Turning entrepreneurial networks into business model innovation for start-ups: A moderated mediation model

Abstract

Purpose - Although it is acknowledged that entrepreneurial networks play a crucial role in fostering business model innovation (BMI) for start-ups, it is unclear how and when these networks affect BMI. The purpose of this research was to develop a moderated mediation model to explore the impact of entrepreneurial networks on BMI in start-ups and to examine the dual mediating effects of causality and effectuation, as well as the moderation of environmental dynamism.

Design/methodology/approach - The proposed framework was tested by hierarchical regression analyses and bootstrapping using samples of 248 start-ups in China.

Findings - The results show that entrepreneurial networks have a significant positive impact on start-up BMI. Causation and effectuation play dual mediating effects between entrepreneurial networks and BMI. Furthermore, the entrepreneurial networks-effectuation-BMI association is stronger in highly dynamic environments whereas the entrepreneurial networks-causation-BMI relationship is unaffected.

Research implications - There are several theoretical contributions resulting from this research. First, the findings offer new insights for understanding the antecedents of start-up BMI. Second, this research adds to the growing literature on resource orchestration (RO) by exploring the dual mediating influences of causation and effectuation in resource management. Third, this research revealed the boundary condition between entrepreneurial networks and BMI by testing the moderating influence of environmental dynamism.

Practical implications - First, startups must effectively use external resources embedded within networks to advance BMI. Second, start-up entrepreneurs should apply causation and effectuation to transform entrepreneurial network resources into BMI. Third, start-up entrepreneurs must dynamically manage resources in response to ever-changing environmental conditions. Resource acquisition and management of entrepreneurial networks can vary significantly in their influence on start-up BMI under different environmental contexts.

Originality/value - First, unlike previous BMI research focused on internal organizational factors, this study highlights the critical importance of entrepreneurial networks as a prerequisite for achieving start-up BMI, contributing to the literature on open innovation and RBV. Second, examining the dual mediating roles of causation and effectuation illustrates the bridging role of strategic decision-making logic in connecting resources to value creation, contributing to the developing RO literature. Third, it explores the moderating influence of environmental dynamism, clarifying how start-up BMI benefit from entrepreneurial networks in differing situations. It also provides a framework for reconciling contradictory findings concerning the association between entrepreneurial networks and innovation.

Keywords Entrepreneurial networks; causation; effectuation; business model innovation; environmental dynamism; resource orchestration

1. Introduction

Business model innovation (BMI), encompassing comprehensive innovation of a firm' boundary-spanning activity systems for value creation and capture, has gained increasing attention due to its potential to boost organizational competitiveness (Amit & Zott, 2015; Casadesus-Masanell & Zhu, 2013). With the advancement of digital technologies and more open markets, firm boundaries have become increasingly blurred. The locus of value creation has shifted from focal firms to inter-organizational networks (Fernandes & Ferreira, 2021; Wang et al., 2020). In the era of open innovation, firms are urged to go beyond organizational boundaries to redesign business models especially for start-ups, which are short of critical resources on their own to address the demands of BMI (Albats et al., 2021). For instance, Uber applies the car-sharing model to become a disruptor in the field of transportation, Pinduoduo relies on the business model of group-buying prices to become popular social e-commerce, and Facebook maintains development through its social networking platform. Co-creating value with stakeholders from entrepreneurial networks is thus a new trend for start-up BMI (Chesbrough et al., 2018).

Although scholars are increasingly recognizing that start-up BMI is embedded in entrepreneurial networks, the BMI research literature from the network perspective is still insufficient. Prior BMI research has primarily been firm-centric and identifies internal resources, including managerial cognition, entrepreneurship, dynamic capability, and organizational characteristics, as significant determinants driving BMI (Foss & Saebi, 2017; Martins et al., 2015; Zhang et al., 2021). Only a few qualitative and case-based research studies

have been conducted on the association between external networks and BMI (Chesbrough, 2010; Spieth et al., 2021; Xu et al., 2022). Scholars are calling for expanding the BMI research beyond the firm level (Amit & Zott, 2015). For example, Dymitrowski and Mielcarek (2023) indicated that the impact of external networks on BMI is certainly worth exploring. Guo et al. (2013) argued that BMI should be considered as a firm's purposely constructed collaboration network. Similarly, Yi et al. (2022) pointed out that BMI is the result of joint efforts by several partners. In addition, the findings on the link between entrepreneurial networks and innovation are mixed (Partanen et al., 2020; van Burg et al., 2022). Some studies showed that entrepreneurial networks are essential strategic resources, positively impacting innovation (Gao et al., 2023; Yu et al., 2022b). Others have determined that being over-embedded in networks constrains new entrants, insulates firms from novel ideas, and limits the development of BMI (Kerr & Coviello, 2020; Yu et al., 2022b). Hence, testing the impact of entrepreneurial networks on BMI represents a significant empirical research gap.

Furthermore, the "black box" of entrepreneurial networks' role in advancing start-up BMI must be found and opened. Most existing research focuses on the direct impacts of entrepreneurial networks, failing to reveal the pathways for facilitating BMI with resource management (Frankenberger & Stam, 2020). Based on resource orchestration (RO) theory, resources are insufficient for start-up BMI. Instead, entrepreneurs must manage resources efficiently and transform them into outputs (D'Oria et al., 2021; Stam et al., 2014). Resource management of entrepreneurs for start-up BMI involves structuring, bundling and leveraging resources effectively, resulting in higher performance (White et al., 2022). In this process, the role of entrepreneurial decision-making logic is emphasized in taking actions to manage resources (Ndofor et al., 2011). Entrepreneurial decision-making logic reflects the entrepreneurs' cognitive perceptions and behavioural patterns. It determines how start-ups strategically integrate and utilize acquired network resources, activating and transforming them into BMI (Badrinarayanan et al., 2019; Sirmon et al., 2011). BMs are innovated when entrepreneurs deploy external and internal resources to create value (White et al., 2022). Hence, decision-making logic is a crucial missing link in the start-up entrepreneurial networks-BMI relationship (Karami & Tang, 2021).

Causation and effectuation provide guidance entrepreneurs for performing resource management in BMI effectively (Alzamora-Ruiz, Fuentes-Fuentes, et al., 2021; Reymen et al., 2017; Yang et al., 2020). In particular, causation is a planning-oriented strategy that focuses on maximizing the value of resources to achieve goals, while effectuation is an action-oriented strategy that focuses on the flexibility of using resources, combining available resources to

control outcomes through trial and error and experimentation (Guo et al., 2016; Sarasvathy, 2001; Wiltbank et al., 2006). As two parallel but non-conflicting strategic decision-making, both logics help start-ups to advance innovation and growth and should be employed by entrepreneurs simultaneously (Alzamora-Ruiz et al., 2020; Zhang et al., 2020b). However, prior researches focus on effectuation while ignoring the influence of causation, lacking empirical research on the links between causation and effectuation and BMI (Yang et al., 2021). Hence, it is necessary to explore how entrepreneurial networks (resource acquisition) affect causation and effectuation (resource management) and thus impact BMI.

Additionally, the impact of entrepreneurial networks on start-up BMI under different environmental contexts remains unclear (White et al., 2022). RO theory suggests that organizational resource management is contingent on certain boundary contexts (Sirmon et al., 2007). The effect of network resource acquisition and management for BMI under different environments can vary significantly (Zhang et al., 2020a). As a result, start-ups should focus on aligning network resource acquisition and strategic decision-making in dynamic environments (Cui et al., 2022; Sirmon et al., 2007). For example, in a highly dynamic environment, the turbulent market forces start-ups to rely more on entrepreneurial networks for new information and resources (Teece, 2018; Zhang et al., 2020a). Such complex context shapes entrepreneurs' actions of acquiring, evaluating, and deploying network resources (White et al., 2022). Entrepreneurs must integrate and utilize network resources with different strategic decision-making to advance BMI (Popa et al., 2017). Therefore, exploring the moderating role of environmental dynamism helps to clarify how BMI benefits from entrepreneurial networks through causation and effectuation in various environments.

The contribution of this research is as follows. First, unlike prior BMI research focused on internal resources from a firm-centric perspective, this investigation highlights the critical importance of external network resources for achieving start-up BMI. It adds value to the understanding of open innovation and RBV. Second, this research contributes to the growing literature on RO theory by exploring the dual mediating influences of causation and effectuation in resource management. It also contributes to resource-based theories by bridging the role of strategic decision-making in connecting network resources to value creation. Third, it investigates the moderating role of environmental dynamism, exploring the boundary condition of entrepreneurial networks in start-ups.

2. Theoretical overview

2.1. Business model innovation for start-ups

A business model (BM) is a boundary-spanning activity system designed to create and capture value (Amit & Zott, 2001; Zott & Amit, 2010). It determines how firms "do business" with suppliers, partners and customers (Zott & Amit, 2007). To capture value, firms need to create a boundary-spanning network with external partners (Wang et al., 2017; Zott & Amit, 2013). BM design has three core elements: content, structure, and governance. Content is concerned with determining which activities should be performed by the local firm and by outside actors. Structure outlines how these activities are linked for BM. Governance describes to whom and where activities need to be performed (Zott & Amit, 2010). Thus, start-ups can promote BMI by adding new activities and resources (novel content), connecting activities or resources in novel ways (novel structure), or bringing in stakeholders to undertake specialized activities (novel governance) (Amit & Zott, 2020; Snihur & Zott, 2020).

Although BMI is a key tool for start-ups to overcome path constraints and obtain a competitive edge, only a few are successful. Start-up BMI often faces unique issues because of being new and small. First, start-ups are short of critical resources to meet the needs of BMI on their own. Prior research suggests that firms can acquire external resources and foster innovation through mergers and acquisitions, purchases and collaboration (Teece, 2018). However, as start-ups usually lack reputation and business history, it can be difficult to obtain resources through these methods (Gao et al., 2023). Second, when attempting to make BMI decisions, start-ups face significant uncertainty and constantly shifting settings. Start-ups lack essential information and expertise as compared to established organizations, and their innovation process is marked by the need to decide and act in the face of dynamic circumstances (Alzamora-Ruiz, del Mar Fuentes-Fuentes, et al., 2021). Therefore, overcoming resource limits to foster start-ups' BMI in dynamic contexts is an essential research issue.

2.2. Entrepreneurial networks and business model innovation

The resource-based view (RBV) suggests that resources are at the centre of any business model (Demil et al., 2015). Start-ups are short of critical assets on their own (Albats et al., 2021). To access resources for BMI, start-ups need to engage with external partners from entrepreneurial

networks to compensate for a lack of internal resources and skills (Xu et al., 2023). By leveraging these networks, start-ups acquire supplementary and diverse resources to achieve disruptive innovation (Ndofor et al., 2011; Yu et al., 2022a). Participation in entrepreneurial networks is critical for overcoming weaknesses and increasing the success of start-up BMI (Felicetti et al., 2023).

Entrepreneurial networks are external resources characterized by the relationships and connections that exist between entrepreneurs and external parties (Hoang & Antoncic, 2003; Ye et al., 2020). Given that BMI encompasses multiple boundary-spanning activities and necessitates external resources, the success of start-ups is intricately linked to their proficiency in effectively generating and leveraging value from entrepreneurial networks (Chesbrough, 2010). BMI can benefit from entrepreneurial networks in several ways. First, entrepreneurial networks facilitate the allocation of diverse resources and allow BMI to support and benefit from spillover resources. Embedded within entrepreneurial networks, companies can gain valuable resources (Batjargal et al., 2013), emotional support (Gao et al., 2021), and organizational legitimacy (Yu et al., 2017). Second, inter-organizational cooperation enhances learning and BMI by circulating novel ideas, knowledge, and resources. The exchange of resources allows partners to learn more quickly, improve the integration of resources and capacities for better innovation, and facilitate BMI (Scott et al., 2022; Zardini et al., 2020). Therefore, entrepreneurial networks can be a facilitator of BMI, and it was hypothesized that:

H_1: Entrepreneurial networks relate positively to BMI

2.3. Influence of causation and effectuation on business model innovation

When beginning to create a BM, entrepreneurs need to make decisions that influence start-up innovation. Causation and effectuation, as two basic decision-making logics, impact the choices of resource management methods in start-up BMI (Alzamora-Ruiz, Fuentes-Fuentes, et al., 2021; Futterer et al., 2018; Guo et al., 2020; Sarasvathy, 2001; Yang et al., 2021). Causation is a plan-oriented strategy. It focuses on established plans and aims at predicting uncertain futures. The principles of causation include establishing goals, profit maximization, competitive analysis, and avoiding surprises (Brettel et al., 2012). Thus, causation enables the efficient and effective management of limited resources in start-up BMI. In contrast, with effectuation, entrepreneurs argue that drawing statistical inferences and calculating expected returns in uncertain environments poses a significant challenge due to the absence of information about probabilities and outcomes (Sarasvathy, 2001). They emphasize

experimentation, limiting affordable losses, leveraging pre-commitments, and implementing flexibility to co-create with stakeholders (Perry et al., 2012). Thus, effectuation encourages the combination of available resources creatively to control outcomes through trial and error and experimentation.

Despite the differences between causation and effectuation, scholars suggest that the two logics coexist within start-ups rather than being mutually exclusive (Galkina et al., 2021), and the use of both leads to superior BMI (Reymen et al., 2015). For example, Sarasvathy (2001) and Lingelbach et al. (2015) indicated that causation and effectuation could coexist in the innovation process. Laine and Galkina (2017) suggested that entrepreneurs must use both simultaneously to thrive in dynamic institutional contexts. Futterer et al. (2018) demonstrated that both logics advance BMI in moderate industry growth conditions. Shirokova et al. (2021) agreed that entrepreneurs should employ both in the venture-creating process and are both positively related to performance.

2.3.1. Influence of causation on BMI

Although its significance, the causation-BMI linkage has attracted relatively little discussion in entrepreneurship literature (Futterer et al., 2018; Laskovaia et al., 2017). Studies on rational decision-making, closely related to causation, support this linkage. These studies demonstrate that conventional strategies, such as meticulous planning, rigorous data analysis, and comprehensive market research, can significantly advance firms' innovation and performance (Brinckmann & Kim, 2015; Peng et al., 2020).

Causation advances BMI for start-ups in several ways. First, setting goals helps entrepreneurs focus their efforts and take steps toward achieving BMI. Stable and clear goals provide quality and dependability in innovation (Salomo et al., 2007). Furthermore, a well-written business plan enhances a firm's legitimacy by enabling entrepreneurs to effectively communicate the feasibility of BMI to stakeholders (Smolka et al., 2018). Second, focusing on profit maximization provides a significant impetus to overcome the new venture bias and advances effective resource exploitation (Chandler et al., 2011). Significant return expectations necessitate challenging current business models (BMs) in customer service, internal and external design processes, and profit generation (Futterer et al., 2018). Third, competitive analysis facilitates access to vital information to advance BMI (Reymen et al., 2015). By monitoring and analyzing market potential market demand (Brettel et al., 2012), start-ups identify critical opportunities for creating and modifying their BMs (Chandler et al., 2011; Dutta et al., 2015; Parida et al., 2016). Finally, avoiding uncertainty enables the identification

of significant risks and improves downside returns (Peng et al., 2020). Start-ups in preventing contingencies encourage entrepreneurs to closely monitor the external environment, reducing uncertainty and creating the upfront potential for innovative BMs. Therefore, it was hypothesized that:

H_2: Causation relates positively to BMI

2.3.2 Influence of effectuation on BMI

Effectual entrepreneurs consider BMI the outcome of iterative learning through trial and error, highlighting the significance of experimenting with BMs (Andries et al., 2020; Chesbrough, 2010). The key to implementation is that the start-ups do not operate with specific BMs, but goals are created through interactions between the start-ups and network participants (Reymen et al., 2017). Empirical research has indicated that effectuation is a critical prerequisite for promoting start-ups BMI (Xu et al., 2022).

According to the entrepreneurship literature, the application of the principles of effectuation promotes start-up BMI. First, entrepreneurs explore various approaches and resources for leveraging BMI through experimentation. Entrepreneurial and innovative activities are a series of experiments to achieve specific goals. Entrepreneurs use trial-and-error methods to assess diversification opportunities, reshape resources, and control losses to a minimum range (Chesbrough, 2010). Second, affordable losses limit innovation's downside risks while encouraging entrepreneurs to capitalize on the unpredictability of new opportunities at a lower cost. Implementing trial-and-error approaches within budget and time constraints minimizes the risk of entrepreneurs suffering significant losses from investment failures in BMI (Smolka et al., 2018). Furthermore, it also helps keep costs under control, creating better opportunities for future performance and growth of BMI (Ruiz-Jimenez et al., 2021). Third, flexibility ensures start-ups maintain sensitivity and thus begin BMI projects with less time and resources to capture potential opportunities (Sarasvathy, 2001; Wiltbank et al., 2006). In addition, flexibility promotes experimentation and improvisation. These innovative activities are widely recognized as a source of innovation. Lastly, pre-commitment provides complementarity of resources, enables cost savings, and reduces uncertainty by sharing risks in the BMI process (Tanriverdi & Venkatraman, 2005). Therefore, we propose that:

H_3: Effectuation relates positively to BMI

2.4. Dual mediating effects of causation and effectuation

Building on resource orchestration (RO) theory, scholars emphasize the significance of effective resource management for generating value from existing resources (Sirmon et al., 2011). It indicated that resource acquisition is insufficient, and better outcomes are achieved only by fully managing resources (D'Oria et al., 2021; Partanen et al., 2020). As entrepreneurs typically have limited resources when starting a new business and BMI, the outcomes of BMI greatly depend on their decisions to manage resources in a value-creating manner (Ruiz-Jimenez et al., 2021). Therefore, strategic decision-making plays a vital role in resource management (Ndofor et al., 2011).

Strategic decision-making influences how network resources are managed, resulting in various outcomes (Galkina & Jack, 2021). The construction, capture, and utilization of network resources can play a crucial role in planning activities and dealing with unexpected situations, ultimately leading to achieving goals (Alzamora-Ruiz et al., 2021). Causation and effectuation enable effective resource management from entrepreneurial networks in BMI (H. Guo et al., 2016). In addition, organizational resources are the foundation of decision-making logic (Guo et al., 2020; Servantie & Rispal, 2018). Therefore, causation and effectuation are potential mediators for linking entrepreneurial networks and BMI.

2.4.1. Mediating effect of causation

Causal entrepreneurs apply a planning-oriented strategy for resource management to achieve goals (An et al., 2020). During resource integration, start-ups establish long-term goals and plans, focus on competitive analysis and forecasting, and select and combine network resources to maximize profits and BMI.

The linkage of entrepreneurial networks-BMI may be mediated by causation in the following ways. First, causation helps start-ups to enhance network connections to acquire the resources needed to achieve BMI. By adopting causation, entrepreneurs build entrepreneurial networks with rational logic because they are driven by defined goals and planning (Galkina & Jack, 2021). Specific and comprehensive business plans help stakeholders comprehend start-ups' visions and potentials better and improve organizational legitimacy, creating resources and support (Brinckmann & Kim, 2015). Second, causation helps start-ups to make good use of network resources to advance BMI with the guidance of set goals. Business plans and high return expectations serve as motivators for entrepreneurs to make decisions effectively and efficiently, allocate resources and make quick decisions (Laskovaia et al., 2017). These activities require entrepreneurs to actively gather details about market dynamics and

environmental information and develop an in-depth knowledge of network resources, resulting in improved BMI. Hence, we argued that:

H_4: The link of entrepreneurial networks to BMI is mediated by causation.

2.4.2. Mediating effects of effectuation

Effectuation is an action-oriented strategy that focuses on the flexibility of using resources. It emphasizes short-term goals that can be met with the available resources, integrating network resources by experimentation to achieve BMI (Deligianni et al., 2020; Mansoori & Lackéus, 2019). In addition, start-ups control losses during the innovation process by making commitments with stakeholders to reduce the possibility of failure, thus fully utilizing the value of resources in BMI.

The link of entrepreneurial networks to BMI is mediated by effectuation as follows. To begin with, effectual entrepreneurs promote experimentation with all available resources to enhance BMI. Effectual entrepreneurs' actions are based on the current means. They tend to conduct network resource combinations creatively through experimentation (Smolka et al., 2018). This generates novel opportunities from entrepreneurial networks, often leading to the adjustment of BMs. Second, the principle of affordable losses advances BMI by restricting costs and maximizing the value of network resources. Making small investments within resource constraints contributes to experimental creativity in a low-cost manner for BMI (Galkina & Chetty, 2015; Sarasvathy, 2001). Third, entrepreneurs with flexibility can take advantage of contingencies. While often unexpected and surprising, such contingencies may serve as catalysts for generating innovative and productive resource combinations. Embracing contingencies proves to be one path to innovation (Read et al., 2009). Finally, stakeholder pre-commitments help entrepreneurs obtain material and emotional assistance and support from entrepreneurial networks. As a result, it was proposed that:

H_5: The link of entrepreneurial networks to BMI is mediated by effectuation.

2.5. Moderating effects of environmental dynamism

RO theory identifies environmental dynamism as a crucial factor for success in resource management (Mura et al., 2014). Environmental dynamism denotes the unpredictability and frequency of changes in the market and technological landscapes of external contexts (Dess & Beard, 1984). For example, rapid technological and market changes foster a collaborative and innovative environment, requiring start-ups to update data and information through

entrepreneurial networks constantly. This allows start-ups to develop in-depth relationships with stakeholders to make strategic decisions and adjust BMs in turbulent environments (Teece, 2018; Zhang et al., 2020a).

With a high degree of environmental dynamism, the entrepreneurial networks-causation-BMI relationship is predicted to be weaker. This is because turbulent environments highlight the limitations of causation, such as weakening the effectiveness of forecasting and reducing the adaptation of plans to environments and stakeholders (Mauer et al., 2018; Song et al., 2011). Also, causal entrepreneurs tend to integrate and utilize network resources step-by-step, which may reduce BMs' timely adaptability to changing environments (Song et al., 2011). In contrast, the entrepreneurial networks-effectuation-BMI relationship is more potent in highly dynamic environments since effectuation offers flexibility that advances organizational learning and experimentation. Environmental dynamism fosters collaboration among network partners and facilitates start-ups in strengthening their strategic flexibility. It also enhances the creative application of network resources to respond to external environmental changes (Deligianni et al., 2020). Furthermore, a turbulent environment forces start-ups to rely more on entrepreneurial networks to enhance pre-commitments and create new values in BMI. Hence, we expect that:

H_6: Environmental dynamism negatively moderates the mediating effect of entrepreneurial networks on BMI through causation

H_7: Environmental dynamism positively moderates the mediating effect of entrepreneurial networks on BMI through effectuation

Figure 1 illustrates the conceptual framework.

[Insert Figure 1]

3. Methodology

3.1. Sample and data collection

This research conducted a survey in China to test its hypotheses. The survey questions were derived from a combination of mature validated scales and interviews. First, the researchers conducted standard back-translation (Tsui et al., 2007; Yang et al., 2021). This procedure ensured that all items could be used in Chinese and that the translation was accurate. Furthermore, the questionnaire was refined based on feedback from multiple entrepreneurs consulted during development. This ensured that the questionnaire reflected the specific

entrepreneurial context of China. Finally, a pilot test was conducted with a sample of five MBA students with prior entrepreneurial experience to authenticate and refine the questionnaire. This group was asked to provide feedback on any areas of difficulty or obscurity in the questionnaire items. Based on their suggestions, minor questionnaire changes were made. The final sample for this study did not include the aforementioned five MBA students.

The selection of start-ups and respondents was guided by two key criteria. First, following the prior research (Peng et al., 2020; Vissa & Chacar, 2009), "start-ups" were defined as firms that had been in operation for less than eight years (the established period was from January 1, 2012, to December 31, 2019). Second, the respondents selected for the study were required to be start-up middle managers, senior managers, chairpersons or general managers. These individuals had a significant influence on strategic decisions and resource allocation, and possessed a comprehensive understanding of external relationships and BMI. Consequently, they could appropriately respond to the survey items.

The questionnaires were distributed between January and March 2020, when the COVID-19 pandemic had already ravaged China. To accommodate the circumstances, online distribution of the questionnaires was required. There were three sources for collecting data. First, the research team utilized personal relationships to distribute questionnaires and expanded the participant pool through snowball sampling. Second, data collection involved reaching out to start-ups in several provinces employing random selection via entrepreneurial associations and MBA centres. Lastly, to ensure comprehensive data collection, the services of the Wen Juanxing company were enlisted as a commissioned entity. Among experts and businesspeople, Wen Juanxing is known as a reliable survey service provider. To ensure the representativeness of the data, a random sampling approach was employed to select respondents from diverse firm sizes, industries, and across various age brackets, encompassing multiple economic sectors.

The authenticity of the sampled entities was validated by visiting the company's official websites and a corporate credit search website. First, responses were deleted that were untraceable, from firms older than eight years, and not completed by middle-level or above supervisors. To determine whether or not the responses met the criteria, background information was analyzed, including individual positions, company identification, and year of establishment. Second, responses that were either missing data or displayed an obvious pattern (repeated use of the same answer format, ABAB) were discarded. The total number of distributed questionnaires was 323, of which 248 were deemed valid, thus yielding a valid response rate of 76.7%.

Among these 248 respondents, 51.41% were between the ages of 25 and 34, and 45.42% held graduate degrees. 80.98% of respondents held chairperson, general managerial, or senior management positions. 60.21% had prior entrepreneurship experience. In this group of start-ups, 27.47% had been in operation for less than three years, while 72.54% had been in business for four to eight years. More than half of the start-ups (59.51%) had between 201 and 500 employees. General manufacturing (25.7%), service industries (33.1%), and new and high-tech enterprises (41.2%) were the prominent industries. Table 1 shows the main features of the sample.

[Insert Table 1]

3.2. Measurements

The variables were rated on a five-point Likert scale. Respondents were shown a series of items and asked to rate their levels of agreement with each item on a scale ranging from one (complete disagreement) to five (representing complete agreement). The Appendix displays specific items for each measure.

3.2.1. Independent variables

Entrepreneurial networks. Following prior work, entrepreneurial networks were measured by seven items (Presutti & Odorici, 2019; Watson, 2007). Respondents assessed how much effort they put into developing intimate relationships with outsiders by seven items.

3.2.2. Mediating variable

Causation and effectuation. The established measures of strategic decision-making developed by Chandler et al. (2011) were employed, which academics are increasingly using (Guo et al., 2020; Smolka et al., 2018). Seven items measured causation. Effectuation was measured by thirteen items with four sub-dimensions: experimentation, affordable loss, flexibility, and pre-commitment.

3.2.3. Dependent variable

Business model innovation (BMI). Zott and Amit (2007) eight-item BMI measurement scale is widely applied in quantitative BMI research. This paper also used it.

3.2.4. Moderating variable

Environmental dynamism. Following prior research, eight items were used to measure environmental dynamism with the two sub-dimensions of market and technology dynamism (Dess & Beard, 1984; Miller, 1988).

3.2.5. Control variables

This study considered control variables at the entrepreneurial and organizational levels. In particular, entrepreneurial characteristics included age, gender, educational background and entrepreneurial experience because of their significant influence on the BMI of start-ups. Organizational-level variables, including enterprise scale, founding year, and industry type, were included, as they also significantly affect BMI.

4. Results

4.1. Reliability and validity

The reliability of variables was tested using Cronbach's alpha in SPSS 22.0. The Cronbach's α for entrepreneurial networks, causation, effectuation, business model innovation, and environmental dynamism were 0.708, 0.718, 0.764, 0.792, and 0.755, all of which were greater than 0.7, indicating an acceptable level of consistency among the variables (Cronbach, 1951). In addition, to estimate the validity of constructs, confirmatory factor analysis (CFA) was performed by Lisrel 8.80. Table 2 reveals that the five-factor model outstripped the other four models in terms of fit, exhibiting the most acceptable level of goodness-of-fit ($\chi 2/df = 1.71$; NNFI = 0.95; CFI = 0.95; IFI = 0.95; RMSEA = 0.05). The results demonstrated convergent validity.

[Insert Table 2]

4.2. Common method bias

As each questionnaire was completed by a single respondent, responses were subjective and prone to recall bias. Therefore, common method bias testing was necessary. First, this was investigated using a confirmatory factor analysis (CFA) approach. As evidenced by the results presented in Table 2, the one-factor model failed to conform to the data when all variables were associated with a single factor. Second, Harman's one-factor method was employed. The first

factor accounted for less than 24% of the variance, which was below the recommended threshold of 30%. The results suggested that common method bias was not a significant issue.

4.3. Descriptive statistics and correlations

The Pearson correlation coefficients for the variables ranged between 0.1 and 0.78 (Table 3), considered within a reasonable range. Additionally, to address the potential impact of multicollinearity, variance inflation factors (VIFs) were assessed across all regression models. The VIFs for all variables were less than 1.522 (Table 4), which is lower than the critical value of ten. Consequently, multicollinearity was not a significant concern.

[Insert Table 3]

4.4. Regression results

4.4.1. Impact of entrepreneurial networks on business model innovation

A hierarchical regression analysis investigated the linkage of entrepreneurial networks and BMI. As shown in Table 4, the findings showed that the influence of entrepreneurial networks on BMI was significantly positive ($\beta = 0.51$, $p < 0.001$) in Model 2, providing evidence supporting Hypothesis 1.

4.4.2. Mediating effects of causation and effectuation

The examination of the mediating effects of causation and effectuation involved the implementation of two distinct methods. The first method employed was the three-step method. Specifically, the mediating role of causation was investigated using regression analysis, as detailed in Table 4. The findings demonstrated that entrepreneurial networks are positively associated with causation (Model 5: $\beta = 0.377$, $p < 0.001$). Furthermore, causation was positively associated with BMI (Model 3: $\beta = 0.537$, $p < 0.001$), thereby supporting Hypothesis 2. Additionally, Model 7 showed that BMI was positively associated with entrepreneurial networks (Model 7: $\beta = 0.358$, $p < 0.001$) and causation (Model 7: $\beta = 0.405$, $p < 0.001$). The regression coefficient of entrepreneurial networks decreased in Model 7 ($\beta = 0.358$, $p < 0.001$) when compared to Model 2($\beta = 0.51$, $p < 0.001$), indicating that causation played a partial mediating role between entrepreneurship networks and BMI. H_4 was supported.

Then, a regression analysis was conducted to test the mediating role of effectuation (Table 4). First, the findings indicated a significant and positive effect of entrepreneurial networks on effectuation (Model 6: $\beta = 0.418$, $p < 0.001$). Second, effectuation was positively associated

with BMI (Model 4: $\beta = 0.562$, $p < 0.001$), supporting H3. Finally, Model 8 revealed the positive association between BMI, entrepreneurial networks, and effectuation. The regression coefficient for entrepreneurial networks was 0.33 ($\beta = 0.33$, $p < 0.001$), and for effectuation was 0.433 ($\beta = 0.433$, $p < 0.001$). Additionally, the regression coefficient of entrepreneurial networks coefficient decreased in Model 8 ($\beta = 0.33$, $p < 0.001$) when compared to Model 2 ($\beta = 0.51$, $p < 0.001$). These findings revealed that effectuation partially mediates entrepreneurial networks and BMI, offering support for H5.

[Insert Table 4]

Based on the method proposed by Preacher and Hayes (2008), the mediating effect was examined using bootstrapping, with 5,000 bootstrap samples selected at a 95% confidence level. Table 5 presents the indirect effects of causation and effectuation. The 95% confidence interval for the indirect effect of causation and effectuation was [0.1282, 0.2582], and causation and effectuation played dual mediating roles between entrepreneurship networks and BMI (0.1899; 0.1899/0.4907*100% = 38.7%). First, the mediating effect of causation was calculated to be 0.0719, indicating that causation explained approximately 14.65% (0.0719/0.4907*100%) of the total indirect effect. The corresponding 95% confidence interval, which did not include zero, was [0.0136, 0.1408], and H4 was supported. Second, the mediating effect of effectuation was determined to be 0.1179, indicating that effectuation explained approximately 24.02% (0.1179/0.4907*100%) of the total indirect effect. The corresponding 95% confidence interval, which did not include zero, was [0.0599, 0.1826], providing evidence supporting H5. These findings showed that causation and effectuation mediate entrepreneurial networks and BMI. Hence, H_4 and H_5 were supported.

[Insert Table 5]

4.4.3. Moderating mediating effect of environmental dynamism

The moderated mediating effects were examined using the SPSS software Process plug-in Model 7. The selection of procedures at a confidence level of 95% was based on 5,000 samples generated by bootstrapping. Tables 6 shows that the confidence interval for the index of moderated mediation for the mediated pathway of causation contained zero ($\beta = 0.0102$; bootstrap CI: [-0.0278, 0.0574]), indicating that environmental dynamism did not moderate the

mediating effects of entrepreneurial networks on BMI through causation. As a result, H6 was not supported.

[Insert Table 6]

For the mediated pathway of effectuation, the result was that the interval for the index of moderated mediation was statistically significant (β = 1.154; bootstrap CI: [0.0485, 0.1912]), with a range that did not include zero (Table 7). The results revealed a conditional indirect effect of entrepreneurial networks on BMI when environmental dynamism increased from low to high, the indirect effect significantly increased (from 0. 0108 to 0.1189). Figure 2 presents the graphical representation of the moderating effect being discussed. These findings indicated that environmental dynamism significantly enhanced the mediating effects of entrepreneurial networks on BMI through effectuation. Hence, H7 was supported.

[Insert Table 7]

[Insert Figure 2]

5. Conclusions, discussion, and implications

5.1. Conclusions and discussion

This research developed a moderated mediation model to examine the influence of entrepreneurial networks on BMI based on the resource orchestration (RO) theory. It investigated the dual mediating effects of causation and effectuation and the moderating role of environmental dynamism. The empirical research was conducted using the hierarchical regression analysis and bootstrap approach using samples of 248 start-ups in China.

First, entrepreneurial networks were positively associated with BMI for start-ups. This result aligns with others' conclusions that entrepreneurial networks facilitate innovation (Micheli et al., 2020; Spieth et al., 2021). According to the RBV, complementary resources obtained from building relationships with external partners (e.g., customers, suppliers, and other organizations) can advance start-up BMI. Entrepreneurial networks assist start-ups in overcoming resource constraints, balancing power asymmetry, adopting external information, and identifying potential opportunities for BMI (Gao et al., 2023; Yu et al., 2022b). Additionally, this finding is consistent with the arguments of open innovation research (Albats et al., 2021; Chesbrough, 2007). Opening up the boundaries of BM helps start-ups to overcome dominant logic and obtain assets (Dasgupta, 2022). Start-ups must extend their focus beyond

firm boundaries and engage with stakeholders to redesign BMs from the network level (Chesbrough et al., 2018). In short, entrepreneurial networks, as important strategic resources, are a critical prerequisite for promoting start-up BMI.

Second, causation and effectuation are mediators between entrepreneurial networks and BMI in start-ups. The results showed that causation and effectuation advance start-up BMI. The positive impact of effectuation supports prior research associating innovation with constructs such as flexibility, experimentation and value co-creation with stakeholders (Alzamora-Ruiz et al., 2021). Furthermore, the prior literature on entrepreneurship indicates that start-ups generally apply flexible and unplanned strategies in BMI. The findings indicate causation is also effective in advancing BMI for start-ups. It provides vital evidence linking innovation to constructs associated with causation, such as planning, precise data analysis, and market research (Brinckmann & Kim, 2015; Peng et al., 2020). The findings encourage may scholars to consider the potential that BMI can be achieved not just through effectuation, a strategy linked to action, but also through causation, a strategy linked to planning (Sarasvathy, 2001; Shirokova et al., 2020).

These results suggest that causation and effectuation activate network resources and transform them into start-up BMI via different paths of resource management (Perry et al., 2012; Yang et al., 2021). Prior research focuses on the direct relationship between network resources and firm outcomes, highlighting the importance of resource possession (Frankenberger & Stam, 2020). However, this research investigated the mediating role of resource management through decision-making logic and demonstrated that causation and effectuation are important strategic decision-making logics that guide network resource management in achieving BMI. In particular, once goals are given, causation focuses on accumulating the resources required and their optimal exploitation to achieve BMI (Guo et al., 2016). Effectuation emphasizes utilizing existing resources and their integration to set goals based on the given means (Guo, 2019). These findings confirm the significance of resource management in unlocking the potential value of resources.

Third, the entrepreneurial networks-effectuation-BMI association is stronger in highly dynamic environments whereas the entrepreneurial networks-causation-BMI relationship is unaffected. This result implies that environmental dynamism enables start-ups to strengthen stakeholder relationships to advance BMI through effectuation. Due to its action-oriented and adaptable decision-making approach, effectuation provides start-ups with effective strategic decision-making. Effectuation encourages start-ups to gain pre-commitments from partnerships, combine the available resources in creative ways, and stay flexible to explore

contingent environments in highly dynamic contexts (Teece, 2018; Zhang et al., 2020a). However, the results did not support that environmental dynamism weakens the entrepreneurial networks-causation-BMI relationship. The possible reason for the finding is the Chinese traditional culture values in the Yin-Yang philosophy (Li, 2014; Peng et al., 2020). Due to the influence of the Yin-Yang philosophy, Chinese businesspeople prefer to be inclusive while addressing conflicts and reconciling the disparities between effectuation and causality. To deal with highly dynamic environments, they tend to adopt two decision-making logics. The findings respond to a call to investigate the application of causation and effectuation in emerging markets (Shirokova et al., 2020; Yu et al., 2018). These findings confirm that although both approaches help start-ups manage resources and innovation, there are differences in the linkage of entrepreneurial networks to BMI through causation and effectuation in dynamic contexts.

5.2. Theoretical contributions

There are several theoretical contributions resulting from this research. First, the paper offers new insights for understanding the antecedents of start-up BMI. The previous BMI literature primarily focused on internal organizational resources as significant BMI-driving determinants (Foss & Saebi, 2017; Martins et al., 2015; Zhang et al., 2021). This is one of few empirical research studies that expands BMI research beyond internal resources and the firm-centric view (Yi et al., 2022). It highlights the critical importance of external network resources as a prerequisite for achieving BMI. It confirms that entrepreneurial networks can be strategic resources. In addition, the findings offer quantitative evidence that developing relationships with various types of entities is beneficial for BMI. The results support the arguments for open innovation by demonstrating the BMI nature of a firm's boundary-spanning activity systems for value creation and capture (Amit & Zott, 2015; Casadesus-Masanell & Zhu, 2013; Chesbrough, 2007). The more openness in BMs, the greater the possibility for start-ups to create value among stakeholders in open innovation. This research addresses the critical need to investigate the determinants of start-up BMI at the network level (Frishammar & Parida, 2019). It also complements the significant work of Amit and Zott (2015) on networks as a driver for BMI. In brief, this research provides new insights into the processes underlying BMI from an inter-organizational network perspective, contributing by adding significant value to the knowledge of open innovation and RBV.

Second, this research adds to the growing literature on RO theory by exploring the dual mediating influences of causation and effectuation in resource management. It contributes to

expanding the implementation of effectuation theory in start-up BMI. Unlike prior studies that emphasize the significance of effectuation in start-ups (Chen et al., 2021; Deligianni et al., 2020; Guo, 2019), it indicates that both causation and effectuation are advantageous in achieving BMI. This perspective entails the joint implementation of causation and effectuation from the cognitive perspective to address resource scarcity and dynamic contexts that commonly characterize start-ups. Based on this ambidextrous perspective, it broadens the research on the outcomes of dual decision-making logic and enriches research on antecedents of start-up BMI.

In addition, this research contributes to a resource-based perspective by providing a more nuanced understanding of the connection between resource acquisition, resource management and value creation. Increasingly scholars have noted that simple direct links between network resources and performance lack face validity (D'Oria et al., 2021; Partanen et al., 2020). Based on RO theory, it proposes a comprehensive framework of the start-up BMI model that involves a combination of entrepreneurial networks (resource acquisition) and decision-making logic (resource management). The findings provide critical evidence that resource acquisition and management are inextricably linked. Both factors are jointly essential determinants of firm performance (D'Oria et al., 2021; Sirmon et al., 2007). It thus extends prior work on RO theory by revealing the potential value of entrepreneurs in resourcing (Sirmon et al., 2011). It also addresses the persistent calls to explore the driving role of strategic decision-making in BMI (Stroe et al., 2018). In short, this study demonstrates the bridging role of strategic decision-making in connecting resources to value creation (Demil et al., 2015; Sarasvathy et al., 2008; Yu & Wang, 2021). It thus strongly responds to the call of Kraaijenbrink et al. (2010) and Sirmon et al. (2007), who pointed out that RBV research is largely mute on these impacts.

Third, this research reveals the moderating impact of environmental dynamism, providing a clear view of the relationship between entrepreneurial networks and BMI. According to RO theory, environmental dynamism, as the most important feature of entrepreneurial context, significantly impacts the effect of entrepreneurial networks (Mura et al., 2014). This research focused on the moderating effect of environmental dynamism on the indirect impact of entrepreneurial networks on BMI through causation and effectuation, contributing to understanding the influence of entrepreneurial networks. The results confirm the combined effects of environmental dynamism and causation and effectuation, highlighting the applicability of each resource management approach. These results are consistent with the findings of Peng et al. (2020) and Shirokova et al. (2020) that the values of entrepreneurs' decision-making logic are impacted significantly by the organizational external environment.

They support the viewpoint in RO theory that resource management efficiency is closely linked to environmental dynamism (Mura et al., 2014). They also contribute to contextualized entrepreneurial research by testing and expanding effectuation theory in start-ups (Shirokova et al., 2020). In short, this study produces more comprehensive and empirical insights into BMI and offer a perspective to resolve the conflicting outcomes concerning the association between entrepreneurial networks and innovation.

5.3. Managerial implications

This research's findings have several managerial implications. First, start-ups must effectively use external resources embedded within networks to advance BMI. Entrepreneurs are suggested to enhance communication and cooperate with multiple external partners, including suppliers, customers, competitors and other organizations. To establish close ties with them, entrepreneurs are encouraged to organize or participate in social activities to maintain consistent contact with stakeholders, including sporting events, special occasion celebrations, and industry meetings. Furthermore, joining organizations such as trade associations, community forums, and sports leagues can also be effective ways for entrepreneurs to expand their social ties and gain valuable resources. Entrepreneurs can establish and strengthen relationships by engaging in these events and organizations, leading to valuable business opportunities and collaboration.

Second, entrepreneurs should apply causation and effectuation to transform entrepreneurial network resources into BMI. Effective resource management is crucial for advancing BMI and requires that entrepreneurs apply the two decision-making approaches. Effectuation enables entrepreneurs to embrace a more dynamic approach to BMI. This approach encourages entrepreneurs to focus on exploring their resources, taking action right away within their budgets and time limits, finding allies with complementary skills at a low cost, and seizing opportunities when they arise. Causation is also an effective way for entrepreneurs to manage resources and enhance BMI, involving setting clear goals to fulfil business plans, conducting competitive analyses of available resources to strengthen innovations, and avoiding surprises to minimize the impact of contingencies. In short, entrepreneurs must overcome an anti-planning bias, recognize the limitations of relying solely on a single strategic decision-making logic, and balance causation and effectuation in innovation management.

Third, entrepreneurs must dynamically manage resources to cope with ever-changing conditions. Resource acquisition and management of entrepreneurial networks can vary significantly in their influence on BMI in different environments. Especially,
start-ups can boost the influence of entrepreneurial networks on BMI through effectuation in highly volatile situations, but the entrepreneurial networks-causation-BMI link remains unaffected. These findings indicate that effectuation is more advantageous than causation in resource-constrained and highly dynamic environments (Chen et al., 2021). China's fast-evolving and reforming economy, the appearance of emerging markets and constant institutional reform have exacerbated the turbulent entrepreneurial environment (Gao et al., 2017). Therefore, Entrepreneurs are encouraged to employ an effectual approach to cope with uncertainty and dynamics in resource management.

5.4. Limitations and future research directions

This research also has certain limitations that necessitate attention in future research. First, the survey was conducted in China, and the sample size was limited. As one of the largest emerging economies, entrepreneurship, and innovation are vital and representative of the business situation in China. The model should be further tested in other countries and business dynamics to improve generalizability. Second, cross-sectional data may cause causation concerns. The evaluation of common method bias in this study was conducted using Harman's single-factor test and confirmatory factor analysis, ultimately proving that it was not a significant issue. However, it is recommended that future researchers obtain long-term data as such data collection would provide a more in-depth and comprehensive understanding of the research model, thus leading to more robust research outcomes. Third, the effects of causation and effectuation may be influenced by organizational contexts. Future research should explore the moderating effects of external context factors (e.g., industry growth) and internal contextual factors (e.g., corporate culture and organizational structure).

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Appendix. Measures

Entrepreneurial networks - Presutti and Odorici (2019), Watson (2007)
1. We cooperate with many customers and suppliers.
2. We communicate with many competitors.
3. We cooperate with many banks.
4. We cooperate with many industry associations.
5. We cooperate with many research institutions.
6. We cooperate with different levels of government department.
7. We cooperate with many service companies.

Causation - Chandler et al. (2011)
1.We analyze long run opportunities and select what we think would provide the best returns.
2. We develop a strategy to best take advantage of resources and capabilities.
3. We design and plan business strategies.
4. We organize and implement control processes to make sure we meet objectives.
5. We research and select target markets and do meaningful competitive analysis.
6. We design and plan production and marketing efforts.
7. We have a clear and consistent vision for where we want to end up.

Effectuation - Chandler et al. (2011)
1. We experiment with different products and/or business models.
2. We tried a number of different approaches until we found a business model that worked.
3. We are careful not to commit more resources than we could afford to lose.
4. We are careful not to risk more money than we are willing to lose with our initial idea.
5. We are careful not to risk so much money that the company would be in real trouble financially if things don't work out.
6. We allow the business to evolve as opportunities emerge.
7. We adapt what we are doing to the resources we have.
8. We are flexible and took advantage of opportunities as they arise.
9. We avoid courses of action that restrict our flexibility and adaptability.
10. We use a substantial number of agreements with customers, suppliers and other organizations and people to reduce the amount of uncertainty.
11. We use pre-commitments from customers and suppliers as often as possible.
12. The agreements with customers, suppliers, and other organizations and people provide the resources needed for the firm's development.
13. The agreements with customers, suppliers, and other organizations and people enable the capture of new opportunities in a varied environment.

Business model innovation - Zott and Amit (2007)
1. The business model brings together new participants.
2. The business model gives access to an unprecedented variety and number of participants.
3. The business model links participants to transactions in novel ways.
4. Incentives offered to participants in transactions are novel.
5 The focal firm has continuously introduced innovations in its business model.
6. There are other important aspects of the business model that make it novel.
7. The firm claim to be a pioneer with its business model.
8. Overall, the company’s business model is novel.

Environmental dynamism - Dess and Beard (1984), Miller (1988)

1. The technology in our industry is changing rapidly.
2. Technological changes provide big opportunities in our industry.
3. A large number of new products have been made possible through technological breakthroughs in our industry.
4. Technological development has an important impact on our industry.
5. Customer preferences change rapidly.
6. Our customers tend to look for new products all the time.
7. There are new customers in the market to buy your products.
8. New customers tend to have product-related needs that are different from those of our existing customers.
9. The needs of new customers have a greater impact on the business area in which the enterprise engages in.