 2013). Chesbrough, who is considered

the pioneer of this ecosystem-based slant, names this model “open innovation” (Chesbrough, 2003). The open approach, unlike its closed counterpart, leverages on the continuous “inflows and outflows of knowledge” across firms and stakeholders to accelerate creation of newness (Chesbrough & Crowther, 2006). Collaborative idea generation, sharing of intellectual property, and continuous cross-sector interaction are the basic principles of the open approach. Their combination in turn leads to an innovation that is open to various individuals and enterprises in the system [(Wynarczyk, Piperopoulos, & Mcadam, 2013), (Pervan, Al-Ansaari, & Xu, 2015)]. The open approach has undoubtedly been well received by the vast majority of the 21st century companies due to its track record for a consistent raising of the bar of innovation practices across industries and firms, and the academic community has spent significant efforts to document its mechanisms across corporates and industries.

However, in spite of its obvious relevance, while open innovation practices have been widely investigated in large corporates, its family-owned counterpart has not always received the scholarly attention it deserves. To date, the literature has been unable to provide conclusive findings to fundamental research questions related to drivers of open innovation in family owned enterprises in consideration of both in-company drivers and environmental determinants (Hossain & Kauranen, 2016). Scholars have in fact focused mostly on the business dynamics piece of innovation, and often overlooked the family system (De Massis, Di Minin, & Frattini, 2015). Our current study is an attempt to fill this gap, and by focusing on cases of Singapore based family firms, it aims to make three contributions. Firstly, to help family-owned firms navigate the complex landscape of innovation initiatives. Secondly, considering that past research had long sought to understand determinants of innovation, with limited work done in consideration of the joint effect of inner-workings of family-owned enterprises and external drivers, this research will bring a holistic approach and provide family firms and policy makers with key strategic insights to push the innovation agenda forward. Thirdly, this work will debate on the impact of tradition and past knowledge in innovation initiatives (de Massis, Frattini, Kotlar, Petruzzelli, & Wright, 2016).

The reasons to focus on family businesses, in Singapore, is twofold. Firstly, family business is the most common ownership business model in the world. They are the backbone of the global economy, with an estimated contribution of over 70% of global GDP, a provision of 50-80% of worldwide private sector jobs, and a financial capital currently supporting 85% of start-ups [

(Osunde, 2017), (European Family Businesses, 2012)]. Southeast Asia, oftentimes defined the engine of global development (United Nations, 2018), has even higher dependency on family firms. Regionally, 80-90% of large companies are family-owned, and there are “good reasons to assume that their role in their respective national economies will remain crucial” (Björnberg, Elstrodt, & Pandit, 2014). Singapore is strategically positioned at the heart of Asia, and besides its well-cemented position as a Southeast-Asian business hub (EDB Singapore, 2017), the city-state is regarded as one of the pioneers of innovation practices in the region. Tracing the history of the nation, it is evident that while in the past, technology and innovation had served in a functional role, today they are “the central engines powering an ambitious economy” (Ng, Lim, & Wong, 2018). Given that Singapore’s most valuable resource is its people, the national government has recognized early that a leading role in the field of innovation, science and technology would set Singapore apart on its journey to become the “Global Asia node” [(Ng, Lim, & Wong, 2018), (Lung, 2018)]. Therefore, developing a deep understanding of Singapore family-owned enterprises’ innovation behaviour is fast becoming a crucial long-term priority, not only for those firms who are currently active in the Lion City, but also for investors and policy makers that must ultimately decide how to better foster the development of the region as a whole.

This paper therefore hopes to provide strategic insights to practitioners, family businesses, and policy makers by addressing the following questions:

- How do Singapore family-owned businesses interpret innovation, and what is their underlying innovation culture?
- What are the main environmental and inner-working drivers of innovation in Singapore based family-owned enterprises ?

The rest of the paper is structured as follows. Section 2 reviews literature on innovation, innovation models, and drivers of innovation in family-owned enterprises. This is followed by a detailed analysis of research gaps that the present work seeks to fill. Section 3 discusses the Singapore family business context along with a comprehensive analysis of the innovation landscape in the city-state. Section 4 presents the research framework, along with a detailed analysis of research contribution. Section 5 discusses the methodological approach, input data, and survey structure. Section 6 presents analysis of the results. Lastly, section 7 discusses managerial implications, research limitations and directions for future research.

Research Background

Business innovation management, especially in corporates, has been widely investigated and many research papers are available in this domain. Some research looked at drivers (or determinants) of innovation, some other attempted to define innovation models, whereas another piece conducted in-country analysis to map the status of innovation practices around the globe. This section reviews previous scholarly work in these areas while introducing fundamental concepts such as definitions of innovation, it also provides insights from previous research on drivers of innovative projects, and innovation models.

Defining Innovation. Despite the broad use of the term innovation, there is often no real agreement on what this term means. Some authors look at innovation from a process perspective, others may define the term from the standpoint of methods, ideas or products. However, the common understanding across industry, academic and practice is that innovation encompasses a series of initiatives geared toward the provision of added value to customers, the scaling up of value delivery to a larger set of customers or some combinations of the two (Galper, 2016). Literature typically categorizes innovation definitions into two main groups namely customer experience innovation and company transformation innovation. Customer experience innovation focuses on how customers directly experience companies’ products and services or their perception of the brand, whereas company transformation innovation impacts the inner-workings of firms and typically refers either to processes or people (Galper, 2016).

According to Oslo Manual, innovation can materialize in a variety of forms namely product, process, marketing, and organisational (OECD & Eurostat, 2005). Product innovation refers to introducing a new product or service to the market or it represents a significant improvement of an existing one. Improvements might include technical specifications, software, raw materials or components and materials, user friendliness or other functional characteristics (OECD & Eurostat, 2005). Typically, product innovation has a direct impact on top-line growth. Process innovation refers instead to the adoption of an improved production or delivery method, which might include changes in production techniques, equipment and/or software (OECD & Eurostat, 2005). Process innovation is generally cost-cutting in nature (e.g. new manufacturing process to reduce unit cost) and is typically reflected in bottom-line growth. Marketing innovation is about the

implementation of new marketing methods and usually consists of changes of any of the four P's of marketing: product (e.g. design or packaging), promotion, price and/or placement (OECD & Eurostat, 2005). Lastly, organizational innovation is about new organizational methods in business practices, workplace organization or external relations (OECD & Eurostat, 2005).

Innovation Determinants. Family-owned enterprises are intrinsically different from their non-family owned counterparts (Gallo, Tàpies, & Cappuyns, 2004), and these dissimilarities are also reflected in the way innovation practices are driven at firms' levels. In fact, unlike non-family owned enterprises, family businesses have the additional family component impacting the way the business is structured and organized (Kellermanns, Eddleston, Barnett, & Pearson, 2008). Literature in innovation management in family businesses divides innovation determinants into two main categories namely external and internal drivers.

External determinants are defined as ecosystem-driven elements that can enable, or limit, the ability of firms to innovate (Avlonitis & Gounaris, 1999). Major external catalysts include government support [(Hadjimanolis, 1999)] partnerships with academia, public agencies, and other private firms (Perkmann & Walsh, 2007), access to external funds (Zhu, Wittmann, & Peng, 2011), and market dynamics (Huizingh, 2011).

Internal determinants are inner-working enablers of innovation. Internal drivers of innovation comprised family and business culture (Hernández-Perlina & Mancebo-Lozano, 2016), which amongst others include factors like family involvement (Lopez-Fernandez, Serrano-Bedia, & Gómez-López, 2015), inter-generational involvement (Sharma, Chrisman, & Chua, 1997), CEO/ C-suite thinking (Zahra, 2005) and business network (Öberg, 2018).

Innovation Models. The concepts of open and closed innovation have attracted interest from academic and practitioners' communities alike. Of the two approaches, the so-called open model has received greater attention, especially in most recent times (Huizingh, 2011). In fact, although the two paradigms at first glance seem to point in opposite directions, oftentimes open innovation is considered the natural development of its closed counterpart. Scholars debate that this evolution from a closed into an open model was made necessary by the combined effect of environmental factors such as change of work patterns (e.g. higher workforce mobility), rise of technologies enabling collaborations across industries and geographies and increased interest of all stakeholders (e.g. suppliers) to contribute in a new way to the creation of innovation [(Chesbrough, 2003), (Dahnlander & Gann, 2010)].

Additionally, in the current business context where profit margins are increasingly affected by stiff competition and uncertainty, it is critical for companies to maximize their returns on innovation investments. Firms emphasizing inside-out open innovation have shown great likelihood to create radical innovations and sell a higher number of new products (Inauen & Shenker-Wicki, 2012). Hence a growing pool of firms are shifting towards an ecosystem-based approach to boost internal capabilities to improve processes, systems, and products through novel collaborative solutions [(Wynarczyk, Piperopoulos, & Mcadam, 2013), (Furr & Shipilov, 2018), (EDB Singapore, 2017)].

Research Gaps

Despite the large amount of research papers available in the domain of business innovation management, it appears that the body of literature is currently unable to provide conclusive findings to fundamental questions about the role of key innovation drivers and their underlying structure, especially within the niche of family-owned enterprises. In addition, limited knowledge has been developed in regard to innovation-enabling determinants in a family-business dominated economy such as Singapore. In fact, from the analysis of previous scholarly work, it appears that the vast majority of the research have focused on Western societies, where findings are not directly applicable to the Asian context. There is a significant void in literature about open innovation in Asia, whereby cultural values are heavily embedded within the way families conduct business. Unlike in Europe and the United States, Asian family-owned businesses are often young organizations where the family has been in business for not more than 50 years [(The Business Times, 2018) (Koh & Kong, 2016a)]. Additionally, while there is a fair number of studies which focused on either internal or external determinants of innovation, there is relatively little attention on their joint effects on firms' performance. Thus, this paper aims to fill these gaps, and by analyzing the perspectives of a diverse group of Singapore family enterprise, this work will map the status of innovation practices in the city-state of Southeast Asia.

The Case Study of Singapore

Why Singapore Family Enterprises

Located in South East Asia with a GDP of \$297.0 billion, Singapore is considered, together with Hong Kong, South Korea and Taiwan, as one of Asia's four economic tigers. Since its independence in 1965, the city-state has gone through an impressive journey of growth and the nation is considered one of the wealthiest countries in the world per capita (US News, 2018).

According to data from the national department of statistics, in 2017 Singapore counted over 220,000 enterprises, of which 99% were SMEs and 85% were locally owned. Similarly, employment reached 3.4 Million people (excluding domestic foreign workers), of which 65% were absorbed by SMEs, and 68% by local firms. Real GDP growth in 2017 was measured at 3.4% (Singapore Department of Statistics, 2017).

Despite the strong appeal and highly favourable conditions for multinational corporations (MNCs) to establish themselves in the city-state, local family-owned enterprises still dominate the domestic economy. Looking at the Singapore Exchange for instance, family-owned firms made up over 60% of listed firms (The Straits Times, 2015), and their role as SMEs, which is by far the key engine of Singapore's economy, is even more central (Gov.sg, 2017). Family businesses contribute to nearly 70% of the national GDP and employ 50% of the workforce (Family Firm Institute, 2018). Additionally, although their presence spans across all sectors of Singapore's economy, their main role is registered in pivotal industries of the local economy such as construction, hospitality, real-estate, manufacturing, services and trading (The Straits Times, 2015).

The country has been consistently ranked as one of the most cosmopolitan cities globally, and its millennials, who often represent the next generation of business leaders, are global citizens while anchored to their own ethnic and cultural roots [(Yeoh, 2004), (Timperio, Tan, Fratocchi, & Pace, 2016)].

A Track Record of Open Innovation Excellence

Over its 50 years of history, Singapore has earned a reputation of being a global innovation hub "at the cutting-edge of modern business" (Basulto, 2015). With a proven track record of excellence, the city-state has always been riding the wave of innovation to set itself apart (Basulto, 2015). In the mid-1960s and 1970s the role that Singapore played was as a low-cost manufacturing hub. By late 1970s and early 1980s, the national economy quickly moved up the value chain of electronics and semiconductors industries to become (after the economic stagnation of 1997 Asia financial crisis) a leading knowledge-based economy today [(Basulto, 2015), (Wong, 2008), (Tan & Phang, 2005)].

At the present time, Singapore business ecosystem collaboratively embraces and promotes the open innovation model [(Shiao, 2018), (Straitstimes.com, 2018)]. According to a recent research by EDB Singapore published in Harvard Business Review (2017), Asia, and Singapore in particular, offers not only favourable conditions to do business, but also a wide array of soft-factors which in turn enable

the region to be on the "leading edge of the innovation curve" (EDB Singapore, 2017). As a result, countless examples of home-grown family owned enterprises with strong innovation capabilities are available, and organizations like Goldbell Group, PBA (Precision Bearings and Automation) Singapore, Cycle & Electric company (Cyclect), Chef-in-Box by JR Group, Hai Sia Seafood, Q Industries, are few of the most successful innovation cases [(Koh & Kong, 2018a), (Koh & Kong, 2016b)]. Bloomberg 2017 global Index on the state of innovation ranks Singapore in third position, ahead of Germany, Switzerland and Finland, and first among other Southeast Asian nations (Jamrisko & Lu, 2018). World Intellectual Property Organization positions the Lion City as the most innovative economy for South East Asia, East Asia, and Oceania, and fifth on a global scale (WIPO, 2018).

Research Framework

In light of previous investigations, both descriptive and empirical in nature, and research gaps described in section two, this study argues that both external (ecosystem) and internal (inner-workings) factors jointly contribute to building family firms' innovation capabilities. This is still a debatable issue within the academic community, and to date the body of literature has been unable to provide conclusive and widely applicable findings. Thus, this study aims to capture the Southeast Asian perspective by mapping the state of innovation practices in the use case of Singapore.

External Determinants

With regards to external determinants of innovation, literature mostly focuses on four distinct factors namely government support, access to external capital, partnerships, and market dynamics.

Government support. Government plays a critical role in building business ecosystems conducive to innovation. They establish policies (Wonglimpiyarat, 2011), design incentive schemes for innovation to thrive, build the legal and regulatory framework (Spithoven, Vanhaverbeke, & Roijackers, 2013), and shape the workforce's skillsets through the implementation of educational and training programmes (Mani, 2011). According to a recent study by Pervan, et al. (2015) on environmental determinants in Dubai SMEs, government policies have a significant impact on innovation capabilities. GreenDot Group for example, which is just one of the many success stories of Singapore based family-owned enterprises, enlisted the support of SPRING Singapore (today named "Enterprise Singapore") to incapsulate

design thinking concepts with their branding strategy with the aim to gain a deeper understanding of their target group (Koh & Kong, 2018b).

Access to external resources. Availability and access to capital is also a key leverage to generate and implement new business ideas, ventures, or even business models. Singapore offers a wide range of financing possibilities including banks, financial institutions, peer-to-peer crowdfunding, angel investors, and more (linkflow Capital, 2018). In this research, we are interested to understand whether the current schemes enable innovation in family businesses, and whether banks and financial institutions in Singapore are supportive in funding innovation ideas and projects.

Partnerships. Academic-industry collaborations as well as partnerships with other private firms or public agencies, are increasingly becoming a key element of efficient national innovation systems. For example, under the academic-industry collaboration scheme, universities become a major contributor of businesses' innovation strategies, especially from the angle of generating and disseminating new and relevant knowledge to private businesses [(Pertuze, Calder, Greitzer, & Lucas, 2010), (Fischer, Vonortas, Schaeffer, & Queiroz, 2016)]. In this regard, Singapore is growing a vibrant national innovation system where academic research excellence plays an increasingly important role. In 2016, on its Research Innovation Enterprise (RIE) 2020 Plan, the national government has unveiled a S\$19 billion (nearly USD \$14 billion, equal to +18% from previous 2015 RIE) plan to support Singapore's R&D efforts with the aim to address national challenges but also to create value to spin off drivers of economic growth. [(National Research Foundation, 2018), (Fai & Kek, 2016)].

Market dynamics. The nature of the market, the competition level, and product types, can create the conditions for firms' to foster their innovation capabilities (Reeves & Deimler, 2011). Rapid changes of market conditions create in fact new business opportunities, and tend to speed up innovation processes so as "to meet unmet needs" (Nemet, 2009). Singapore is a highly dynamic market and a catalyst of dynamism across the entire Southeast Asian region. Looking at 2017 alone, the city-state received US\$62b of foreign direct investment, standing in 5th position in the global top 20 foreign investment hubs (Singapore Business Review, 2018). In addition to the dynamism related to foreign investments, favourable regulatory framework, and favourable taxation schemes for foreign firms contribute to raise the bar of competitiveness in the domestic market.

Internal Determinants

According to previous investigations, elements like family and business culture (family involvement, top management or C-Suite philosophy towards innovation and company culture) and extended business network are the internal factors that contribute to family firms' innovation capabilities.

Family and Business Culture. Family and business culture factors are related to innovation management in family enterprises such as family involvement, multi-generational involvement, innovative characteristics/CEO strategic thinking which are more than general organizational culture. Family involvement typically refers to the degree of involvement of family members in the management organization and structure of the family firm (Lopez-Fernandez, Serrano-Bedia, & Gómez-López, 2015). Most research published to date concur that a greater family involvement corresponds to a higher interest of the firm to pursue innovation initiatives. In fact, direct involvement of family members takes away the need for short-term/ quick wins to move the focus to longer-term goals, which are the typical timeframes of innovation initiatives (Mustakallio, Autio, & Zahra, 2002). In regards to multi-generational involvement, according to survey findings of Deloitte (2016), the majority of next-generation business leaders believe that innovation is key for business survival and growth. The 61% of respondents argued that the current generation are well aware of challenges in innovation but, according to 40% of respondents, current generation leaders were not willing to take the risks associated with it. Additionally, 51% of next-generation leaders shared their intention to be more risky in their decision-making, although in a more controlled way. In this regard, PBA Singapore is a good example of differences in cross-generational perceptions of innovation and inner strengths of this "sandbox approach". PBA Singapore's CEO Derrick Yap, when he first joined the organization, had to convince its father of his capabilities to transform the business by taking on the great challenge of transforming the company's Malaysian market business with the support of only a six-member team. Today, Malaysia contributes to 30% of PBA's group revenue streams (Koh & Kong, 2018a). The level of involvement of top management (e.g. CEO) or C-Suite also appears to have a certain degree of impact on the firm's innovation capabilities (Yadav, Prabhu, & Chandy, 2007). In this regard, Dyer and Gregersen (2012) wrote that the "behaviour of leaders matter—big time", in the innovation processes. Additionally, risk-taking behaviour of management, encouragement of creativity, and participation of all staff in the innovation process, to name but a few, are also

critical elements of innovation orientation [(Maher, 2014), (Szczepańska-Woszczyzna, 2014)]. Network. A business network consists of a series of companies that are directly and indirectly connected through social and/or economic ties. Innovation is connected to business networks in several ways. This connection might exist due to the fact that creation of newness may be the result of interaction between business partners (Öberg, 2018), but also due to the change that innovation will bring in the interaction patterns among business partners, [(Ostendorf, Mouzas, & Chakrabarti, 2014)].

Contribution of the Current Research

This work will shed light on key catalysts of open innovation in family-owned firms. Particularly, by leveraging on a sample of family firms in Singapore, a highly dynamic, yet culturally Asian society in Southeast-Asia, this research will bring the following contributions:

- Identify the main drivers of innovation across family firms examining both internal and external determinants. This will enable academics and practitioners to identify the most critical factors fostering innovation in Singapore based family firms,
- Illustrate the unique elements of Singapore family-owned business culture with regard to innovation management practices.
- Understand the impact of tradition and past knowledge in the innovation activities to specifically understand whether firms with strong ties to traditional values are able to roll successful innovation initiatives, and if so to what extent.
- Bridge theory with practice, and provide family businesses with a set of key determinants, as well as practical insights for policy makers to build a more inclusive and thriving innovation ecosystem.

Methodology and Sample Characteristics

Survey Structure & Measurement of Constructs

In order to test the meet the research objectives, a questionnaire was developed and a survey administered over the period October - December 2018. The items used to measure the constructs were finalized based on an extensive literature review on business innovation management in combination with group discussions with senior executives of Singapore family-owned businesses. The combination of literature with focus group discussions was needed to ensure that wording and sequencing of questions were appropriate before administering the actual questionnaire. As a result, a questionnaire of 71 items was conceived. Out of these 71 survey items, 33 were about demographics of respondents and characteristics

of industries they operate in, whereas the remaining 38 were in the form of a seven-point Likert scale anchored on environmental and inner-workings determinants of open innovation. Environmental Determinants. Questions designed to assess government-supported initiatives require opinions on the policies designed by the national government to support the development of firms' innovation capacities, and particularly about availability and accessibility to government financial assistance schemes, but also about orientation of innovation initiatives towards creation of intellectual property (IP). Questions on accessibility to financial resources required responses on non-government related financial schemes including both external funding (e.g. angel investors, crowd funding, and bank loans) and internal funding (family capital). Partnerships were measured through questions regarding collaborations with education institutions (universities, polytechnic) and public sector agencies, as well as eagerness to repeat such experiences in future. Finally, market dynamics were assessed using questions on industries' competitiveness level, as well as industries' eagerness to embrace mega trends such as automation, 3D printing, artificial intelligence and machine learning.

Internal Determinants Questions related to family and business culture required responses on family's approach and philosophy towards innovation such as risk-taking behaviour, family involvement, knowledge of the industry, top management involvement in innovation initiatives, passion for newness, and level of innovation from next-generation business leaders. Business network was measured using ad-hoc questions on type of network fostering innovation, and access to friends and acquaintances' finances to fund innovation.

After the data collection phase, a series of multivariate statistical analysis using SPSS v25 software package were undertaken in order to explore the structure of innovation enabling determinants. Details of analysis and results are included in Section 6.

Sample

Firms to be contacted are family-owned organizations sited in Singapore. Considering that literature has been quite ambiguous in defining enterprises that fall under the umbrella of family businesses (Voordeckers, Van Gils, & Van den Heuvel, 2007), we defined our sample to include organizations that are controlled by one family group through "a clear majority of ordinary voting shares", and have family representation at management level (Lopez-Fernandez, Serrano-Bedia, & Gómez-López, 2015). In order to identify the group of firms to include in the study, the database of the "Business Families

Institute, Singapore Management University” (BFI@SMU) was used. In total, 100 family enterprises operating in key industries of Singapore economy such as construction, hospitality, real-estate, manufacturing, services and trading were approached to take part in the research. These organizations constitute the population targeted by this research. The questionnaire was sent via e-mail, with follow up clarifications via phone calls. To motivate a timely and complete response, the respondents were informed that they will receive a summary of research findings when the report is launched. Overall, a total of 61 unique subjects participated in the survey, of which 28 questionnaires were discarded due to incomplete responses. The remaining 33 responses which were eventually considered valid were provided by family enterprises with overseas presence in 15 countries across ASEAN (mostly Singapore, Malaysia, China, Indonesia, and Vietnam) and beyond (Hong Kong, India, Brazil etc.), and business profiles of respondents are summarized in Table 1.

Table 1 Business Profile of Respondents.

Category	%
Industry of Firms	
Logistics & Supply Chain (Procurement, Transportation, Storage)	30%
Manufacturing	17%
Wholesale and retail trade	13%
Construction and/or property development	7%
Food & Beverage related services	7%
Financial Services and/or insurance activities	6%
Professional, scientific and technical activities	6%
Others (ICT, Hospitality, Chemicals, Healthcare, and other)	15%
Size of firm	
Below 50 employees	20%
Between 50 and below 200 employees	30%
Above 200 employees	50%
Annual Turnover	
Above S\$ 1 and below 5 Mil	18%
Above S\$ 5 and below 20 Mil	12%
Above S\$ 20 and below 50 Mil	21%
Above S\$ 50 and below 100 Mil	14%
S\$100 Mil and above	35%
Gender of Individual	
Male	80%
Female	20%
Group Age of Individual	
18-29	21%
30-39	52%
40-49	15%
50-59	6%
60-69	6%
Generation of Individual	
First	3%
Second	58%
Third	27%
Fourth and above	12%

Analysis & Results

This study serves to examine the correlation between environmental and internal innovation drivers on family-owned firms’ innovation capabilities. That is, this research aims to deepen the understanding on innovation determinants taking into consideration the joint effect of both external and inner-working factors. In this section of the paper, we provide insights on the techniques that were selected to meet the objectives of this study as well as research findings. Results are structured into two main areas namely demographic and multivariate statistical analysis.

Demographics. Following the survey, the primary data collected was consolidated. Prior to the testing of the research hypotheses, a descriptive analysis of questionnaire responses matched to demographic profiles of respondents and their industries was undertaken to summarize key characteristics of data collected. Key information is summarized in Tables 2, 3, and 4.

Table 2 Respondents’ Sentiment about Innovation within their Industries.

Category	%
Competition Level	
Intense	90%
Oligopoly	10%
Pace of Innovation	
Fast	33%
Moderate	9%
Slow	58%
Key Driver of Competitiveness	
Heavy physical infrastructure	68%
Intellectual property	18%
Capital intensity	4%
Combination of above options	10%

The large majority of respondents (90%) is operating in industries characterized by intense competition levels. However, surprisingly, respondents characterize the pace of innovation as “slow”, which is likely related to the type of businesses which our sampled firms were involved in. The interviewed firms operated mostly in traditional businesses, where physical infrastructure were the main assets rather than intangible assets and resources such as intellectual property.

Table 3 Respondents’ sentiment about the importance of various Innovation forms.

Innovation types	Utmost Importance	Of secondary Importance	Of tertiary Importance	Of Least Importance
Product	25%	14%	32%	29%
Process	43%	39%	18%	0%
Marketing	7%	18%	32%	43%
Organizational	25%	29%	18%	29%

Most responders (43%) believed that process innovation was the most critical form among all types of innovation, followed by organizational

innovation that had been ranked as top priority by 25% of our respondents. Interestingly, product innovation does not represent the primary form for our sampled firms. In fact, only 14% of respondents ranked this as the main priority.

Table 4 Sales due to innovation, market share, and growth of innovation expenses.

Percentage	Revenue percentage growth due to innovation (period 2013-2018)	Innovation expenses percentage increase (period 2013-2018)
Less than 5%	40%	43%
Between 5% and 10%	20%	17%
Between 10% and 30%	17%	27%
Between 30% and 50%	17%	7%
Between 50% and 70%	7%	3%
Between 70% and 100%		-
More than 100%		3%

The large majority of the sample did not leverage on innovation to drive their revenue streams in the period of consideration. 40% of the sample had in fact experienced less than 5% revenue growth due to innovation, which partially explained also the limited investment on innovation projects.

Multivariate Statistical Analysis. In order to meet the objectives of this study an exploratory principal component analysis (PCA) along with a measurement of internal consistency (reliability) of constructs via Cronbach's alpha and convergence via composite reliability and Average Variance Extracted (AVE) was conducted.

Factors Structure

PCA is a variable-reduction mathematical procedure that allows us to reduce a larger set of correlated variables into a smaller set of uncorrelated "artificial" constructs namely "principal components". Principal components are the underlying factors accounting for most of the variance of original variables [(LAERD , 2018), (Gunday, Ulusoy, Kilic, & Alpkan, 2011)]. As mentioned, in this study PCA was used with the twofold objective of deepening the understanding of intrinsic connections across various constructs (innovation and drivers of innovation. In particular, a PCA with varimax rotation was performed on innovation drivers and, as suggested by Kim & Mueller (1978) only factors with eigenvalues greater than 1 were retained for further analysis (results in Table 5 and 6). As a result, nine factors are extracted of which eight were related with drivers of innovation, and one represented firms'

innovation capabilities.. These factors were labelled based on the items included in each. The total variance explained on innovation drivers was 84%. Cronbach's alpha test and composite reliability were above the recommended 0.600/0.700 principle (except for composite reliability for factor 8, which was slightly below the threshold of 0.6), hence it can be stated that the survey items performed well in capturing their respective latent variables (Hair Jr., F., Black, Babin, & Anderson, 2014). Average Variance Extracted (AVE) was also calculated for convergence validity so as to assess the extent to which the variance of latent variables were explained by the survey items. Considering that all AVEs values are greater than 0.50 threshold, it can be concluded that more than the 50% of the variance of constructs can be explained by their respective items (Vinzi, Chin, Henseler, & Wang, 2010).

Findings from PCA highlighted that all innovation drivers documented in existing literature are relevant for the Singapore context, in addition, two further catalysts namely family capital and (personal) network also play a role in the fostering of innovation initiatives. Thus, results of PCA bring a few considerations. First, private family wealth plays a significant role in fostering innovation initiatives in Singapore. Second, the distinctive elements of family and business culture of Singapore family-owned enterprises include family involvement, know-how of internal processes and products, passion for innovation, innovation spirit, and risk-taking attitude (which are correlated via Cronbach alpha of 0.902). Third, personal network and professional network are independent elements and both are drivers of innovation initiatives. Results of PCA are valid considering that Reliability, Convergence, AVE, and discriminant validity are within acceptable ranges.

After reducing the initial set of variables into a more manageable subset of factors, a correlation analysis was performed to understand correlation among components and results are in Table 6.

While not all correlations were statistically significant, some interesting associations also emerged, suggesting the possible existence of indirect effect (mediations) of innovation drivers on innovation capabilities.

Table 5 Cronbach's alpha, Factor Loading, Eigenvalues, Variance explained, AVE, loadings, and composite reliability (Drivers of Innovation).

No	Items	Factor Load	Eigenvalue	Cum. % Variance Explained	Cronbach α	AVE	Composite Reliability
1	Family and business Culture		6.996	19%	0.902	0.608	0.902
	Family involvement drives innovation.	0.736					
	An extensive know-how of internal processes, product, and organization foster innovation.	0.576					
	Passion for newness is a fundamental driver of innovation	0.831					
	Innovation spirit foster innovation and progress	0.793					
	Top management involvement foster innovation	0.809					
2	Access to external Funds		3.286	32%	0.883	0.566	0.900
	It is easy relatively easy to access to angel investors to fund innovation initiatives	0.949					
	It is relatively easy to access to crowd funding to fund innovation initiatives	0.951					
3	Government Supported Initiatives		2.165	43%	0.74	0.501	0.830
	The national government provides with a series of financial assistance schemes such as grants, loan & insurances, tax incentives, investments which are very helpful to nurture innovation in family firms.	0.580					
	It is easy to identify the most appropriate government financial assistance scheme(s) that fits with my needs, and I believe it is easy to apply for such schemes.	0.900					
	Advanced technology is a key element to withstand competition	0.650					
	People are the main source of innovation	0.670					
	Innovation initiatives shall be oriented towards generation of Intellectual properties	0.700					
4	Market Dynamics		1.761	52%	0.685	0.647	0.785
	Innovation is necessary to withstand competition	0.843					
5	Partnerships		1.574	60%	0.709	0.713	0.832
	Partnerships with educational institutes (universities, high schools) foster innovation	0.781					
6	Network		1.31	68%	0.618	0.585	0.733
	Do you use friends' capitals to fund innovation?	0.881					
7	Family capital		1.108	76%	-	0.775	0.775
	Family capital are the main source of funds for innovation initiatives	0.88					
8	External Network		1.053	84%	0.688	0.5	0.662
	Singapore's legal and regulatory framework nurtures innovation and promotes the development of a conducive business environment whereby innovation spirit can truly thrive	0.801					
	A solid network fosters innovation	0.600					

Table 6 Correlation Analysis.

	μ	SD	Family and business Culture	Access to external Funds	Government Supported Initiatives	Market Dynamics	Partnership	Network	Family capital	External Network
Family and business Culture	5.2	1.7	1	-0.026	.329**	0.157 ¹	-0.092	.215*	-0.132	.328**
Access to external Funds	2.1	1.8		1	0.145 ¹	-0.026	0.096	.275*	0.000	.267*
Government Supported Initiatives	4.4	1.7			1	-0.021	-0.009	.240*	0.056	.351**
Market Dynamics	4.5	1.8				1	0.135 ¹	-0.059	-0.189 ¹	.334**
Partnership	2.2	1.9					1	.216*	-0.054	-0.031
Network	2.5	2.0						1	0.289 ¹	.231*
Family capital	4.8	1.8							1	-.308*
External Network	4.4	1.6								1

** Correlation is significant at the 0.01 level

* Correlation is significant at the 0.05 level

¹ Correlation is significant at the 0.1 level

Discussion

This study analysed catalysts of open innovation in Singapore based family-owned enterprises in consideration of both environmental and inner-working determinants. The first finding of this research is a confirmation of the general strong passion of family-owned enterprises to undertake innovation initiatives. Srinivasa Raghavan Nadathur, founder of Nadathur Estates, in a recent conversation about his firms' approach on innovation mentioned that "The passion for innovation, to experiment, to create something that nobody has attempted before is intrinsic in Nadathur DNA" (Business Families Institute, 2018). The same passion has been detected throughout focus groups discussions and comments in the survey.

Regarding the empirical findings, drawing on a sample of 33 relevant family firms' responses, various insights can be offered to both scholars and practitioners.

First, while previous literature highlight six major factors among determinants of open innovation, our current research detected eight determinants. Particularly, two additional innovation determinants namely family capital and external network were detected via PCA. The remaining six catalysts of innovation projects (family and business culture, access to external funds, government supported initiatives, market dynamics, partnership, network, family capital, and external network) were found to play an important role in the Singapore family business ecosystem, confirming existing literature in this regard.

Second, the vast majority of our sampled firms mentioned process innovation as the most critical type, followed by organizational innovation. Process innovation is considered superior by our sampled firms due to its capabilities to drive product innovation, marketing and organisation structure (and people). Similarly, organizational innovation is ranked of utmost importance due to the increasing need to adopt technologies such as digitalization, robotics and automation, which demand that a proper organizational structure be in place. One of the respondents, a 3rd generation family business leader of a Singapore SME in his responses to this survey questionnaire highlighted that "The right processes create the necessary conditions to shape products, as well as marketing and organisation structures". On the same lines, a 2nd generation family business leader of another Singapore based family-owned firm reasoned out that "It is important that we have an efficient process in our business to minimize costs and increase customer satisfaction, especially in the current business context of stiff competition and uncertainty.

Having in place cutting-edge processes is a key differentiator".

Third, access to external funds is quite important to family businesses of Singapore, and findings of this study highlight that for Singapore family enterprises, external funds can be of diverse nature such as from angel investors, or crowd funding, but banks loans and they appeared to be still the preferred funding mechanism for innovation initiatives. Policy makers should take these factors into consideration when strengthening policy intervention for innovation. For instance the government could focus on catalysing innovation-thinking and culture through a process of continuous policy support and strategy development e.g. via facilitation of funds acquisition, training, incubator and acceleration activities.

Managerial Implications

This study provides strategic insights for family business firms to navigate the complex landscape of innovation initiatives, and also key takeaways for policy makers to strengthen their policy intervention for innovation. Particularly, insights of this study show that while environmental determinants have an important role in the development of innovation capabilities internal factors play a fundamental role too. Therefore, while injection of external capital and policies are still necessary, it appears that those elements alone are but not sufficient. Therefore, while the external ecosystem plays a crucial role for the development of innovation capabilities, it must be coupled with inner-workings determinants of the family firms too. Therefore, for family business to successfully innovate, both dimensions must be concurrently taken into account and nurtured.

Limitations

This work has a number of limitations. The first is the limited generalizability of the results to other Southeast Asian countries. Despite the fact that Singapore is one of the most cosmopolitan cities in the world characterized by family-owned enterprises with a wide exposure to other neighbouring countries' culture, Singapore's business ecosystem is unique and thus the findings from this study cannot be generalized to the context of other Southeast Asian countries. The second limitation is the small sample size. A wider pool of respondents would reinforce current findings and provide deeper insights on the status of innovation practices in the city-state.

Future work

Findings of this study opened several avenues for future research. First, one can apply structural equation modelling (SEM) to uncover mediations among variables, weights, loadings, paths, as well as provide an estimation of latent variables scores. As mentioned earlier in this paper, outcomes of PCA and correlation analysis suggest the possible existence of indirect effect (mediations) of innovation drivers on innovation capabilities. Thus a future study might want to fill this gap through a larger sample of data. Second, for future studies one can expand the geographic scope from one single nation to the entire ASEAN region. This would allow cross-comparison of country's business ecosystem, and status of innovation practices across the Southeast Asian region. This is particularly relevant in light of developments in the ASEAN Economic Community (AEC) arising from cross-border trade and thus open innovation practices. Third, future research could comparatively assess the perception of innovation practices between current and next generations. This would allow for the design of appropriate strategies to foster innovation initiatives across multi generations to build lasting innovation capabilities within family firms.

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