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The moderating effect of environmental dynamism on entrepreneurship and open innovation

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Background: The effect of entrepreneurship on open innovation under challenging environmental dynamics remains an unresolved issue critical for global economic progress, as the environmental dynamics alter businesses' capacity for entrepreneurship.

Aim: This study aims to examine how entrepreneurship influences open innovation in Chinese companies by investigating the moderating role of environmental dynamism.

Setting: A survey questionnaire collected data from 329 middle and senior managers in Shandong, Shanghai, Beijing and other provinces.

Method: This study used hierarchical regression analysis as the data analysis method to test the causal relationships and mediating and moderating effects of each hypothesis.

Results: It was found that entrepreneurship has a significant positive impact on open innovation in firms. Specifically, entrepreneurial risk-taking and anticipation positively affected open innovation behaviour and strategic orientation of innovation. Moreover, environmental dynamism moderated the relationship between entrepreneurial mechanisms and open innovation.

Conclusion: The findings provided new insights into how environmental dynamism shapes the emergence of innovative companies in China. The study suggests entrepreneurs should adjust efforts to promote open innovation behaviour according to the degree of dynamism.

Contribution: The study expands and improves the development of the resource-based view and the capability-based view from a theoretical perspective. Furthermore, it broadens the theoretical lens by examining how the strategic orientation of innovation towards entrepreneurship supports open innovation practices to improve the operational performance of organisations. Finally, this research empirically examined the moderating impact of environmental dynamism on the relationship between entrepreneurial strategic orientation and open innovation-based environmental dynamism on company performance.

Keywords: entrepreneurship; open innovation; strategic orientation of innovation; environmental dynamism; entrepreneurial risk-taking; entrepreneurial anticipation.

Introduction

In today's society, entrepreneurs play a crucial role, and it is vital to consider their impact on the personal, social, financial and strategic levels. Encourage entrepreneurship and inspire more people to engage in innovation, laying a solid foundation for China's economy to maintain medium-to-high-speed growth. As an important industry for economic development, the high-tech industry is not only an important engine for promoting China's economic growth but also a gathering place for entrepreneurship. In 2020, China's scientific and technological progress has contributed more than 60% of its gross domestic product (GDP). As a result, a lot of businesses in China are focussed on entrepreneurship and innovation in science and technology to try and encourage the use of novel discoveries for business growth in terms of performance, growth and development. In business, high-quality development is supported and driven by scientific and technological innovation, which is a substantial contribution.

As such, Rezaei and Ortt (2018) denoted that for a company to succeed, having an entrepreneurial mindset is a crucial component. In a similar vein, Rua (2018) stated that a company that aggressively pursues opportunities and engages in technical innovation is also described as one that engages in risky initiatives and makes decisions that lead to new entrants. To better comprehend open innovation, which would be reflected in operational effectiveness,

the technology competency of organisations is specifically researched. Anderson (2021) affirmed that a firm's technological capabilities in open innovation lead to enhanced operations. This is the main motivation behind the current study's focus on the entrepreneurship influence mechanism to examine how open innovation, which consists of inbound and outbound knowledge, affects the perception of firms' operational performance. This study gains additional significance when environmental dynamism is considered as a moderating factor. It is extremely pertinent in the current dynamic environment. The existing literature has neglected a dimension, namely the relationship between entrepreneurship, strategic orientation of innovation and open innovation, especially the influence of open innovation on entrepreneurship in promoting industrial innovation efficiency.

This article studies the relationship between entrepreneurial risk-taking and anticipation, open innovation behaviour and strategic orientation of innovation from the perspective of environmental dynamism, which can reveal an important reason for the improvement of innovation efficiency of small and medium-sized high-tech enterprises in China, and also provide an important basis for policy decision-making of government departments and innovation decision-making by enterprise departments.

This article starts out by going through some theoretical viewpoints on entrepreneurship, open innovation and environmental dynamism. Research hypotheses were established based on the studied literature. This article then goes on to detail the study method and results of the data analysis. Based on the findings, the study then addresses the findings, implications, limitations and directions for future study.

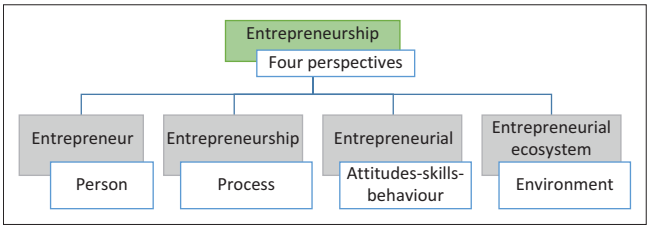
Entrepreneurship

According to research, maintaining the proper balance between innovation-driven transformation and proficiency-driven stability is the managerial problem faced by business owners throughout the spectrum (Cho & Lee 2018). A strong desire for change is necessary for entrepreneurial management because it is opportunity-driven and disregards resources' availability and potential obstacles (Hisrich & Ramadani 2017). Based on this, Jantunen (2005) described entrepreneurship as a demonstration of how to develop an organisation and innovate within or outside a company. It is the ability to take chances, be imaginative and put ideas into practice. Additionally, it implies the capacity to organise and manage tasks in order to meet the predetermined objectives (Lounsbury et al. 2019). Hence, the term 'entrepreneurship' can be viewed in a variety of ways as shown in Figure 1.

Based on these viewpoints, Davidsson, Delmar and Wiklund (2017) expressed that entrepreneurship refers to the possession of specialised knowledge and aggressive activity that causes changes in the economy. Landstrom, Fayolle and Santos (2017) added that entrepreneurship is driven by opportunities or by a need. The entrepreneurship process starts with opportunity exploration and progresses to opportunity usage, which results in value generation. Opportunities prevail freely for entrepreneurs and because of the different nature, the startup's success depends on the entrepreneur's special understanding, skills, aptitudes and the way they organise the operations. As a result, it may be said that the economy is heterogeneous and that people, companies and geographical regions differ in terms of how they utilise and use opportunities (Hisrich & Ramadani 2017). Researchers have identified a variety of factors such as self-awareness, independence and persistent learning as aspects that inspire entrepreneurs to launch their own businesses (Staller & Kirschke 2021). These factors are greatly influenced by the entrepreneurial ecosystem in which an entrepreneur operates.

The entrepreneurial ecosystem is the environmental aspects (such as government, the venture capital sector, the financial system and society) that make up and have an impact on new businesses either directly or indirectly. The success of businesses is greatly influenced by external factors such as industry and economic structure, and regulatory and innovative changes (Hisrich & Ramadani 2017). Harel, Schwartz and Kaufmann (2021) highlighted that an entrepreneur is a hero whose biggest quality is taking chances by vehemently establishing and implementing innovation procedures within the firm by obtaining external resources. Nonetheless, as a leader, the entrepreneur is in charge of overseeing all organisational management tasks, even though this means that the entrepreneur may not always follow the traditional organisational theory. Additionally, this view recognises that an entrepreneur's role is to develop fresh ideas and turn them into desired results (Walsh & Cunningham 2016). Therefore, entrepreneurs need to create open innovation projects that fit with their firms' strategies. The advantages of open innovation significantly contribute to a firm's position. Nevertheless, open innovation cannot be used in businesses if there are little opportunities for product development or invention. In this case, it is the responsibility of the entrepreneur to continuously focus on the newest trends and methods to improve operational efficiency.

Promoting dynamic approaches like open innovations in business firms is crucial for comprehending the role of entrepreneurship. In 2013, Wynarcxyk undertook a study on the influence of open innovation approaches on export



Source: Adopted from World Economic Forum, 2020, *World economic situation and prospects 2020*, United Nations, viewed 28 February 2023, from https://www.vlebooks.com/vleweb/product/openreader?id=none&isbn=9789213583296

FIGURE 1. Many viewpoints on the conception of entrepreneurship.

performance and innovative skills (Qureshi 2018). The study's conclusions included information on how small and medium enterprises' (SMEs) competitiveness is influenced by a variety of internal characteristics, such as their capacity for entrepreneurship, organisational structure and research and development (R&D) capabilities. In addition, it appears that the concept of open innovation is intrinsically linked to the growing trend of globalisation.

In support, Mazzarol and Reboud (2017) added that an entrepreneur who acts as a businessperson is required to carry out a variety of tasks, including identifying market opportunities, developing new products and production procedures, and managing and combining elements of innovation approaches. Therefore, an entrepreneur plays a vital role in creating new ideas and prospects, having the ability to manage ambiguous risks, and providing a fresh combination of necessary skills for strengthening the business competitiveness, and survival and guaranteeing a healthy performance.

The entrepreneurship in the digital economy has attracted the attention of scholars. Li, Li and Xie (2024) found that exposed to a broad impact from digital technologies, innovations driven by genuine entrepreneurship are expected to create a wider impact. Chen et al. (2024) showed that entrepreneurship has a significant positive impact on the dual innovation and enterprise growth of technology-based small and medium-sized enterprises, and its promotion effect on exploratory innovation in dual innovation is stronger. The digitalisation application level dimension has a U-shaped moderating effect on the relationship between entrepreneurship and exploratory innovation, exploitative innovation and enterprise growth.

Open innovation

Bringing about change is an essential component of entrepreneurship, but separating out market-related activity is the main factor that leads to entrepreneurship (Davidsson et al. 2017). Entrepreneurship only occurs when value is created, which may be calculated by analysing the business' level of innovation activity. Thus, because of rising competition, rapid technical advancements, globalisation and the current economic crisis, businesses are more pushed than ever to reevaluate their plans (Santoro et al. 2018). As a result, businesses have begun to switch from close to open innovation. Conboy and Morgan (2011) expressed that the era of open innovation began with businesses boosting their efforts to license out and sell internally generated technologies to other businesses as well as their research collaborations and reliance on external information to develop new products and services.

Although the concept of open innovation is not novel to businesses, in recent years it has emerged as a popular topic in the field of innovation management study (Blume 2020). Moreover, Santoro et al. (2018) exposed that the abundant literature on open innovation encompasses management, governance, strategy and competitiveness. In order to develop rigorous partnerships with stakeholders in their ecosystem, businesses are increasingly integrating open innovation techniques into their operations (Scuotto et al. 2017). This is because such open and engaging collaborations foster a thriving exchange of internal and external knowledge, assisting firms in repeatedly introducing additional innovations. These businesses reduce their fixed and variable costs while improving performance by combining internal and external expertise (West & Bogers 2014). Usman and Vanhaverbeke (2017) further emphasise that this integration is a crucial step in the open innovation approach, which encourages cooperation within the ecosystem. In reality, Open Innovation Theory surpasses the internal perspective presented in knowledge management literature by asserting that firms can and should leverage both external and internal ideas, as well as utilise both internal and external channels to market their technology (Usman & Vanhaverbeke 2017).

Morgan, Obal and Jewell (2021) presented that businesses classified as knowledge-based, technology-intensive and utilising innovative business models are likely to engage in open innovation. As such, entrepreneurship is the act of integrating innovation into a firm's business model. Chesbrough (2017) claimed that open innovation techniques encompass both inbound (Technology Exploration) and outbound (Technology Exploitation) efforts. Hung and Chou (2013) also expressed that a firm can expand its horizons and increase the depth of its own knowledge base through inbound open innovation. Thus, businesses that adopt inbound open innovation may gain from fresh perspectives and knowledge combinations, as well as fresh market prospects and improved problem-solving skills. As opposed to inbound open innovation, outbound open innovation refers to the utilisation of internal ideas or technological know-how that are disseminated outside of the organisation through licensing, patenting or contractual agreements to obtain financial and nonfinancial benefits (Hung & Chou 2013). Prior research has indicated that companies are more likely to achieve higher competitive advantages when they pursue both outbound and inbound open innovation (Lichtenthaler 2008).

Open innovation in a digital economy is also a focus of attention for scholars. Open innovation can promote business success or stimulate entrepreneurship, but it can also bring challenges to entrepreneurship (Nambisan, Siegel & Kenney 2018). Kim, Roh and Boroumand (2024) provided a theoretical framework proposing that the underlying motivations for each open innovation approach may exhibit notable differences.

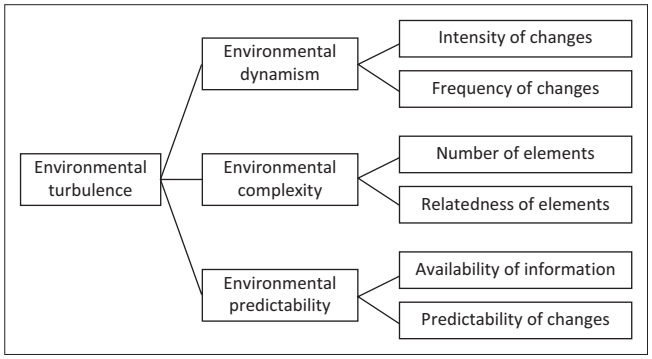
Environmental dynamism

According to Zhou et al. (2019), environmental dynamism constitutes one of the three dimensions of environmental turbulence. The discussion of the concept of environmental turbulence's dimensions suggests that events might alter, be unclear and take unexpected turns at the same time.

Environment dynamism, complexity and predictability – also known as environmental munificence – are the three elements of turbulence. The three components have been divided into two additional sub-dimensions as presented in Figure 2.

According to Endres (2017), environmental dynamism describes the rapid and unpredictable change in the surrounding environment of a firm. This implies that the advantages of innovative activities of a business depend on the environment in which they are carried out. A dynamic environment is one that includes technological advancements, shifting consumer preferences and shifts in material supply or demand for products. According to research by Blume (2020) and Morgan et al. (2021), open innovation strategy is more appropriate in environments marked by market and technology volatility, globalisation and intense competition. According to researchers, the building of a robust knowledge management capability for open innovation practices, however, requires consideration of both low- and high-dynamic situations (Martinez-Conesa, Soto-Acosta & Carayannis 2017).

Studies on the moderating impact of environmental dynamism on various dependent variables in diverse contexts have produced inconsistent results in innovation management. However, Martinez-Conesa et al. (2017) exposed that environmental dynamism has no influence on the link between knowledge management competency and open innovation practices. Yet, academics agree that environmental dynamism captures the turbulence of change in an organisation's environment, which affects the connection between company-level strategy and firm performance (Ting, Wang & Wang 2012). Mohammad (2019) added that dynamism in the environment also endangers an organisation's ability to perform. Product life cycles typically have relatively brief lifespans and face more frequent technological paradigm shifts when environmental dynamism is high (Schilke 2014). Because product life cycles are brief, particularly in highly dynamic contexts, businesses must continually look for and employ fresh external information as well as regularly exploit new internal ideas or technological knowledge. When there is significant environmental dynamism, this instability may have an undesirable impact on the business's operational effectiveness.



Source: Adopted from Volberda, H.W. & Van Bruggen, G.H., 1997, *Environmental turbulence: A look into its dimensionality*, Erasmus Institute of Research and Management, viewed 18 January 2019, from http://hdl.handle.net/1765/6438

FIGURE 2: Dimension of environmental turbulence.

Theoretical analysis

'Open innovation' is gradually becoming the dominant mode of enterprise innovation. This theory points out that enterprises should raise the role of external creativity and external marketisation channels to the same important position as that of internal creativity and internal marketisation channels under the closed innovation mode, balance and coordinate internal and external resources for innovation, and not only place the innovation goal on traditional product management.

The stability of the environment provides a predictable framework for businesses, making long-term investments and partnerships in open innovation more feasible. Open innovation crosses the line between corporate strategy components and, as a result, establishes itself as the primary method of innovation strategy. Open innovation has a significant effect on corporate entrepreneurship, with open innovation serving as a suitable mediator (Valmohammadi et al. 2024).

Chesbrough (2006) defined open innovation as the practice of innovation and the cognitive mode of creating, interpreting and researching these practices. In other words, open innovation is both a management practice and a cognitive mode. Accordingly, enterprises should fully leverage internal and external ideas and resources, as well as access to market channels, to maximise their own market access, shorten the time for enterprise products and ideas to enter the market, and reduce uncertainties. Enterprises that integrate resources to create market opportunities are said to exhibit entrepreneurial behaviour, with its core concept being a revolution, which has implications for risk, trust, accountability and innovation.

The aforementioned attributes define the theory of innovation, which has become an urgent question to clarify the mechanism through which entrepreneurship enables enterprises to engage in open innovation. Cheng and Shiu (2015) stated that because of the constraints of the dynamic changes in the external environment, entrepreneurs tend to be trapped in a challenging strategy-oriented choice: enterprises face the dilemma of choosing between 'marketability' to meet practical demands and 'technology' to lead industry reform. Scholars worldwide have conducted extensive theoretical and empirical studies on the mechanism of entrepreneurship on open innovation, primarily reflecting that entrepreneurship promotes open innovation in enterprises and influences innovation openness from the two sub-dimensions of environmental dynamism (intensity and frequency of changes) (Endres 2017; Mammassis & Kostopoulos 2019; Zhou et al. 2019).

However, existing studies fail to address the potential changes in the relationship between entrepreneurship and open innovation under different levels of environmental dynamism (Heracleous & Bartunek 2021). By focussing on the relationship between entrepreneurship and open

innovation, this article argues that it is challenging to reach a more explanatory and operational research conclusion. Thus, it is necessary to consider the role of various factors between the two and clarify the environmental dynamism, such as knowledge, skill updating and product upgrading, and their impact on open innovation. This is based on the findings of a study by Ali (2017), which demonstrated that environmental dynamics moderate the relationship between the entrepreneurial mechanism and business performance, with the entrepreneurial mechanism contributing positively to firm success.

Since the concept of open innovation was first introduced nearly 20 years ago, corporate scholars have closely studied it because of its impact on entrepreneurial success and growth. According to Chesbrough (2020), businesses must adapt to the new social reality and adopt an open innovation model to create and maintain long-term competitive advantages. This allows them to fully utilise both internal and external resources and creative talent to support the achievement of sustainable innovation (Chesbrough 2020).

In Open Innovation Theory, businesses can and should employ both internal and external ideas, as well as internal and external channels to market, to enhance their technology (Chesbrough 2006). According to this paradigm, businesses can and ought to utilise both internal and external sources of inspiration, as well as internal and external channels for distributing their products. The goal of open innovation is to improve business practices by assisting organisations in going beyond simply developing and commercialising new ideas. The notion of open innovation has provided many practitioners with a new vocabulary to discuss the nature of R&D, assisting in the shift of predominant R&D logic from internal discoveries to outward interaction. It also encourages company executives to experiment with various novel models to generate and market innovation.

Understanding the activities of open innovation is crucial to comprehending the concept. The business model of an organisation influences which knowledge inflows can spur innovation and which knowledge should be shared with other firms. This defines the model of the future of open innovation in an entrepreneurial setting (Chesbrough 2017). Gassmann, Enkel and Chesbrough (2010) confirmed that a variety of already-existing entrepreneurial activities have been incorporated under the umbrella of open innovation. According to Hossain (2013), other ideas like value creation, crowdsourcing and distributed innovation intersect with open innovation. Based on this, Gassmann et al. (2010) further classified open innovation into the following three macro-methods.

The outside-in method

A corporation's ability to innovate can be improved by enhancing its internal knowledge base through the integration of suppliers, customers and outside knowledge sourcing. For outside-in open innovation, Bianchi et al. (2011) identify several organisational models, such as in-licensing, minority equity investments, acquisitions, joint ventures, R&D contracts and research financing, the procurement of technical and scientific services, and non-equity alliances.

The inside-out method

Generating revenue through commercialising ideas, licensing intellectual property and advancing technology by bringing ideas to the outside world. In their 2011 study, Bianchi et al. (2011) identified several organisational models for inside-out open innovation, including licensing out, spinning out new businesses, selling innovation projects, forming joint ventures to commercialise technology, providing technical and scientific services, corporate venturing investments and non-equity alliances.

The coupled method

Combining the outside-in and inside-out processes by forming partnerships with complementary allies, where cooperation and compromise are essential for success. Conboy and Morgan (2011) stated that the linked process approach combines the inside-out (getting ideas to market) and outside-in (gaining external knowledge) processes and that because of this hybridisation, some authors may not always investigate it.

Based on this classification, Hossain (2013) noted that research combining entrepreneurship with open innovation significantly contributes to a better understanding of their correlations.

Research hypothesis

Entrepreneurial risk-taking, entrepreneurial anticipation and open innovation behaviour

This article argues that entrepreneurial risk-taking has a positive effect on open innovation behaviour. A core process of the innovation process is to seek ideas and originalities with potential commercial value. Enterprises often invest a mass of resources and time to search for innovative opportunities. These investments and efforts effectively improve the enterprise's ability to create, utilise and restructure new and existing knowledge (Hung & Chou 2013; Martinez-Conesa et al. 2017; Morgan et al. 2021; Scuotto et al. 2017). In addition, Joseph Alois Schumpeter (2017) believed that the entrepreneur is to develop and utilise market opportunities by technological innovation or organisational innovation.

Entrepreneurship is to create new resources and realise the commercialisation of new products and provide new services for customers (Conboy & Morgan 2011). Entrepreneurship is a dynamic factor that affects the innovation openness of enterprises. It is the inherent instinct of entrepreneurs to take the lead in adopting the new mode of open innovation to implement innovation. Entrepreneurship promotes the open innovation of enterprises and influences the openness of innovation from the four dimensions of innovation,

cooperation, risk and competition (World Economic Forum 2020). In light of this, the article proposes the hypothesis:

H1a: There is a positive relationship between entrepreneurial risk-taking and open innovation behaviour.

This article makes the case that entrepreneurial insights have a favourable impact on open innovation behaviour. Firstly, entrepreneurial intuition unexpectedly aligns with open innovation behaviours. Both of them support increasing the flow of innovation components and big-data-based collaboration to accelerate the pace of technological innovation. They also both insist on accelerating the pace and lowering the cost to achieve creative competitive advantages. Secondly, entrepreneurship emphasises the strategic condition of an organisation and represents the initiative, inventiveness and risk-taking of a business (Ali 2017).

Schumpeter (2017) was the first person to recognise the quality of the initiative, and he believed that the initiative of entrepreneurship is one of the most important characteristics of entrepreneurs. Being proactive reflects the entrepreneur's initiative, which is the first element of the enterprise to win the opportunity. Being proactive is opportunity-seeking. There is an anticipation view exists that involves introducing new products or services into the competition and anticipating future demand to create change and shape the environment. A number of people enrol creative creation, problem prevention, effective communication, adaptability, future positioning, implementation of new processes and introduction of new products and services as signs of being proactive (Nasution et al. 2011). In the complex and changeable living environment, proactive entrepreneurs are able to respond to the changes in the market environment under the complex and changeable living market and able to stabilise the performance of the enterprise. There is a significant relationship between the initiative of entrepreneurship and entrepreneurial activities. Also, the initiative of entrepreneurship can obviously improve entrepreneurial performance (Kennard 2022). In line with this, the study proposed the hypothesis:

H1b: There is a positive relationship between entrepreneurial anticipation and open innovation behaviour.

Entrepreneurial risk-taking, entrepreneurial anticipation and strategic orientation of innovation

The concept of entrepreneurship has been accompanied by innovation since its birth. In the beginning, entrepreneurship was manifested as a series of optimal allocation behaviours of economic resources generated by the realisation of innovative economic value (Schumpeter 2017). Rainey (2010) assessed enterprise development strategy from the perspective of senior managers and analysed its constraints. The research showed that entrepreneurs' strategic recognition had a great impact on enterprise development strategy, and the study believed that enterprise development strategy required the full participation of enterprise managers, among which entrepreneurship was the most influential factor. Barney (1986) believes that corporate development strategy is gradually formed in the process of corporate development. The development strategy is formed because of the influence of corporate culture, and it is very prone to change under the influence of entrepreneurship. According to Lorsch (1986), corporate culture is the key to the success of an enterprise, and spiritual culture promotes the implementation of strategic management change. According to Davidsson et al. (2017), entrepreneurship as a crucial resource for strategic management is of vital importance to the development and research of entrepreneurship, which is necessary to enterprises regardless of their size. Therefore, this article makes the following hypothesis:

H2a: There is a positive relationship between entrepreneurial risk-taking and the strategic orientation of innovation.

H2b: There is a positive relationship between entrepreneurial anticipation and the strategic orientation of innovation.

Enterprise strategic orientation of innovation and open innovation behaviour

The advantage of open innovation lies in obtaining sufficient information and technology resources from the external market to cover the shortage of internal innovation resources and commercialising the innovation results through external and internal channels rapidly, so as to respond promptly to the market demand to maximise commercial profits and thus improve the innovation performance of enterprises (Morgan et al. 2021). As a new sustainable innovation paradigm, open innovation has attracted extensive attention from entrepreneurs.

According to Blume (2020), both open innovation and independent innovation have a significant impact on the innovation performance of enterprises. Additional inspections show that there is a reverse correlation between innovation sources and innovation performance. Under the effect of an open innovation strategy, the reverse effect is more obvious. Also, there is a positive correlation between innovation degree and innovation performance. Under the effect of an open innovation strategy, the positive influence degree will be strengthened (Chen, Zang & Luo 2017). In other words, the interaction and matching between independent innovation strategy and open innovation play a positive role in the improvement of enterprise innovation performance. The article argues that:

H3: There is a positive relationship between enterprise strategic orientation of innovation and open innovation behaviour.

The mediating effect of enterprise innovation strategic orientation

As a connection of action between entrepreneurship and open innovation behaviour, a firm strategic orientation of innovation may be highly effective in predicting firm open innovation behaviour. Through the implementation of an innovation strategy in enterprises, enterprises can obtain innovation factors from the outside more efficiently and also

transform from closed innovation to open innovation. The influence of entrepreneurial risk-taking and anticipation on open innovation behaviour is implemented through strengthening innovation strategic orientation. Therefore, a firm strategic orientation of innovation may play a mediating role between entrepreneurship and its sub-dimensions and open innovation behaviour. Therefore, this article puts forward the following hypothesis:

H4: The association between entrepreneurship and open innovation behaviour is mediated by the strategic orientation of innovation in a firm.

The moderating effect of environmental dynamism

Several academics concur that the external environment has a significant impact on the management discipline (Bourgeois 1980) and that there is empirical support for the idea that the external environment can influence a wide range of corporate strategy decisions (Goll, Brown & Rasheed 2007). Also, a number of researchers have looked into how the external environment influences the relationship between entrepreneurial orientation and firm performance (Ali 2017; Hung & Chou 2013; Ting et al. 2012; Mohammad 2019; Schilke 2014).

Environmental dynamism is a measure of how quickly an environment is changing. For instance, Song and Kang (2019) explained environmental dynamism as the pace of change in consumer preferences and organisational productivity across time. Dynamic environments are by definition volatile and lack patterns and regularities (Kennard 2022).

Environmental characteristics like dynamism and munificence may modify the association between the variables of pro-activeness, inventiveness and the risk-taking propensity of entrepreneurial attitude and success (Song & Kang 2019). Song and Kang (2019) added that firms operating in dynamic contexts are more likely to gain from new product innovation than firms operating in stable conditions.

The adoption of proactive corporate activities and environmental dynamism intuitively go hand in hand (Kickul & Gundry 2002). Businesses that are proactive and aggressively look for possibilities will succeed better than businesses that are reluctant to take advantage of market prospects, even when industry conditions in a dynamic environment are vulnerable to quick change. Proactive tactics can be used successfully and economically to take advantage of the numerous new opportunities that dynamic surroundings create for businesses, giving them a competitive advantage over rivals (Rezaei & Ortt 2018). Similarly, Ali (2017) exposed that dynamic environmental factors would compel firms to stop acting proactively in order to protect their scarce resources. Based on each of these reasons, proactive actions will be more and more favourably correlated with firm performance in generous conditions than in dynamic settings.

According to Ali (2017), dynamic environments encourage entrepreneurial enterprises to provide evidence of innovative activities, which are less common in stable situations. Such businesses benefitted from proactive initiative-taking actions because they could set the terms of competition by entering the market first and making their technology the norm. Rezaei and Ortt (2018) discovered that pro-activeness with dynamism relation is positively and significantly associated with market expansion, sales growth and profitability.

According to many points of view, dynamic settings will also lead to a larger correlation between entrepreneurial risk-taking and business performance (Jantunen 2005; Mohammad 2019; Schilke 2014; Ting et al. 2012). Landstrom et al. (2017) noted that enterprises that do not take chances in dynamic situations will see their market share and growth rate decline and will not be able to compete effectively against more aggressive rivals. Rezaei and Ortt (2018) discovered that in dynamic situations, there is a greater correlation between entrepreneurial risk-taking and business performance. To navigate the ongoing changes typical in dynamic contexts, companies must make bold, risk-taking strategic decisions. These considerations indicate that, compared to stable environments, dynamic contexts are more conducive to businesses enhancing their business performance through entrepreneurial risk-taking.

The relationship between numerous organisational characteristics and business success is moderated by the dynamic environment (Ali 2017). Mohammad (2019) revealed that environmental dynamism influences how decisions are made and how well businesses execute. In light of this, there is a compelling case for accepting entrepreneurial orientation when a business operates in a dynamic setting. The strategic orientation of enterprise innovation is supposed to seek information resources and technology resources more rapidly, and also the innovation process is more complex. Wijbenga and Van Witteloostuij (2007) proposed that enterprises engaged in open innovation have the ability and habit to look beyond the existing market, and they are able to pay attention to the future market. Whether the innovation strategy orientation can strengthen open innovation behaviour or not depends on the innovation strategy that greatly supports enterprises to obtain sufficient information and technology resources from the external environment (Dess & Beard 1984). Under the background of the Internet era with increasing uncertainty of the external environment, the drastic changes in external market demand and industry technology make enterprises more willing to adopt open innovation behaviour instead of the original closed innovation behaviour. It is found that enterprise open innovation is affected by R&D capability, asset specificity, environmental uncertainty and other factors (Song & Kang 2019). As a result of this, the following hypothesis is proposed:

H5: Environmental dynamism will increase the influence of the strategic orientation of innovation on open innovation behaviour. That is, the higher the environmental dynamism, the stronger the positive effect of strategic orientation of innovation on open innovation behaviour.

In general, this article suggests a conceptual framework for entrepreneurship, strategic enterprise innovation and open innovation behaviour as presented in Figure 3.

Materials and methods

Research design

Hierarchical regression is a group analysis of several independent variables, mainly used for model comparison or to determine the importance of variables. It is often used in regression analyses that use demographic variables as control variables, or in studies of mediating effects. Control variables refer to items that may interfere with the model, such as gender, age, education and other basic information.

This article tests the hypothesis proposed by collecting data from a questionnaire survey. The targets of the survey are mainly middle and senior managers who are familiar with the company's innovative decisions and operational conditions (Zahra 1996). In addition to the variables of company establishment time, employee number and enterprise type, all the variables used in this article were measured using a 5-point Likert scale, where 1 indicates very low or strongly disagree, and 5 indicates very high or strongly agree. Data collection was conducted in two stages: The first stage was the pre-survey, which involved the distribution of the survey questionnaire to a limited number (preferably 5–10) of participants to complete it. This is popularly referred to as a pilot study which helps to minimise errors, the need for extra work from the researchers and participants as well as the waste of research resources by providing the data needed for evaluation of all parts of the main study. In this case, the feedback obtained through the pilot study helped to make essential corrections to the questionnaire and to ensure that the questionnaire was able to collect all critical and essential data needed for the current study. This means that questionnaires were modified and improved according to the feedback of the respondents during the survey.

The second stage was the actual formal investigation, which involved the distribution of the questionnaires to the targeted sample size of 400 respondents from various businesses operating (middle and senior managers in small and medium-sized high-tech enterprises) in Shandong, Shanghai, Beijing and other provinces and cities. Beijing and Shanghai are municipalities directly under the central government of China and are the economic, educational and innovation centres of China. According to the China Statistical Yearbook, Shandong Province is a province in China where the national high-tech enterprises and small and medium-sized high-tech enterprises grow rapidly. The sample distribution provinces have a better innovation environment and market competition atmosphere, which are suitable for conducting research on open innovation. A total of 400 electronic questionnaires were sent out, and 386 questionnaires were collected with a recovery rate of 96.5%. Removing some unqualified questionnaires, 329 valid questionnaires remained which was an effective response rate of 82.25%.

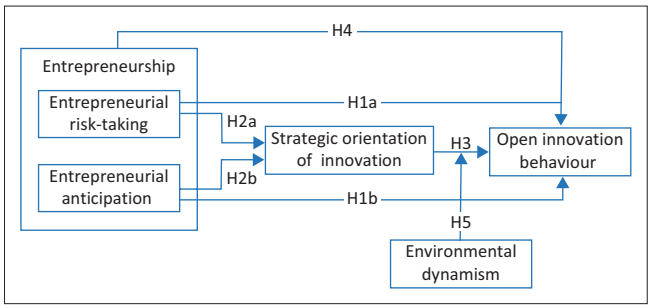


FIGURE 3: Conceptual model.

Variables of measure

In addition to the control variables such as the year of the company's establishment, the number of employees, the nature of the company, the industry, the working years of the respondents and the position of the respondents and other basic information of the enterprise and the respondents, the other variables were measured by five-level Likert scale. The details are as follows (see Table 1):

Entrepreneurship

According to the research of Zhang (2020) and Liu et al. (2008), entrepreneurial risk-taking and entrepreneurial anticipation are respectively measured by four items, among which the representative items of entrepreneurial risk-taking are 'entering many new industries and having bought a lot of companies in different industries'. Representative items of entrepreneurial anticipation such as 'Whether having stripped several unprofitable business units or not' and 'A restructuring exercise was undertaken to ensure increased coordination and communication between the business units'.

Innovation strategic orientation

According to the research of Dess and Beard (1984), the measurement is carried out through three questions, representing questions such as 'The Company invests huge capital to innovate the production process or service process, and the company often takes the lead in launching new products or services in the market' (Zahra 1996).

Open innovation behaviour

Referring to the research of Zhang, Chen and Li (2015), nine questions were used for measurement, representative questions such as 'Often embed externally developed knowledge and technology into the company's R&D projects and believe that commercialisation by external organisations is conducive to improving the company's R&D performance' (Milton, Bull & Bauman 2011).

Environmental dynamism

Referring to the research of Chan and Idris (2017), the measurement is carried out through five questions, representing questions such as 'In our industry, knowledge and skills are rapidly updated' and 'In our industry, customers are constantly looking for brand new products' (Chan & Idris 2017).

TABLE 1: List of constructs and the items adapted from the reference used.

Construct	Item	Reference adapted from
Entrepreneurship	• Entering many new industries • Having various businesses in different industries • Stripping several unprofitable business units or not • Restructuring to ensure increased coordination and communication between the business units	Zhang (2020); Liu et al. (2008)
Innovative strategic orientation	• Investing huge capital to innovate the production process or service process • Taking the lead to launch new products or services	Endres (2017)
Open innovation behaviour	• Often embed externally developed knowledge and technology into the company's R&D projects • Commercialisation by external organisations is conducive to improving the company's R&D performance	Zhang et al. (2015)
Environmental dynamism	• In our industry, knowledge and skills are rapidly updated • In our industry, customers are constantly looking for brand-new products	Cheng and Shiu (2015)

Note: Please see the full reference list of the article, Li, S. & Zhang, K., 2025, 'The moderating effect of environmental dynamism on entrepreneurship and open innovation', *South African Journal of Economic and Management Sciences* 28(1), a5767. https://doi.org/10.4102/sajems.v28i1.5767, for more information.

R&D, research and development.

Ethical considerations

Ethical clearance to conduct this study was obtained from the Shandong Women's University, Institutional Review Board (reference no.: 2023/IRB/#057_).

Results

Data analysis

The questionnaire survey data were coded into SPSS, a statistical software package, to facilitate data analysis and generate statistical information for addressing the research hypotheses. The structured questionnaire with primary data ensured effective and efficient data collection. SPSS was chosen for its user-friendly interface and versatility in conducting analytical tests and presenting results through graphs, tables and charts, facilitating accessible interpretation of the analysis.

Research results

Statistical Package for the Social Sciences enabled the researcher to perform a range of analytical tests and present the results in graphs, tables and charts, facilitating the understanding of the analysis outcomes. The research output included descriptive and inferential results necessary for drawing conclusions. Statistical Package for the Social Sciences was deemed appropriate for this research, as it aided the researcher in addressing the research questions and achieving the research objectives. The findings are as follows:

Reliability and validity test

In this study, the reliability and validity of the variable measures were evaluated using Cronbach's alpha coefficient, Kaiser–Meyer–Olkin (KMO), Bartlett's test, factor analysis and correlation coefficients. Cronbach's alpha coefficient was used to assess the reliability of the measures for entrepreneurship, innovation strategic orientation, open innovation behaviour and environmental dynamism. The KMO value and Bartlett's test of sphericity were used to assess the validity of these variables.

TABLE 2: Correlation analysis of variables (N = 329).

Variable	Mean	Standard deviation	1	2	3	4
1. Entrepreneurship risk-taking	2.570	0.94	-	-	-	-
2. Entrepreneurship anticipation	3.216	0.87	650**	-	-	-
3. Strategic orientation of innovation	3.190	1.00	642**	663**	-	-
4. Environmental dynamism	3.390	0.84	530**	624**	761**	-
5. Open innovation	3.310	0.84	574**	662**	667**	726**

**, Significantly correlated at the level of 0.01 (bilateral).

Reliability and validity test of each variable measurement scale

The exploratory factor analysis process commenced with performing the KMO Measure of Sampling Adequacy and Bartlett's test of sphericity on a set of items for each variable. Bartlett's test for sphericity yielded significant results (p = 0.000) for all measures (entrepreneurship, innovation strategic orientation, open innovation behaviour and environmental dynamism). The KMO values (ES1 and ES2 = 0.887; ISO = 0.756; OIB = 0.918 and ED = 0.884) indicated that the sample size was adequate for evaluating the factor structure. The process produced substantial Bartlett's test of sphericity values with KMO values above 0.6 for each item, confirming the data's suitability for factor analysis. Lastly, the alpha coefficients for ES1 (0.856), ES2 (0.843), ISO (0.906), OIB (0.944) and ED (0.920) were established. These values demonstrated high internal consistency, as reliability coefficients above 0.70 are considered acceptable (Lounsbury et al. 2019).

Descriptive statistical analysis results

Table 2 presents the descriptive statistical analysis of the variables involved in this study, displaying the mean value, standard deviation and correlation coefficients for each variable.

Table 2 illustrates the significant positive correlations between entrepreneurship and strategic orientation of innovation (r = 0.663, p < 0.01), environmental dynamism and strategic orientation of innovation (r = 0.761, p < 0.01) and open innovation and environmental dynamism (r = 0.726, p < 0.01). These findings provide initial support for the hypotheses tested in this study.

The significant correlations preliminarily verified the hypotheses. Additionally, the variance inflation factor (VIF) diagnostic was conducted for each variable entering the regression model before the regression analysis. All VIFs were found to be within 3.5, well below the threshold of 10, indicating no substantial multicollinearity among the variables.

The results of the reliability and validity tests, along with the descriptive statistical analysis, lay a solid foundation

for the subsequent hypothesis testing and discussion. These significant positive correlations align with the theoretical framework and provide initial evidence supporting the proposed relationships. The absence of multicollinearity ensures robust regression analysis, allowing for an accurate assessment of the hypothesised relationships.

This study tests the hypotheses using statistical techniques such as regression analysis and structural equation modeling, with findings interpreted in light of the existing literature and discussed in terms of their implications for theory and practice. The study's limitations and directions for future research will also be addressed, providing a comprehensive understanding of the impact of entrepreneurship on open innovation, with innovation strategic orientation as a mediator and environmental dynamism as a moderator.

Discussion

Hypothesis testing results

In this study, hierarchical regression is utilised to evaluate the aforementioned hypothesis. The findings are displayed in Table 3.

M1 is a regression model with entrepreneurship (risk-taking) and entrepreneurship (anticipation) as explanatory variables and strategic orientation of innovation as explained variables. The results of M1 show that the model F value is 45.41. Based on the significance test, the regression coefficient of explanatory variable entrepreneurship (risk-taking) on the strategic orientation of innovation is 0.343, which is significant at the 1% level. The regression coefficient of the explanatory variable, entrepreneurship (anticipation) on the strategic orientation of innovation is 0.495, which is significant at the 1% level, indicating that entrepreneurship has a positive impact on innovation strategy orientation. Hypotheses H2a and H2b are confirmed.

TABLE 3: Results of hierarchical regression (N = 329).

Variable	Strategic orientation of innovation (M1)	Open innovation behaviour		
		M2	M3	M4
Variable of control				
Years of service	0.05	0.03	0.04	0.02
Position	0.00	0.03	0.00	0.00
Year of establishment	0.02	0.00	0.01	0.01
Number of employees	0.08	0.03	0.00	0.03
Nature of the enterprise	0.01	0.12**	0.08	0.08
Industry	0.03	0.04	0.08	0.07
Explanatory variable				
Risk-taking	0.34 ***	-	0.21***	0.10**
Anticipation	0.49 ***	-	0.49***	0.33***
Mediating variable				
Strategic orientation of innovation	-	0.56***	-	0.31***
F	45.41 ***	38.82***	37.39 ***	42.99***
R^2	0.53	0.46	0.48	0.55

Note: Constant terms are not reported in Table 3.

*, Significantly correlated at the level of 0.05; **, Significantly correlated at the level of 0.01; ***, Significantly correlated at the level of 0.001.

M2 is a regression model with strategic orientation of innovation as the explanatory variable and open innovation behaviour as an explained variable. The results of M2 show that the model F value is 38.82. Based on the significance test, the regression coefficient of the explanatory variable, the strategic orientation of innovation on open innovation behaviour is 0.557, which is significant at the 1% level. It indicates that the strategic orientation of innovation has a positive impact on open innovation behaviour, and hypothesis H3 is proved.

M3 is a regression model with entrepreneurship (risk-taking) and entrepreneurship (anticipation) as explanatory variables and open innovation behaviour as explained variables. M3 results show that the model F value is 37.39. Based on the significance test, the regression coefficient of the explanatory variable, entrepreneurship (risk-taking) on open innovation behaviour is 0.212, which is significant at the 1% level. The regression coefficient of the explanatory variable, entrepreneurship (anticipation) on open innovation behaviour is 0.486, and it is significant at the 1% level, indicating that entrepreneurship has a positive impact on open innovation behaviour, and H1a and H1b are confirmed.

On the basis of M3, M4 is added into the strategic orientation of innovation variable to test the mediating effect of strategic orientation of innovation between entrepreneurship and open innovation behaviour. The results show that the participation performance of the explanatory variable remains at a significant level below 1% after adding the mediating variable. However, the regression coefficient of entrepreneurship (risk-taking) decreases from 0.212 to 0.105 and the regression coefficient of entrepreneurship (anticipation) decreases from 0.486 to 0.332. According to the test criteria of the mediation effect, it can be determined that the strategic orientation of innovation has a partial mediating effect on the relationship between participation in entrepreneurship and open innovation behaviour. That is, part of the positive effect of entrepreneurship on open innovation behaviour is realised through strategic orientation of innovation, which is confirmed by hypothesis H4.

Adjustment test: Adding the adjustment effect of environmental dynamism of the adjustment variable, the samples were divided into two groups: high environmental dynamism (N = 149) and low environmental dynamism (N = 180). The results show that environmental dynamism positively moderates the relationship between the strategic orientation of innovation and open innovation behaviour. In the group with higher environmental dynamism, the regression coefficient of strategic orientation of innovation is higher ($\beta = 0.428$, $p < 0.001$), indicating that the influence of strategic orientation of innovation on open innovation behaviour is stronger when the environmental dynamism is higher. Thus, H5 is confirmed. In addition, the moderating effects are graphed in Figure 4. It is found that the positive relationship between the strategic orientation of innovation and open innovation behaviour has a higher dynamic slope in high environment dynamism.

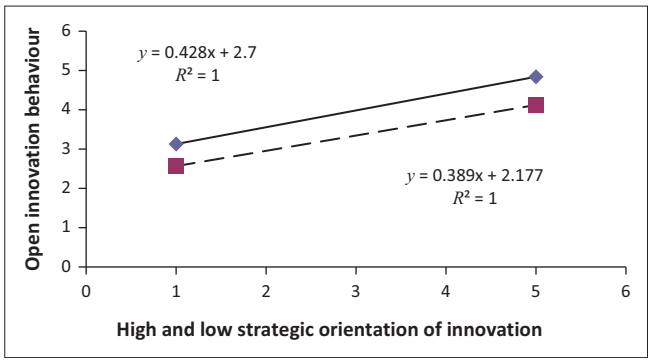


FIGURE 4: The moderating effect of environmental dynamism on the relationship between strategic orientation of innovation and open innovation behaviour.

Moreover, the slope of the former increases more significantly under high market orientation, which supports the test of H5 in this article.

Based on the empirical test results, the relationships for the constructs in the conceptual model are as follows:

- Entrepreneurial risk-taking has a positive impact on open innovation behaviour, and entrepreneurial anticipation has a positive impact on open innovation behaviour. Entrepreneurial risk-taking and entrepreneurial anticipation promote open innovation behaviour through different mechanisms, respectively. Valmohammadi et al. (2024) found that open innovation has a positive impact on Corporate Entrepreneurship in Iranian companies. However, in an emerging economy, Chaston and Scott (2012) found that entrepreneurship does not have a positive impact on open innovation when investigating the middle and senior management of Peruvian enterprises. Given the open nature of Chinese firms, the study draws a contrarian conclusion. On the one hand, entrepreneurs invest a large number of resources and time to seek innovation opportunities. These investments and efforts effectively improve enterprises' ability to create, use and reorganise new knowledge and to promote open innovation behaviour. Entrepreneurs, on the other hand, actively seek opportunities to introduce new products and services in the competition and anticipate future demands to create changes and shape the environment to promote open innovation behaviour.
- Entrepreneurial risk-taking has a positive impact on the strategic orientation of innovation, and entrepreneurial anticipation has a positive impact on the strategic orientation of innovation. He et al. (2024) came to similar conclusions, and they found that strategy innovation was very prone to change under the influence of entrepreneurship. An enterprise's strategic orientation of innovation plays a mediating role in the relationship between entrepreneurship and open innovation behaviour, that is, the influence of entrepreneurs' risk-taking and anticipation on open innovation behaviour is realised through strengthening the strategic orientation of innovation. Strategic orientation is defined as a strategic direction choice for enterprises to obtain a competitive advantage, while the strategic orientation of innovation is an enterprise's intention to participate in innovation, which determines the scope and intensity of innovation and ultimately helps improve innovation performance. This article embeds the strategic orientation of innovation into the relationship between entrepreneurship and open innovation, explaining how entrepreneurial risk-taking and entrepreneurial anticipation positively affect open innovation behaviour through a holistic strategic intent.
- Environmental dynamism will strengthen the impact of strategic orientation of innovation on open innovation behaviour that is, the higher the environmental dynamism, the stronger the positive effect of strategic orientation of innovation on open innovation behaviour. In other words, environmental dynamism intermediates a strong and favourable influence of innovation's strategic orientation on open innovation behaviour. The higher the degree of dynamic environment, the more significant the positive effect of entrepreneurial risk-taking and anticipation on open innovation behaviour. Environmental dynamics have a moderating effect on entrepreneur orientation, firms' performance, knowledge management and open innovation in most research (Ali 2017; Mammassis & Kostopoulos 2019; Martinez-Conesa et al. 2017). Moreover, the mediating effect of strategic orientation of innovation on open innovation behaviour is also moderated by environmental dynamism. The higher the environmental dynamism is, the stronger the strategic orientation of innovation in the mediating effect between entrepreneurial risk-taking and anticipation and open innovation behaviour.

The research findings show that entrepreneurial risk-taking and entrepreneurial anticipation have a positive impact on open innovation behaviour. Entrepreneurial risk-taking and entrepreneurial anticipation have a positive impact on the strategic orientation of innovation. An enterprise's strategic orientation of innovation plays a mediating role in the relationship between entrepreneurship and open innovation behaviour. Environmental dynamism will strengthen the impact of strategic orientation of innovation on open innovation behaviour. Small and medium-sized enterprises are the 'capillaries' of the Chinese economy, playing an important role in driving innovation, promoting employment and improving people's lives. The findings of this article extend the application of entrepreneurship, open innovation and strategic orientation of innovation research in the context of China's small and medium-sized high-tech enterprises, which is beneficial to fostering entrepreneurship in small and medium-sized high-tech enterprises and enhancing their understanding of the environment, such as the digital economy, artificial intelligence and the trend of reverse globalisation.

Limitations and future research

Limitations

Although this study has some limitations, it also points out the direction for future research. This article adopts the cross-sectional data of the current year of the

enterprise to verify the hypothesis proposed. Whereas the effectiveness of this method has been widely recognised, longitudinal data can be used to explore the evolution process of the relationship between the two in future research. In addition, the surveyed enterprises in this article are mainly distributed in Shandong, Beijing and Shanghai, and also the industry distribution is relatively dispersed. While many conditions are set in the process of questionnaire collection in the research design to ensure the effectiveness of the questionnaire, the external environment varies greatly among different regions and industries and therefore there are some differences in the innovation strategies and open innovation behaviours adopted.

Future research

Data should be collected on enterprises in specific industries that can be considered to improve the reliability of data results further. Furthermore, this article analyses the influence of entrepreneurship's risk-taking and anticipation dimensions on the strategic orientation of enterprise innovation and open innovation behaviour. The different moderating relationships between the innovation, cooperation and competitiveness of entrepreneurship on the technological knowledge and the advantage of new product development could be considered in the subsequent research.

Conclusion

Theoretical contributions

This article has focussed on small and medium-sized high-tech enterprises in China, exploring the influence of entrepreneurial spirit on open innovation behaviour, as well as the mediating and moderating effects of strategic orientation of innovation and environmental dynamism. Through empirical research, it is shown that entrepreneurs with risk-taking and anticipation adopt a wide-ranging and more in-depth approach to open innovation in order to obtain external technological resources as much as possible. Therefore, this article makes a significant contribution to the study of open innovation.

Firstly, by examining the role of entrepreneurship and strategic orientation of innovation in assisting enterprises' open innovation practices, this study contributes knowledge to the theoretical perspective. The resource-based view and the capability-based view are both expanded and improved by this work from a theoretical perspective. The innovation literature makes it clear that, even while organisational competencies are essential for achieving a competitive advantage, there is still room for improvement.

Secondly, this study expands on how open innovation can be used to boost a certain area of a firm's performance (operational) in order to gain a competitive edge. There is currently a dearth of research in the business world examining the relationship between entrepreneurship and open innovation on firm performance. As a result, the present study broadens the theoretical framework by examining how the strategic orientation of innovation towards entrepreneurship supports open innovation practices to improve the operational performance of organisations.

Thirdly, the research empirically examines the moderating impact of environmental dynamism on the relationship between entrepreneurial strategic orientation and open innovation-based environmental dynamism on company performance. The findings add to the body of literature on open innovation by showing that in the extremely dynamic setting of this study, the impact of open innovation on perceived operational performance will wane.

Practical and management implications

This study sheds some light on how open innovation behaviour is used in businesses highly dynamic settings. Therefore, based on the findings, the study presents the following practical implications.

Entrepreneurial risk-taking has a positive impact on open innovation behaviour, and entrepreneurial anticipation has a positive impact on open innovation behaviour. Entrepreneurial risk-taking has a positive impact on the strategic orientation of innovation, and entrepreneurial anticipation has a positive impact on the strategic orientation of innovation. An enterprise's strategic orientation of innovation plays a mediating role in the relationship between entrepreneurship and open innovation behaviour, that is, the influence of entrepreneurs' risk-taking and anticipation on open innovation behaviour is realised through strengthening the strategic orientation of innovation. Environmental dynamism will strengthen the impact of strategic orientation of innovation on open innovation behaviour, that is, the higher the environmental dynamism, the stronger the positive effect of strategic orientation of innovation on open innovation behaviour.

In order to improve enterprises' open innovation behaviour, entrepreneur' risk-taking and anticipation behaviour depend on enterprises' innovation strategy behaviour and the dynamic environment to adjust their efforts to promote open innovation behaviour. According to the research of this article and the discussion of the research conclusions, the more dynamic the environment, the more risk-taking and anticipation the entrepreneurs are. Thus, it is a more efficient strategy to positively influence open innovation behaviour by strengthening the strategic orientation of innovation. When the environment is less dynamic, the influence of innovation strategy orientation on open innovation behaviour becomes weakened, which guides entrepreneurs' risk-taking and anticipation behaviour to be more effectively influenced by other methods.

However, the relationship formulated between entrepreneurial risk-taking and entrepreneurial anticipation towards strategic

orientation is because of the growing integration of strategic anticipation and strategic entrepreneurship in businesses, despite data indicating the absence of a comprehensive framework, philosophical, theoretical and conceptual fundamentals of knowledge for strategic anticipation. Strategic anticipation helps to improve the elements that support entrepreneurs. The findings show that customer needs have been a major factor in the success of business entrepreneurship because meeting customer needs and wishes helps to improve the conditions for business entrepreneurship.

When the external dynamic environment of enterprises is high, entrepreneurs are supposed to strengthen the strategic orientation of innovation and expand the open innovation behaviour in order to improve the innovation performance of enterprises. However, when the external dynamic environment of enterprises is low, the positive influence of the strategic orientation of innovation on open innovation behaviour becomes weaker. Entrepreneurship should strengthen open innovation behaviour through other ways, so as to improve enterprise innovation performance. This is based on the study findings which reveal that entrepreneurship plays an influential role in organising and implementing open innovation practice in business. Therefore, according to this study, the influence of entrepreneurship is manifested through the entrepreneurial vision and entrepreneurial skills and capabilities of the entrepreneur.

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Competing interests

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Authors' contributions

S.L. is the first author of this article and was responsible for designing the framework, conceptualising the methodology and drafting the original manuscript. K.Z., the second author and corresponding author, conducted the formal analysis, managed the project and oversaw the validation process, among other responsibilities.

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Data availability

The data that support the findings of this study are available from the corresponding author, K.Z., upon reasonable request.

Disclaimer

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References

Ali, A.Y.S., 2017, 'Entrepreneur orientation and firms' performance: The moderating role of environmental dynamism', *International Journal of Economics, Business and Management Research* 1(5), 425–447.

Anderson, B.S., 2021, *Entrepreneurial orientation and strategic leadership: A behavioral approach*, Palgrave Macmillan, Cham.

Barney, J.B., 1986, 'Organizational culture: Can it be a source of sustained competitive advantage?', *Academy of Management Review* 11(3), 656–665. https://doi.org/10.5465/amr.1986.4306261

Bianchi, M., Cavaliere, A., Chiaroni, D., Frattini, F. & Chiesa, V., 2011, 'Organisational modes for open innovation in the bio-pharmaceutical industry: An exploratory analysis', *Technovation* 31(1), 22–33. https://doi.org/10.1016/j.technovation.2010.03.002

Blume, T., 2020, *New taxonomy for corporate open innovation initiatives: Best practices and an empirical validation among Germany's 500 biggest companies*, 1st edn., Springer Fachmedien Wiesbaden Imprint Springer Gabler.

Bourgeois, III, L.J., 1980, 'Strategy and environment: A conceptual integration', *Academy of Management Review* 5(1), 25–39. https://doi.org/10.2307/257802

Chan, L.L. & Idris, N., 2017, 'Validity and reliability of the instrument using exploratory factor analysis and Cronbach's alpha', *International Journal of Academic Research in Business and Social Sciences* 7(10), 400–410. https://doi.org/10.6007/IJARBSS/v7-i10/3387

Chaston, I. & Scott, G.J., 2012, 'Entrepreneurship and open innovation in an emerging economy', *Management Decision* 50(7–8), 1161–1177. https://doi.org/10.1108/00251741211246941

Chen, H., Zang, S. & Luo, X., 2017, 'Application analysis of open innovation model based on entrepreneurship', *Business Economics Research* 23, 102–104.

Chen, X., He, J., Wu, K. & Han, G., 2024, 'Research on the impact of entrepreneurial spirit on dual innovation and firm growth under the moderating effect of digitization level: Evidence from technology-based SMEs', *Journal of Beijing Union University* 22(6), 1–16. https://doi.org/10.2139/ssrn.4858472

Cheng, C.C. & Shiu, E.C., 2015, 'The inconvenient truth of the relationship between open innovation activities and innovation performance', *Management Decision* 53(3), 625–647. https://doi.org/10.1108/MD-03-2014-0163

Chesbrough, H., 2006, *Open business models: How to thrive in a new innovation landscape*, Harvard Business School Press, Boston, MA.

Chesbrough, H., 2017, 'The future of open innovation: The future of open innovation is more extensive, more collaborative, and more engaged with a wider variety of participants', *Research-Technology Management* 60(1), 35–38. https://doi.org/10.1080/08956308.2017.1255054

Chesbrough, H.W., 2020, *Open innovation results: Going beyond the hype and getting down to business*, 1st edn., Oxford University Press.

Cho, Y.H. & Lee, J.H., 2018, 'Entrepreneurial orientation, entrepreneurial education, and performance', *Asia Pacific Journal of Innovation and Entrepreneurship* 12(2), 124–134. https://doi.org/10.1108/APJIE-05-2018-0028

Conboy, K. & Morgan, L., 2011, 'Beyond the customer: Opening the agile systems development process', *Information and Software Technology* 53(5), 535–542. https://doi.org/10.1016/j.infsof.2010.10.007

Davidsson, P., Delmar, F. & Wiklund, F., 2017, 'Strategic entrepreneurship: Creating a new mindset', in M.A. Hitt, R.D. Ireland, M.C. Camp & D.L. Sexton (eds.), *Entrepreneurship as growth: Growth as entrepreneurship*, pp. 328–342. John Wiley & Sons.

Dess, G.G. & Beard, D.W., 1984, 'Dimensions of organizational task environments', *Administrative Science Quarterly* 29(1), 52–73. https://doi.org/10.2307/2393080

Endres, H., 2017, *Adaptability through dynamic capabilities: How management can recognize opportunities and threats*, Springer Fachmedien Wiesbaden, viewed 28 February 2023, from https://public.ebookcentral.proquest.com/choice/publicfullrecord.aspx?p=5143544.

Gassmann, O., Enkel, E. & Chesbrough, H., 2010, 'The future of open innovation', *R&d Management* 40(3), 213–221. https://doi.org/10.1111/j.1467-9310.2010.00605.x

Goll, I., Brown Johnson, N. & Rasheed, A.A., 2007, 'Knowledge capability, strategic change, and firm performance: The moderating role of the environment', *Management Decision* 45(2), 161–179. https://doi.org/10.1108/00251740710727223

Harel, R., Schwartz, D. & Kaufmann, D., 2021, 'The relationship between innovation promotion processes and small business success: The role of managers' dominance', *Review of Managerial Science* 15, 1937–1960. https://doi.org/10.1007/s11846-020-00409-w

He, K., Bouncken, R.B., Kiani, A. & Kraus, S., 2024, 'The role of strategic orientations for digital innovation: When entrepreneurship meets sustainability', *Technological Forecasting and Social Change* 205, 123503.

Heracleous, L. & Bartunek, J., 2021, 'Organization changes failure, deep structures, and temporality: Appreciating wonderland', *Human Relations* 74(2), 208–233. https://doi.org/10.1177/0018726720905361

Hisrich, R.D. & Ramadani, V., 2017, 'Foundation of entrepreneurial management', in *Effective entrepreneurial management*, pp. 1–15, Springer, Cham.

Hossain, M., 2013, 'Open innovation: So far and away forward', *World Journal of Science, Technology and Sustainable Development* 10(1), 30–41. https://doi.org/10.1108/20425941311313083

Hung, K.P. & Chou, C., 2013, 'The impact of open innovation on firm performance: The moderating effects of internal R&D and environmental turbulence', *Technovation* 33(10–11), 368–380. https://doi.org/10.1016/j.technovation.2013.06.006

Jantunen, A., 2005, 'Knowledge-processing capabilities and innovative performance: An empirical study', *European Journal of Innovation Management* 8(3), 336–349. https://doi.org/10.1108/14601060510610199

Kennard, M., 2022, *Innovation and entrepreneurship*, Routledge Taylor & Francis Group.

Kickul, J. & Gundry, L., 2002, 'Prospecting for strategic advantage: The proactive entrepreneurial personality and small firm innovation', *Journal of Small Business Management* 40(2), 85–97. https://doi.org/10.1111/1540-627X.00042

Kim, Y., Roh, T. & Boroumand, R.H., 2024, 'Resource recombination perspective on open eco-innovation: Open innovation type, strategic orientation, and green innovation', *Business Strategy and the Environment* 33(7), 1–14. https://doi.org/10.1002/bse.3806

Landstrom, H., Fayolle, A. & Santos, S.C., 2017, *The emergence of entrepreneurial behavior: Intention education and orientation*, Edward Elgar Publishing, Cheltenham.

Li, J., Li, Y. & Xie, L., 2024, 'Schumpeter in the digital age: Entrepreneurship and technological diffusion', *Journal of Technology Economics* 43(9), 44–55.

Lichtenthaler, U., 2008, 'Integrated roadmaps for open innovation', *Research-Technology Management* 51(3), 45–49. https://doi.org/10.1080/08956308.2008.11657504

Liu, S., Zhou, Q., Huang, T. & Liu, X., 2008, 'Research on the relationship between corporate strategy, human resource management system and corporate performance', *China Management Science* 3, 181–192.

Lorsch, J.W., 1986, 'Managing culture: The invisible barrier to strategic change', *California Management Review* 28(2), 95–109. https://doi.org/10.2307/41165187

Lounsbury, M., Cornelissen, J., Granqvist, N. & Grodal, S., 2019, 'Culture, innovation, and entrepreneurship', *Innovation* 21(1), 1–12.

Mammassis, C.S. & Kostopoulos, K.C., 2019, 'CEO goal orientations, environmental dynamism and organizational ambidexterity: An investigation in SMEs', *European Management Journal* 37(5), 577–588. https://doi.org/10.1016/j.emj.2019.08.012

Martinez-Conesa, I., Soto-Acosta, P. & Carayannis, E.G., 2017, 'On the path towards open innovation: Assessing the role of knowledge management capability and environmental dynamism in SMEs', *Journal of Knowledge Management* 21(3), 553–570. https://doi.org/10.1108/JKM-09-2016-0403

Mazzarol, T. & Reboud, S., 2017, *Entrepreneurship and innovation*, Tilde Publishing, Melbourne.

Milton, K., Bull, F.C. & Bauman, A., 2011, 'Reliability and validity testing of a single-item physical activity measure', *British Journal of Sports Medicine* 45(3), 203–208. https://doi.org/10.1136/bjsm.2009.068395

Mohammad, H.I., 2019, 'Mediating effect of organizational learning and moderating role of environmental dynamism on the relationship between strategic change and firm performance', *Journal of Strategy and Management* 12(2), 275–297. https://doi.org/10.1108/JSMA-07-2018-0064

Morgan, T., Obal, M. & Jewell, R.D., 2021, 'Strategic change and innovation reputation: Opening up the innovation process', *Journal of Business Research* 132, 249–259. https://doi.org/10.1016/j.jbusres.2021.03.055

Nambisan, S., Siegel, D. & Kenney, M., 2018, 'On open innovation, platforms, and entrepreneurship', *Strategic Entrepreneurship Journal* 12(3), 354–368. https://doi.org/10.1002/sej.1300

Nasution, H.N., Mavondo, F.T., Matanda, M.J. & Ndubisi, N.O., 2011, 'Entrepreneurship: Its relationship with market orientation and learning orientation and as antecedents to innovation and customer value', *Industrial Marketing Management* 40(3), 336–345. https://doi.org/10.1016/j.indmarman.2010.08.002

Qureshi, N.A., 2018, *How entrepreneurs are managing open innovation in SMEs*, Halmstad University, Halmstad.

Rainey, D.L., 2010, *Sustainable business development: Inventing the future through strategy, innovation, and leadership*, Cambridge University Press, Cambridge.

Rezaei, J. & Ortt, R., 2018, 'Entrepreneurial orientation and firm performance: The mediating role of functional performances', *Management Research Review* 41(7), 878–900. https://doi.org/10.1108/MRR-03-2017-0092

Rua, O.L., 2018, *Entrepreneurial Orientation and Opportunities for Global Economic Growth*, IGI Global.

Santoro, G., Ferraris, A., Giacosa, E. & Giovando, G., 2018, 'How SMEs engage in open innovation: A survey', *Journal of the Knowledge Economy* 9(2), 561–574. https://doi.org/10.1007/s13132-015-0350-8

Schilke, O., 2014, 'On the contingent value of dynamic capabilities for competitive advantage: The nonlinear moderating effect of environmental dynamism', *Strategic Management Journal* 35(2), 179–203. https://doi.org/10.1002/smj.2099

Schumpeter, J.A., 2017, *Essays: On entrepreneurs, innovations, business cycles and the evolution of capitalism*, Routledge.

Scuotto, V., Del Giudice, M., Bresciani, S. & Meissner, D., 2017, 'Knowledge-driven preferences in informal inbound open innovation modes. An explorative view on small to medium enterprises', *Journal of Knowledge Management* 21(3), 640–655. https://doi.org/10.1108/JKM-10-2016-0465

Song, H.J. & Kang, K.H., 2019, 'The moderating effect of CEO duality on the relationship between geographic diversification and firm performance in the US lodging industry', *International Journal of Contemporary Hospitality Management* 31(3), 1488–1504. https://doi.org/10.1108/IJCHM-12-2017-0848

Staller, T. & Kirschke, C., 2021, *Personality assessment with id37: Motivation and the ability to self-direct*, Springer.

Ting, H.F., Wang, H.B. & Wang, D.S., 2012, 'The moderating role of environmental dynamism on the influence of innovation strategy and firm performance', *International Journal of Innovation, Management, and Technology* 3(5), 517. https://doi.org/10.7763/IJIMT.2012.V3.288

Usman, M. & Vanhaverbeke, W., 2017, 'How start-ups successfully organize and manage open innovation with large companies', *European Journal of Innovation Management* 20(1), 171–186. https://doi.org/10.1108/EJIM-07-2016-0066

Valmohammadi, C., Sadeghi, M., Taraz, R. & Mehdikhani, R., 2024, 'Business analytics, corporate entrepreneurship, and open innovation', *Management Decision* 62(6), 1977–2001. https://doi.org/10.1108/MD-04-2023-0502

Volberda, H.W. & Van Bruggen, G.H., 1997, *Environmental turbulence: A look into its dimensionality*, Erasmus Institute of Research and Management, viewed 18 January 2019, from http://hdl.handle.net/1765/6438.

Walsh, G.S. & Cunningham, J.A., 2016, 'Business failure and entrepreneurship: Emergence evolution and future research', *Foundations and Trends in Entrepreneurship* 12(3), 1–285. https://doi.org/10.1561/0300000063

West, J. & Bogers, M., 2014, 'Leveraging external sources of innovation: A review of research on open innovation', *Journal of Product Innovation Management* 31(4), 814–831. https://doi.org/10.1111/jpim.12125

Wijbenga, F.H. & Van Witteloostuijn, A., 2007, 'Entrepreneurial locus of control and competitive strategies–The moderating effect of environmental dynamism', *Journal of Economic Psychology* 28(5), 566–589. https://doi.org/10.1016/j.joep.2007.04.003

World Economic Forum, 2020, *World economic situation and prospects 2020*, United Nations, viewed 28 February 2023, from https://www.vlebooks.com/vleweb/product/openreader?id=none&isbn=9789213583296.

Zahra, S.A., 1996, 'Governance, ownership, and corporate entrepreneurship: The moderating impact of industry technological opportunities', *Academy of Management Journal* 39(6), 1713–1735. https://doi.org/10.2307/257076

Zhang, M., 2020, 'Will resource patchwork inhibit entrepreneurship?', *Research in Science of Science of Science* 38(5), 121–129.

Zhang, Z., Chen, Z. & Li, Y., 2015, 'Research on the relationship between open innovation, absorptive capacity, and innovation performance', *Science Research Management* 36(3), 49–56.

Zhou, Y., Shu, C., Jiang, W. & Gao, S., 2019, 'Green management, firm innovations, and environmental turbulence', *Business Strategy and the Environment* 28(4), 567–581. https://doi.org/10.1002/bse.2265