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Article

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A study on entrepreneurial innovation among entities in Singapore

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Abstract

The present study aimed to study the entrepreneurial innovation among entities in Singapore. It evaluated the various obstacles that affect entrepreneurial innovation within entities. Further, it has also analysed the various elements that are crucial to overcome the obstacles that affect entrepreneurial innovation within entities. Various factors related to various sources of information fostering innovation activities in an organization were also studied. Difference between the product innovation and process innovation was studied. Furthermore, organizational innovation and marketing innovation were also studied. Lastly, organizational innovation's degree of observed effect in the organization was also studied. Cross-sectional analysis using realism as epistemological view was undertaken in this study. Deductive research approach along with web-based survey using descriptive research design is the research methods followed in this study. Tools for results' analysis include descriptive analysis, Q-Q plots, KMO and Bartlett's test, factor analysis and Chi-square tests. The study concluded that enterprises need to work aggressively in the new product development, market opportunities, organization capabilities to ensure that the organizations grow. It is highlighted that process innovation and product innovation have effects on the economic performance of the organization. It does flag that the market innovations are linked with the ways the enterprises change, evolve and develop their fundamental capabilities, which are part of the organizational innovations. Also, the study showed that organizational innovation has greatly helped to improve the quality of the goods or services and reduced costs per unit output. The reduced time to respond to customer or supplier needs and improved employee satisfaction and/or reduced rates of employee turnover is also seen as a significant observed effect of entrepreneurial innovation. Managerial and theoretical implications along with Ideas for future research is also provided.

Keywords: Innovation, Entrepreneurial innovation, Product innovation, Process innovation, Organizational innovation, Marketing innovation

Introduction

Beyond the skills needed such as marketing, management, risk rating capabilities, creativity, evaluation, judgement, management, etc., innovation is seen as one of the key dimensions among the entrepreneurial self-efficacy (Yeh et al., 2021). It was observed

that the large entrepreneurs do make significant contributions not only to employment and economic growth, but also to the innovation (Ke et al., 2023). Research does show that innovation would be an important source of competitive advantage for firms (Liu et al., 2023). A study that has examined nearly 200 corporate-level strategies highlight that the innovation is vital for the success of the entrepreneur and the organization (Choi & Valikangas, 2001). Innovation is also seen as crucial in the study conducted in 2020 in purposively selected enterprises that studied the key dimensions of entrepreneurial management and the dominant behaviours related to the concept of entrepreneurship among the owners of the surveyed companies (Igielski, 2022). Entrepreneurial innovation is seen as one of the competitive advantages that the organizations need to look at (Shiferaw et al., 2023) Though there exist the challenges, it is important for the managers and policymakers to look out for strategies to overcome the challenges and assist in the mediating effector of the various factors (Nguyen et al., 2021). Singapore and its business community needs to foster the culture entrepreneurial innovation to succeed in the growing competition globally and also regionally. Enterprises need to study about the various factors that hamper innovation activities or projects or influencing a decision not to new innovation in the organization. Further, differences among the product innovation, process innovation, market innovation, organizational innovation, etc., need to be studied.

Innovations, irrespective of the type of innovations, are crucial for the success of the start-ups. For instance, bigger organizations acquire start-ups because (Ratten, 2022) establishing innovative business practices and success is difficult. Furthermore, the urge to think different is usually better with the entrepreneurs who work on start-ups and with certain organizations, which has developed the culture of innovation within the organization itself (Ilyas et al., 2023; Klenner et al., 2022). Entrepreneurs' roadmap for success is often linked with their organizations' ability to do well in areas such as technology and innovation capability. (Cueto et al., 2022; Szakálné Kanó et al., 2022). These innovative desires provide organizations with business opportunities that reshape the scale and areas in which the organizations operate. The innovation abilities of the organization do play a crucial role in the success of the entity. Understanding the importance of entrepreneurial innovation among entities, governments worldwide take a range of policy initiatives by offering support and incentives to the organizations beyond formal and informal training to foster the innovative culture in the organization (Komlósi et al., 2022). They try to establish entrepreneurial ecosystems to enhance their capabilities, as it is crucial for organizations to understand the various obstacles they face and ways to overcome them. (Okoi et al., 2022) Even during the COVID-19 pandemic the transformation of business was foster by the entrepreneurial innovation (Sahi et al., 2023a; Santos et al., 2023). There are even successful examples of collaboration between public and private sector institutions in Singapore that normally share different goals and perspectives. Such entrepreneurial innovations would go beyond product innovation and lead to every other opportunity like process, market, and organizational innovation (Lee & Vavitsas, 2021). Countries see that innovation is crucial for the country's economic growth and tend to have a stronger emphasis on the policy. It is seen that the policy implications for promoting innovation policy as a critical driver for the economy in Asia-Pacific (Qureshi et al., 2021).

Entities' strengths in innovations are often valued based on their innovations' abilities to create economic and social value (Minhas & Sindakis, 2022). It is key that the managers have open innovation strategies and activities by viewing the innovation process and opportunities from a variety of innovative perspectives beyond product innovation. Research and development may also include innovation opportunities in the market, process, etc., as the commercialization of the innovative practices is crucial for the entrepreneurs' success (Wang et al., 2021a, 2021b). Entrepreneurial leadership does play the major role in the startup's innovativeness based on the quantitative study and on the analysis of a large-sample data set gathered by a German startup innovation survey (Lago et al., 2023). Organizational innovation's degree of observed effect in the organization is also crucial. There is a positive relationship between the entrepreneur and the provision of resources for innovation within the organization. The organization's ability to work with society and various stakeholders does contribute to its innovative capabilities. For instance, organizations do work with universities or institutes of science and technology apart from the suppliers, distributors, competitors, etc. (Hansen et al., 2022; Yesuf et al., 2023). The establishment of such partnerships may also help foster entrepreneurial innovation within the organization, which is not limited to product innovation (de Faria et al., 2019). As such the innovation does contribute to the organizational performance, the presents study's value-added findings, results and conclusion do build the existing literature. Therefore, the present study attempted to study the entrepreneurial innovation among entities in Singapore in the context of product innovation, process innovation, market innovation and organizational innovation, which is the novelty of the study.

Problem statement

Organizations do face the issues of entrepreneurial innovation as the obstacles vary across cost issues, market issues, skills issues, absence of process and systems, etc. Such problems need to be addressed and counter with strategies that are relevant to Singapore. With challenges prevailing on the innovation issues related to the entrepreneurial process, studies are needed to address and leverage in the respective market and industry (Arend, 2020). Sources of information on making decisions related to entrepreneurial innovation would range from internal sources within the organization to market courses or institutional sources. Other sources like trade, academic community and industry associations and publications would also assist. Various factors hindering entrepreneurial innovation would be cost factors, knowledge factors and market factors which would also account for the present study's research problem. There have been perceptions that revolutionary product innovation does generates superior sales returns compared to the process innovation (Blichfeldt & Faullant, 2021). Similarly, there are arguments that favour market innovation over organizational innovation. These comparisons and issues are also required to be addressed.

Research questions

With the prevailing research problems in the entrepreneurial innovations among the Singapore entities, the research questions that are developed for this study are as follows:

- o What are the various obstacles that affect entrepreneurial innovation within entities?
- o To what extent are the various elements that are crucial to overcome the obstacles that affect the entrepreneurial innovation within entities?
- o What are various sources of information for innovation activities in an organization?
- o What are the various factors that hamper innovation activities or projects or influencing a decision not to innovate in the organization?
- o Is there a significant difference between product innovation and process innovation that the organization focuses?
- o Is there a significant difference between organizational innovation vs marketing innovation that the organization focuses? What was the organizational innovation's degree of observed effect in the organization?

Objectives of the study

Present research aims to study the entrepreneurial innovation among entities in Singapore. The various objectives of the study are as follows:

- To evaluate the various obstacles that affect the entrepreneurial innovation within entities.
- To analyse the various elements that are crucial to overcome the obstacles that affect the entrepreneurial innovation within entities.
- To examine various sources of information for innovation activities in an organization.
- To investigate the various factors that hamper the innovation activities or projects or influencing a decision not to innovate in the organization.
- To compare the difference between product innovation and process innovation that the organization focuses
- To compare the difference between organizational innovation vs marketing innovation that the organization focuses and to also examine the organizational innovation's degree of observed effect in the organization

Significance of the study

Entrepreneurs are seen as proactive agents and innovation is one of the key requirements to succeed. Irrespective of whether they are start-ups or existing organizations, they need to foster the innovation culture within the organization. They would ideally need to look to overcome the prevailing obstacles and explore entrepreneurial opportunities not only for themselves, but also for industry and community benefits. For instance, the entrepreneurial actors need to strive and engage in improvised venturing to create innovation not limited to product, process, market or organization but also social innovation especially in the era of physical distancing due to COVID-19 situation (Scheidgen et al., 2021). It is highlighted that process innovation and product innovation has effects on the economic performance of the organization (Wang et al., 2021a, 2021b). Similarly, market innovation assists in expansion of existing markets or creation of the new markets (Branstad & Solem, 2020). Enterprises need to work aggressively in

the new product development, market opportunities, organization capabilities to ensure that the organizations grow. In fact, during the COVID-19 pandemic situation, entrepreneurs and businesses have to revive the innovation spirit and strategies. Changes in the macro-environmental and micro-environmental factors does contribute to various types of innovation during the crisis periods (Sahi et al., 2023). In the above context, the present on the entrepreneurial innovation among entities in Singapore is crucial.

Literature review

The present section provides the review of the various studies and literature related to the research questions of the present study. The literature reviews' discussion has led to the decisions on the variables that need to be studied in each of the research objectives. Research gap is also provided along with conceptual framework and the hypotheses.

Obstacles to entrepreneurial innovation

A longitudinal study conducted to analyse the obstacles related to innovation among 4319 innovative start-ups highlights those entrepreneurial innovations are affected due to the soaring costs of activities related to innovations. Further, there also exist shortage of commercial and organizational capabilities and competencies to innovate. Further, there are also complications in collaborating with various other stakeholders of the industry. It is seen that market research needs to be done to understand the varying obstacles across different markets (Noelia & Rosalia, 2020). Obstacles for growth in entrepreneurial innovation may be serious in the early stages of the organizations, as the skill set needed to succeed is in the developing or lacking stage. There are issues where start-ups would face difficulty in winning the market due to branding, reputation, pricing issues, etc. Potential risk, trust and learning are the key issues for the innovators at the early stages. Systems and processes are also not at the advanced level. These obstacles would need to be looked at for fostering the growth of entrepreneurial innovation (Van Fossen et al., 2018) and is evident in the conclusions made on the study of the Entrepreneurial challenges of COVID-19 (Lahm, 2022; Sharma et al., 2022).

It is also to be noted that the organizational size would play a role in entrepreneurial innovation, as innovation decisions vary across small organizations compared to small-medium enterprises or large organizations. Widely, it can be noted that cost issues, market access and institutional obstacles are significant discouraging barriers, while market access and also the skillset or the staff with adequate knowledge and experiences are the obstacles that would affect the organization's intensity to invest in innovation (Arza & López, 2021). As such, the obstacles need to be studied from the perspective of Singapore entrepreneurial innovation with following variables/statements:

OS1: Excessive focus on immediate, short-term performance.

OS2: Inadequate allocation of resources or staff.

OS3: A tendency of senior managers to expect fast payoffs from projects.

OS4: The absence of systems and structures to effectively manage the innovation process.

OS5: A strong belief within the organization that innovation is an inherently risky activity.

Elements to overcome obstacles to entrepreneurial innovation

To overcome the barriers related to entrepreneurial innovation, the leaders does play a crucial role. Their alertness on the changes to the environment and the resources' needs along allocation is vital. These alertness would have a strong social and economic impact within the enterprises and would in turn assist in creating innovation fostering environment and engagement with internal and external stakeholders (Fellnhofer, 2021), (De Silva et al., 2021) also highlight that the capabilities of the leaders or the founders does help the organizations to overcome the challenges and convert them as opportunities. A study among the small-medium enterprises leaders argues that the leaders' characteristics have a significant influence in the adoption of challenges. Further, the mechanisms (processed), partners (stakeholders), motives and action plans or sequence of adoption to overcome the challenges plays a major role (Barrett et al., 2021). To an extent, the motivational drivers help the entrepreneurs and the entities to overcome these challenges (Plata et al., 2021). Resources such as the digital technologies also help to revive the entrepreneurial resilience as highlighted by (Carayannis & Morawska-Jancelewicz, 2022; Sharma et al., 2022).

Based on the above reviews, the following hypothesis is studied in the present research:

H1: No association found between the obstacles to entrepreneurial innovation.

With the obstacles identified in the earlier section and reviews presented in the current section, the following variables/statements were used to study the various elements to overcome obstacles:

EOC1: I believe that the leaders are important, and they would help to overcome the issues and obstacles that the innovation opportunities are hindered, e.g. resource allocation, showing commitment, leading by example, etc.

EOC2: I think that staff who are empowered by means of systems and processes taking over the organization helps to overcome the obstacles.

EOC3: Skills, knowledge management and talent management are key for entrepreneurial innovation.

Sources of information for fostering entrepreneurial innovation

Innovation does arise on the entrepreneurial activities, but it is crucial to study the influence and effects of the micro-level actors. They play a key role in the functioning of the innovation system, as they shape the understandings, behaviours, beliefs and perceptions of the entrepreneur (Wilde & Hermans, 2021). In the similar context, a study by Fellnhofer (2021) on the stakeholder engagement based on the research conducted across participants from four countries highlight that the sources of information on entrepreneurial innovation is helped by the existence of ecosystems. Also, the various stakeholders influence prevails and assist on creating the alertness across the entrepreneurs' innovation efforts. This would lead to value-chain strategies that are industry specific (Al-Hakimi et al., 2021; Cieřlik, 2022). A study on the innovations related to the Singapore and London entrepreneurial ecosystems does argue that various actors in the entrepreneurial ecosystems need to be considered (Harris, 2021).

Another research also highlights that the cooperation for innovation activities helps but the industry peers along with the users as one of the key sources of innovation is crucial (Globocnik & Faillant, 2021). It is also argued that cooperation at regional and

international is considered as a good support for growth or entrepreneurial innovation, as the study found a positive correlation on such investigation (Rossi et al., 2022). Another study also found the regulatory frameworks, institutional supports and other networks would assist in the entrepreneurial initiatives (Lafuente González et al., 2022). Competitors are also the source of information as highlighted in the investigation on whether to cooperate with the competitor by (Li et al., 2021). Interfirm R&D cooperation was also suggested by Wyrwich et al., (2022). The various sources of information do assist the Entrepreneurs to work on both industrial and consumer firms introduce new products (Sahi et al., 2023b).

The role of university and the public research institutions are also seen as important in the study conducted to understand the role of industry on entrepreneurial innovation in Singapore (Cheah et al., 2020). B2B relations and the role as an information source is seen as crucial for entrepreneurial innovation by Zheng et al., (2021). Similarly, grass-roots innovation also assists the entrepreneurs (Singh et al., 2021). With the prevailing context, sources of information and cooperation for innovation activities needs to be studied in the Singapore context and would assist the stakeholders. Variables/ statements that will be studied are provided below.

Internal:

IS1: Employees, managers, internal R&D departments.

External:

Market sources.

IS2a: Suppliers.

IS2b: Customers.

IS2c: Competitors.

IS2d: Consultants, R&D institutes.

Institutional sources.

IS3a: Universities/educational institutional.

IS3b: Government or research institutions.

Other sources.

IS4a: Seminars and conferences.

IS4c: Research journals and publications.

IS4c: Business and industry associations.

Factors hindering innovation activities

An examination of the macro-level determinants and their impact on the opportunities for the entrepreneurs' innovation abilities are crucial. The study conducted with the datasets from 2007 to 2018 of 149 countries argued that the macro factors like prevailing economic governance in the country, education level, health, social capital, etc., does play a major role (Jabeur et al., 2022; Oliver-Márquez et al., 2022). Another meta-analysis study of 76 samples from more than 30 countries flagged the business environmental factors irrespective of whether they are developing or developed country has effects of the firms' capabilities in the context of innovation (Gupta & Chauhan, 2021). A study on the innovation outputs based on the 203 public enterprises also highlights that Research and development collaborations as one of the crucial factors that assist in the performance related to the entrepreneurial innovations. This would assist the enterprises to

bridge the problems related to lack of qualified personnel, information on technology, information on markets, etc. (Strazzullo et al., 2022; Zhu et al., 2021).

Further, it is also crucial to have adequate information about customers, competitors, suppliers and other market factors, as they are crucial in the decisions related to the entrepreneurial innovation (Alshanty & Emeagwali, 2019). This is even applicable to the state capital investing and operating companies to promote better corporate decision-making, including the improving of innovation input (Wu et al., 2023). The study by (Wonglimpiyarat, 2013) highlighted the issues in the innovation funding policies even in the much-advanced industrializing countries like Singapore and Taiwan. The study highlights that there needs to innovate financing policies with possible intervention by government authorities to foster entrepreneurial innovation. For instance, a study by Diehl et al., (2020) also underlined that AgriFood Innovation Park was implemented by the Economic Development Board, Singapore Food Agency (SFA), and Enterprise Singapore, budget by Ministry of Trade & Industry. Such initiatives and factors do play a role in the community's entrepreneurial innovation.

Based on the above reviews, the following hypothesis is studied in the present research:

H2: No association found the factors affecting the entrepreneurial innovation.

The details of the variables/statements used to study factors hindering innovation activities are as follows:

FC1: Cost factors.

FC2: Knowledge/skill availability factors.

FC3: Market factors.

Product innovation vs process innovation

Both product innovation and process innovation do have a significant effect on the enterprises' performance. A study conducted among the 159 blockchain-based ventures argued that the product innovation is crucial and is one of the leading enablers in the entrepreneurial innovation which could lead to disruptive innovation and adoptive innovation (Zheng et al., 2021). Product innovation is crucial with the nature of the process involved in the product development. It would be minor changes to the existing product or major revisions to the existing product. It is crucial for entrepreneurs to manage their product innovation. The findings of the multi-case research with the sample of 15 founders argued that the entrepreneurs need to revise or change the content of the product and they should need to manage digital product innovation (Bunduchi et al., 2022). A study by Alshanty and Emeagwali (2019) highlights that the process innovation helps organizations to improve the productivity, reduce costs, etc., which in turn would also assist in enterprises' ability to develop its product innovation capabilities.

Another study also highlights that process innovation does have a direct impact on the enterprises' economic performance, whereas the product innovation has indirect impact on the economic performance. These were the results of the data collected from 642 enterprises from China (Wang et al., 2021a, 2021b). Similarly, another study by Han and Zhang (2021) does show that managers and policymakers need to focus on the product innovation and as such the study found that there is a positive influence of entrepreneurial alignment on product innovation. However, it is also crucial to get all elements right for the product innovation to be successful. Such innovations are linked to process

innovations, which shows that the innovations in the processes like supply chain processes also play a role in the product innovation (Lv & Qi, 2019). It is crucial to invest in both the product and process innovations, as they are complementary, though entrepreneurs are heavily affected by the benefits of product innovation (Y. Wang et al., 2019).

Based on the above reviews, the following hypothesis is studied in the present research:

H3: No association found between product innovation and process innovation.

The variables/statements that are used to compare the difference between product innovation and process innovation that the organization focuses are provided below.

Product innovation.

PT1: Almost new or significantly improved goods.

PT2: Slightly new or significantly improved (e.g. resale of new goods purchased from other enterprises, changes of aesthetic nature).

PT3: New or significantly improved services.

Process innovation.

PC1: Almost new or significantly improved methods producing goods or services.

PC2: Slightly new or significantly improved logistics, delivery or distribution methods for the goods or services produced by the enterprise.

PC3: New or significantly improved supporting activities for the processes, such as maintenance systems or operations for purchasing, accounting, or computing.

Organizational innovation/degree of observed effect.

DOS1: Reduced time to respond to customer or supplier needs.

DOS2: Improved quality of the goods or services.

DOS3: Reduced costs per unit output.

DOS4: Improved employee satisfaction and/or reduced rates of employee turnover.

Organizational innovation vs marketing innovation

A support score and meta-analysis study among 52 independent samples among the 44 different articles showed that the management innovation or the organization innovation has positive impact on the organization's performance (Walker et al., 2015). In the context of organizational innovation, a business model innovation was proposed as the mediating variable which saw that such innovations have positive effects of new product development performance. These are results from the study conducted among 400 Spanish small and medium enterprises (Ferrerias-Méndez et al., 2021). A study on the innovations across the public sector industry highlights that changes within the organization or management structure contributing to experimentation, effectively communicating between different departments and in particular with low-performing employees and departments, feedback channels, raise the staff motivation and morale will assist in the organizational innovation (Demircioglu & Audretsch, 2017). For instance, specific organizational capabilities are vital for entrepreneurial innovation that would capture the opportunities (De Silva et al., 2021).

Market innovation does need to be looked at the various market actors and practices along with the social factors linked with the market exchanges. It is crucial as the market boundaries are becoming invisible in present day digital economy supported with better supply chain networks than ever before. Market innovation may be seen as three different types of namely creation, change and combination. These are crucial for enterprises

to innovate the markets successfully (Geiger & Kjellberg, 2021). Branstad and Solem (2020) highlighted that market innovation is more about the enterprises' expansion of existing or creation of the new markets. This would happen in the context of changes in the marketing strategies or even partners with external stakeholders. Newness has often been whether it is "creating a market", "create new markets" and "coconstructing a novel market" (Sprong et al., 2021). This is also crucial for established entrepreneurs or increasing the longevity of the entrepreneurs (Ke et al., 2023b). Also, the market innovations are linked with the ways the institutions change, evolve and develop their fundamental capabilities, which are part of the organizational innovations. These are critical for market innovation outcomes (Ekman et al., 2021). The details of the variables/statements used to compare the difference between organizational innovation vs marketing innovation that the organization focuses are provided below.

Organizational innovation

OI1: New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within the enterprise.

OI2: A major change to the organization of work within the enterprise, such as changes in the management structure or integrating different departments or activities.

OI3: New or significant changes in the relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting.

Marketing innovation

MI1: New or significantly improved marketing information systems to better use marketing skills within the enterprise.

MI2: Significant changes to the design or packaging of a good or service (exclude routine/seasonal changes such as clothing fashions).

MI3: New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses.

Based on the above reviews, the following hypothesis is studied in the present research:

H4: No association found between the organizational innovation and market innovation.

Research gap and theoretical framework

The literature reviews show that it is crucial for organizations to study the entrepreneurial innovation among entities in Singapore. There are various obstacles that obstructs the entrepreneurial innovation and needs to be overcome, for which the various information sources needs to be tapped at along with the cooperation for innovation activities in an organization. Reviews also showed the need for and importance of product innovation, process innovation, market innovation and organizational innovation. There are limited studies in the Singapore context and as such it can be seen as there exists the research gap that needs to be addressed. Based on the reviews and research gaps, along with the variables that need to be studied, the theoretical framework is provided in Fig. 1.

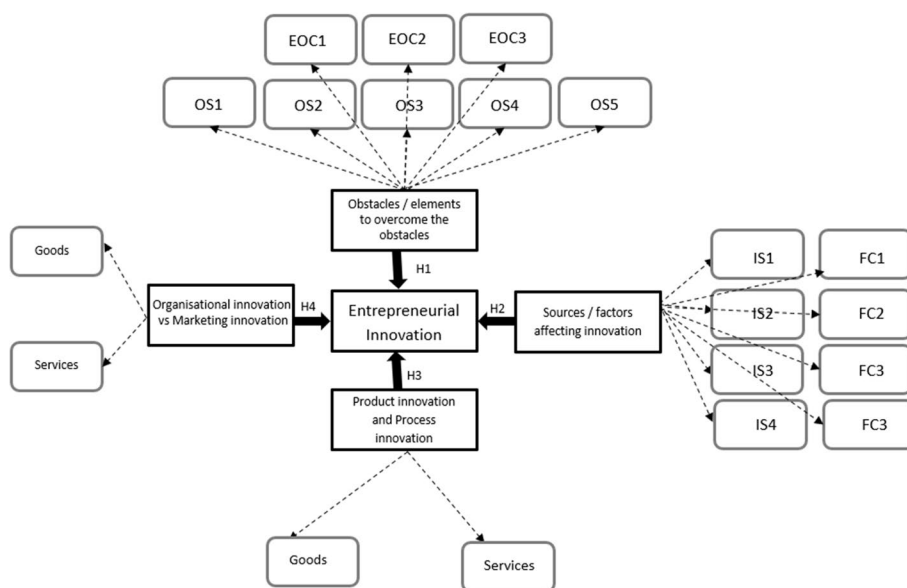


Fig. 1 Theoretical framework of the study

Research methodology

Based on the research gap presented in the literature review in the context of the research problem and research questions, the research methodology and methods are arrived at in this study. Current research is quantitative research, as its research objectives require collecting the quantified data rather than the data, which are quality based. The epistemology position of the study is critical realism, as it helps recognize the natural order of the events and discourses (Bryman, 2016). In the present study, such philosophy helps in studying the events or variables that foster entrepreneurial innovation among entities in Singapore. Further, the present study has used the deductive theory as it has reviewed the previously existing studies on entrepreneurial innovation and arrived at a research gap leading to the conceptual framework presented in Fig. 1. Based on the theoretical considerations of the framework, the research process has deduced the hypotheses (Bryman, 2016), (Alasuutari et al., 2008). Due to time and cost constraints, the present study has adopted a cross-sectional design. In a cross-sectional design, data are collected at a single point in time and is collected simultaneously. The study has used a mono-method as the research choice, as the quantifiable data related to the entrepreneurial innovation among Singapore entities were collected using a survey method. The present study has employed a web-based online survey as the research strategy method. The contact method used was online, due the COVID issues and to ensure that the researcher and participants safety.

Descriptive research is used in the present study as collects the opinions/responses from the managers about the entrepreneurial innovation among the Singapore entities. As such, descriptive research produces the accurate presentation of the persons, events or situations (Saunders et al., 2007) and the present study presents the views of the managers about entrepreneurial innovation. A web-based Questionnaire has been

chosen as the research instrument. Questionnaires have been predominated with demographic questions followed by rating questions with five points scale for the variables. The variables in the questionnaire are related to various obstacles that affect the entrepreneurial innovation within entities, measures to overcome the challenges, sources of information and cooperation for innovation activities in an organization, factors affecting innovation activities, etc. Variables for comparing the product innovation vs process innovation and organizational innovation vs marketing innovation have also used the rating scales with five-point scale measurement.

Research method and sampling design

The present study required primary data related to the managers' views on entrepreneurial innovation. Primary data are data collected for that purpose, and in this study, data are collected to address the research problem and research questions related to the current research (Saunders et al., 2007). The population of the study are managers in Singapore. Non-managerial (line jobs and staff jobs) do not qualify for this study. The sampling design used in the study is non-probability-based convenience sampling. Convenience sampling has been selected due to accessibility issues coupled with time and cost constraints in reaching out to the managers in Singapore. Though there are criticisms that convenience sampling has problems with the generalization of the findings, the study has attempted to look at a better sample size to ensure representativeness. Any survey conducted in similar contexts can use probability sampling to improve the current research and also the questionnaire was reviewed and approved by Amity Global Institute's Research Ethics Committee on 11 November 2021.

Usually, the sample size and the sampling technique are adopted based on the availability of resources. The sample size of 200 has been chosen considering the time and cost issues that the study is affected. Large sample size is often associated with the sample representativeness of the population and also helps in better statistical analysis. Further, the sampling error would decrease when the sample size increases (Alasuutari et al., 2008), (Bryman, 2016). A minimum sample of 100 is a must for the quantitative survey, as Daniel and Kent (2005) highlighted, and this study has fulfilled the requirement with 200 participants in the survey. It is highly desirable to conduct a pilot study, especially with the sampling technique being used as convenience sampling. A pilot study was conducted with 20 participants. The pilot study has helped with the working nature of the questionnaire. With the survey being a self-administered online questionnaire, any issues related to the questions should be considered. However, as there were no issues found in the pilot study, the final survey used the same questionnaire with no changes made to the questionnaire.

Validity and reliability tests

Content validity was conducted with discussions and input from two industry experts who work in the research and development departments. Construct validity was done by getting inputs from the Statistics experts. This ensures that the survey questionnaire has proper measurement techniques suitable for planned data analysis tools usage. Cronbach's Alfa tests were conducted to check the reliability of the data collected. Reliability statistics are presented in Table 1, which shows that all the items related to the variables

Table 1 Reliability statistics

Variables/statements	Number of items	Cronbach's alpha score
Obstacles to entrepreneurial innovation	5	0.838
Elements to overcome obstacles	3	0.740
Sources of information and cooperation for innovation activities	11	0.816
Factors hindering innovation activities	3	0.733
Difference between product innovation and process innovation that the organization focuses	6	0.817
Difference between organizational innovation vs marketing innovation that the organization focuses	6	0.896
Organizational innovation/ degree of observed effect	4	0.725

have a score of 0.70. Nunnally (1978) highlighted that the reliability score of 0.70 is considered reliable for social research. As such, it can be considered that the research instrument, i.e. questionnaire, has met the requirements of the validity and reliability tests.

Results and findings

Data were collected from the participants of the study, who are the managers of the enterprises in Singapore. The total respondents of the survey are 200 managers working in Singapore.

Demographic statistics of the participants

When studying the entrepreneurial innovation among entities in Singapore, it is essential to ensure that the data are representative, as respondents may represent a variety of enterprises like different types of ownership of the organization, different size of the organization in the context of number of staff and revenue turnover. Further, the managers themselves would fall in different managerial levels. Table 2 shows the demographic statistics related to the respondents.

When looking at the number representation of the different levels of the managers with the varied responsibility, it can be seen that 38% are the first line managers. They are generally the functional heads such as production/it/sales/accounting supervisors. These managers are the operational heads, and good representation in the study of entrepreneurial innovation is always vital. Middle management like general manager, department manager, etc., who are usually involved in the tactical role is represented with 39%. Top managers like CEO, president, vice president, etc., have the least representation with 23%. The survey results have adequate representation from all different types of organizations in ownership with maximum representation from the possible small-medium enterprises where private companies limited by shares represented the maximum numbers (37%). Both limited partnership and limited liability partnership represent 14% each. 15% of the sample are with the partnership as the ownership type. The least representation has been from sole proprietorship and public limited company with 20 entities from each category.

Analysis of the size of the organization that the survey participants represent can be seen from the number of employees and the annual turnover. Based on the yearly turnover, the majority (58%) of the respondents are from entities that have a yearly

Table 2 Demographic classification of the respondents

Level of management responsibility	Number of respondents	Percentage
First line managers (functional heads—production/IT/sales/accounting supervisors)	76	38.0
Middle managers (general manager, department manager, etc.)	78	39.0
Top managers (CEO, president, vice president, etc.)	46	23.0
Total	200	100.0
Type of the organization (on ownership basis)	Number of respondents	Percentage
Sole proprietorship	20	10.0
Partnership	30	15.0
Limited partnership (LP)	28	14.0
Limited liability partnership (LLP)	28	14.0
Private company limited by shares	74	37.0
Public limited company	20	10.0
Total	200	100.0
Size of respondent's organization (annual turnover)	Number of respondents	Percentage
Less than \$1 million	26	13.0
Greater than \$1 million and less than or equal to \$15 million	116	58.0
Greater than \$15 million and less than or equal to \$50 million	48	24.0
Greater than \$50 million	10	5.0
Total	200	100.0
Total number of employees in the respondent's enterprise	Number of respondents	Percentage
Less than 20 employees	12	6.0
21 to 50 employees	108	54.0
51 to 100 employees	66	33.0
101 to 300 employees	6	3.0
More than 300 employees	8	4.0
Total	200	100.0

turnover of greater than \$1Million and less than or equal to \$15 Million. 24% of the entities have a turnover greater than \$15Million and less than or equal to \$50 Million. 26 entities have a least annual turnover of less than \$1 million. Ten participants represent a large company category with greater than \$50million. Based on the statistics of the size of the respondent's organization by annual turnover, it can be confirmed that there has been adequate representation from every size of business organization.

When the participants of the survey numbers are looked at based on the total number of employees of their enterprise, it can be seen that the majority (54%) of the participants are from organizations where the employee size is between 21 and 50 employees. The next big category is 51 to 100 employees size organization with 33% representation. Twelve participants are from small organizations with less than 20 employees. 14 participants are from entities with employee strength greater than 100 employees.

Q–Q (quantile–quantile) plots

Though there has been adequate representation from all the categories, it is essential to see whether the data are with normal distribution. The data are plotted in the Q–Q plots to see the normal distribution pattern in the graph. Figures 3, 4, 5 and 6 show that the normal distribution exists with plotted points along the straight line in the graphs, and it can be concluded that the data are representative. Model description for Q–Q plots is provided in Table 11 in the Appendix.

Obstacles to entrepreneurial innovation

On the analysis of obstacles to entrepreneurial innovation, Table 3 shows that based on the mean score of 4.52, inadequate allocation of resources or staff and the absence of systems and structures to effectively manage the innovation process are the most important obstacles that the organizations face. Both these obstacles are of 0.251 as the variance. The other three obstacles namely are excessive focus on immediate, short-term performance, a tendency of senior managers to expect fast payoffs from projects and strong belief within the organization that innovation is an inherently risky activity are next important obstacles with the mean score of 3.75. Variance of these obstacles is 0.791.

Elements that are crucial to overcome the obstacles

The elements to overcome the obstacles to entrepreneurial innovation are shown in Table 4. Table 4 shows that autonomy and empowerment is vital along with the systems and processes laid down in the organization to foster innovation is the most important element with 100% of the participants responding as that it is either important (48%) or very important (52%). It can be seen that leaders are important, as they are the ones who would lead the organization in the path of entrepreneurial innovation along with the vision, goal, commitment, resources, etc., as they would demonstrate their commitment and also allot necessary resources is 64% importance (important: 42% and very important: 22%). Similar to leadership importance, the participants see that skills, knowledge management and talent management is key for entrepreneurial innovation are important, as there is a need to harness entrepreneurial talent throughout organizations with 42% seeing as important, 21% seeing as very important and 27% are neutral.

Table 3 Obstacles to entrepreneurial innovation

Obstacles	Valid	Mean	Std. deviation	Variance
Excessive focus on immediate, short-term performance	200	3.7500	0.88964	0.791
Inadequate allocation of resources or staff	200	4.5200	0.50085	0.251
A tendency of senior managers to expect fast payoffs from projects	200	3.7500	0.88964	0.791
The absence of systems and structures to effectively manage the innovation process	200	4.5200	0.50085	0.251
A strong belief within the organization that innovation is an inherently risky activity	200	3.7500	0.88964	0.791

Table 4 Elements that are crucial to overcome the obstacles

Elements/ importance level	EOC1		EOC2		EOC3	
	Number of respondents	Percentage	Number of respondents	Percentage	Number of respondents	Percentage
Not important	0	0	0	0	0	0
Less important	18	9.0	0	0	18	9.0
Neutral	54	27.0	0	0	54	27.0
Important	84	42.0	96	48.0	84	42.0
Very important	44	22.0	104	52.0	44	22.0
Total	200	100.0	200	100.0	200	100.0

EOC1: I believe that the leaders are important, and they would help to overcome the issues and obstacles that the innovation opportunities are hindered, e.g. resource allocation, showing commitment, leading by example, etc.

EOC2: I think that staff who are empowered by means of systems and processes taking over the organization helps to overcome the obstacles

EOC3: Skills, knowledge management and talent management are key for entrepreneurial innovation

Hypothesis testing

H1: No association found between the obstacles to entrepreneurial innovation.

Test statistics

	OS1	OS2	OS3	OS4	OS5
Chi-square	45.600 ^a	0.320 ^b	45.600 ^a	0.320 ^b	45.600 ^a
df	3	1	3	1	3
Asymp. Sig	< 0.001	0.572	< 0.001	0.572	< 0.001

^a 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0

^b 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 100.0

The results show that there is no association found between the obstacles to entrepreneurial innovation. As such the H1 is accepted.

Sources of information fostering entrepreneurship innovation activities

The various sources of information related to the entrepreneurship innovation are vital along with the possible opportunities that the entrepreneurs can cooperate with. Table 5 provides the various sources of information that the entrepreneurs would rely upon along with possible areas of cooperation.

The sources of the information that the entrepreneurs would look at can be broadly classified into internal and external. Internal sources are information supplied by employees, managers and internal R&D departments. External sources would be from the market like suppliers, customers, competitors, consultants and R&D institutes. External sources would also be from Institutional Sources like Universities / Educational Institutional and Government or research institutions. Lastly, the other sources would include information from Seminars and Conferences, Research journals and publications and also Business and industry associations. Tables 3, 4 show that information from employees, managers and internal R&D departments and customers are the most vital with 4.52 as the mean score. The next ranked source of information is

Table 5 Sources of information and cooperation for innovation activities

Information source	Mean	Standard deviation	Variance	Rank based on mean
Internal				
Employees, managers and internal R&D departments	4.52	0.50	0.25	1
External				
Market sources				
Suppliers	3.04	0.91	0.82	6
Customers	4.52	0.50	0.25	1
Competitors	4.43	0.55	0.31	2
Consultants and R&D institutes	3.75	0.89	0.79	3
Average score for market sources	3.94	0.71	0.54	
Institutional sources				
Universities/educational institutional	3.03	0.94	0.87	7
Government or research institutions	3.06	0.90	0.80	4
Average score for institutional sources	3.05	0.92	0.84	5
Other sources				
Seminars and conferences	3.75	0.89	0.79	3
Research journals and publications	3.04	0.91	0.82	4
Business and industry associations	3.75	0.89	0.79	3
Average score for other sources	3.51	0.90	0.80	

competitors with the mean score of 4.43. In the external sources, the market sources are most important with the average mean score of 3.94. The next important sources are research journals, publications, business and industry associations which had the average mean score as 3.51. The least used source of information about entrepreneurial innovation are sources from institutional sources with the average mean score of 3.05.

Factors affecting innovation activities

Factor analysis, which is a data/dimension reduction technique has been performed to study the importance of the factors. The factor analysis of these variables is presented in Table 6a–c.

Table 6a: Communalities clearly shows that cost factors and the marker factors are the important factors affecting the entrepreneurship innovation actions with 0.988 as the score. Knowledge/skill availability factors are the least factor (0.048) for the respondents of the study. These results show that the innovators are driven by the market and cost factors. Further communalities show that 2 out of 3 (0.994 each) items have the extraction with greater than 0.30 as the extraction score and this shows that there is reasonably no issue of distortion of results due to sample size. Ideal factor loading score is 70% and the results indicate that 67.5% as extraction sums of squared loadings, making the variables near reasonable.

Table 6 a: Communalities

Factors	Initial	Extraction
FC1	1.000	0.988
FC2	1.000	0.048
FC3	1.000	0.988

Extraction Method: Principal Component Analysis

b: Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.025	67.494	67.494	2.025	67.494	67.494
2	0.975	32.506	100.000			
3	– 1.110E–16	– 3.701E–15	100.000			

Extraction method: principal component analysis

c: Component matrix

Factors	Component 1
FC1	0.994
FC2	0.219
FC3	0.994

Extraction method: principal component analysis

a. 1 components extracted

- FC1: Cost factors
- FC2: Knowledge/skill availability factors
- FC3: market factors

Hypothesis testing

H2: No association found the factors affecting the entrepreneurial innovation.

Test statistics

	FC1	FC2	FC3
Chi-square	45.600 ^a	0.320 ^b	45.600 ^a
df	3	1	3
Asymp. Sig	<0.001	0.572	<0.001

^a 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0

^b 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 100.0

The results show that there is no association found the factors affecting the entrepreneurial innovation. Hence, H2 is accepted.

Product innovation

To analyse the product innovation initiatives, Table 7a–d along with Fig. 2 scree plot provides the factor analysis including the KMO and Bartlett’s Test. Table 7a: KMO and Bartlett’s test shows that the Kaiser–Meyer–Olkin measure of sampling adequacy is 0.723. The sampling adequacy for Kaiser–Meyer–Olkin (KMO) measure should be ideally 0.70 and above to show that there exist adequate items in each of the factors studied.

Table 7 a: KMO and Bartlett's test

Kaiser–Meyer–Olkin measure of sampling adequacy		0.723
Approx. Chi-square		253.733
Bartlett's test of sphericity	df	3
	Sig.	< 0.001

b: Communalities

Variables	Initial	Extraction
PT1	1.000	0.724
PT2	1.000	0.787
PT3	1.000	0.788

Extraction method: principal component analysis

c: Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.299	76.635	76.635	2.299	76.635	76.635
2	0.403	13.424	90.059			
3	0.298	9.941	100.000			

Extraction method: principal component analysis

d: Component matrix

Variables	Component 1
PT1	0.888
PT2	0.887
PT3	0.851

Extraction method: principal component analysis

a. 1 components extracted

PT1: Almost new or significantly improved goods

PT2: Slightly new or significantly improved (e.g. resale of new goods purchased from other enterprises, changes of aesthetic nature)

PT3: New or significantly improved services

With 0.723 as the measure, it can be concluded that there exist adequate items in the variables' related to the product innovation. Further Table 7b: Communalities shows that all the 3 items (0.788, 0.787, 0.724) have the extraction with greater than 0.30 as the extraction score and this shows that there is no issue of distortion of results due to sample size. Ideal factor loading score is 70% and the results indicate that 76.6% as extraction sums of squared loadings, making the variables near reasonable.

Product innovation of almost new or significantly improved goods is the lowest with the score of 0.724. The highest is new or significantly improved services with 0.788 followed by the option of slightly new or significantly improved (e.g. resale of new goods purchased from other enterprises, changes of aesthetic nature) which is 0.787.

Process innovation

To analyse the process innovation initiatives, Table 8a–c provides the factor analysis the variables.

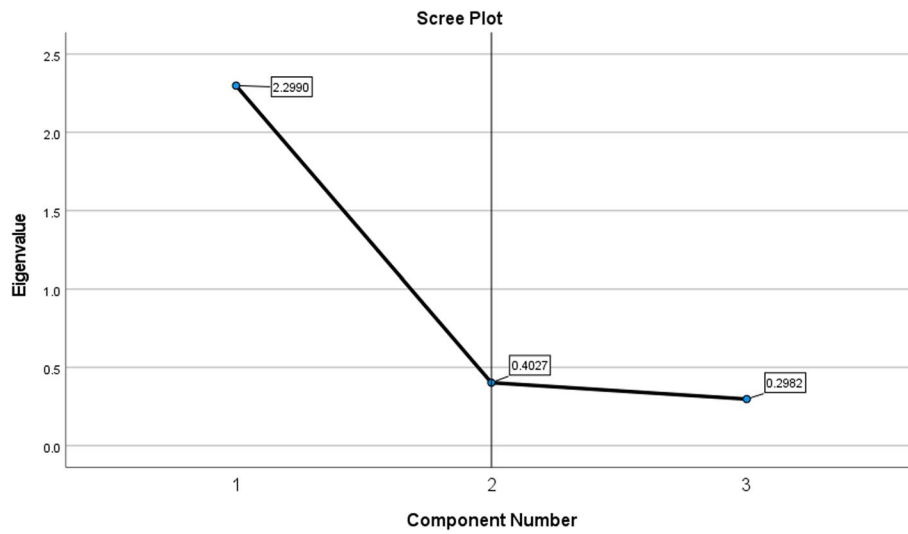


Fig. 2 Scree plot

Table 8 a: Communalities

Communalities		
Variables	Initial	Extraction
PC1	1.000	0.044
PC2	1.000	0.952
PC3	1.000	0.954

Extraction method: principal component analysis

b: Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	1.949	64.969	64.969	1.949	64.969	64.969
2	0.978	32.612	97.581			
3	0.073	2.419	100.000			

Extraction method: principal component analysis

c: Component matrix

Variables	Component 1
PC1	0.209
PC2	0.975
PC3	0.977

Extraction method: principal component analysis

a. 1 components extracted

PC1: Almost new or significantly improved methods producing goods or services

PC2: Slightly new or significantly improved logistics, delivery or distribution methods for the goods or services produced by the enterprise

PC3: New or significantly improved supporting activities for the processes, such as maintenance systems or operations for purchasing, accounting, or computing

Table 8: Communalities clearly shows that “New or significantly improved supporting activities for the processes, such as maintenance systems or operations for purchasing, accounting, or computing” is the most significant variable with 0.954 followed by slightly new or significantly improved logistics, delivery or distribution methods for the goods or services produced by the enterprise with 0.952. Almost new or significantly improved methods producing goods or services is least variable (0.044) for the respondents of the study. These results show that the innovators are looking at the upgradation and updating of the present or existing innovation rather than the totally new innovations in the process innovation categories. Further it also shows that 2 out of 3 (0.952 and 0.954) items have the extraction with greater than 0.30 as the extraction score and this shows that there is reasonably no issue of distortion of results due to sample size. Ideal factor loading score is 70% and the results indicate that 65% as extraction sums of squared loadings, making the variables near reasonable.

Hypothesis testing

H3: No association found between product innovation and process innovation.

Test statistics						
	PT1	PT2	PT3	PC1	PC2	PC3
Chi-square	45.600 ^a	46.880 ^a	81.120 ^a	79.240 ^a	43.960 ^a	45.600 ^a
df	3	3	3	3	3	3
Asymp. Sig	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

^a 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0

The results show that there are no association found between product innovation and process innovation. Hence, H3 is accepted.

Table 9 Variables related to organizational and marketing innovations

Variables/statements	Number of respondents	Mean	Std. deviation	Variance
Organizational innovations				
New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within the enterprise	200	3.7500	0.88964	0.791
A major change to the organization of work within the enterprise, such as changes in the management structure or integrating different departments or activities	200	3.7500	0.88964	0.791
New or significant changes in the relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting	200	4.5200	0.50085	0.251
Marketing innovations				
New or significantly improved marketing information systems to better use marketing skills within the enterprise	200	3.7500	0.88964	0.791
Significant changes to the design or packaging of a good or service	200	4.5200	0.50085	0.251
New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses	200	3.7500	0.88964	0.791

Table 10 Organizational innovation/degree of observed effect

Organizational innovation/ degree of observed effect	Number of respondents	Mean	Std. deviation	Variance
Reduced time to respond to customer or supplier needs	200	3.7500	0.88964	0.791
Improved quality of the goods or services	200	4.5200	0.50085	0.251
Reduced costs per unit output	200	4.5200	0.50085	0.251
Improved employee satisfaction and/or reduced rates of employee turnover	200	3.7500	0.88964	0.791

Organizational and marketing innovations

The variables related to the organizational and marketing innovations that foster the entrepreneurial innovation are provided in Table 9 which shows that most organizations in the context of related to organizational and marketing innovations agree that they had tied up with other firms or even the public institutions or alliances, partnerships, outsourcing or sub-contracting with mean score of 4.52. This aligns with the marketing innovations, where organizations have made significant changes to the design or packaging of a good or service (with same mean score as 4.52). The rest of the possible innovations are exactly at same level with the mean score of 3.75.

Organizational innovation/degree of observed effect

Table 10 shows that organizational innovation has greatly helped to improved quality of the goods or services and reduced costs per unit output. Both these arguments have the highest mean score of 4.52. The means score 3.75 for the reduced time to respond to customer or supplier needs and improved employee satisfaction and/or reduced rates of employee turnover.

Hypothesis testing

H4: No association found between the organizational innovation and market innovation.

Test statistics						
	OI1	OI2	OI3	MI1	MI2	MI3
Chi-square	45.600 ^a	45.600 ^a	0.320 ^b	45.600 ^a	0.320 ^b	45.600 ^a
df	3	3	1	3	1	3
Asymp. Sig	<0.001	<0.001	0.572	<0.001	0.572	<0.001

^a 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 50.0

^b 0 cells (0.0%) have expected frequencies less than 5. The minimum expected cell frequency is 100.0

The results show that there are no association found between the organizational innovation and market innovation. Hence, H4 is accepted.

Discussion and evaluation

The findings, discussion and evaluation related to the study are presented below.

Obstacles to entrepreneurial innovation

It is seen that the inadequate allocation of resources or staff and the absence of systems and structures to effectively manage the innovation process are the most

important obstacles that the organizations face. The study by Van Fossen et al. (2018) and Naranjo-Africano et al. (2023) support this finding and argues that systems and processes are also not at the advanced level and one of the major obstacles that would need to be looked at for fostering the growth of entrepreneurial innovation. The other three obstacles namely are excessive focus on immediate, short-term performance, a tendency of senior managers to expect fast payoffs from projects and strong belief within the organization that innovation is an inherently risky activity are next important obstacles. Arza and López (2021) also found that these findings are crucial and skillset or the staff with adequate knowledge and experiences are the obstacles that would affect the organization's intensity to invest in innovation. As hypothesis, testing no association found between the obstacles to entrepreneurial innovation, organizations need to strategize carefully to overcome all the obstacles.

Sources of information fostering entrepreneurship innovation activities

The present research shows that information from employees, managers and internal R&D departments and customers are the most vital. In the similar context, the findings of Fellnhöfer (2021) on the stakeholder engagement highlighted that these sources of information on entrepreneurial innovation have helped by the existence of entrepreneurial innovations ecosystems. In the external sources, the market sources are most important. These are vital and would lead to value-chain strategies that are industry specific as found by Al-Hakimi et al., (2021). The next ranked source of information is competitors. Studies by Li et al., (2021) also argue that competitors are the key source of information. The least used source of information about entrepreneurial innovation are sources from institutional sources, which was seen as in Inter-firm R&D cooperation as suggested by Wyrwich et al., (2022). The next important sources are research journals, publications, business and industry associations. Such associations foster the B2B relations and also has the role as an information source for entrepreneurial innovation as flagged by Zheng et al., (2021). These sources of information do have stronger impact on the firm's performance, especially on the micro and small-medium enterprises (Ayinaddis, 2023).

Factors affecting innovation activities

Results showed that cost factors and the market factors are the important factors affecting the entrepreneurship innovation action. Test of hypothesis also showed that there is no association found the factors affecting the entrepreneurial innovation. The argument that cost is seen as an issue for the entrepreneurial innovation is supported by Wonglimpiyarat (2013), who highlighted the issues in the innovation funding policies even in the much-advanced industrializing countries like Singapore and Taiwan. Market is also seen as crucial as it helps to have adequate information about customers, competitors, suppliers and other market factors, as they are assisting in the decisions related to the entrepreneurial innovation (Alshanty & Emeagwali, 2019). Knowledge/skill availability factors are seen as the least important factor. However, it would also be seen as a factor that would assist the enterprises to bridge the problems

related to lack of qualified personnel, information on technology, information on markets, etc. (Zhu et al., 2021). The factors do provide the sense of urgency for innovation realization among the entities (Mitcheltree, 2023).

Product innovation vs process innovation

It is to be noted that there is no association found between product and process innovation. The highest form of product innovation is new or significantly improved services followed by the option of slightly new or significantly improved (e.g. resale of new goods purchased from other enterprises, changes of aesthetic nature). A study by Bunduchi et al., (2022) supports with the findings of the present study highlighting that the entrepreneurs need to revise or change the content of the product and they should need to manage digital product innovation. Product innovation of almost new or significantly improved goods is the lowest form of innovation, however Zheng et al., (2021) argued that such product innovations are crucial and is one of the leading enablers in the entrepreneurial innovation which could lead to disruptive innovation and adoptive innovation. Similarly, another study by Han and Zhang (2021) does show that managers and policymakers need to focus on the almost product innovation new or significantly improved goods as such the study found that there is a positive influence of entrepreneurial alignment on product innovation.

In the context of process innovation, new or significantly improved supporting activities for the processes, such as maintenance systems or operations for purchasing, accounting, or computing” is the most significant innovation followed by slightly new or significantly improved logistics, delivery or distribution methods for the goods or services produced by the enterprise. These results show that the innovators are looking at the upgradation and updating of the present or existing innovation rather than the totally new innovations in the process innovation categories. The results support the findings of the study by Alshanty and Emeagwali (2019) which highlights that the process innovation helps organizations to improve the productivity, reduce costs, etc. Also supporting these findings of process innovation, innovation Lv and Qi (2019) argued that process innovations like supply chain processes play a role in the entrepreneurial innovation of the enterprise.

Organizational and marketing innovations

With hypothesis test showing no association with organizational and marketing innovations, the study found that most organizations in the context of related to organizational and marketing innovations agree that they had tied up with other firms or even the public institutions or alliances, partnerships, outsourcing or sub-contracting with mean score. This aligns with the marketing innovations, where organizations have made significant changes to the design or packaging of a good or service. These results are supported by Geiger and Kjellberg (2021) who argued that it is crucial for enterprises to innovate the markets successfully, similarly aligning to the present study's findings (Branstad & Solem, 2020) highlighted that market innovation is more about the enterprises' expansion of existing or creation of the new markets.

Conclusions

The present work aimed to study the entrepreneurial innovation among entities in Singapore. It evaluated the various obstacles that affect entrepreneurial innovation within entities. Further, it has also analysed the various elements that are crucial to overcome the obstacles that affect entrepreneurial innovation within entities. Various factors related to various sources of information fostering innovation activities in an organization were also studied. Difference between the product innovation and process innovation was studied. Furthermore, organizational innovation and marketing innovation were also studied. Lastly, organizational innovation's degree of observed effect in the organization was also studied. The study concluded that enterprises need to work aggressively in the new product development, market opportunities, organization capabilities to ensure that the organizations grow. It is highlighted that process innovation and product innovation have effects on the economic performance of the organization. It does flag that the market innovations are linked with the ways the enterprises change, evolve and develop their fundamental capabilities, which are part of the organizational innovations. Also, the study showed that organizational innovation has greatly helped to improve quality of the goods or services and reduced costs per unit output. The reduced time to respond to customer or supplier needs and improved employee satisfaction and/or reduced rates of employee turnover is also seen as a significant observed effect of entrepreneurial innovation.

Managerial implications of the study

The managerial implications of the study for the stakeholders are provided below.

Creation of entrepreneurial ecosystems

The issues related to the various obstacles related to the entrepreneurial innovation and struggle for information from different sources are clear from the study results. Further, cost, and market also with knowledge/skill availability factors have been the bottle neck for fostering entrepreneurial innovations. In this context, entities and different associations with the help of the governmental bodies would look to create entrepreneurial ecosystems, which would assist in entrepreneurial innovations.

Venture capital to assist cost issues and assistance from business incubators

With cost being one of the major hindrances, access to venture capitalists is crucial. It is recommended that the systems and processes related to the venture capital and crowd funding initiatives are eased for the access of entrepreneurs. These initiatives would not only give the funding, but also help in getting the managerial expertise along with the access to such networks. To overcome the obstacles to entrepreneurial innovation and access to the information, business incubators facility access and support would assist not only the new start-ups but also the current entities, which are looking for radical change.

Win-win strategy among competitors

With competitors fighting out in the market, it would be ideal that they would look for options of cooperation as a win-win strategy. This would help develop entrepreneurial innovation with minimal duplication or wastage of efforts, especially in market innovation where for example supply chain collaborations would help.

Role of business and trade associations

Business and trade associations would also assist in accessing the various information that the entrepreneurs need to foster innovation. As the association of respective industries, business association would be able to better access than individual entities. The cost of acquiring such information would also be with minimal impact for the entities.

Leader's commitment and participation in the networks

To ensure that the entrepreneurs overcome obstacles that hinder innovations, the leader should be committed and comfortable in building the networks. There is a string relationship with the leader's access to the networks to leaders being alert to entrepreneurship innovations.

Improvement in product and process innovation

Though there are perceptions that that revolutionary product innovation does generate superior sales returns compared to the process innovation, it is critical that the process innovation helps organizations to improve the productivity, reduce costs, etc., which in turn would also assist in enterprises' ability to develop its product innovation capabilities. So, enterprises need to equally improve product and process innovation.

Improvement in organizational innovation and marketing innovation

As both organizational innovation and marketing innovation complement each other, managers should improve both these innovations. As such, market innovation may have positive effects of new product development performance while organizational innovation would help effectively communicating between different departments and in particular with low-performing employees and departments, feedback channels, raise the staff motivation and morale. Overall, both the innovations help in the entrepreneurial innovation that would capture the opportunities.

Theoretical implications of the study

As such, the present study provides insights into the business community challenges and how it fosters the culture entrepreneurial innovation. These are crucial to succeed in the growing competition globally and also regionally. Enterprises are in urgent and important need to study about the various factors that hamper innovation activities or projects or influencing a decision not to innovate in the organization. Obstacles and the sources of information fostering entrepreneurship innovation activities need to be acquired. The lessons of the findings clearly show that the importance for entities to understand the differences among the product innovation, process innovation, market innovation, organizational innovation, etc. It is crucial to ensure that entities work on the strategies required as the study found that there is a positive influence of entrepreneurial alignment on different types of innovation.

Limitations of the study and ideas for future research

The study has the limitation of time and cost. A probability-based sampling would have been better than a convenience sampling method, as the data collected through the convenience sampling method have issues of data quality. Due to time limits and cost constraints, the study was done as a mono-method. Hence, there is a bias, and multiple/mixed methods would have been ideal for diverse data collection. Variables chosen are limited to time constraints of the survey duration. The data quality may have been better with more variables, addressing the research problems from a broader context. In future, studies can add more variables and also widen the scope of the study beyond Singapore. Similarly, the studies can compare the entrepreneurial innovation practices between the established entities and start-ups. Likewise, the studies can compare the entrepreneurial innovation practices among SMEs, small business and multinational corporations. There can also be studies conducted on social innovations and its impact on the entrepreneurs, which is not addressed in the current study. The present study does have a wider research breath with various topics and further researches can explore depths in the topics. Also, there exist opportunities for exploring further research horizons that can be found in understanding the 'why' behind the various causations, enabling the research of more robust and well-supported innovation reforms for companies. For instance, it would even explore the reasons for why the academic institutions were less used than other information sources.

Appendix

See Table 11 and Figs. 3, 4, 5 and 6

Table 11 Model description for Q–Q plots

Model description		
Model name		MOD_2
Series or sequence	1	Q1 (level of management responsibility of the respondents)
	2	Q2 (type of organization of the respondents)
	3	Q3 (size of respondent's organization)
	4	Q4 (total number of employees in the respondent's enterprise)
Transformation		None
Non-seasonal differencing		0
Seasonal differencing		0
Length of seasonal period		No periodicity
Standardization		Not applied
Distribution	Type	Normal
	Location	Estimated
	Scale	Estimated
Fractional rank estimation method		Blom's
Rank assigned to ties		Mean rank of tied values
Applying the model specifications from MOD_2		

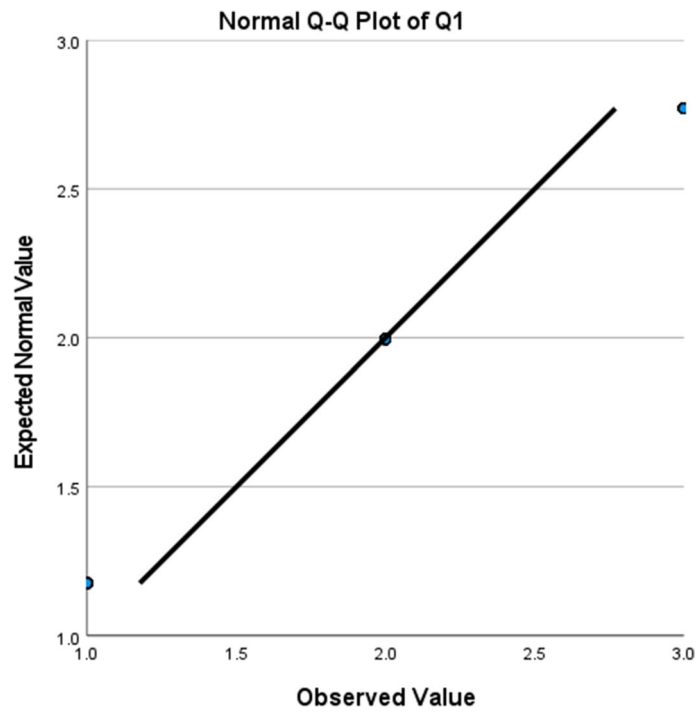


Fig. 3 Q-Q plots for level of management responsibility of the respondents

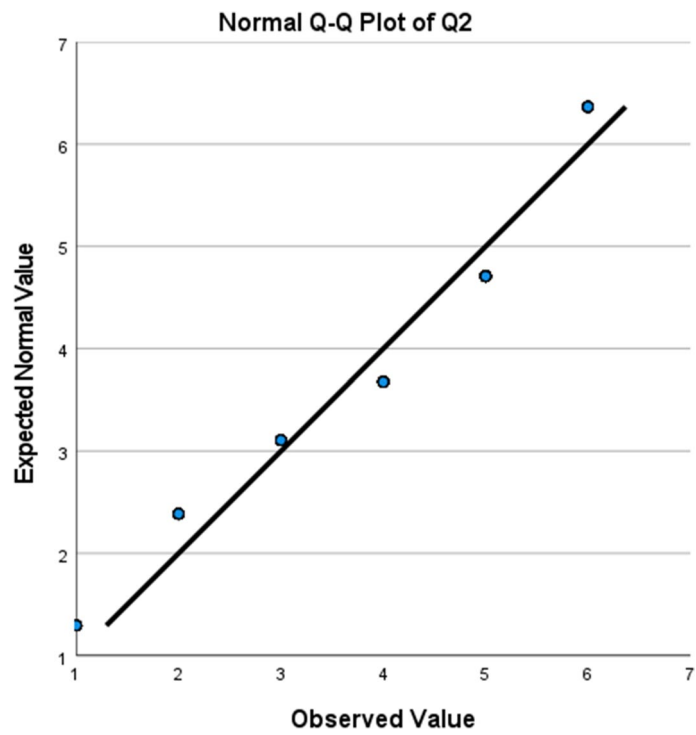


Fig. 4 Q-Q plots for type of organization of the respondents

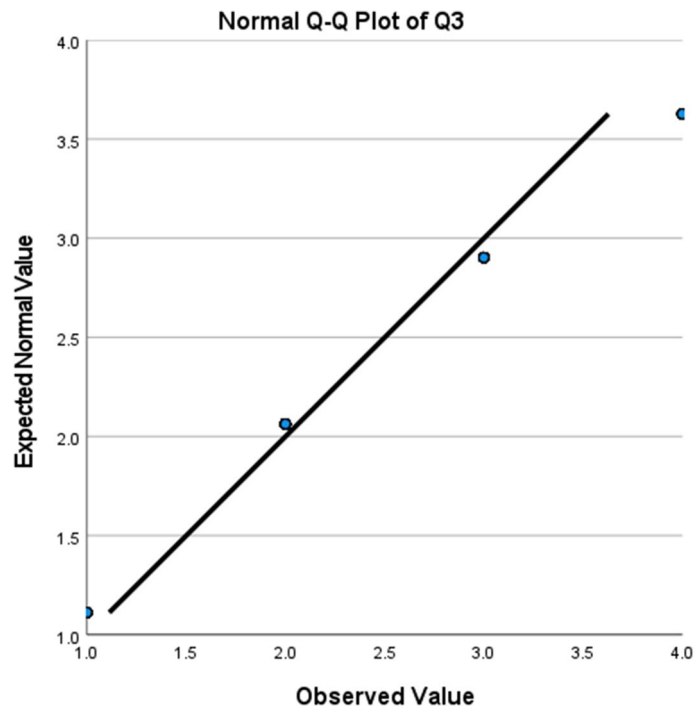


Fig. 5 Q-Q plots for size of respondent's organization

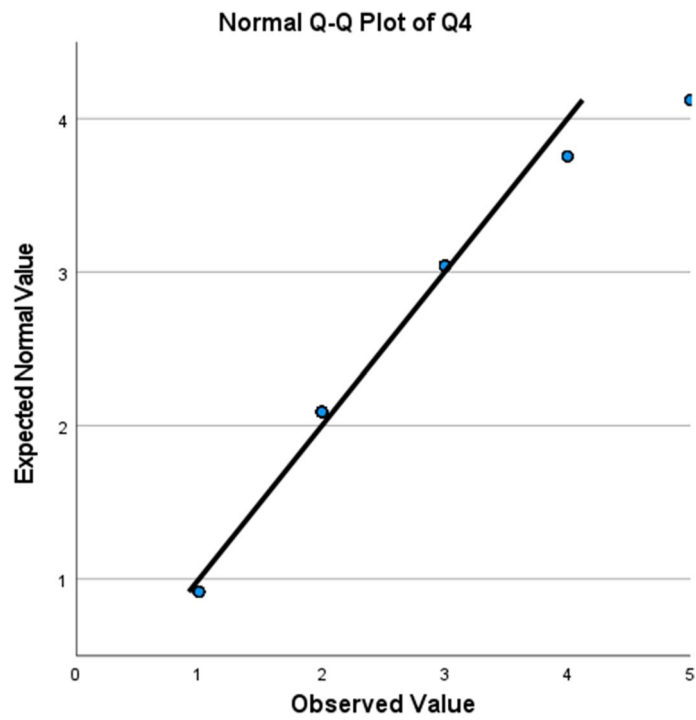


Fig. 6 Q-Q plots for total number of employees in the respondent's enterprise. Source: SPSS output of the collected data

Questionnaire

Title: a study on entrepreneurial innovation among entities in Singapore

1. Level of management responsibility (Tick ONE only).
2. Non-managerial (line jobs and staff jobs)—do not qualify for this study
3. First line managers (functional heads—production / IT/ sales / accounting supervisors)
4. Middle managers (general manager, department manager, etc.)
5. Top managers (CEO, president, vice president, etc.)

Non-managerial (line jobs and staff jobs)—do not qualify for this study.

2. Type of your organization (Tick ONE only)
 - o Sole proprietorship
 - o Partnership
 - o Limited partnership (LP)
 - o Limited liability partnership (LLP)
 - o Private company limited by shares
 - o Public limited company
 - o Size of your organization (Tick ONE only).
 - o Less than \$1 million
 - o Greater than \$1 million and less than or equal to \$15 million
 - o Greater than \$15 million and less than or equal to \$50 million
 - o Greater than \$50 million
 - p Total number of employees in your enterprise. (Tick ONE only).
 - o Less than 20 employees
 - o 21 to 50 employees
 - o 51 to 100 employees
 - o 101 to 300 employees
 - o More than 300 employees

Please rate (Tick) the following obstacles to entrepreneurial innovation within your organization

Obstacles	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Excessive focus on immediate, short-term performance					
Inadequate allocation of resources or staff					
A tendency of senior managers to expect fast payoffs from projects					
The absence of systems and structures to effectively manage the innovation process					
A strong belief within the organization that innovation is an inherently risky activity					

Elements that are crucial to overcome the obstacles listed in Question 5

Elements to overcome obstacles	Very important	Important	Neutral	Less important	Not important
---------------------------------------	-----------------------	------------------	----------------	-----------------------	----------------------

I believe that the leaders are important, and they would help to overcome the issues and obstacles that the innovation opportunities is hindered, e.g. Resource allocation, showing commitment, leading by example, etc.

I think that staff who are empowered by means of systems and processes taking over the organization helps to overcome the obstacles

Skills, knowledge management and talent management are key for entrepreneurial innovation

Sources of information fostering entrepreneurship innovation activities

Information source	Very important	Important	Neutral	Less important	Not important
---------------------------	-----------------------	------------------	----------------	-----------------------	----------------------

- Internal
 - Employees, managers, internal R&D departments
 - Market sources
 - Suppliers
 - Customers
 - Competitors
 - Consultants, R&D institutes
 - Institutional Sources
 - Universities/educational institutional
 - Government or research institutions
 - Other Sources
 - Seminars and Conferences
 - Research journals and publications
 - Business and industry associations
-

Factors affecting innovation activities

Factors	Very Important	Important	Neutral	Less Important	Not Important
----------------	-----------------------	------------------	----------------	-----------------------	----------------------

- Cost factors
 - Knowledge/skill availability factors
 - Market factors
-

Product innovation

During the three to four years 2018 to 2021, do you agree that your enterprise introduced:

Variables/statements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Almost new or significantly improved goods					
Slightly new or significantly improved (e.g. resale of new goods purchased from other enterprises, changes of aesthetic nature)					
New or significantly improved services					

Process innovation

During the three to four years 2018 to 2021, do you agree that your enterprise introduced:

Variables/statements	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Almost new or significantly improved methods producing goods or services					
Slightly new or significantly improved logistics, delivery or distribution methods for the goods or services produced by the enterprise					
New or significantly improved supporting activities for the processes, such as maintenance systems or operations for purchasing, accounting, or computing					

Organizational and marketing innovations

During the three to four years 2018 to 2021, do you agree that your enterprise introduced:

Variables related to organizational and marketing innovations	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Organizational innovations					
New or significantly improved knowledge management systems to better use or exchange information, knowledge and skills within your enterprise					
A major change to the organization of work within your enterprise, such as changes in the management structure or integrating different departments or activities					
New or significant changes in your relations with other firms or public institutions, such as through alliances, partnerships, outsourcing or sub-contracting					

Variables related to organizational and marketing innovations	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree
Marketing innovations					
New or significantly improved marketing information systems to better use marketing skills within your enterprise					
Significant changes to the design or packaging of a good or service					
New or significantly changed sales or distribution methods, such as internet sales, franchising, direct sales or distribution licenses					

If your enterprise introduced an organizational innovation during the three to four years 2018 to 2021, how important were each of the following effects?

Organizational innovation/degree of observed effect	Very high	High	Medium	Low	Very Low	Not relevant
Reduced time to respond to customer or supplier needs						
Improved quality of your goods or services						
Reduced costs per unit output						
Improved employee satisfaction and/or reduced rates of employee turnover						

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Author contributions

ER: conceptualization, methodology, investigation, project administration, review and editing. NN: software, validation, visualization, and statistical analysis, supervision, resources, investigation. SBSM: data curation, formal analysis, original draft writing, proofreading, grammar editing, and overall review. GVJ: conceptualization, review and editing, visualization, formal analysis. All authors read and approved the final manuscript.

Availability of data and materials

Authors gathered data through questionnaire.

Declarations

Informed consent

All study participants provided informed consent.

Competing interests

We are hereby declaring that there are “No Competing interests”.

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