Antecedents, Moderators, Mediators and Outcome of Open Innovation: A Study Among Manufacturing Firms in the UK

Cephas Tetteh

A thesis submitted for the degree of Doctor of Philosophy

Essex Business School

University of Essex

September 2023

Acknowledgements

First, I want to thank my supervisors, Dr Caleb Kwong and Dr Young-Ah Kim for their support throughout my PhD journey. Their guidance and constructive feedback played a role in nurturing my passion for the research domain.

Additionally, I want to express my appreciation to the University of Essex for providing me with this remarkable opportunity to pursue my PhD. Also, I would like to acknowledge Dr Misagh Tasavori, along with my cherished friends and fellow PhD colleagues.

Lastly, I must not forget to thank God and my beloved family for their unending support, which has been a constant source of strength and motivation.

Abstract

This thesis integrates the resource-based theory, the capability-based view, and the contingency approach to examine the key antecedents, moderators, mediators, and outcomes of open innovation. Based on an extensive and rigorous systematic literature review, using a comprehensive set of survey data from 206 manufacturing firms in the UK, and employing quantitative techniques, this thesis integrates three interrelated papers on open innovation.

The first paper (Chapter 2) examines the current state of knowledge in open innovation literature. Nine hundred and forty-four (944) articles from leading journals were reviewed and synthesised linking open innovation with its antecedents, moderators, mediators and outcomes. Overall, the findings identify common themes in the literature, reveal unexpected omissions, and highlight research gaps that, if pursued, could enrich the literature. For academics, the systematic review provides a reliable and up-to-date knowledge base, and for practitioners, it provides a reference point for developing the field and building knowledge.

The second paper (Chapter 3) examines the influence of technological capability and marketing capability on inbound and outbound open innovation, and the moderating effect of government support. The study shows that technological capability enhances inbound and outbound open innovation, while marketing capability hinders inbound and outbound open innovation. In addition, the study shows that the interaction of government support and technological capability is significant and positive for inbound open innovation, but insignificant for outbound open innovation. Furthermore, the interaction of government support and marketing capability is significant and negative for both inbound and outbound open innovation.

The third paper (Chapter 4) examines the internal mechanisms in the relationship between inbound and outbound open innovation on firm performance. It was found that both

inbound and outbound open innovation were not significantly related to firm performance. In addition, strategic flexibility negatively mediated the relationship between outbound open innovation and firm performance, while innovation performance did not mediate this relationship. Furthermore, strategic flexibility and innovation performance were serial mediators in the relationship between outbound open innovation and firm performance. In addition, organisational relearning positively moderated the relationship between inbound open innovation and firm performance.

In summary, this thesis provided a strong case for why research on open innovation is crucial for both academics and practitioners.

Keywords: Inbound open innovation, Outbound open innovation, Technological capability, Marketing capability, Government support, Strategic flexibility, Organisational relearning, Innovation performance, Firm performance.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

RBV – Resource-Based View

EFA – Exploratory Factor Analysis

CFA – Confirmatory Factor Analysis

PCA – Principal Component Analysis

SEM – Structural Equation Modelling

CMB – Common Method Bias

KMO – Kaiser-Meyer-Olkin

AVE – Average Variance Extracted

CR – Construct Reliability

RMSEA – Root Mean Square Error of Approximation

CFI – Comparative Fit Index

TLI – Tucker-Lewis Index

IFI – Incremental Fit Index

GFI – Goodness of Fit Index

FP – Firm Performance

IP – Innovation Performance

INB – Inbound Open Innovation

OUT – Outbound open innovation

TC – Technological Capability

MK – Marketing capability

GS – Government Support

RE – Organisational relearning

SF – Strategic Flexibility

Chapter 1: Introduction

1.1 Research Background

This thesis examines the key antecedents, moderators and mediators of open innovation and their collective impact on firm performance. The concept of open innovation emerged as an effective approach for firms to adapt to changes in a dynamic environment characterised by changing consumer needs, increased competition, resource scarcity, technological advances and rapid market development to ensure competitiveness (Chesbrough, 2003; Ovuakporie *et al.*, 2021; Zhang *et al.*, 2023). More and more companies are now pursuing open innovation as an alternative innovation model to closed innovation (Zhang *et al.*, 2023), resulting in a dramatic increase in its reputation among academics and practitioners (Gad David *et al.*, 2023; Radziwon and Bogers, 2019). Obradović, Vlačić and Dabić (2021) pointed out that since Chesbrough's introduced open innovation in 2003, scholarly publications have skyrocketed, resulting in over 4,000,000 documents indexed in Google Scholar in 2020. Furthermore, open innovation has demonstrated its efficacy with favourable outcomes with prominent multinational corporations, including IBM, Lucent, Intel (Chesbrough, 2003), DSM (Kirschbaum, 2005) and Procter & Gamble (Dodgson, Gann and Salter, 2006).

However, companies do not always benefit from open innovation (Li, Li and Wu, 2022). For example, Procter & Gamble, which once enjoyed popularity for its adoption of open innovation, now faces a decline in innovation courage and internal entrepreneurship due to its excessive reliance on external resources (Li, Li and Wu, 2022). Accordingly, it has become a challenge to understand the benefits and possible limitations of open innovation (Bogers *et al.*, 2019; da Silva Meireles, Azevedo and Boaventura, 2022). However, given the popularity of open innovation, many aspects of the field remain unclear and underdeveloped (Bogers *et al.*, 2017; West and Bogers, 2014).

In the early conceptualisation of open innovation, Chesbrough emphasised that "...valuable ideas can come from inside or outside the firm, and they can also come to market from inside or outside the firm" (Chesbrough, 2003, p. 43). Building on Chesbrough's comment on open innovation (2003, p. 43), the field has developed over the years (Obradović, Vlačić and Dabić, 2021). For example, Dahlander and Gann (2010) broadened this definition to encompass the pecuniary and non-pecuniary motivations of stakeholders when they participate in knowledge exchange.

In the realm of knowledge exchange, scholarly literature predominantly explores two primary facets of open innovation: inbound open innovation, commonly known as "outside-in" and outbound open innovation, commonly known as "inside-out" (Chesbrough and Crowther, 2006; Jin, Guo and Zhang, 2022; Popa, Soto-Acosta and Martinez-Conesa, 2017); although Gassmann and Enkel (2004) added a third dimension – coupled open innovation. Therefore, this research focuses on both inbound and outbound open innovation.

Inbound open innovation involves the opening up of the firm's innovation process to various external parties. This approach is categorised into two main forms: sourcing and acquiring, which can be either financial or nonfinancial (Dahlander and Gann, 2010). Sourcing practices are usually the non-pecuniary form of inbound open innovation, and they involve links with customers, suppliers, and technology scouting (Flor, Oltra-Mestre and Sanjurjo, 2021). Acquisition in the realm of innovation is primarily financial, focusing on obtaining knowledge to fuel innovative endeavours (Dahlander and Gann, 2010). This can be accomplished through two main means: firstly, by procuring technology and knowledge from the open market, and secondly, by actively fostering strategic partnerships and collaborative research initiatives with external firms and academic institutions (Dahlander and Gann, 2010; Huang *et al.*, 2014; van de Vrande, Vanhaverbeke and Duysters, 2011). Companies have the option to access technology and knowledge through intermediaries specialising in innovation, outsourcing their

research and development (R&D) efforts, or entering into licensing agreements (Flor, Oltra-Mestre and Sanjurjo, 2021).

Outbound open innovation occurs when firms permit the exploitation of unused and underutilised ideas and assets by external firms and it is categorised into two main forms – revealing and selling – both of which can be either pecuniary or non-pecuniary (Dahlander and Gann, 2010). Revealing, the non-pecuniary form of outbound open innovation, entails the deliberate sharing of internal resources with external firms, without immediate financial gains (Dahlander and Gann, 2010; Henkel, Schöberl and Alexy, 2014). This sharing may involve knowledge contributions through donations or as part of a standard-setting process, all to derive indirect benefits for the organisation (Dahlander and Gann, 2010; Henkel, Schöberl and Alexy, 2014). Selling is pecuniary and concerns how firms commercialise their inventions and technologies by selling or licensing resources (Flor, Oltra-Mestre and Sanjurjo, 2021). Examples include out-licensing of intellectual property and external corporate venturing (Flor, Oltra-Mestre and Sanjurjo, 2021).

In contrast to outbound open innovation, most firms tend to prefer inbound open innovation because they are less willing to disclose knowledge to external parties than to absorb freely available knowledge from outside firms (Cheah and Ho, 2021). Nevertheless, the declining extent of a company's involvement in outbound open innovation should not undermine the importance of this subject (Cheah and Ho, 2021). Therefore, considering that scholars have directed their focus primarily to either inbound open innovation (Laursen and Salter, 2006) or outbound open innovation (Lichtenthaler, 2009), this study contributes to the limited studies that amalgamate inbound and outbound open innovation within a unified framework (Lu, Qi and Hao, 2023).

Nonetheless, open innovation yields numerous advantages, including hastened innovation outcomes, swifter adaptation to emerging market demands, enhanced financial performance, the discovery of novel technology markets, and a shortened time to market (Du, Leten and Vanhaverbeke, 2014; Greco, Grimaldi and Cricelli, 2016; Laursen and Salter, 2006). There are inherent risks linked to the implementation of inbound and outbound open innovation activities (Shaikh and Randhawa, 2022). For instance, when it comes to inbound open innovation, excessive dependence on external R&D via partnerships and acquisitions can potentially result in a decrease in the internal expertise and capabilities of the established entity (Manzini, Lazzarotti and Pellegrini, 2017). Moreover, outbound open innovation is considered the riskiest type of open innovation because competitors may have access to the incumbent's closely guarded assets, where the potential for R&D spillovers is always the highest (Shaikh and Randhawa, 2022). Hence, grasping the advantages and potential constraints of open innovation has presented a considerable challenge (Bogers *et al.*, 2019; da Silva Meireles, Azevedo and Boaventura, 2022). Therefore, academics (Brunswicker and Chesbrough, 2018; Chen, Chen and Vanhaverbeke, 2011; Ferreras-Méndez *et al.*, 2015) have jointly advocated for a heightened emphasis on firm-level research. They promote the exploration of internal and external factors that can exert either favourable or adverse influences on the implementation of open innovation practices (Brunswicker and Chesbrough, 2018; Chen, Chen and Vanhaverbeke, 2011; Ferreras-Méndez *et al.*, 2015).

In this context, although researchers have delved into the organisational capabilities and established routines that facilitate the integration of open innovation (El Maalouf and Bahemia, 2023), there exists a noticeable void in the literature concerning the repercussions of these firm capabilities on open innovation (Cheng and Shiu, 2015; Taghizadeh *et al.*, 2020). Hence, to propel the advancement of knowledge in this domain, this paper narrows its scope to investigate how technological capability and marketing capability influence the implementation of inbound

and outbound open innovation activities. The significance of technological capability for innovation has been well-established (Zhou and Wu, 2010). In the scope of this research, technological capability pertains to a firm's ability to either lead the development of innovative technologies or employ them in the production of new products (Liu, Gu and Liu, 2022; Zhou *et al.*, 2014). It is worth highlighting that companies engaged in both inbound and outbound open innovation typically derive enhanced value from their knowledge and technological proficiencies (Lichtenthaler, 2008; van de Vrande *et al.*, 2009). In this regard, Taghizadeh et al. (2020) found technological capability to enhance open innovation.

However, as capabilities are deeply intertwined in organisational routines (Teece, 2007), a company that boasts a strong technological capability often has a well-entrenched technological infrastructure. This can sometimes result in a hesitance to embrace change that might necessitate the development of a new or incompatible technological foundation (Leonard-Barton, 1992). However, although strong technological capability raises concerns about rigidity issues (Leonard-Barton, 1992), it can also help reduce risks and costs in exploration (Zhang, 2016). Therefore, it holds significant importance to understand how technological capability influences inbound and outbound open innovation.

Similarly, marketing capability has long been considered valuable in the innovation literature (Weerawardena, 2003). In this study, marketing capability assesses the firm's ability to identify and satisfy customer needs (Liu, Gu and Liu, 2022; Zhou *et al.*, 2014). Scholars (Martin, Raj and Javalgi, 2016; Morgan and Rego, 2006; Mu, 2015) have pointed out that a firm's possession of marketing capabilities can help it build strong relationships with customers so that it can meet customers' changing needs. Despite these benefits, there are concerns that firms with high marketing capability may be extremely risk-averse and less likely to explore externally and seek new ideas due to their focus on current customers (Zang and Li, 2017). This may be a concern given that open innovation involves the exploration of ideas and knowledge

outside of the firm (Chesbrough, 2003). Thus, although marketing capabilities can assist organisations in addressing evolving customer demands (Mu, 2015), they can also become entrenched 'rigidities' in the organisational fabric, leading to resistance to sudden change (Kaleka and Morgan, 2019; Leonard-Barton, 1992). Hence, it is relevant to comprehend how marketing capabilities influence inbound and outbound open innovation.

Recent developments in the resource-based view (RBV) have emphasised the contingent view of capabilities (Morgan, Feng and Whitler, 2018). Without a comprehensive understanding of the relevance and impact of contingencies, it can be challenging to explore and cultivate technological and marketing capabilities and harness their full potential for the successful implementation of inbound and outbound open innovation initiatives. Consequently, this research delves into the role of government support as a moderating factor in the connection between technological capability and marketing capability, particularly within the realm of inbound and outbound open innovation.

In this study, government support assesses local government's financial and non-financial support to regional firms (Zhang and Merchant, 2020). The literature has independently examined and acknowledged the importance of government support in promoting open innovation (Cheah and Ho, 2020) and firm capability (Adomako, Amankwah-Amoah and Danquah, 2022). Reasons for government support for innovation in firms include higher productivity (Afcha and Garciá-Quevedo, 2016), encouraging firms to take on riskier projects (Vanino, Roper and Becker, 2019) and creating more skilled jobs (Castillo *et al.*, 2020). However, given that in closed innovation, government funding can potentially displace internal R&D endeavours (Gelabert, Fosfuri and Tribó, 2009), it is imperative to establish whether the moderating impact of government support is consistent for both technological capability and marketing capability in the realm of open innovation.

In parallel with the rising adoption of open innovation by businesses, there is a growing body of academic research examining its effects on firm performance (Bogers, Foss and Lyngsie, 2018; Ovuakporie *et al.*, 2021). Among the studies conducted, the general assumption is that open innovation is beneficial because "the more a firm interacts with other organisations, the greater its access to external ideas, competencies, knowledge, technologies and other intangibles, and the greater its chances of successfully innovating" (Greco, Grimaldi and Cricelli, 2016, p. 501). However, other researchers (e.g., Schäper *et al.*, 2023) are ambivalent about this relationship. They argue from evidence that open innovation and financial performance have an S-shaped relationship (Schäper *et al.*, 2023). This may occur because open innovation entails search and coordination costs, which may reduce firms' profits (Fu, Liu and Zhou, 2019; Schäper *et al.*, 2023).

Nevertheless, it is essential to recognise that open innovation comprises both inbound and outbound dimensions (Hung and Chou, 2013). Prior studies have predominantly focused on the advantages of inbound open innovation concerning firm performance, paying comparatively less attention to its counterpart, outbound open innovation (Jin, Guo and Zhang, 2022). Therefore, there is a clear imperative to achieve a holistic understanding of how both inbound and outbound open innovation collectively impact firm performance within an integrated framework.

To resolve the inconsistent empirical findings, open innovation scholars have frequently proposed that the most likely explanation lies in the potential contingent factors that either enable or restrict firms from harnessing the advantages of open innovation (Zhu *et al.*, 2019). However, few studies have investigated the internal mechanism between open innovation and firm performance (Lu, Qi and Hao, 2023). Therefore, to advance knowledge in this area, this paper limits the discussion to strategic flexibility, innovation performance and organisational relearning in this relationship.

Strategic flexibility captures "the ability to adjust available means to better achieve current and expected future objectives in accordance with an encountered situation" (Liu *et al.*, 2013, p. 86). Strategic flexibility has been found to contribute positively to firm performance (Combe *et al.*, 2012). However, despite the recognised positive impact of strategic flexibility on new product development (Kandemir and Acur, 2012) and explorative innovation (Zhou and Wu, 2010), its exploration within the realm of open innovation literature remains largely uncharted. Recognising the pivotal role that strategic flexibility plays in enhancing a company's competitiveness amid volatile markets (Hitt, Keats and DeMarie, 1998), this study asserts that its significance is equally pertinent for open innovation, especially in the context of outbound open innovation.

The focus on outbound open innovation is because even though it provides firms with strategic advantages such as high market position and high market reputation, which can help to easily attract excellent collaborators, thereby reducing the cost of partner search (Lu, Qi and Hao, 2023). This research argues that because strategic flexibility helps firms respond quickly to changing market conditions (Grewal and Tansuhaj, 2001), it can help firms achieve or maintain their higher market position and reputation from outbound open innovation. Therefore, in light of the potential impact of outbound open innovation on innovation performance (Fu, Liu and Zhou, 2019; Lu, Qi and Hao, 2023), coupled with the subsequent influence of innovation performance on overall firm success (Mahmoud, Hinson and Anim, 2018), it becomes plausible to consider that the serial mediation of strategic flexibility and innovation performance could offer valuable insights into the diverse outcomes observed in the relationship between outbound open innovation and firm performance.

Moreover, it is imperative to recognise that the open innovation literature has hitherto neglected to delve into the substantial impact of organisational relearning. This study introduces a novel perspective by examining how organisational relearning functions as a moderating

factor in shaping the link between inbound open innovation and firm performance. Organisational relearning occurs when firms acquire new knowledge and establish new routines (Zhao, Lu and Wang, 2013). In such a situation, organisational relearning is expected to be important in integrating the newly acquired knowledge from external parties with the firm's internal knowledge (Azmi, 2008; Zhao and Wang, 2020), which can improve firm performance.

1.2 Research Gaps

Firstly, while open innovation can be categorised into two primary dimensions - inbound and outbound, the predominant focus of research has been on inbound open innovation (Lu, Qi and Hao, 2023). Hence, this research, which thoroughly investigates both inbound and outbound open innovation within a cohesive framework, makes a significant contribution to the relatively scarce body of research in this domain (Lu, Qi and Hao, 2023).

Although scholars have acknowledged the influence of firm capabilities on open innovation, the study of this relationship remains insufficient (Cheng and Shiu, 2015; Taghizadeh *et al.*, 2020). Consequently, this research augments the existing body of research by addressing the relatively scarce investigations into the influence of technological capability and marketing capability on both inbound and outbound open innovation (Liao, Fu and Liu, 2020; Taghizadeh *et al.*, 2020).

Moreover, even though scholars have promoted a contingency approach to understanding marketing capabilities (Morgan, Feng and Whitler, 2018), and have emphasised the necessity for more empirical insights concerning the association between government support and capabilities (Coudounaris, 2018; Falahat *et al.*, 2021), to my awareness, the moderating influence of government support on the interplay between technological capability and marketing capability in the inbound and outbound open innovation context remains an uncharted area. Therefore, there is a research gap and limited understanding in this regard.

Furthermore, previous studies have predominantly focused on exploring the link between open innovation and innovation performance, with less emphasis on investigating firm performance (Zhang *et al.*, 2018). Furthermore, in these inquiries, scholars have often chosen to concentrate solely on either inbound or outbound open innovation or have amalgamated them into a single construct, frequently overlooking a comprehensive exploration of both inbound and outbound open innovation within an integrated framework (Lu, Qi and Hao, 2023). As a result, this study augments the relatively modest body of research by scrutinising the impact of inbound and outbound open innovation on firm performance.

Additionally, it is noteworthy that there exists a diverse array of findings concerning the connection between open innovation and firm performance, with some of these findings lacking a definitive consensus (Ogink *et al.*, 2023; Schäper *et al.*, 2023). Innovation scholars have suggested that intervening mechanisms may help resolve conflicting findings in the antecedent-outcome relationship (Tsai *et al.*, 2022). Despite this suggestion, there is limited research on the internal mechanism connecting open innovation and firm performance (Lu, Qi and Hao, 2023). This research introduces strategic flexibility and organisational relearning to explain the inconsistencies in the findings.

1.3 Research Questions

The above-mentioned gaps in the literature motivated this research. The primary research inquiry addressed in this thesis is: *What are the antecedents, moderators, mediators, and outcomes of open innovation?*

The overarching research question of the thesis is elucidated by addressing the specific research questions posed in each of the three distinct papers, which constitute the core chapters of this study. The initial paper comprises a systematic review of the literature related to open

innovation. This paper helps to link open innovation with its antecedents, moderators, mediators, and outcomes.

The second paper examines the influence of technological capability and marketing capability on inbound and outbound open innovation, and the moderating effect of government support. Therefore, drawing on the resource-based view (RBV), the capability-based view, and the contingency approach, and analysing 206 sampled UK manufacturing firms, the second paper answers the following questions:

1. Does technological capability enhance the implementation of both inbound and outbound open innovation?
2. Does marketing capability hinder the implementation of both inbound and outbound open innovation?
3. Does government support positively moderate the influence of technological capability on both inbound and outbound open innovation?
4. Does government support positively moderate the influence of marketing capability on both inbound and outbound open innovation?

The third paper examines the internal mechanisms in the association between inbound and outbound open innovation on firm performance. Drawing on the RBV, the capability-based view, and the contingency approach, and analysing a sample of 206 UK manufacturing firms, the third paper answers the following questions:

1. Does inbound open innovation have a positive impact on firm performance?
2. Does outbound open innovation have a positive impact on firm performance?
3. Does outbound open innovation have a positive impact on strategic flexibility?
4. Does strategic flexibility have a positive impact on firm performance?

5. Does strategic flexibility mediate the influence of outbound open innovation on firm performance?
6. Does outbound open innovation have a positive impact on innovation performance?
7. Does innovation performance have a positive impact on firm performance?
8. Does innovation performance mediate the influence of outbound open innovation on firm performance?
9. Does strategic flexibility have a positive impact on innovation performance?
10. Are strategic flexibility and innovation performance serial mediators in the relationship between outbound open innovation and firm performance?
11. Does organisational relearning positively moderate the relationship between inbound open innovation and firm performance?

1.4 Theoretical Foundations

Over the past decade, the field of open innovation has witnessed notable progress (Dahlander, Gann and Wallin, 2021). Nevertheless, it still faces the persistent hurdle of having relatively constrained theoretical underpinnings (Dahlander and Gann, 2010; Sengupta and Sena, 2020; West and Bogers, 2014). To fill this void in the existing body of literature, this research employs a multi-theoretical approach to comprehend open innovation. It integrates foundational principles from the resource-based view, capability-based view, and contingency approach. The details of these theories are presented below.

1.4.1 Resource-Based View

The core of the resource-based view (RBV) is the notion that companies attain a competitive edge through the ownership of resources that are valuable, scarce, non-replicable, and not easily duplicated (Barney, 1991). These resources can be tangible and intangible assets that the firm manages to implement strategies aimed at gaining a competitive advantage (Nath, Nachiappan and Ramanathan, 2010). Tangible assets include the firm's factories, products and

distribution systems; intangible assets include the firm's reputation with customers and teamwork among managers (Ho and Huang, 2020).

Given that Barney (1991) defined resources broadly to include both assets and capabilities, there was no provision in the RBV to indicate how these resources are deployed and transformed to achieve competitive advantage. In addressing this gap, scholars have proposed that for specific resources to translate into enhanced performance, it is crucial to undertake appropriate strategic measures to effectively leverage these resources (Hult, Ketchen and Slater, 2005). This becomes particularly pertinent in cases where resources remain static, and the mechanisms by which these resources influence performance remain predominantly a black box (Priem and Butler, 2001). In this regard, although resources and capabilities are critical to RBV (Kozlenkova, Samaha and Palmatier, 2014), a firm may outperform its competitors and achieve a competitive advantage not because it has better resources, but rather because of its distinctive capabilities to deploy those resources (Day, 2011; Morgan, Katsikeas and Vorhies, 2012). This assertion forms a fundamental principle of the capability-based view, a continuation of the RBV, which will be discussed below.

It is crucial to highlight that this study considers inbound and outbound open innovation as strategic resources.

1.4.2 Capability-Based Theory

Capability-based theory, as a continuation of RBV, posits that the mere possession of a firm's resources or acquiring external ones is insufficient for establishing new competitive platforms, rather it is the manner in which these resources are deployed and harnessed through the firm's capabilities that generate value (Day, 1994; Helfat and Winter, 2011; Teece, Pisano and Shuen, 1997). A capability refers to "the ability of an organisation to perform a coordinated set of tasks using organisational resources to achieve a specific end result" (Helfat and Peteraf,

2003, p. 999). Moreover, Amit and Schoemaker (1993, p. 35) define capabilities as "the ability of an organisation to use resources, usually in combination, through organisational processes to achieve a desired end".

This research adopts the RBV, and the capability view to understand: (a) the impact of technological and marketing capabilities on inbound and outbound open innovation; (b) the influence of inbound and outbound open innovation on firm performance; (c) and the mediating effect of strategic flexibility on the influence of outbound open innovation on firm performance.

In this regard, marketing capabilities may be rare, valuable, non-substitutable and difficult to imitate because they are based on a firm's tacit knowledge that is deeply embedded in organisational routines and processes (Bodlaj and Čater, 2022; Dutta, Zbaracki and Bergen, 2003; Krasnikov and Jayachandran, 2008). In addition, given that technological capabilities are embedded in organisational routines over time (Taghizadeh *et al.*, 2020), internally generated technologies present a formidable challenge to replication due to the confidentiality and self-protective measures surrounding them (Zang and Li, 2017). This confers an unparalleled advantage in the context of introducing novel products and venturing into new markets (Zang and Li, 2017).

However, while capabilities evolve, they can also become entrenched 'rigidities' in the organisational fabric and are likely to resist abrupt change (Leonard-Barton, 1992). Hence, while it is anticipated that technological and marketing capabilities will impact inbound and outbound open innovation, this research aims to clarify the specific nature and direction of these relationships.

Furthermore, the RBV is utilised to comprehend the influence of inbound and outbound open innovation on firm performance. First, firms explore important resources, mostly in the form of technologies and relevant knowledge from external parties, to enhance internal

innovation, facilitate inter-organisational boundaries and generate innovation outcomes valued by customers (Chesbrough, 2003; Nguyen, Huang and Tian, 2023a). The externally acquired technologies through technology exploitation are then integrated with internal resources and capabilities to create fresh knowledge, which proves advantageous for partner firms (Nguyen, Huang and Tian, 2023a). All these practices require advanced, valuable and rare technologies in the open innovation practice (Nguyen, Huang and Tian, 2023a).

Second, to sustain a competitive advantage over an extended period, companies may choose to engage in inter-organisational collaborations. In doing so, they can harness complementary assets from various stakeholders, integrate these resources and capabilities in distinctive ways, and make strategic investments in relationships to facilitate either inbound open innovation, outbound open innovation, or both (Holgersson, Granstrand and Bogers, 2018; Nguyen, Huang and Tian, 2023a). This is to create causal ambiguity and social complexity to make innovation processes inimitable and non-substitutable (Barney, 1991), which may lead to superior firm performance.

Additionally, the capability-based theory is applied to understand how strategic flexibility mediates the influence of outbound open innovation on firm performance. Outbound open innovation is considered a key strategic resource that has potential value for firms (Bodlaj and Čater, 2022), while strategic flexibility is an important deployment mechanism through which the potential value of outbound open innovation can be realised. It is only when firms exploit their outbound open innovation and develop strategic flexibility that they can improve firm performance.

1.4.3 Contingency Approach

According to the contingency approach, there is no universally superior approach to organisation management (Ginsberg and Venkatraman, 1985). An organisation's effectiveness

results from matching its key characteristics with contingencies that reflect the organisation's situation (Donaldson, 2001). An organisation must find the fit between itself and the contingency factors to enhance performance (Donaldson, 2006). The organisation must also remain flexible and adjust to shifts in both internal and external environments to effectively address emerging contingencies (Nguyen, Huang and Tian, 2023b).

Consistent with open systems theory, contingency theory views organisations as open systems (Scott, 1987). Similarly, the theoretical underpinnings of open innovation are based on the open systems model of an organisation where the organisational boundary is porous to facilitate interaction between the organisation and its environment (Chesbrough, 2006).

In this context, the contingency approach is used to understand: (a) the moderating effect of government support on the influence of technological and marketing capabilities on inbound and outbound open innovation; (b) and the moderating effect of organisational relearning on the relationship between inbound open innovation and firm performance.

1.5 Methodological Approach

1.5.1 Sample and Data Collection

The present research aligns with the philosophical approach of positivism, primarily due to its association with the utilisation of quantitative methodology (Saunders, Lewis and Thornhill, 2007) to address the research inquiries presented in chapters 3 and 4. The first paper (Chapter 2) was a systematic review, while the second (Chapter 3) and third papers (Chapter 4) collected data using an online administered questionnaire. In the case of the systematic review, data were sourced from the Scopus database, which is widely recognised within the business literature field and has been frequently employed in prior open innovation reviews (Lopes and de Carvalho, 2018; Obradović, Vlačić and Dabić, 2021). It includes relevant and high-ranking journals published in the fields where open innovation has appeared since its inception in 2003.

The methodology involved the use of keywords: "open innovation" OR "inbound open innovation" OR "outbound open innovation" OR "coupled open innovation" OR "outside-in process" OR "inside-out process" OR "openness depth" OR "openness breadth". This led to an initial generation of 6297 documents published in business journals from 2003 to 31st December 2020. However, after applying inclusion and exclusion criteria such as journals listed in the Chartered Association of Business Schools (CABS) 2018 ranked 1 and above, journal articles published in English and in the fields of Business, Management and Accounting and eliminating duplicates, retraction papers, and those that merely made passing mentions of open innovation in their title, abstract, or full text without engaging in substantive discussion. This resulted in a total of 944 articles for the review.

For the second and third papers, a cross-sectional data collecting system using an online administered questionnaire survey was developed to collect data from managers within different sectors of manufacturing companies in the UK. The research exclusively concentrated on managers within manufacturing companies, operating under the assumption that they possess the requisite knowledge regarding innovation and creativity within the organisation (Genc, Dayan and Genc, 2019). This belief underpins their ability to comprehensively evaluate the overall impact of the study variables (Genc, Dayan and Genc, 2019). The sampling frame was developed using the ORBIS database, a comprehensive resource providing a complete roster of manufacturing firms in the UK. ORBIS stands out as the largest and most widely utilised firm-level database, aggregating information from diverse sources (Riccaboni, Wang and Zhu, 2021). Subsequently, I obtained a comprehensive list of all manufacturing firms in the UK with a minimum of 10 employees.

The rationale for focusing on the UK stems from its status as a European country characterised by a high rate of technological innovation (Ciampi *et al.,* 2021). British manufacturers hold significant importance, contributing substantially to Europe's overall

manufacturing outputs and resource demands (Esfahbodi *et al.,* 2017). The choice of the UK also facilitates a more meaningful comparison with existing studies on open innovation, which predominantly involve Western firms (Lu and Chesbrough, 2022). Notably, open innovation finds explicit mention in the UK National Innovation Strategy (Audretsch and Belitski, 2023). Consequently, these manufacturing companies in the UK serve as an ideal focus for investigating the variables of interest in this study.

After obtaining ethical approval from the University of Essex Ethics Committee and identifying the sector for this study, I used the random stratified sampling method to obtain a selection of 1000 manufacturing companies in the UK who received the online questionnaire from July 2022 to December 2022. This type of questionnaire is usually administered by post or email. In this study, an internet-based online social survey was used (Bryman, 2012), and the questionnaire was designed using Qualtrics – an integrated platform for survey design and data collection (Thornton, Henneberg and Naudé, 2015).

When designing the questionnaire, the recommendations put forth by Podsakoff et al. (2003) as procedural measures to mitigate the potential of common method bias (CMB) were implemented. First, the items designed to measure the predictor and dependent variables were strategically placed at various points within the questionnaire. Second, respondents were guaranteed confidentiality and assured of the anonymity of any information they provided. Third, respondents were informed that there were no right or wrong answers, fostering an environment of openness. Fourth, established scale designs were employed to mitigate any ambiguity in the items. Fifth, the hypothesised model incorporated direct, indirect, and moderating relationships among the study variables, rendering the model specification intricate. Consequently, it is improbable for respondents to anticipate the relationships among latent constructs while completing the survey. Hence, CMB is unlikely to pose a concern for this study.

The survey was divided into four sections, which are discussed below. The initial section of the questionnaire featured a brief introduction outlining the study's objectives.

The second section was followed by two screening questions to select suitable respondents from the sampling frame. Initially, respondents were requested to evaluate their knowledge of innovation activities within their respective firms, aiming for a minimum score of 4 on a seven-point scale ranging from 1 (poor) to 7 (excellent) (Thornton, Henneberg and Naudé, 2015). Then, to mitigate idiosyncratic start-up influences, firms should ideally have a minimum operational history of 18 months (Sheehan, Garavan and Morley, 2020). Therefore, only respondents who met the screening criteria were allowed to complete the questionnaire. In doing so, Qualtrics restriction was set to allow one response per IP address to protect against double-counting of responses (Goodman, Cryder and Cheema, 2013; Zahoor and Al-Tabbaa, 2020). Out of the 1000 potential respondents contacted, a total of 643 respondents were eligible to take part in the study.

The third section contains items used to measure the variables of interest (i.e., strategic flexibility, technological capability, innovation performance, marketing capability, inbound open innovation, government support, outbound open innovation, organisational relearning, and firm performance) which were structured on a 7-level Likert-type scale format to reflect the assessment criteria (Mendoza *et al.,* 2021).

The fourth section contained demographic characteristics such as firm age, number of years in the firm, number of full-time employees in the firm, and the firm's geographical market, which were further used as 'control variables' in the data analysis. The questionnaire concluded with an expression of gratitude to the respondents for generously dedicating their valuable time to participate in the research.

After three reminders, I received a total of 75 questionnaires in the first round, 83 questionnaires in the second round and 78 questionnaires in the third round resulting in a total of 236 filled-in questionnaires. After eliminating unusable, incomplete, and unengaged questionnaires, I retained 206 usable surveys representing a response rate of 20.6% for analysis in chapters 3 and 4. This is an acceptable response rate in organisational studies (Greer, Chuchinprakarn and Seshadri, 2000; Scarborough, 2011).

Non-response bias is often a problem for survey research and compromises the study results. In this study, a non-response bias test was conducted according to the procedure of Armstrong and Overton (1977). I performed t-tests comparing early and late respondents. The final sample was divided into two groups where the first 20% of respondents were considered early respondents, and the last 20% of respondents were considered late respondents (Zahoor and Al-Tabbaa, 2020). The t-tests performed on the responses of these two groups showed no statistically significant difference between the two groups indicating that non-response bias is not an issue in this research (Armstrong and Overton, 1977).

1.6 Structure of the Thesis

The thesis is structured chronologically and systematically in five parts: (A) Introduction, (B) Systematic review on open innovation, (C) The effects of technological capability and marketing capability on open innovation: The moderating effect of government support (D) The internal mechanisms between open innovation and firm performance (E) Conclusion. Therefore, this thesis contains one review paper (B) and two empirical papers (C and D). To emphasise, these three papers are interconnected, working together coherently to address the overarching research question.

The introduction furnishes a holistic perspective of the research endeavour, encompassing elements such as research gaps, research inquiries, theoretical foundations,

methodological approach, and the study's layout. It offers a summary of the research, deliberates on the research gaps, and questions, elucidates the theoretical underpinnings, outlines the methodological approach, and delineates the study's organisational structure.

The first paper (B) systematically analyses the antecedents, moderators, mediators, and consequences of open innovation. Following this rigorous review, the study identifies current themes and omissions in the literature. Gaps are also identified to strategically position the thesis.

The second paper (C) The Impact of Technological Capability and Marketing Capability on Open Innovation: The Moderating Effect of Government Support, employed an RBV, a capability-based view and a contingency approach.

The third paper (D) The Internal Mechanisms Between Open Innovation and Firm Performance, employed an RBV, capability-based view and contingency approach.

Finally, the last chapter (F) provides an overall conclusion for the study. It also outlines the future research agenda for open innovation research.

Chapter 2: Open Innovation: A Systematic Review and Future Research Agenda

Abstract

Over the past decade, a substantial body of empirical research has emerged regarding the antecedents and outcomes of open innovation. Nonetheless, there exists a paucity of empirical research that delves into the underlying mechanisms and contextual limitations of the connection between open innovation and its antecedents and consequences. Hence, this thesis seeks to consolidate the current body of knowledge to pinpoint the factors that precede open innovation, the factors that modify its effects, the factors that mediate its impacts, and the outcomes it yields. Through an extensive content analysis of 944 articles retrieved from the Scopus database, this review discerns distinct research trajectories within the domain of open innovation while also highlighting unresolved questions. Consequently, this paper delivers a substantial contribution to the open innovation literature, shedding light on existing gaps and potential avenues in the field. These insights hold significance for both researchers and industry practitioners alike.

Keywords: Open innovation, Systematic review, Scopus.

2.1 Introduction

Since the inception of the open innovation concept by Chesbrough (2003) in his influential publication, it has garnered significant interest from both the academic community and industry professionals. This attention is evident in the scholarly discourse and practical applications (e.g., Gad David *et al.*, 2023; Radziwon and Bogers, 2019). Open innovation scholars have demonstrated their commitment to the field through special issues in top journals, the provision of PhD courses and the hosting of conferences aimed at enriching the understanding of the field (Dahlander, Gann and Wallin, 2021). Remarkably, in the year 2020 alone, hundreds of papers addressing open innovation were published (Dahlander, Gann and Wallin, 2021). This underscores the fact that open innovation has solidified its position among the most thoroughly researched and widely published subjects in the realm of innovation management (Bigliardi *et al.*, 2020).

Nonetheless, the intricate nature of research related to open innovation (Lopes and de Carvalho, 2018) and its multifaceted nature (Bogers *et al.*, 2017) has led to a lack of a unanimous consensus regarding the definition of open innovation (Dahlander and Gann, 2010; Randhawa, Wilden and Hohberger, 2016; West and Bogers, 2014). Chesbrough (2006, p. 1) defined open innovation as “the purposeful inflow and outflow of knowledge to accelerate internal innovation and to expand markets for the external use of innovation, respectively”. This definition emphasises the bidirectional flow of knowledge from outside to inside the firm (inbound or outside-in open innovation) and from inside to outside the firm (outbound or inside-out open innovation) (Chesbrough, 2006). In contrast to outbound open innovation, prior reviews (Lopes and de Carvalho, 2018; Obradović, Vlačić and Dabić, 2021) have revealed that scholars have predominantly directed their focus toward inbound open innovation. However, Gassmann and Enkel (2004) introduced an additional facet of open innovation termed 'coupled open innovation,' which amalgamates both inbound and outbound open innovation practices.

In addition to the maturity of the field (Dahlander, Gann and Wallin, 2021), the fragmented body of knowledge on open innovation (Huizingh, 2011; Randhawa, Wilden and Hohberger, 2016) has created challenges for researchers interested in investigating the key antecedents of open innovation (Lopes and de Carvalho, 2018). Nevertheless, it is imperative to comprehend the factors that either enable or hinder open innovation at the micro-foundational level (Ahn, Minshall and Mortara, 2017), organisational (Bogers *et al.*, 2017) and environmental levels (Popa, Soto-Acosta and Martinez-Conesa, 2017). Furthermore, it is not enough to understand the antecedents of open innovation. Therefore, it is essential to consider the underlying mechanisms (Ahn, 2020; Naqshbandi and Tabche, 2018) and boundary conditions that facilitate open innovation (Naqshbandi and Tabche, 2018).

In addition to investigating the factors that lead to open innovation, scholars (Lopes and de Carvalho, 2018) have primarily recognised the performance consequences of open innovation. However, the connection between open innovation and performance has produced varying and inconclusive results (Nguyen, Huang and Tian, 2023b). Scholars have found either a positive (Cheng and Huizingh, 2014), negative (Fu, Liu and Zhou, 2019), S-shaped (Schäper *et al.*, 2023) or inverted U-shaped relationship between open innovation and performance (Zhang *et al.*, 2018). This calls for the investigation of contingency factors and underlying mechanisms that could explain the inconsistencies in findings (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022; Lu, Qi and Hao, 2023). However, few studies have investigated the internal mechanisms of this relationship (Lu, Qi and Hao, 2023).

Hence, to offer a comprehensive understanding of the antecedents, factors that moderate, intermediaries, and consequences of open innovation, this chapter presents a systematic review of the open innovation literature. This review serves as a foundation for this study to make a valuable contribution to the field of open innovation, building upon the findings of previous reviews.

2.2 Gaps in Existing Systematic Reviews

Despite the immense contribution of existing systematic reviews on open innovation to the academic field and policy decisions (Obradović, Vlačić and Dabić, 2021), it is crucial to acknowledge certain limitations that necessitate identification to guide further improvements. For instance, the systematic review undertaken by Dahlander and Gann (2010), which employed content analysis of 150 articles, primarily focused on elucidating the definition of open innovation. It delineated two inbound processes (sourcing and acquiring) and two outbound processes (revealing and selling). Consequently, the earlier systematic review addressing the definition of open innovation did not encompass the concept of coupled open innovation.

In addition, Huizingh's (2011) review was limited to addressing the questions of what (the content of open innovation), when (context dependency) and how (the process). Moreover, West and Bogers' (2014) review, which included 291 articles published between 2003 and 2010, was limited to investigating how and why firms use external sources of innovation (focusing on inbound and coupled open innovation) in four main linear processes: acquisition, integration, commercialisation of external innovations, and interaction between the firm and its collaborators. Despite their immense contributions, their findings did not include articles focusing solely on outbound open innovation.

Furthermore, the systematic review conducted by Lopes and de Carvalho (2018), employing bibliometrics, content analysis, and mind mapping to analyse articles published from 2003 to 2017, had certain limitations. They placed primary emphasis on the examination of critical variables in open innovation, the ramifications of open innovation (both inbound and outbound) on organisational and innovation performance, and the factors influencing the relationship between open innovation and organisational and innovation performance. As a

result, it left unaddressed queries about the moderating and mediating elements in the association between open innovation and its precursors, as well as the intermediaries in the relationship between open innovation and its performance outcomes (Lopes and de Carvalho, 2018).

In a more recent development, the systematic review conducted by Obradović, Vlačić and Dabić (2021), which encompassed a content analysis of 239 articles published from 2003 to 2019, was constrained in its scope. It primarily offered insights into open innovation, with a specific emphasis on inbound and outbound open innovation, within the context of the manufacturing industry. In doing so, these authors explored the theoretical underpinnings, research trends and methodologies in the field (Obradović, Vlačić and Dabić, 2021). However, it is worth noting that the researchers did not incorporate studies that specifically addressed coupled open innovation.

This review aims to bridge this gap by providing the following contributions to the open innovation literature. First, although prior review papers have acknowledged key antecedents of open innovation (Lopes and de Carvalho, 2018), they have not provided information on key moderators and mediators of this relationship. This review identifies moderating and mediating factors that have been investigated in previous studies and draws on theories to make future recommendations. This will help to provide a comprehensive understanding of which theories to adopt and which factors to focus on to gain a deeper understanding of the antecedents of open innovation.

Additionally, while previous review papers have recognised the significance of open innovation in influencing performance, only a handful of reviews, such as the work by Lopes and de Carvalho (2018) have incorporated moderators in this association. Hence, to advance our understanding in this domain, this research offers insights into both moderators and

mediators that have been explored in the context of the relationship between open innovation and its outcomes.

2.3 Research Questions

This study seeks to bridge the above-mentioned gaps and aims to solve the following research questions:

1. What are the antecedents of open innovation?
2. What are the moderators in the relationship between open innovation and its antecedents?
3. What are the mediators in the relationship between open innovation and its antecedents?
4. What are the consequences of open innovation?
5. What are the moderators in the relationship between open innovation and its outcomes?
6. What are the mediators in the relationship between open innovation and its outcomes?

The paper's structure is organised as follows. The next section briefly outlines the methodology used. Next, a thorough synthesis of the findings is presented, encompassing the antecedents, moderators, mediators, and outcomes of open innovation. Ultimately, this section culminates with a discussion of the reviewed papers and conclusion.

2.4 Methodology

2.4.1 Data Collection

In accordance with best practice (Short, 2009), the following steps were taken to search for articles for this review: (1) Scopus database was used to search for articles published on open innovation (Lopes and de Carvalho, 2018; Obradović, Vlačić and Dabić, 2021). Various search strings were devised, drawing from existing systematic literature reviews on open innovation, and the search period was restricted to articles published up to December 31, 2020. The search terms used were "open innovation" OR "inbound open innovation" OR "outbound

open innovation" OR "coupled open innovation" OR "outside-in process" OR "inside-out process" OR "openness depth" OR "openness breadth"; (2) Furthermore, during the screening process, only peer-reviewed articles were considered to ensure the quality of the selected literature. Thus, book chapters and dissertations were excluded as their quality cannot be verified due to the lack of peer review (Newman *et al.*, 2021); (3) and finally, included only articles published in business journals and listed in CABS 2018 journals ranked 1 and above.

Once the articles were obtained, I first screened them for relevance to the study by looking at the keywords, title and abstract. However, to ensure that nothing relevant was missed, I extended my inclusion decision to include the methodology. By following this criterion, I ended up eliminating articles that were irrelevant to open innovation. After this initial screening, I proceeded with an in-depth reading of the full text to select papers that focused on open innovation as a central theme and to eliminate papers that only mentioned open innovation in passing. Figure 1 below provides further details on the final selection of 944 articles for the systematic review.

2.5 Review of Empirical Research on Open Innovation

2.5.1 Introduction

In the following sections, I undertook an empirical examination of the open innovation literature. I initiated the research by thoroughly examining the body of work concerning the antecedents of open innovation. This involved a deep dive into the elements that moderate this phenomenon and an exploration of the variables that mediate the connection between open innovation and its precursors. Following that, I analysed the substantial outcomes of open innovation, delving into the factors that moderate these outcomes and investigating the variables that mediate the relationship between open innovation and its outcomes. Lastly, I provided future recommendations on open innovation.

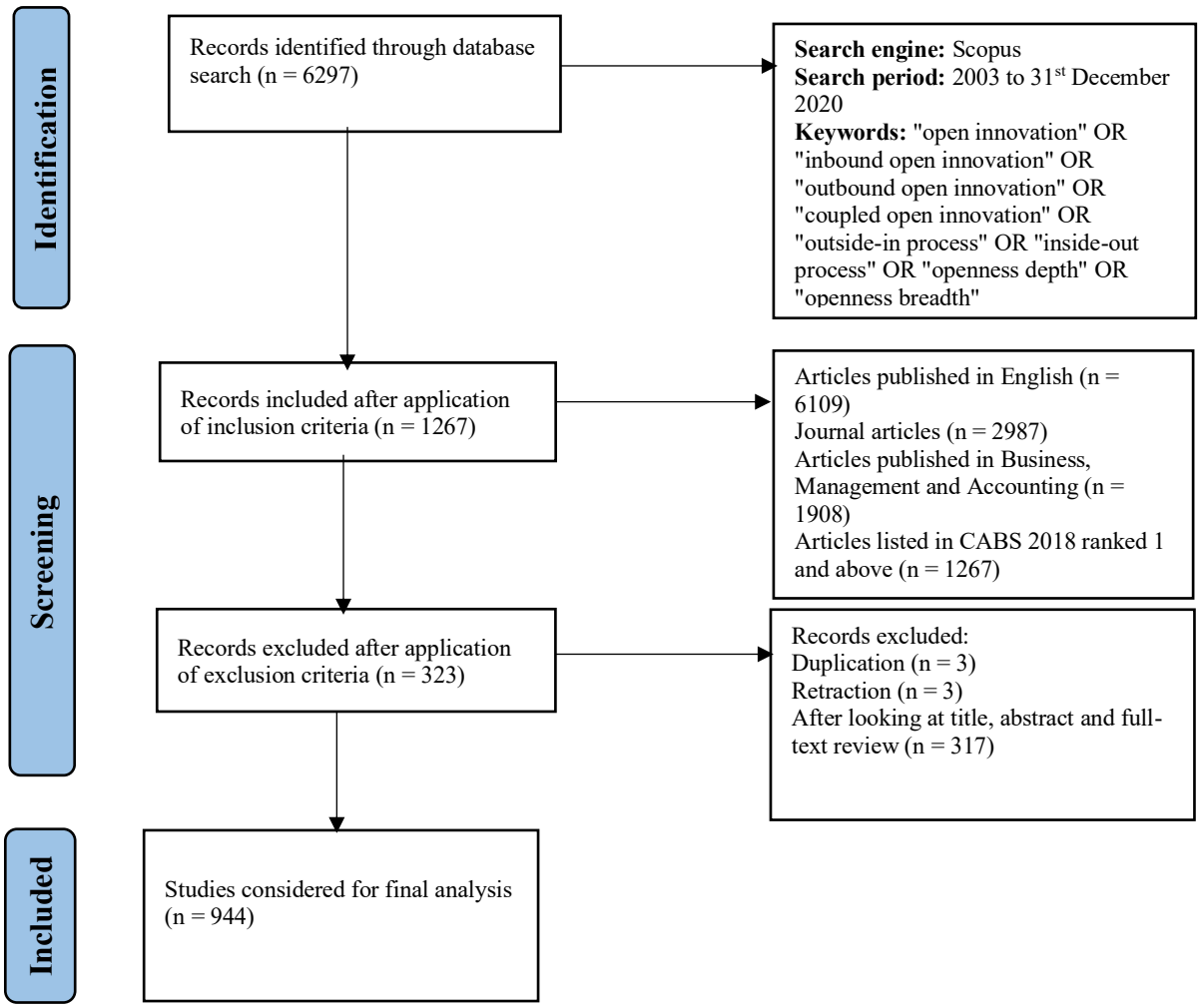


Figure 1: Review Procedure Based on PRISMA Protocol

2.5.2 Antecedents of Open Innovation

An increasing plethora of studies have investigated the factors that could encourage or impede involvement in open innovation. In these studies, open innovation has been treated as a dependent variable influenced by antecedents at different levels of analysis: individual, organisational, and external environment. In the upcoming sections, I delve into the crucial precursors of open innovation to elucidate contradictory findings and identify areas where knowledge gaps persist.

2.5.2.1 Individual-Level Antecedents of Open Innovation

In recent times, scholars (Bogers, Foss and Lyngsie, 2018; Salter *et al.*, 2015) have advocated for a more nuanced comprehension of open innovation, particularly at the micro-foundational level. In this context, the impact of individual-level factors on open innovation has garnered attention. For instance, drawing upon the knowledge-based view of the firm, Naqshbandi and Jasimuddin (2018) discovered that leadership centred on knowledge enhances both inbound and outbound open innovation. Similarly, Naqshbandi and Tabche, (2018) observed a positive correlation between empowering leadership and inbound and outbound open innovation. This implies that the presence of empowering leaders contributes to the acquisition of external knowledge as well as the effective sharing, utilisation, and commercialisation of a company's internal knowledge base (Naqshbandi and Tabche, 2018).

Moreover, Bogers, Foss, and Lyngsie (2018) identified a significant positive relationship between innovative leadership and inbound open innovation, indicating that innovative leaders facilitate engagement in acquiring external knowledge. Additionally, the establishment of open innovation coalitions by leaders was discovered to be significantly and positively linked to employees' willingness to embrace external contributions (Rangus and Černe, 2019).

Concerning educational qualifications, Bogers, Foss and Lyngsie (2018) identified a positive correlation between the educational levels of employees and their openness. Additionally, they observed a significant positive relationship between the diversity of educational backgrounds among employees and the overall openness of the firm (Bogers, Foss and Lyngsie, 2018). To support this positive association, they highlighted that a substantial presence of employees with diverse educational experiences offers firms a broader knowledge base, enabling them to effectively harness external knowledge resources (Bogers, Foss and Lyngsie, 2018). On the contrary, Rangus and Černe (2019) found that employee education is

not significantly related to the formation of open innovation coalitions by managers. In support of this finding, Ahn, Minshall and Mortara (2017) found CEOs' academic degrees not to be significantly related to open innovation adoption.

In addition, other studies have identified various management styles and roles employed during open innovation. This is imperative considering that most studies on open innovation tend to highlight its implications for management without necessarily examining the critical roles played by management (Ollila and Yström, 2017). In particular, a study by Ollila and Yström (2017) identified three roles that managers played during open innovation collaboration. Managers played the roles of facilitator, tactician and sense giver in open innovation collaboration (Ollila and Yström, 2017).

Furthermore, managerial experience (Bianchi *et al.*, 2011; Usman and Vanhaverbeke, 2017), CEO and entrepreneurial characteristics (Ahn, 2020; Ahn, Minshall and Mortara, 2017; Santoro *et al.*, 2020), gender (Salter *et al.*, 2015), employee age and tenure (Bogers, Foss and Lyngsie, 2018), changes in professional identity (Lifshitz-Assaf, 2018), and employee motivation have all been found to influence open innovation engagement (Rangus and Černe, 2019).

Despite these studies, this systematic review confirms the assertion of scholars such as Bogers, Foss and Lyngsie (2018), who found that compared to organisational level factors, there are few studies dedicated to understanding the crucial role of individuals in open innovation.

2.5.2.1.1 Moderators of the Relationship between Open Innovation and its Individual-Level Antecedents

While somewhat scarce, previous research has explored the contextual limitations of the connections between open innovation and its antecedents at the individual level. From the

review, it was realised that scholars have identified individual and organisational factors as moderators in these relationships.

2.5.2.1.2 Individual Factors as Moderators

There has been limited research on personal factors acting as moderators. For example, a study by Bogers, Foss and Lyngsie (2018) found that the diversity of employees' work history positively moderated the impact of employees' diverse educational backgrounds and the firm's use of external knowledge sources. That is, although a strong knowledge base through education is crucial for seeking knowledge and information outside the firm, this impact is enhanced when employees have diverse work histories.

2.5.2.1.3 Organisational Factors as Moderators

Compared to individual factors acting as moderators, it was noted that more studies examined organisational factors as moderators. However, research in this area is constrained and deserves greater attention from scholars. A study conducted by Burcharth, Knudsen and Søndergaard (2014) among Danish manufacturing firms revealed that various facets of employee training initiatives organised by these firms played distinct moderating roles. They found that employee training (i.e., professional training, training for creativity and innovation) positively moderated the effect of not-invented-here syndrome on inbound open innovation practices, while employee training (i.e., nurturing special talent) negatively moderated the effect of not-invented-here syndrome on inbound open innovation practices (Burcharth, Knudsen and Søndergaard, 2014). The authors explained that professional training (i.e., training that focused on improving employees' already existing skills) and training for creativity and innovation (i.e. training that focused on improving employees' innovation and idea generation) helped to limit the negative attitude (not-invented-here) of employees in companies (Burcharth, Knudsen and Søndergaard, 2014). However, training programmes that focused on nurturing special talents (i.e., developing employees' leadership skills) improved the negative attitude

(not-invented-here) exhibited by employees towards open innovation (Burcharth, Knudsen and Søndergaard, 2014). The authors argued that this was possible because such training aims to make employees self-involved and empowered, which could contribute to employees undervaluing knowledge outside their company (Burcharth, Knudsen and Søndergaard, 2014). Furthermore, they found that employee training (i.e., nurturing special talent) positively moderates the impact of the not-shared-here syndrome on outbound open innovation practices (Burcharth, Knudsen and Søndergaard, 2014). However, professional training and training for creativity and innovation did not moderate the impact of the not-shared-here syndrome on outbound open innovation practices (Burcharth, Knudsen and Søndergaard, 2014).

In a separate study, Hahn, Minola and Eddleston (2019) illustrated that the engagement of start-ups in strategic planning exerted a favourable moderating influence on the connection between having multiple scientists as founders of an innovative start-up and inbound open innovation, particularly in terms of search breadth and search depth. In other words, startups that emphasised the cultivation of a business mindset played a pivotal role in encouraging founders to actively seek knowledge beyond the boundaries of their own company. They also found that start-ups emphasising non-commercial goals negatively moderated the relationship between having multiple scientists as founders of an innovative start-up and inbound open innovation (search breadth and search depth) (Hahn, Minola and Eddleston, 2019). That is, deviating from a business world (strategic planning) and emphasising a scientific world (non-commercial goals) is detrimental for founders who want to venture into open innovation, as it could lead to a decrease in start-up performance (Hahn, Minola and Eddleston, 2019).

Overall, despite the contributions that scholars have made in highlighting some moderators, studies in this area are limited and therefore warrant further studies.

2.5.2.1.4 Mediators of the Relationship between Open Innovation and its Individual-Level Antecedents

There is a scarcity of studies that have delved into the underlying mechanisms that elucidate how individual-level factors influence open innovation.

2.5.2.1.5 Organisational Factors as Mediators

The review revealed that scholars have relied on organisational factors as mediators of these relationships, neglecting individual and environmental level factors. For example, a study by Naqshbandi and Tabche (2018) found that organisational learning culture partially mediated the association between empowering leadership and inbound and outbound open innovation. That is, empowering leaders provides a conducive environment where learning culture is supported, and knowledge inflows or outflows are facilitated.

In accordance with the knowledge-based view, Naqshbandi and Jasimuddin (2018) furnished evidence demonstrating that knowledge management capabilities acted as a full mediator in the association between knowledge-focused leadership and inbound and outbound open innovation. In essence, leaders who establish more effective means of communicating their organisation's goals and expectations to their workforce play a crucial role in moulding the company's capacity to assimilate external knowledge and monetise its internal knowledge resources (Naqshbandi and Jasimuddin, 2018).

In a recent study, Ahn (2020) uncovered that the educational background of a CEO indirectly influences open innovation, with this influence mediated through internal R&D efforts. The scholar argued that CEOs' involvement in their firms could lead to a focus on internal R&D, thereby building and enhancing a firm's absorptive capacity, which is crucial for integrating knowledge and ideas from organisations outside the firm (Ahn, 2020).

Overall, despite the contributions that scholars have made in highlighting some mediators, studies in this area are limited and therefore warrant further research.

2.5.2.2 Firm-Level Antecedents of Open Innovation

Consistent with the trends identified in previous reviews (e.g., Randhawa, Wilden and Hohberger, 2016), my research findings also highlight that the predominant focus of previous studies has been on examining open innovation primarily from a firm-level perspective.

Several studies revealed inconsistent findings regarding the importance of firm characteristics on open innovation. In terms of firm size, a study by van de Vrande et al. (2009) revealed that small and medium-sized enterprises (SMEs) in the Netherlands actively engage in various open innovation activities, with a particular focus on those associated with market-related objectives; however, they found that, compared to small firms, medium-sized firms are, on average, more involved in open innovation practices. Furthermore, Drechsler and Natter (2012) found that larger firms were more involved in open innovation. On the other hand, Lorenz et al. (2020) found that firm size was not significantly related to search depth but was significantly and negatively related to search breadth.

In addition to firm size, various other firm characteristics, including but not limited to firm age (Dong and Netten, 2017; Keupp and Gassmann, 2009), industry categorisation (such as manufacturing and service firms) (Stephan, Andries and Daou, 2019), ownership structure (Keupp and Gassmann, 2009), affiliation with a corporate group (Stephan, Andries and Daou, 2019), geographical location (Dong and Netten, 2017), and the degree of firm internationalisation, all play a role in influencing open innovation (Brem, Nylund and Hitchen, 2017).

Furthermore, there are additional studies that have concentrated on investigating how the internal capabilities of a firm can affect the execution of open innovation practices.

Capabilities are intangible resources that refer to a firm's expertise (Martinez *et al.*, 2019). A firm's internal capabilities are manifested in different forms, ranging from organisational capabilities to innovation resources (Martinez *et al.*, 2019). These resources include not only a firm's knowledge expressed in its R&D and skilled personnel but also networking capabilities and organisational capital (Martinez *et al.*, 2019).

The significance of firm capabilities and resources encompassing technological capabilities (Taghizadeh *et al.*, 2020), organisational resources (in terms of absorbed slack and unabsorbed slack) (Wang, Guo and Yin, 2017), innovation capabilities (knowledge resources, absorptive capacity, entrepreneurial orientation) (Wu, Lin and Chen, 2013), organisational capabilities (exploratory capabilities) (Cheng and Shiu, 2015), knowledge-based dynamic capabilities (Cheng, Yang and Sheu, 2016), knowledge management capabilities (Martinez-Conesa, Soto-Acosta and Carayannis, 2017), knowledge structure (component knowledge and architectural knowledge) (Zhou *et al.*, 2019), intellectual capital, strategic orientation (Nobakht *et al.*, 2020) and absorptive capacity have all been acknowledged are explored in the open innovation literature (Naqshbandi and Tabche, 2018).

Furthermore, although the critical role of organisational structures (formalisation, specialisation, centralisation, decentralisation) has been acknowledged in the open innovation literature, studies in this area are rather inconclusive and limited. In this context, formalisation has been identified as having a substantial and positive correlation with inbound open innovation (Gentile-Lüdecke, Torres de Oliveira and Paul, 2020), as well as coupled open innovation practices (Oltra, Flor and Alfaro, 2018). Conversely, Gentile-Lüdecke, Torres de Oliveira and Paul (2020) reported a detrimental impact of formalisation on outbound open innovation, whereas Oltra, Flor, and Alfaro (2018) found no significant association between formalisation and either inbound or outbound open innovation practices.

Moreover, while the centralisation of decision-making has been identified as a positive influence on inbound and coupled open innovation (Gentile-Lüdecke, Torres de Oliveira and Paul, 2020), the study conducted by Popa, Soto-Acosta and Martinez-Conesa (2017) found that centralisation of decision-making does not exhibit a significant association with either inbound or outbound open innovation. In contrast, specialisation exhibits a significant and positive correlation with inbound and outbound open innovation (Gentile-Lüdecke, Torres de Oliveira and Paul, 2020). Another study concluded that decentralisation does not display a significant association with inbound, outbound, or coupled open innovation practices (Oltra, Flor and Alfaro, 2018).

Furthermore, the literature widely acknowledges the crucial role of organisational culture in either facilitating or impeding open innovation. On the one hand, Alassaf et al. (2020) established that an open innovation culture significantly and positively impacts both inbound and outbound open innovation activities. This observation aligns with the findings of Naqshbandi and Tabche (2018), who also detected a noteworthy positive effect of organisational learning culture on both inbound and outbound open innovation. Additionally, a significant and positive association was identified between entrepreneurial culture and inbound open innovation (Markovic *et al.*, 2020). Moreover, innovation climate has been found to enhance inbound and outbound open innovation (Popa, Soto-Acosta and Martinez-Conesa, 2017).

On the other hand, Mount and Martinez (2014) emphasised that a close organisational culture and a hierarchical culture stand out as primary challenges that constrain Rowntree's ability to embrace openness. In addition, organisational culture (in the form of a lack of innovative culture) acted as a barrier to open innovation (Leckel, Veilleux and Dana, 2020). Furthermore, Radnejad, Vredenburg and Woiceshyn (2017) found that a firm's corporate culture served as a challenge to R&D collaboration. They clarified that companies oriented

towards short-term profit are less inclined to embrace risk, potentially impeding the innovation process (Radnejad, Vredenburg and Woiceshyn, 2017). Therefore, to overcome some of these challenges, a proactive cultural change is crucial to adapt to a new R&D paradigm (Thong and Lotta, 2015).

Overall, despite the valuable insights provided by these studies, certain discrepancies in the findings have emerged. As a result, there is a necessity to investigate the moderating and mediating elements that influence the association between open innovation and its organisational-level factors.

2.5.2.2.1 Moderators of the Relationship between Open Innovation and its Organisational-Level Antecedents

From the review, a limited number of studies have ventured into examining the moderators that impact the association between open innovation and its organisational-level antecedents. Among these investigations, more focus has been placed on the moderating impact of organisational and environmental factors, with individual factors receiving relatively less attention.

2.5.2.2.2 Organisational Factors as Moderators

In examining the moderating effect of organisational factors, a study by Wang and Guo (2020) revealed absorptive capacity to positively moderate the association between financial slack and external knowledge search. Another study of manufacturing firms in the United States found that a firm's absorptive capacity positively moderates the relationship between absorbed slack and openness in knowledge search (Wang, Guo and Yin, 2017). Contrastingly, it was discovered that a firm's absorptive capacity does not moderate the link between unabsorbed slack and openness in knowledge search (Wang, Guo and Yin, 2017). Additionally, Naqshbandi and Tabche (2018) found absorptive capacity not to function as a

moderating factor in the link between organisational learning culture and both inbound and outbound open innovation. However, upon conducting separate analyses for sector types (manufacturing and services), they revealed that absorptive capacity did, serve as a moderator in the association between organisational learning culture and outbound open innovation specifically within the services sector (Naqshbandi and Tabche, 2018). Yet, this moderating effect was not observed in the manufacturing sector (Naqshbandi and Tabche, 2018). Moreover, the interactive effect between absorptive capacity and financial slack on external knowledge search is weakened by industrial competition intensity (Wang and Guo, 2020). Industrial competition intensity also negatively moderates the influence of absorptive capacity on external knowledge search (Wang and Guo, 2020).

In terms of intellectual capital, Barrena-Martínez et al. (2020) revealed that human capital and relational capital exhibit a significant negative interaction on open innovation success. However, the interaction effect between human and relational capital on open innovation success was not significant (Barrena-Martínez *et al.*, 2020). The interaction effect between structural and relational capital was also not significant for open innovation success (Barrena-Martínez *et al.*, 2020).

2.5.2.2.3 Environmental Factors as Moderators

When examining the moderating role of environmental factors, Popa, Soto-Acosta and Martinez-Conesa (2017) found that environmental dynamism enhanced the positive effect of innovation climate on outbound open innovation. However, environmental dynamism did not strengthen the positive effect of innovation climate on inbound open innovation (Popa, Soto-Acosta and Martinez-Conesa, 2017). Another study found that environmental dynamism did not moderate the positive relationship between knowledge management capabilities and open innovation (Martinez-Conesa, Soto-Acosta and Carayannis, 2017). Furthermore, Popa, Soto-Acosta and Martinez-Conesa (2017) found that environmental competitiveness did not

amplify the beneficial influence of an innovation climate on both inbound and outbound open innovation.

In the context of market dynamism, Zhu et al. (2017) identified that market dynamism exerted a negative moderating influence on the link between a firm's business ties and inbound open innovation. However, they observed that market dynamism did not significantly moderate the relationship between a firm's business ties and outbound open innovation (Zhu *et al.*, 2017). Furthermore, they detected a noteworthy positive moderating effect of market dynamism on the relationship between university ties and inbound open innovation, but this moderating effect was not evident in the relationship between a firm's business ties and outbound open innovation (Zhu *et al.,* 2017).

In summary, prior research has not extensively examined individual factors as moderators influencing the connection between open innovation and its organisational-level counterparts. Therefore, further examination in this area is warranted.

2.5.2.2.4 Mediators of the Relationship between Open Innovation and its Organisational-Level Antecedents

The review underscored the limited focus on exploring how specific factors might serve as mediators in the relationship between open innovation and its organisational-level precursors. While some studies have investigated the mediating role of individual and organisational factors, there has been a relative lack of attention on environmental factors in this regard.

2.5.2.2.5 Individual Factors as Mediators

A few studies, although limited in number, have delved into individual factors as mediators in the relationship between open innovation and its organisational-level factors. For example, as demonstrated in the study conducted by Alassaf *e*t al. (2020), employees'

knowledge and reward were found as mediators in the relationship between an organisation's culture of openness and its open innovation activities. They also found that employees' positive attitudes towards receiving and sharing external knowledge mediated the relationship between open culture and open innovation (Alassaf *et al.*, 2020). Furthermore, the involvement of employees in knowledge sourcing and knowledge sharing practices, along with the rewarding of open innovation activities, were revealed to mediate the relationship between an open border organisation and open innovation adoption (Alassaf *et al.*, 2020).

2.5.2.2.6 Organisational Factors as Mediators

In investigating the mediating influence of organisational factors, a study by Markovic et al. (2020) revealed that open innovation enablement played a positive mediating effect on the influence of entrepreneurial culture on inbound open innovation. They also found that open innovation support did not mediate the relationship between entrepreneurial culture and inbound open innovation (Markovic *et al.*, 2020). In a separate study, Madrid-Guijarro, Martin and García-Pérez-de-Lema (2020) discovered that the formalisation of innovation strategy acted as a mediating factor in the link between human resource capital and inbound and outbound open innovation activities. They also found formalisation of innovation strategy to mediate the relationship between commitment to learning and inbound and outbound open innovation activities (Madrid-Guijarro, Martin and García-Pérez-de-Lema, 2020). Furthermore, the formalisation of innovation strategy mediated the relationship between risk-taking for learning and inbound and outbound open innovation activities (Madrid-Guijarro, Martin and García-Pérez-de-Lema, 2020).

2.5.2.3 External Environmental Antecedents of Open Innovation

A growing number of studies have examined environmental factors as antecedents of open innovation. Scholars have found inconsistent results on the impact of environmental dynamism and some of its components (i.e., market turbulence, technology turbulence,

competitive intensity, among others) on open innovation. For example, environmental dynamism has been found to positively (Martinez-Conesa, Soto-Acosta and Carayannis, 2017) and negatively related to open innovation (Wang, Guo and Yin, 2017). While others (Ferreras-Méndez *et al.*, 2015) have found it not to be significantly associated with breadth of openness.

In terms of market turbulence, a study by Zang et al. (2014) found market turbulence to enhance knowledge search depth, but not knowledge search breadth. On the contrary, a study of manufacturing firms in the Pacific Northwest found that market turbulence was significantly and negatively related to open innovation (Sisodiya, Johnson and Grégoire, 2013). Furthermore, Cheng and Shiu (2015) found market turbulence not to be significantly associated with inbound and outbound open innovation.

Another important aspect of environmental dynamism examined in the literature is technological turbulence. Prior investigations have unveiled a significant and favourable impact of technological turbulence on both inbound and outbound open innovation practices (Cheng, Yang and Sheu, 2016; Zhou *et al.*, 2019). Conversely, Zang et al. (2014) reported that technological turbulence exhibited a significant and positive relationship solely with knowledge search depth, but not with knowledge search breadth. Additionally, Cheng and Shiu (2015) found that technological turbulence did not exhibit a significant association with open innovation.

In addition, competitive intensity is another important component of environmental uncertainty. Cheng, Yang and Sheu (2016) reported competitive intensity to be significantly and positively linked with outbound open innovation practices but found no such relationship with inbound open innovation. Conversely, Wang, Guo and Yin (2017) discovered that industry concentration, used as an inverse proxy for competitive intensity, exhibited a significant and positive relationship with search openness. However, in contrast, other studies (Cheng and

Shiu, 2015; Lichtenthaler, 2009) did not observe a significant link between competitive intensity and the adoption of inbound and outbound open innovation strategies.

While open innovation offers valuable advantages, firms face the potential risk of losing appropriability knowledge through their engagement with external partners (Chen, Zhang and Wang, 2022). In response to this challenge, firms may opt for the deployment of appropriability mechanisms (Spithoven and Teirlinck, 2015). In the context of the North American solar industry, a study conducted by Zobel, Balsmeier and Chesbrough (2016) determined that the patent stock of a new entrant had a notable and positive impact on innovation openness. Additionally, Spithoven and Teirlinck (2015) identified a significant positive relationship between both formal and informal appropriation mechanisms and the practice of R&D outsourcing.

Conversely, Freel and Robson (2017) found that the use of formal and informal innovation protection mechanisms was not significantly associated with coupled open innovation. They also found that informal protection mechanisms enhanced inbound open innovation, while formal protection mechanisms were not significantly related to inbound open innovation (Freel and Robson, 2017). Another study revealed a concave relationship between firms' appropriability strategies and the extent of their external search and innovation collaboration (Laursen and Salter, 2014). Moreover, compared to formal mechanisms, Rouyre and Fernandez (2019) found that informal mechanisms play a limited role in managing tensions that may arise from knowledge sharing and protection between firms.

Another group of studies has concentrated on the association of government with open innovation. A study by Ahn (2020) found government support to enhance openness. Furthermore, considering that government agents are crucial for the establishment of science parks (Amankwah-Amoah, 2016), a study by Silva et al. (2020) found that science parks

promote open innovation through spontaneous mechanisms, deliberate actions and as public policy vectors. Furthermore, it was observed that public support for innovation, encompassing both financial and non-financial assistance, resulted in an augmentation of the level of openness (Cano-Kollmann, Hamilton and Mudambi, 2017). They also found that non-financial support has a greater impact on openness than financial support (Cano-Kollmann, Hamilton and Mudambi, 2017). On the contrary, De Marco, Martelli and Di Minin (2020) found that SMEs that received public funding in the form of grants were less engaged in open innovation than those that did not receive funding.

The influence of the cultural environment on open innovation has been explored in various studies. For example, a study conducted by Brockman, Khurana and Zhong (2018) unveiled that the cultural dimension of individualism exhibited a significant and positive association with open innovation, suggesting that cultures that place a premium on individualism might foster more favourable conditions for open innovation practices. Conversely, the cultural dimension of hierarchy was identified as significantly and negatively linked to open innovation, implying that cultures with a pronounced hierarchical orientation could impede open innovation (Brockman, Khurana and Zhong, 2018). Furthermore, Brockman, Khurana and Zhong (2018) established that social trust at the country level displayed a significant and positive association with open innovation. This implies that a higher degree of social trust within a country's culture could enhance collaborative open innovation efforts among organisations. Additionally, Brockman, Khurana and Zhong (2018) identified that a higher Gross Domestic Product (GDP) improves open innovation.

In summary, the cultural environment, social trust, and economic factors can play significant roles in shaping the openness and success of innovation practices in different regions and countries.

2.5.2.3.1 Moderators of the Relationship between Open Innovation and its External Environmental Antecedents

While some strides have been taken to examine the factors that affect the connection between open innovation and its external environmental antecedents, it is worth noting that studies in this area are constrained and limited in number. Previous studies have relied on how organisational and external environmental factors could serve as moderators in this relationship at the neglect of individual-level factors.

2.5.2.3.2 Organisational Factors as Moderators

In terms of organisational factors as moderators, a study by Hagedoorn and Zobel (2015) found R&D capabilities to positively moderate the relationship between preference for intellectual property rights and open innovation. Moreover, Brockman, Khurana and Zhong (2018) found high-tech intensive firms to strengthen the positive relationship between social trust and open innovation.

2.5.2.3.3 Environmental Factors as Moderators

In terms of external environmental factors as moderators, Brockman, Khurana and Zhong (2018) found the positive relationship between social trust and open innovation to be stronger in countries with relatively weak legal systems.

2.5.2.3.4 Mediators of the Relationship between Open Innovation and its External Environmental Antecedents

A significant void is evident in the existing literature regarding the mediation of the association between open innovation and its external environmental antecedents. This gap offers a promising path for future research to delve into these intricate mechanisms and offer valuable insights. For instance, in a study conducted by Ahn (2020) among small and medium-

sized enterprises (SMEs) in Korea, it was revealed that internal research and development (R&D) explained the influence of government support on open innovation.

2.5.3 Outcomes of Open Innovation

An increasing body of research has concentrated on investigating the influence of open innovation on its outcomes. The following section highlights key outcomes of open innovation.

2.5.3.1 Performance Indicators

From the review, various dimensions of performance have been scrutinised as outcomes in prior studies. In the subsequent section, I will explore the connection between open innovation and various performance metrics as well as other outcomes. When evaluating firm performance, the primary focus has been on financial performance (Lopes and de Carvalho, 2018), encompassing indicators such as firm growth (Xia and Roper, 2016), return on investment, sales growth (Cheng and Huizingh, 2014), and return on sales (Lichtenthaler, 2009).

Prior research has yielded diverse findings concerning the influence of open innovation on firm performance (Li, Li and Wu, 2022). While some studies have showcased that open innovation practices positively affect firm performance (Oltra, Flor and Alfaro, 2018; Popa, Soto-Acosta and Martinez-Conesa, 2017), others have suggested that the effects may vary (Michelino *et al.*, 2015). On the one hand, inbound, outbound, and coupled open innovation practices have been identified as significantly and positively correlated with firm performance (Oltra, Flor and Alfaro, 2018; Popa, Soto-Acosta and Martinez-Conesa, 2017).

On the other hand, other studies have discovered evidence to the contrary. For instance, Michelino et al. (2015) revealed an inverted U-shaped association between inbound open innovation and financial performance, along with a U-shaped relationship between outbound open innovation and financial performance. Consistent with this discovery, Caputo et al. (2016)

also identified an inverted U-shaped relationship between inbound open innovation and financial performance.

Another measure of performance relates to innovation indicators. Despite the considerable volume of studies dedicated to examining the impact of open innovation on innovation performance, the outcomes continue to yield inconclusive results. Notably, certain scholars have identified a positive influence of open innovation on innovation performance (Zhou *et al.*, 2019). For example, Roper, Vahter and Love (2013) revealed that the externalities of openness in innovation are positively associated with firm innovation performance. Reinforcing this discovery, research indicates that both inbound, outbound, and coupled open innovation activities exhibit significant and positive associations with innovation performance (Cheng and Huizingh, 2014; Zhou *et al.,* 2019).

On the contrary, other scholars have found that open innovation is significantly and negatively associated with innovation performance. For example, a significant negative relationship was found between the breadth of partners in open innovation collaborations and innovation performance (in terms of both novelty and efficiency) (Bengtsson *et al.*, 2015). Also, the greater the heterogeneity in the breadth of the open innovation channel, the worse the innovation performance (Huang *et al.*, 2015). Other studies found that open innovation was not significantly related to innovation performance (Bagherzadeh *et al.*, 2020; Chen, Vanhaverbeke and Du, 2016).

In addition, open innovation has been found to be detrimental to innovation performance. For example, Gimenez-Fernandez and Sandulli (2017) found an inverted U-shape relationship between the breadth of R&D outsourcing and innovation performance. In addition, Ferraris, Bogers and Bresciani (2020) revealed an inverted U-shaped relationship between external knowledge sourcing and innovation performance. Specifically, they found that open

innovation breadth contributed more to radical innovation, while open innovation depth contributed more to incremental innovation (Ferraris, Bogers and Bresciani, 2020).

2.5.3.2 Appropriability Mechanisms

Furthermore, different appropriability mechanisms have been studied as outcomes of open innovation. For example, Zobel, Lokshin and Hagedoorn (2017) found a significant positive relationship between external search breadth and formal appropriability mechanisms. In contrast, open innovation was not significantly related to formal intellectual property appropriability regimes (i.e., patent, registration and copyright) (Huang *et al.*, 2014), formal appropriability mechanisms (Zobel, Lokshin and Hagedoorn, 2017), and negatively related to patent applications (Papa *et al.*, 2021).

Moreover, research has demonstrated that the extent and thoroughness of external search exerted a favourable impact on informal appropriation mechanisms (Zobel, Lokshin and Hagedoorn 2017). Additionally, it was observed that the level of openness exhibited a positive and significant relationship with the adoption of informal intellectual property (IP) appropriation mechanisms, including secrecy, product design complexity, as well as rapid and frequent product/service changes (Huang *et al.*, 2014).

2.5.3.3 Other Outcomes

Open innovation has also been studied for other outcomes. A research carried out by Rumanti et al. (2020) focusing on SMEs in Indonesia unveiled a significant and positive association between open innovation and cleaner production. Additionally, the literature has documented the influence of open innovation on digital technologies. For instance, Lorenz et al. (2020) identified a significant positive correlation between search depth and the adoption of digital technology, although they did not find a significant relationship between search breadth and digital technology adoption.

2.5.3.4. Moderators of the Relationship between Open Innovation and its Outcomes

Previous studies have examined factors that might function as moderators in the association between open innovation and its outcomes. In comparison to organisational and environmental factors, there has been relatively less emphasis on comprehending how individual factors might act as moderators in this relationship.

2.5.3.4.1 Individual Factors as Moderators

Some studies have delved into individual factors acting as moderators in the relationship between open innovation and its outcomes. For instance, Salge et al. (2013) uncovered that project leaders with direct experience in new product development positively moderated the connection between search openness and new product creativity. Moreover, they pinpointed that project leaders possessing direct experience in new product development, along with those having a broader background in leadership, amplified the connection between search openness and the success of new product initiatives (Salge *et al.*, 2013). In another investigation, Eftekhari and Bogers (2015) found entrepreneurs' open mindset to positively moderate the association between open innovation and the survival of new ventures. In addition, Salter et al. (2015) found that the time horizon of individuals' R&D efforts moderates the relationship between openness and ideation performance, such that the threshold of openness at which diminishing or negative returns set in is higher for those with a long-term focus. They also found that connections to senior managers did not moderate the relationship between individual openness and ideation performance (Salter *et al.*, 2015). Individual knowledge breadth also moderated the relationship between openness and ideation performance (Salter *et al.*, 2015).

The influence of managerial characteristics as a moderator has also been investigated. For instance, managerial technical competence was discovered to positively moderate the impact of employees' depth of utilisation of knowledge sources on their innovative work output

(Badir, Frank and Bogers, 2020). Conversely, when managers had a higher level of technical competence, the influence of employees' breadth of use of external knowledge on innovative work output became more negative or less positive (Badir, Frank and Bogers, 2020).

2.5.3.4.2 Organisational Factors as Moderators

Certain studies have explored organisational factors as moderators in the association between open innovation and its outcomes. Previous research has examined the moderating effect of various organisational factors such as knowledge structure (Zhou *et al.*, 2019), formalisation and decentralisation in the organisational structure (Oltra, Flor and Alfaro, 2018), formal liaison devices (Cruz-González, López-Sáez and Navas-López, 2015), business model innovation (Zhu *et al.*, 2019), knowledge-based dynamic capabilities (Cheng, Yang and Sheu, 2016), technological opportunities (Huang *et al.*, 2019) and strategic human resource practices (Ardito and Messeni Petruzzelli, 2017).

Regarding the moderating effects of absorptive capacity, R&D investment and internal R&D, prior studies have revealed varied findings. On the one hand, they have been observed to positively strengthen the association between open innovation and firms that outperform others (Alexy, Bascavusoglu-Moreau and Salter, 2016). On the other hand, absorptive capability, R&D investment, or internal R&D either did not serve as moderators or played a significant negative moderating role. For instance, Mei, Zhang and Chen (2019) found absorptive capacity to weaken the influence of SME linkages with prominent organisations and service intermediaries on innovation performance. In a different study, R&D investment was found to negatively moderate the influence of open innovation on underperforming firms (Alexy, Bascavusoglu-Moreau and Salter, 2016). On the contrary, Chen, Vanhaverbeke and Du (2016) found a higher level of internal R&D to not moderate the effect of external knowledge sourcing from science-based partners on firms' innovation performance.

Moreover, Wang, Chin and Lin (2020) found that ambidexterity in knowledge search, manifested as breadth and depth, moderates the inverted U-shaped relationship between firm openness and innovation performance. Furthermore, Ferraris, Bogers and Bresciani (2020) found that internal embeddedness positively moderates the effect of knowledge sourcing on innovation performance. The firm's R&D and social integration mechanisms were also found to positively moderate the effect of the breadth and depth of the firm's knowledge sourcing on environmental innovation (Ghisetti, Marzucchi and Montresor, 2015).

Another study examined the moderating role of strategic human resource practices (heterogeneous work groups and brainstorming sessions). For example, Ardito and Messeni Petruzzelli (2017) found that both the establishment of heterogeneous work groups and brainstorming sessions positively moderate the inverted U-shape effect of external search breadth on product innovation. In a separate study, modern human resource management practices were found to positively moderate the relationship between external knowledge flows from market-based actors and firm innovativeness and social media use (de Zubielqui, Fryges and Jones, 2019). Additionally, there are findings indicating that human resource management plays a positive moderating role in the relationship between knowledge acquisition and innovation performance (Papa *et al.*, 2020). Furthermore, employee retention was identified as another positive moderator in the relationship between knowledge acquisition and innovation performance (Papa *et al.*, 2020).

In addition, the influence of organisational knowledge protection mechanisms as a moderator has been examined. For example, Wadhwa, Freitas and Sarkar (2017) found that employee retention strategies and secrecy moderated the inverted U-shaped relationship between the extent of extramural R&D and firm innovativeness. Conversely, knowledge complexity did not moderate the inverted U-shape relationship between the extent of extramural R&D and firm innovativeness (Wadhwa, Freitas and Sarkar, 2017).

Another study examined the moderating role of organisational mechanisms in R&D. For example, Bianchi et al. (2016) found external consultants to positively moderate the inverted U-shaped relationship between inbound open innovation (external technological knowledge acquired through R&D outsourcing) and product innovation performance. They also found dedicated R&D units to positively moderate the inverted U-shape relationship between inbound open innovation (external technological knowledge acquired through R&D outsourcing) and product innovation performance (Bianchi *et al.*, 2016).

The influence of partner alignment as a moderator has also been investigated. For example, Zacharias, Daldere and Winter (2020) found that partner alignment positively moderates the relationship between highly interactive open innovation activities and technology adaptiveness and market adaptiveness. However, they found partner alignment to negatively moderate the relationship between weakly interactive open innovation activities on technology adaptiveness and market adaptiveness (Zacharias, Daldere and Winter, 2020).

In addition, industrial innovation disruptiveness and organisational innovation have been examined as moderators. For example, Cheng et al. (2020) found that the relationship between search breadth and average innovation performance was not statistically significant regardless of disruptiveness. They also found the relationship between search depth and average innovation performance to be statistically significant regardless of disruptiveness (Cheng *et al.,* 2020). In addition, the relationship between search depth and innovation performance variance is statistically significant when disruptiveness is not relatively high (Cheng *et al.*, 2020). In another study, Anzola-Román, Bayona-Sáez and García-Marco (2018) found organisational innovation not to moderate the externally sourced innovation activities-successful technological innovations link.

Moreover, several studies have explored firm-level characteristics, such as sector type, firm age (Expósito, Fernández-Serrano and Liñán, 2019), firm size (Carree, Lokshin and Alvarez, 2019) and ownership strategies (Chen *et al.*, 2020) as potential moderators.

Some studies have also examined how firm-level barriers could act as a moderating variable. For example, Monteiro, Mol and Birkinshaw (2017) found that a lack of resources and a lack of qualified personnel by a focal in-sourcing firm moderated the positive effect of openness to external knowledge on innovation performance. They also found the use of secrecy to mitigate the positive effect of openness to external knowledge on innovative performance (Monteiro, Mol and Birkinshaw, 2017).

2.5.3.4.3 Environmental Factors as Moderators

Several studies have investigated environmental factors as potential moderators in the relationship between open innovation and its outcomes. For example, Lichtenthaler (2009) observed that the degree of technological market turbulence amplified the positive influence of outbound open innovation on firm performance. Additionally, the transaction rate strengthened the positive influence of outbound open innovation on firm performance (Lichtenthaler, 2009). However, in the study by Sofka and Grimpe (2010), a technologically advanced environment did not demonstrate a moderating effect on the association between market-driven and supply-driven search strategies and innovation performance. In contrast, when examining technological environmental dynamism, it was found to negatively moderate the impact of external search breadth on firm performance but positively moderate the influence of external search depth on firm performance (Cruz-González, López-Sáez and Navas-López, 2015).

In addition, it was observed that market turbulence had a positive moderating impact on the association between external technology acquisition and external technology exploitation regarding firm performance (Hung and Chou, 2013). Moreover, market dynamism

positively moderated the impact of market knowledge sourcing (specifically, customer sourcing and competitor sourcing) on sensing capability (Endres, Helm and Dowling, 2020). However, Wang and Li-Ying (2014) found no moderating effect of technology market development on the relationship between inward technology licensing and a licensee firm's new product development performance.

In another study, the interaction effects of vertical collaboration and competitor collaboration on firm failure were found to decrease during the financial crisis period, while financial crisis and horizontal collaboration did not significantly interact on firm failure (Martinez *et al.*, 2019). Moreover, pro-business environment and market development were found to positively moderate the relationship between openness and innovation performance (Chen *et al.*, 2020).

Certain studies have explored the role of appropriation mechanisms as moderators in the realm of open innovation. For instance, Alexy, Bascavusoglu-Moreau and Salter (2016) identified that patenting exhibited a favourable moderating influence on the connection between open innovation and firms experiencing lower performance. However, this moderating effect was not observed in the realm of open innovation among high-performing firms (Alexy, Bascavusoglu-Moreau and Salter, 2016). Furthermore, patenting did not exert a moderating impact on the positive linkage between outbound open innovation and firm performance (Lichtenthaler, 2009).

2.5.3.5. Mediators of the Relationship between Open Innovation and its Outcomes

Prior studies have primarily focused on organisational factors as mediators in the association between open innovation and its outcomes.

2.5.3.5.1 Organisational Factors as Mediators

In the review, it was evident that numerous studies have concentrated on investigating organisational factors as mediators, while individual and environmental factors have received comparatively less attention. This section highlights studies that have explored organisational factors as mediators. For instance, Faems et al. (2010) identified that enhanced product innovation performance acted as a mediator in the positive relationship between a technology alliance portfolio and financial performance. In another study, it was found that innovation capabilities acted as a mediating factor in translating the positive influence of external openness into improved firm performance (Wu, Lin and Chen, 2013).

Furthermore, several mediating factors have been identified in the association between open innovation activities and various outcomes. Knowledge learning and organisational capabilities have been shown to mediate the relationship between open innovation activities and innovation performance (Cheng and Shiu, 2015). Technology-related capabilities were found to fully mediate the relationship between access to external technological resources and competitive advantage in product innovation (Zobel, 2017). Internal relational social capital has been found to mediate the effect of collaboration with business and scientific partners on innovation ambidexterity (Lazzarotti *et al.*, 2017). In addition, potential absorptive capacity mediated the link between external knowledge seeking and process innovation, whereas realised absorptive capacity did not mediate the relationship between external knowledge seeking and process innovation (Aliasghar, Rose and Chetty, 2019).

Moreover, de Zubielqui, Fryges and Jones (2019) identified the mediating role of social media in the association between external knowledge flows from market-based actors and innovation capacity. Additionally, organisational learning goal orientation has been identified as a mediator in the positive association between open innovation activities (both

inbound and outbound open innovation) and organisational ambidexterity (Chen and Liu, 2019).

2.6 Discussions and Directions for Future Research

2.6.1 Introduction

The previous sections identified key antecedents, moderators, mediators, and outcomes of open innovation. The antecedents of open innovation were categorised into individual, organisational and external environmental factors. It was also found that most studies focused on organisational-level antecedents compared to individual and external environmental factors. Furthermore, it was found that most studies on the outcomes of open innovation have focused on different performance indicators such as firm performance and innovation performance. The following section outlines significant gaps in the existing literature and offers recommendations for researchers and practitioners.

2.6.2 Individual-Level Antecedents of Open Innovation: Future Directions

A significant body of research has delved into exploring the crucial individual-level factors affecting open innovation. While there have been advancements in this research domain, it remains somewhat fragmented. Consequently, I propose recommendations for prospective studies to further enhance our understanding of this field.

First, prior studies that explored the effect of leadership styles on open innovation have primarily concentrated on leadership styles with positive connotations. However, given that leaders sometimes use harmful methods to influence their followers (Mackey *et al.*, 2021), it would be relevant to investigate the influence of destructive leadership types such as aversive leadership (Bligh *et al.*, 2007), corrupt leadership and dishonest leadership (Kellerman, 2004) on open innovation.

Second, previous studies (Bianchi *et al.*, 2011; Usman and Vanhaverbeke, 2017) have examined the influence of managerial experience on open innovation. It is recommended that researchers determine whether there are differences in experience gained from local or foreign contexts on open innovation. This is relevant because some scholars (Magnusson and Boggs, 2006), using insights from the resource-based view, have identified foreign experience as a valuable, rare and inimitable resource for the firm.

Furthermore, despite the review showing different manager/CEO/entrepreneur characteristics on open innovation, there is a paucity of studies in this area. The review found limited studies on the influence of personality and psychological factors on open innovation. Future studies could draw insights from the upper echelon theory, which suggests that the personality traits of individuals in top management influence firm-related decisions, and that organisations reflect the priorities and values of top management (Hambrick, 2007), to examine the influence of CEO/manager personality traits on open innovation. In this context, it would be intriguing to explore how personality traits, such as narcissism, which have been observed among business leaders (Marquez-Illescas, Zebedee and Zhou, 2019), may influence their involvement in open innovation.

2.6.2.1 Moderators of the Relationship between Open Innovation and its Individual-Level Antecedents: Future Directions

The review emphasises the scarcity of research concerning the moderating influence of individual factors on the impact of open innovation on individual-level antecedents. To improve our understanding, integrating insights from social exchange theory (Blau, 1964) could provide valuable perspectives on how individual factors may act as moderators in open innovation contexts.

Indeed, beyond the limited studies mentioned (Burcharth, Knudsen and Søndergaard, 2014; Hahn, Minola and Eddleston, 2019), there is a paucity of research examining the influence of organisational factors as moderators in the relationship between open innovation and its individual-level precursors. To further extend this area, future studies could incorporate insights from trait activation theory (Tett and Guterman, 2000) to provide a theoretical framework to elucidate how situational cues may act as moderators in this context.

Indeed, an intriguing observation is the unexplored aspect of external environmental factors as moderators on the link between open innovation and its individual-level antecedents. To address this research gap, insights from social cognitive theory (Bandura, 1986) can be harnessed to elucidate this boundary condition. According to social cognitive theory, an individual's actions and outcomes emerge from an interplay between personal factors, including cognitive, affective, and biological elements, and environmental events (Bandura, 1986). Incorporating this perspective into future studies could provide valuable insights into how external environmental factors may moderate the relationship between individual-level factors and open innovation behaviour.

2.6.2.2 Mediators of the Relationship between Open Innovation and its Individual-Level Antecedents: Future Directions

The review highlighted a gap in the literature concerning the exploration of individual factors as mediators in the relationship between open innovation and its individual-level precursors. While previous research has shown that managerial experience can influence open innovation (Usman and Vanhaverbeke, 2017), future studies can delve deeper into this area, considering possible mediators. For instance, incorporating insights from the expectancy-value model (Fishbein and Ajzen, 1975) researchers can explore the mediating effect of self-perceptual factors including entrepreneurial self-efficacy and personal attitude, in explaining how managerial experience affects open innovation behaviour. This approach could offer a

more comprehensive comprehension of the underlying mechanisms involved in the open innovation process.

Regarding the mediation of organisational factors, although some studies (e.g., Naqshbandi and Jasimuddin, 2018; Naqshbandi and Tabche, 2018) have demonstrated the effect of internal capabilities as mediators in the association between leadership style and open innovation, this area remains relatively underexplored. Future research could delve into the mediating influence of knowledge management capabilities in connecting transformational leadership and open innovation. Furthermore, to enhance our comprehension of the mediating function of organisational factors, I recommend that future research incorporate social bonding theory (Hirschi, 1969). This theory posits that a strong bond between a leader and an employee can mitigate negative employee behaviour and promote the attainment of organisational objectives (Hirschi, 1969). By concentrating on this dynamic, future research can explore how leadership trust can explain the mechanism between various leadership styles (e.g., destructive, transformational, and empowering) and open innovation.

2.6.3 Organisational-Level Antecedents of Open Innovation: Future Directions

In contrast to the individual and environmental antecedents of open innovation, it was discovered that extensive research efforts have been dedicated to examining the impact of organisational factors on open innovation. Despite these studies, there is still room for scholars to improve this area. For example, future studies could explore the influence of reactive and proactive market orientation, organisational politics, perceived organisational justice and organisational cynicism, on open innovation. In addition, given the recent outbreak of COVID-19, it would be crucial for scholars to investigate the direction of influence of technological capability, marketing capability, workplace flexibility, remote work flexibility, and infrastructure flexibility on open innovation.

2.6.3.1 Moderators of the Relationship between Open Innovation and its Organisational Level Antecedents: Future Directions

The review found that there was a lack of studies examining individual factors as moderators of the linkage between open innovation and its organisational-level factors. Drawing on the conservation of resources theory (Hobfoll, 1989) may help to explain such a boundary condition. This theory suggests that resource loss is more important than resource gain (Hobfoll, 1989). Furthermore, the intensity of resource loss tends to have a more detrimental effect on individuals who are already exposed to stressful environments. Therefore, researchers can apply this theory to investigate whether stressful events facilitate or inhibit engagements in open innovation.

The research reviewed primarily emphasised environmental dynamics as moderators in the realm of open innovation (Martinez-Conesa, Soto-Acosta and Carayannis, 2017; Popa, Soto-Acosta and Martinez-Conesa, 2017). However, it is worth considering that organisational cultures are influenced by national cultures (Liu, Tsui and Kianto, 2021). To further enrich the comprehension of these linkages, future studies could explore the moderating effect of national culture on the association between organisational culture and open innovation, indicating a detailed perspective of these interactions.

2.6.3.2 Mediators of the Relationship between Open Innovation and its Organisational Level Antecedents: Future Directions

Apart from a few studies (e.g., Alassaf *et al.*, 2020), there are limited studies that have examined individual factors as mediators of the relationship between open innovation and its individual antecedents. Future studies could use insights from the conservation of resources theory (Hobfoll, 1989) to understand the mechanism underlying this relationship. According to the conservation of resource theory, "successfully coping with challenging circumstances leads to increased resources" (Hobfoll, 2002, p. 315), and resource loss is more important than

resource gain (Hobfoll, 1989). Therefore, researchers could explore the role of employee forgiveness in mediating the link between breaches of the psychological contract and the promotion of open innovation.

Furthermore, there is a dearth of research exploring the mediating impact of organisational factors concerning the relationship between open innovation and its organisational-level antecedents. Future investigations could benefit from employing the dynamic capability view proposed by Teece (2007) to enhance our understanding of this domain.

2.6.4 Environmental-Level Antecedents of Open Innovation: Future Directions

In terms of the regulatory environment, previous studies (Drechsler and Natter, 2012; Laursen and Salter, 2014) have focused on the influence of formal appropriability mechanisms (e.g., intellectual property rights and patent stocks) and informal appropriability mechanisms (e.g., secrecy, design complexity, and lead-time advantage over competitors) on open innovation. However, other aspects of the regulatory environment remain unexplored. For example, future studies could examine: (1) the influence of the rule of law on open innovation; (2) the impact of the judicial system on open innovation; (3) and the impact of industry regulations (e.g., bank financing) on open innovation.

Regarding the macroeconomic and financial market environment, few studies (e.g., Brockman, Khurana and Zhong, 2018) have shown how a country's economic indicators (such as GDP) influence open innovation. Thus, researchers have paid less attention to this area. Future studies could investigate the influence of interest rates and economic freedom on open innovation.

2.6.4.1 Moderators of the Relationship between Open Innovation and its Environmental Level Antecedents: Future Directions

The review found that there was a lack of studies that have examined the moderating effect of individual factors on the relationship between open innovation and its environmental-level factors. This is worrying given the information that could be provided. Drawing on insights from person-situation theories, such as social cognitive career theory (Lent, Brown and Hackett, 1994), could explain how individual and contextual factors might interact to predict the level of individual engagement in open innovation. Specifically, researchers can examine the moderating effect of personality traits (e.g., openness to experience and self-efficacy) on the influence of a country's formal institutions (business freedom and investment freedom) on open innovation.

Moreover, limited studies (e.g., Brockman, Khurana and Zhong, 2018; Hagedoorn and Zobel, 2015), have investigated the moderating role of organisational factors on the relationship between open innovation and its environmental-level antecedents. Incorporating insights from the flexibility firm theory (Rodgers, 1992) could expand this area. This theory provides an explanation of how organisational structures need increased elasticity to get the best out of employees by allowing them to work from home while organisational activities are still in operation (Rodgers, 1992). Given the recent global outbreak of COVID-19, it would be valuable for researchers to explore how workplace flexibility moderates the influence of COVID-19 on open innovation.

Furthermore, only a few studies (e.g., Brockman, Khurana and Zhong, 2018) examined the moderating role of environmental factors on the influence of open innovation and its external environmental factors. Future studies could explore how aspects of the political environment, socio-cultural environment, macroeconomic and financial market environment could act as moderators.

2.6.4.2 Mediators of the Relationship between Open Innovation and its Environmental Level Antecedents: Future Directions

Regarding organisational factors as mediators, only a few studies such as those of Ahn (2020) found the mediating role of internal R&D on the relationship between government support and open innovation. This suggests that scholars have paid less attention to the mediating role of organisational factors. Future studies could: (1) investigate the mediating role of knowledge capabilities on the impact of open innovation on innovation performance; (2) and investigate the mediating role of absorptive capabilities on the influence of open innovation on innovation performance.

In addition, scholars have not investigated environmental factors as mediators in this relationship. This denies the intellectual community the mediating role of environmental factors. Future scholars could explore this area.

2.6.4.3 Moderators of the Relationship between Open Innovation and Outcomes: Future Directions

Regarding individual factors as moderators, some studies (e.g., Badir, Frank and Bogers, 2020; Eftekhari and Bogers, 2015) have found certain aspects of leaders and managers as moderators in this relationship. However, this area still requires further improvements from researchers. For instance, Salge et al. (2013) found leader experience as a moderating factor, but this study did not examine the type of experience, foreign experience or local experience. Therefore, future studies could examine the type of leader's experience (foreign experience and local experience) on the impact of open innovation and financial performance.

Regarding organisational factors as moderators, despite improvements in this area, other organisational factors have not been examined as moderators. For example, future studies could investigate: (1) the moderating effect of workload on the relationship between open

innovation and innovation performance; (2) and the moderating effect of firm location on the association between open innovation and innovation performance.

In terms of environmental factors as moderators, despite the progress, other environmental factors have not been examined by scholars as moderators on the relationship between open innovation and its outcomes. Therefore, future studies could explore this domain further.

2.6.4.4 Mediators of the Relationship between Open Innovation and Outcomes: Future Directions

The review found that previous studies have not paid much attention to individual factors as mediators of the relationship between open innovation and its outcomes. This indicates the paucity of studies in this area. It would be crucial for scholars to examine the mediating role of micro-foundational variables in this relationship. Therefore, scholars could examine the mediating role of perceived social status on the relationship between open innovation and innovation performance.

Regarding organisational factors as mediators, despite these improvements, there are other organisational factors that could act as mediators but have not been explored in the literature. Future studies could explore this domain.

Regarding environmental factors as mediators, previous studies have not investigated their mediating role in the relationship between open innovation and its outcomes. This calls for scholars to investigate how environmental factors could explain this relationship. Future studies could investigate the mediating role of country-level social trust on the relationship between open innovation and financial performance.

2.7 Conclusion

In this research, I have endeavoured to identify, critically analyse and provide a comprehensive picture of the antecedents, moderators, mediators and outcomes of open innovation. This systematic review aims to act as a useful catalyst and guide, highlighting gaps in literature and, in turn, helping future scholars to make further contributions to this exciting field.

Chapter 3: The Effects of Technological Capability and Marketing Capability on Open Innovation: The Moderating Effect of Government Support

Abstract

This study leverages the resource-based view, capability-based view, and contingency approach to investigate whether the adoption of both inbound and outbound open innovation is influenced by the presence of technological and marketing capabilities. In addition, this research examined whether government support plays a synergistic or antagonistic role in these relationships. Using empirical data gathered from 206 manufacturing firms in the UK, the study's findings unveiled that technological capability positively impacts both inbound and outbound open innovation initiatives. However, marketing capability hinders firms' implementation of both inbound and outbound open innovation. In addition, this study found a positive interaction effect of government support and technological capability on inbound open innovation, but not significant on outbound open innovation. On the contrary, there was a significant negative interaction effect of government support and marketing capability on inbound and outbound open innovation.

Keywords: Inbound open innovation, Outbound open innovation, Technological capability, Marketing capability, Government support.

3.1 Introduction

Over the past decade, the concept of open innovation has been a topic of significant interest among both academics and practitioners (Gad David *et al.*, 2023; Purdy *et al.*, 2023). Open innovation has been a central topic in discussions across various disciplines, including entrepreneurship, innovation, management, organisation studies, management, sociology, strategy, and economics (Nguyen, Huang and Tian, 2023b). More generally, companies have come to accept that they do not have all the 'smart' people working for them, so they need to 'find and tap the knowledge and expertise of smart people outside the company' (Chesbrough, 2003, p. 38). As a result, certain aspects of open innovation have been adopted by companies (Purdy *et al.*, 2023). Specifically, the Innovation Benchmark report revealed that 61% of the surveyed organisations used the open innovation model to drive innovation within their organisations, while 35% of these organisations reported customers as their innovation stakeholders (PricewaterhouseCoopers, 2017) - a key mechanism of the open innovation strategy (Purdy *et al.*, 2023). Examples of open innovation include Samsung's 'open source', Procter & Gamble's (P&G) 'connect and develop' and Huawei's 36 joint innovation centres around the world (Fu, Liu and Zhou, 2019).

Among the various reasons why firms adopt open innovation is to gain competitive advantage in an environment characterised by technological complexity, resource scarcity, globalisation, and increased competition (Zhang *et al.*, 2023). To remain competitive, firms must outpace their competitors (Tsai *et al.*, 2022), and this could be challenging for them, particularly if they rely exclusively on internally developed knowledge (Chesbrough, 2003). To overcome this challenge, companies are encouraged to be more open to external ideas and knowledge from external partners (Kian and Yusoff, 2015) to create advantages and stimulate growth (Hellström *et al.*, 2015). Therefore, open innovation can lead to an increase in

knowledge complementarities to generate faster and higher quality innovations for increased firm productivity (Audretsch and Belitski, 2023).

Open innovation refers to "the use of purposeful inflows and outflows of knowledge to accelerate internal innovation and expand markets for external use of innovation, respectively" (Chesbrough, 2006, p. 1). This definition underscores the two primary categories of open innovation – inbound open innovation, which pertains to knowledge inflows, and outbound open innovation, which pertains to knowledge outflows (Chesbrough, 2006). Despite the success stories associated with open innovation, some companies have encountered difficulties in harnessing its benefits (Li, Li and Wu, 2022). For example, for inbound open innovation, almost 50% of firms have failed to benefit from their international research and development (R&D) collaborations (Aliasghar and Haar, 2023; Lichtenthaler and Lichtenthaler, 2010). In terms of outbound open innovation, almost 95% of patents are not licensed or commercialised (Aliasghar and Haar, 2023). In summary, deriving benefits from open innovation is a challenging endeavour (Zhu *et al.*, 2019).

However, even though open innovation consists of two main modes (inbound and outbound open innovation), many scholars neglected these dimensions and only treated open innovation as a single dimension (Santoro, *et al.*, 2018). Moreover, most scholars focused more on inbound open innovation (Ebersberger *et al.*, 2021). Until recently, outbound open innovation has also received more implementation in companies (Salampasis and Mention, 2019). Despite the increasing interest from both academics and practitioners in inbound and outbound open innovation (Naqshbandi and Jasimuddin, 2018), there are limited studies that have integrated inbound and outbound open innovation within the same framework (Lu, Qi and Hao, 2023). Therefore, this study aims to add to these limited studies in this regard.

Previous studies have examined open innovation from different perspectives (Zhang *et al.*, 2023). One stream of research focuses on the critical enablers and precursors of open innovation, while the other stream of research delves into the performance outcomes of open innovation (Zhang *et al.*, 2023). Regarding the first stream of research, a systematic review by da Silva Meireles, Azevedo and Boaventura (2022) found that organisational (business) factors, including firm characteristics, capabilities and skills, account for a significant portion of the factors that influence open innovation. Despite the advancements made, numerous aspects of the field remain relatively unexplored, and our comprehension of open innovation still requires further development (Bogers *et al.*, 2017; West and Bogers, 2014). Accordingly, some scholars (e.g., Brunswicker and Chesbrough, 2018; Chen, Chen and Vanhaverbeke, 2011; Ferreras-Méndez *et al.*, 2015; Gad David *et al.*, 2023) have called for more research at the firm level on internal and external factors that can positively or negatively influence open innovation.

Following the first stream of research that explores internal factors driving firms towards open innovation (Naqshbandi and Jasimuddin, 2018) recent research has delved into the essential need for acquiring new, unavailable, and advanced knowledge and technologies in the creation of novel products and processes (Nguyen, Huang and Tian, 2023a). However, possessing valuable and rare assets alone is insufficient for maintaining competitive advantage because other firms can mimic, replicate, and emulate these technologies, as well as offer alternative products stemming from the same technologies (Barney, 1991). What firms truly require is the ability to create something truly unique and irreplaceable to secure a lasting competitive edge (Nguyen, Huang and Tian, 2023a). Therefore, open innovation requires a firm's ability to manage knowledge/resources effectively (Liao, Fu and Liu, 2020).

This perspective has prompted researchers to recognise the significance of technological capability and market information management capability within the realm of the open innovation literature (Liao, Fu and Liu, 2020; Taghizadeh *et al.*, 2020). While the findings of

these studies are to be acknowledged, scholars have paid limited attention to the influence of technological capability and marketing capability on open innovation (Liao, Fu and Liu, 2020), thus providing a limited understanding of how these firm capabilities affect open innovation. This study focuses on both marketing capability and technological capability because they are valuable assets for firms (Zang and Li, 2017) and important sources of competitive advantage (Su *et al.*, 2013).

However, despite the acknowledged significance of technological and marketing capabilities in driving performance (Davcik *et al.*, 2021; Su *et al.*, 2013), new product development (Eisend, Evanschitzky and Calantone, 2016) and innovation ambidexterity (Zang and Li, 2017), to my awareness, no study has explored the effects of both technological and marketing capabilities on inbound and outbound open innovation within a unified framework. This means that even though marketing capability and technological capability are relevant to open innovation, they have evolved separately, and researchers have not yet integrated them within a single framework to investigate their impact on inbound and outbound open innovation. Except for Liao, Fu and Liu's (2020) research, where marketing capability and technological capability were examined within a unified framework, the authors concentrated on their moderating roles in the connection between inbound and outbound open innovation and its impact on firm performance. Hence, this study utilises the capability-based theory to bridge the existing gap in the literature.

In addition to examining the direct influence of technological capability and inbound and outbound open innovation, this research builds on the contingency approach to investigate the conditions under which technological capability results in engagement in inbound and outbound open innovation. This is imperative given that open innovation practices and firm capabilities are contingent on environmental factors (Ju, Jin and Zhou, 2018; Popa, Soto-Acosta and Martinez-Conesa, 2017). In this regard, previous studies have acknowledged the

importance of government support for technological capabilities (Adomako, Amankwah-Amoah and Danquah, 2022) and open innovation (de Jong, Kalvet and Vanhaverbeke, 2010; Wang, Vanhaverbeke and Roijakkers, 2012).

While existing literature has emphasised the potential advantages of technological capability in the open innovation context (Taghizadeh *et al.*, 2020), to my knowledge, there has been no exploration in the literature regarding both conceptual and empirical analyses on the influence of technological capability on both inbound and outbound open innovation under varying levels of government support. As a result, this study aims to explore whether government support and technological capability interact synergistically or antagonistically, influencing both inbound and outbound open innovation. In this endeavour, the study seeks to broaden the horizons of open innovation literature by addressing the existing gap regarding the moderating influence of government support in shaping the relationship between technological capability and both inbound and outbound open innovation.

Furthermore, acknowledging that open innovation activities are influenced by a blend of internal and external factors (Huizingh, 2011; Popa, Soto-Acosta and Martinez-Conesa, 2017) and that the development of firm capabilities is influenced by the business context (Lichtenthaler, 2009; Popa, Soto-Acosta and Martinez-Conesa, 2017; Teece, 2007). This research adopts a contingency approach to explore the specific conditions under which marketing capability plays a role in facilitating inbound and outbound open innovation. This represents a significant expansion of the open innovation literature because, even though there is existing evidence of government support's influence on open innovation (Cheah and Ho, 2020), there has not been a prior investigation into the effect of marketing capability on inbound and outbound open innovation while accounting for varying levels of government support. Consequently, the primary question at hand is not just whether marketing capability is beneficial for inbound and outbound open innovation, but rather, it seeks to pinpoint the specific

conditions, particularly the level of government support, under which marketing capability has an impact on inbound and outbound open innovation. In its pursuit of this objective, the study pushes the frontiers of the open innovation literature and effectively addresses a significant void in the existing body of knowledge. It accomplishes this by elucidating the potential synergistic or antagonistic effects of government support and marketing capability on inbound and outbound open innovation.

Using quantitative data from an online survey of 206 UK manufacturing firms and drawing on RBV, capability-based theory and the contingency approach, this research aims to provide answers to the following research questions:

1. Does technological capability enhance the implementation of both inbound and outbound open innovation?
2. Does marketing capability hinder the implementation of both inbound and outbound open innovation?
3. Does government support positively moderate the influence of technological capability on both inbound and outbound open innovation?
4. Does government support positively moderate the influence of marketing capability on both inbound and outbound open innovation?

Overall, this study contributes in the following ways. First, this research makes a tremendous contribution to the current literature by shifting its focus to both inbound and outbound open innovation, diverging from the prevailing emphasis on inbound open innovation in existing research (Lu, Qi and Hao, 2023).

Second, despite the considerable volume of research dedicated to open innovation (Obradović, Vlačić and Dabić, 2021), this study enhances the discourse surrounding inbound

and outbound open innovation by extending upon the limited research that delves into the impact of technological and marketing capabilities on open innovation (Liao, Fu and Liu, 2020).

Third, this study extends the principles of RBV and capability view during the open innovation process. The relevant open innovation literature has used these theories to explain the adoption of open innovation (Keinz and Marhold, 2020; Popa, Soto-Acosta and Martinez-Conesa, 2017). Capability-based theory, as a continuation of RBV, posits that the mere possession of a firm's resources or acquiring external ones is insufficient for establishing new competitive platforms, rather it is the manner in which these resources are deployed and harnessed through the firm's capabilities that generate value (Day, 1994; Helfat and Winter, 2011; Teece, Pisano and Shuen, 1997).

These theories were adopted to explain the positive influence of technological capability on inbound and outbound open innovation. Given that technological capabilities are embedded in organisational routines over time (Taghizadeh *et al.*, 2020), internally generated technologies present a formidable challenge to replication due to the confidentiality and self-protective measures surrounding them (Zang and Li, 2017). This confers an unparalleled advantage in the context of introducing novel products and venturing into new markets (Zang and Li, 2017). However, the finding of a negative effect of marketing capability on inbound and outbound open innovation can also provide theoretical and practical implications for managers. This is empirically supported by other studies (Jang and Zedtwitz, 2023; Liao, Fu and Liu, 2020) encouraging firms to focus on enhancing technological capability rather than increasing marketing capability when engaging in open innovation.

Fourth, although few studies have examined the relevance of technological capability and marketing capability in the open innovation context (Liao, Fu and Liu, 2020), they have not examined the moderators between them. This study adds to the knowledge of this

relationship to provide a deeper understanding by drawing on the contingency approach to propose government support as a moderator on the impact of technological and marketing capabilities on inbound and outbound open innovation. The relevant open innovation literature has used the contingency approach to explain the adoption of open innovation (Popa, Soto-Acosta and Martinez-Conesa, 2017). According to the contingency approach, an organisation's effectiveness stems from aligning its key characteristics with contingencies that mirror the organisation's situation (Donaldson, 2001). It is crucial for an organisation to establish alignment between itself and the contingency factors to augment performance (Donaldson, 2006). This theory was adopted to explain the findings from this study which revealed that governmental support proved advantageous for companies possessing technological capabilities and concentrating on inbound open innovation. In contrast, such support did not yield benefits for firms with marketing capabilities engaged in both inbound and outbound open innovation.

Fifth, from a theoretical standpoint, this research adopts a multifaceted approach by integrating both the capability-based view and the contingency approach. This integration facilitates a thorough examination of the complex interplay between inbound open innovation, technological capability, marketing capability, government support, and outbound open innovation.

The remainder of the paper adheres to this outlined structure. First, the subsequent sections delve into a review of the relevant literature before formulating the hypotheses. This is followed by the methodology, a summary of results, and a discussion.

3.2 Literature Review and Hypotheses Development

3.2.1 Technological Capability and Inbound and Outbound Open Innovation

While the importance of technological capability has been duly recognised in the domain of innovation research (Seo, Song and Jin, 2023; Wang, Jin and Zhou, 2023; Zhou and Wu, 2010), technological capability remains underexplored in the open innovation literature (Liao, Fu and Liu, 2020; Taghizadeh *et al.*, 2020). Among the few studies conducted, technological capability has been examined as an antecedent (Taghizadeh *et al.*, 2020) or outcome of open innovation (Paik and Chang, 2015). Furthermore, within the limited body of research examining technological capability as a precursor of open innovation, scholars have not definitively established whether the nature of this relationship holds for inbound and outbound open innovation. This research endeavours to address and bridge this specific gap in the literature.

The following reasons may elucidate why a direct influence of technological capability on inbound and outbound open innovation may be anticipated. First, regarding inbound open innovation, it can be contended that technological proficiency plays a pivotal role for companies in minimising the hazards and expenditures associated with exploration (Zhang, 2016). Additionally, it can help diminish the uncertainty linked to R&D investments, broadening the horizons of such investments, and adeptly assimilating novel technologies (Kang, Baek and Lee, 2017). This makes firms more receptive to new external technology information (Berkhout, Hartmann and Trott, 2010). This further receptivity increases firms' ability to access technology information about the knowledge base and technology of their partners and competitors (Hansen and Lema, 2019; Liao, Fu and Liu, 2020; Lichtenthaler and Lichtenthaler, 2009) thereby minimising their fear of opportunistic behaviour and knowledge leakage and promoting a firm's openness mind-set (Liao, Fu and Liu, 2020). A firm's openness mindset is

key to exploring inbound open activities, such as exploring external sources in depth (Liao, Fu and Liu, 2020).

Second, the focus of outbound open innovation is for firms to acquire resources and capabilities that they do not have internally and to use these resources for successful technology commercialisation (Hu, McNamara and McLoughlin, 2015; Liao, Fu and Liu, 2020; Sivadas and Dwyer, 2000). A firm with strong technological capability can help select trusted and qualified partners who can provide access to the necessary resources for technology transfer (Sears and Hoetker, 2014). Higher investment in technological capability increases the ability of firms to assess similarities and differences in the skills and knowledge of collaborators (Ortega, 2010). Consequently, the transfer of technology becomes more inclined toward achieving notable success, subsequently amplifying the benefits derived from outbound open innovation initiatives (Liao, Fu and Liu, 2020). This gives rise to the subsequent hypothesis:

> **Hypothesis 1:** Technological capability has a significant positive impact on (a) inbound open innovation (b) and outbound open innovation.

3.2.2 Marketing Capability and Inbound and Outbound Open Innovation

While the role of different capabilities can be essential, the core of strategy design is the firm's ability to identify and respond to market needs (Day, 2011). Marketing is important in today's competitive environment (Porter, 2008) and innovation is fundamental to the competitive advantage process (Varadarajan, 1992; Weerawardena, 2003). While previous research has furnished evidence of the beneficial influence of marketing capability on competitive advantage (Chu, Li and Lin, 2011) and firm performance (Martin, Javalgi and Ciravegna, 2020), this study adopts a distinctive standpoint by elucidating the rationale for expecting marketing capability to hinder engagement in both inbound and outbound open innovation.

First, according to RBV (Barney, 1991), a firm consists of a bundle of organisational resources. Although these organisational resources can be beneficial, firms need complementary capabilities to deploy these resources to achieve relevance and performance differentiation (Helfat, 1997; Newbert, 2007; Teece, 2007). The capability view argues that the effective deployment of valuable and idiosyncratic capabilities leads to competitive advantage and performance differentials (Kaleka and Morgan, 2019; Lages and Styles, 2009; Zhou *et al.*, 2007). However, while capabilities evolve, they can also become entrenched 'rigidities' in the organisational fabric and are likely to resist abrupt change (Kaleka and Morgan, 2019; Leonard-Barton, 1992). This can lead to additional uncertainty and/or inertia in the development of intended strategies (Kaleka and Morgan, 2019; Morgan, Katsikeas and Vorhies, 2012), which may hinder their engagement in inbound and outbound open innovation.

Moreover, considering that marketing capability encompasses a firm's capacity to effectively cater for both current and future customer needs (Dutta, Narasimhan and Rajiv, 1999; Vorhies, Morgan and Autry, 2009), this capability equips firms with the means to foster strong relationships with external stakeholders such as customers, channels and suppliers through various means such as communication, pricing, personal sales and advertising (Narasimhan, Rajiv and Dutta, 2006). This means that firms with superior marketing capability tend to pay attention to existing routines and similar knowledge to refine managerial practices (Kyriakopoulos, Hughes and Hughes, 2016). As a result, this challenge may potentially hinder their ability to acquire diverse and novel knowledge associated with open innovation processes (Jang and von Zedtwitz, 2023).

In a study of Chinese high-tech enterprises, Liao, Fu and Liu (2020) found a significant negative three-way interaction effect among inbound open innovation, technological capability, and market information management capability on performance. The research revealed that firms with high technological capability experienced increased performance gains from

inbound open innovation when paired with a moderate information management capability (Liao, Fu and Liu, 2020). However, both high and low levels of market information management capability impeded the positive impact of technological capability on the relationship between inbound open innovation and performance (Liao, Fu and Liu, 2020). The authors suggested that firms with strong market information management might be entrenched in existing marketing paths, potentially overlooking emerging technology information and being hesitant to transition to new technology platforms (Dutta, Narasimhan and Rajiv, 1999; Feng, Morgan and Rego, 2017; Liao, Fu and Liu, 2020). Conversely, a low market information management capability could hinder firms by sticking to outdated market knowledge and being unsupportive of technology opportunities (Luca and Atuahene-Gima, 2007).

Another study by Jang and Zedtwitz (2023) addresses the research question of when to open up the innovation process before and after product launch to maximise new product development performance, focusing on comparing the effectiveness of closed and open innovation processes. The authors discovered that the positive impact of open new product development strategies is more pronounced when technological capability is high but diminishes when marketing capability is high (Jang and Zedtwitz, 2023). According to the findings, firms with strong marketing capabilities do not experience significant benefits from opening up innovation processes in new product development (Jang and Zedtwitz, 2023). This supports the idea that higher marketing capability in a firm tends to hinder its ability to acquire innovative and disruptive knowledge from external sources, both before and after product launch (Yang *et al.,* 2020). Consequently, the authors concluded that if opting for an open innovation approach (either before or after product launch), it is preferable to focus on enhancing technological capability rather than increasing marketing capability (Jang and Zedtwitz, 2023). Drawing from these arguments, this research proposes the following hypothesis:

Hypothesis 2: Marketing capability is significantly and negatively related to (a) inbound open innovation (b) and outbound open innovation.

3.2.3 Moderating Effect of Government Support on Technological Capability and Inbound and Outbound Open Innovation

The literature suggests that the innovation process does not take place in a vacuum but requires a set of institutional structures that provide support to enhance this process (Caraça, Lundvall and Mendonça, 2009). In this regard, the relevance of government has been acknowledged in the open innovation literature (de Jong, Kalvet and Vanhaverbeke, 2010; Wang, Vanhaverbeke and Roijakkers, 2012) and in building technological capabilities (Adomako, Amankwah-Amoah and Danquah, 2022; Lin and Lai, 2021). However, the potential moderating influence of government support on the link between technological capability on both inbound and outbound open innovation has yet to be thoroughly investigated.

The following arguments may provide reasons why government support may enhance the influence of technological capability on inbound and outbound open innovation. First, government support may strengthen firms' intentions to share information and knowledge in the open innovation process. During the open innovation process, organisations actively partake in knowledge sharing, a practice that carries the potential for considerable knowledge leakage and the emergence of opportunistic behaviour (Drechsler and Natter, 2012). However, the existence of government support in terms of a sound legal system and effective intellectual property can help reduce opportunistic behaviour and increase trust between partners (Liu, Ying and Wu, 2017), which can encourage engagement in open innovation activities.

Second, according to the innovation theory, firms are less likely to possess superior capabilities in developing innovations if they rely solely on recombining their existing internal knowledge (Katila and Ahuja, 2002). However, firms that maintain close ties with the

government often enjoy privileged access to critical resources controlled by the government and to publicly funded research and development (R&D) (Yi, Wang and Kafouros, 2013). This access affords firms opportunities to introduce new and diverse elements into their technological resource base, consequently enhancing the likelihood of valuable and rare technological recombination (Yi, Wang and Kafouros, 2013). In this regard, government support can contribute to the efficient appropriation and allocation of resources in open innovation activities. By providing market and technology information and supporting research projects, the government can provide useful information and understanding of the market and technology (Wei and Liu, 2015). Drawing from these arguments, the hypothesis posits that:

> **Hypothesis** 3: Government support positively moderates the relationship between technological capability and (a) inbound open innovation (b) and outbound open innovation.

3.2.4 Moderating Effect of Government Support on Marketing Capability and Inbound and Outbound Open Innovation

Although scholars have reiterated that internal and external factors are important for a firm's strategy towards open innovation (e.g., Huizingh, 2011; Taghizadeh *et al.*, 2020), a call for a contingency approach to marketing capability is needed (Morgan, Feng and Whitler, 2018). This study attempts to respond to this call by providing reasons why government support may weaken the expected negative relationship between marketing capability and inbound and outbound open innovation.

First, building marketing capability requires resource inputs (Sun, Ding and Price, 2020), such as the need for a qualified marketing manager for a marketing department and relational ties with government agencies to enable firms to respond quickly to the marketing function (Germann, Ebbes and Grewal, 2015; Song, Wang and Parry, 2010; Sun, Ding and

Price, 2020). However, even though superior marketing capabilities can also reduce the cost of a firm's marketing efforts (Arora and Nandkumar, 2012) and enhance the competitiveness of existing products (Zang and Li, 2017). This resource commitment can be an issue for small firms and new ventures. For small businesses, lack of resources, small target markets and human resources can lead to underdeveloped marketing capabilities (Blankson, Motwani and Levenburg, 2006; Gilmore, Carson and Grant, 2001; Mc Cartan-Quinn and Carson, 2003). In addition, they also face market imperfections in new ventures and difficulties in obtaining external funding due to the belief in market failure (Cosh, Cumming and Hughes, 2009; Oh *et al.*, 2009; Rotger, Gørtz and Storey, 2012).

However, these resource input concerns can be addressed when marketing capabilities interact with the government to align firm resources with the market. From a transactional perspective, establishing relationships with the government can offer a governance advantage due to their influence over resource control (Yi, Wang and Kafouros, 2013). Firms that maintain close ties with the government are more likely to receive preferential treatment, including subsidies, enhanced property rights, advantageous policies, and improved public services (Yi, Wang and Kafouros, 2013). The government extends a degree of protection to these firms, reducing their reliance on market forces (Yi, Wang and Kafouros, 2013). Consequently, firms in such positions have access to options provided by the government, supplementing their resource pool beyond the confines of formal market channels (Yi, Wang and Kafouros, 2013), which could reduce transaction costs and help firms to benefit from marketing capabilities.

Second, a firm's marketing capability is based on how well the firm captures marketing information and environmental conditions (Ali, Ng and Kulik, 2014). Without this information, firms will find it difficult to understand customer needs and develop an effective marketing strategy (Wiklund and Shepherd, 2003). Government support can help in this case. Strong ties with the government can allow firms to experience fewer bureaucratic delays, respond faster

and better to customer needs, and protect their credibility in the marketplace from external threats (Acquaah, 2007). Accordingly, it is hypothesised that:

> **Hypothesis 4:** Government support positively moderates the negative relationship between marketing capability and (a) inbound open innovation (b) outbound open innovation.

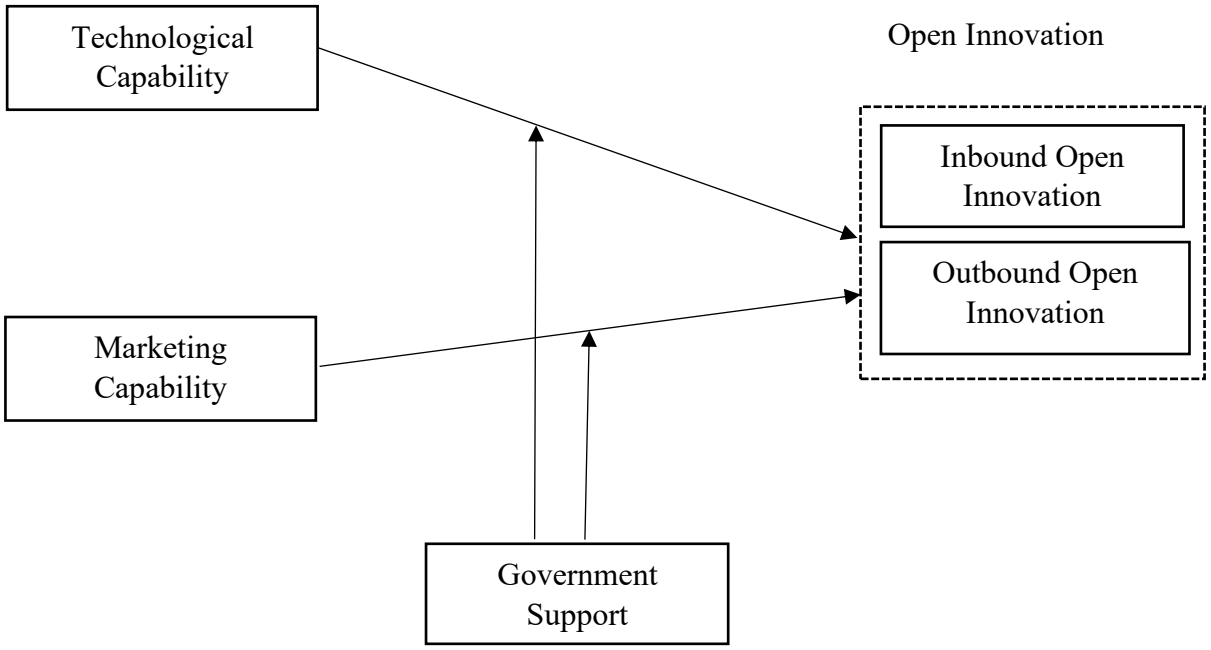


Figure 2: Conceptual Model for Paper 2

3.3 Methodological Approach

3.3.1 Sample and Data Collection

The study's sample comprised managers from various sectors of manufacturing companies in the UK. The decision to focus solely on managers from these manufacturing firms was based on the assumption that they possess the requisite knowledge of innovation and creativity within the organisation, enabling a comprehensive assessment of the study variables (Genc, Dayan and Genc, 2019). The sampling frame was developed using the ORBIS database, a widely utilised firm-level database capturing information from diverse sources (Riccaboni,

Wang and Zhu, 2021). A complete list of manufacturing firms in the UK with a minimum of 10 employees was obtained through this database.

The choice of the UK as the study's geographical focus was informed by its status as a European country characterised by a high rate of technological innovation (Ciampi *et al.,* 2021). British manufacturers are noteworthy for their significant contribution to Europe's total manufacturing outputs and resource requirements (Esfahbodi *et al.,* 2017). Additionally, selecting the UK facilitates a meaningful comparison with existing studies on open innovation, which predominantly feature Western firms (Lu and Chesbrough, 2022). Moreover, open innovation is explicitly emphasised in the UK National Innovation Strategy (Audretsch and Belitski, 2023), making it an ideal context for investigating the variables of interest in this study.

After obtaining ethical approval from the University of Essex Ethics Committee, this research employed random stratified sampling to select 1000 manufacturing companies in the UK, which were then sent the online questionnaire between July 2022 and December 2022. The survey, conducted through Qualtrics, an integrated survey design and data collection platform (Thornton, Henneberg and Naudé, 2015), utilised an internet-based online social survey approach (Bryman, 2012). To address potential common method bias (CMB), recommendations from Podsakoff et al. (2003) were implemented in questionnaire design, such as strategically positioning predictor and dependent variable items at various points, ensuring respondent confidentiality and anonymity, emphasising no right or wrong answers, and utilising well-established scale designs.

Following three rounds of reminders, the study garnered 236 completed questionnaires, with 75 responses in the first round, 83 in the second, and 78 in the third. Subsequently, a meticulous screening process was applied to eliminate unusable, incomplete, and unengaged questionnaires. As a result, 206 surveys were deemed usable and retained for analysis. This

yielded a response rate of 20.6%, a figure deemed acceptable within the context of organisational studies (Greer, Chuchinprakarn and Seshadri, 2000; Scarborough, 2011).

To assess non-response bias, a t-test was examined between early and late respondents (Armstrong and Overton,1977). The final sample was divided into two groups where the first 20% of respondents were considered early respondents, and the last 20% of respondents were considered late respondents (Zahoor and Al-Tabbaa, 2020). The t-tests performed on the responses of these two groups showed no statistically significant difference between the two groups indicating that non-response bias is not an issue in this research (Armstrong and Overton, 1977).

3.3.2 Measures

All constructs were measured using multi-item scales derived from previous studies. A seven-point Likert scale was employed for all the items, which was deemed appropriate and consistent with the approach utilised in other studies within the open innovation literature (Gad David *et al.*, 2023; Marzi *et al.*, 2023). The measurement scale of all constructs included in the conceptual framework is discussed below.

Inbound Open Innovation: Inbound open innovation was measured using 5 items developed by Cheng and Huizingh, (2014). Table 1 lists the items used to measure inbound open innovation.

Table 1: Measuring Items - Inbound Open Innovation

Inbound Open Innovation (Cheng and Huizingh, 2014)
Regarding your firm, to what extent do you agree or disagree with the following statements? (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. External partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities are directly involved in all our innovation projects.

2. All our innovation projects are highly dependent upon the contribution of external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities.
3. Our firm often buys R&D-related services from external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities.
4. Our firm often buys intellectual property, such as patents, copyrights, or trademarks, from external partners to be used in our innovation projects.
5. Our firm invests in other firms because we would like to obtain synergies that are beneficial to our innovation projects.

Outbound Open Innovation: Outbound open innovation was measured using 4 items developed by Cheng and Huizingh (2014). Table 2 lists the items used to measure outbound open innovation.

Table 2: Measuring Items - Outbound Open Innovation

Outbound Open Innovation (Cheng and Huizingh, 2014)
Regarding your firm, to what extent do you agree or disagree with the following statements? (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. Our firm often sells licenses, such as patents, copyrights, or trademarks, to other firms so as to better benefit from our innovation efforts. 2. Our firm often offers royalty agreements to other firms to better benefit from our innovation efforts. 3. Our firm strengthens every possible use of our own intellectual properties so as to better benefit our firm. 4. Our firm founds spin-offs to better benefit from our innovation efforts.

Technological Capability: Technological capability was assessed using Zhou and Wu's (2010) five-item scale, which measures a firm's ability to use various technologies. Table 3 lists the items used to measure technological capability.

Table 3: Measuring Items - Technological Capability

Technological Capability (Zhou and Wu, 2010)
Compared to your major competitors, how would you evaluate your firm's capabilities in the following areas? (1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better). 1. Acquiring important technological information. 2. Identifying new technology opportunities. 3. Responding to technological changes. 4. Mastering the state-of-art technologies. 5. Developing a series of innovation constantly.

Marketing Capability: Marketing capability was measured using 4 items developed by Zhou *et al.* (2014), which assesses the firm's ability to identify and satisfy customer needs. Table 4 lists the items used to measure marketing capability.

Table 4: Measuring Items - Marketing Capability

Marketing Capability (Zhou *et al.*, 2014)
Compared with your major competitors, how do you rate your firm's capabilities in the following areas? (1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better). 1. We devote substantial resources to understanding customer needs. 2. All of our business functions are integrated in serving the needs of our target market. 3. We frequently launch new advertising campaigns to promote our products. 4. We have extensive distribution channel coverage to make our products widely available.

Government Support: Government support was assessed using Zhang and Merchant's (2020) four-item scale, which measured local government's financial and non-financial assistance to regional firms. Table 5 lists the items used to measure government support.

Table 5: Measuring Items - Government Support

Government Support (Zhang and Merchant, 2020)
Please indicate the extent to which you agree or disagree with each of these statements about your organisation. (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. In supporting of local business, the government and its agencies have provided needed technology information and other technical support. 2. In supporting of local business, the government and its agencies have provided important market information. 3. In supporting of local business, the government and its agencies have played a significant role in providing financial support. 4. In supporting of local business, the government and its agencies have helped firms obtain licenses for import of technology, manufacturing and raw material, and other equipment.

Control Variables: The study incorporated several control variables pertaining to the firm's demographic characteristics. These included firm age, measured across four levels (1-5 years, 6-10 years, 11-20 years, and 21 years and above) (Scaliza *et al.*, 2022). The number of years employees had worked in the firm was also considered, with four levels (1-5 years, 6-10 years, 11-20 years, and 21 years and over) (Scaliza *et al.*, 2022). Additionally, firm size was assessed through the number of full-time employees, categorised into four levels (1-9 employees, 10-49 employees, 50-249 employees, and 250 employees and above) (Eller *et al.*, 2020). The geographical market of the firm was recorded as local market, national market, European market, and global market.

3.4 Exploratory Factor Analysis (EFA)

According to Zhang *et al.* (2018), conducting EFA prior to testing a measurement model is key to obtaining a general structure of the proposed indicators. Essentially, the purpose of EFA is to eliminate items with low loadings to retain only items in a measure that are highly

intercorrelated. In this study, the multi-item constructs were assessed by measuring data adequacy, choice of factor extraction method, choice of factor rotation method, factor loadings and reliability.

To assess the appropriateness of the data for factor analysis, Barlett's sphericity test and the Kaiser-Meyer-Olkin (KMO) test were employed. As a general principle, a statistically significant Barlett's test of sphericity (i.e. sig. < .05) indicates that items are intercorrelated and therefore the data are appropriate for factor analysis (Hair *et al.*, 2014). Therefore, both statistical measures (i.e., Bartlett's sphericity test and KMO) were calculated in SPSS for all constructs. Principal component analysis was used for data reduction, as the latent constructs were already known, and the aim was to identify and eliminate problematic items. Furthermore, orthogonal rotation (i.e. varimax) was used in data reduction to interpret the factors (Hair *et al.*, 2014). Factor loadings, that is the correlation between items and factors, were then used to distinguish between factors. Factor loadings in the range of ±.30 to ±.40 are considered sufficient for the interpretation of the factor structure, but loadings of ±.50 or higher are considered practically significant. In addition, Cronbach's alpha was utilised to evaluate the internal consistency of the constructs.

Based on the steps discussed to perform EFA, five factors explained 77.517% of the variance with an eigenvalue of at least 1. The Kaiser-Meyer-Olkin (KMO) was .837, showing acceptable sampling adequacy, and Bartlett's test of sphericity of 1887.814 ($p < 0.001$) was significant. The five factors were reliable measures as Cronbach's alpha ranged from .718 to .915. Table 6 shows the results of the EFA.

Table 6: EFA and Reliability of Constructs

Constructs	**Item**	**Factor loading**	**VIF**	**Cronbach's α**
Inbound open innovation	INB3	.857	1.752	.780
	INB4	.740	2.010	
	INB5	.739	1.842	
Outbound open innovation	OUT1	.768	2.887	.847
	OUT2	.870	2.403	
Technological capability	TC1	.884	3.272	.915
	TC2	.859	2.978	
	TC3	.855	2.963	
	TC4	.876	3.032	
	TC5	.802	2.442	
Marketing capability	MK2	.811	1.811	.718
	MK3	.893	1.623	
Government support	GS1	.897	4.099	.899
	GS2	.851	3.878	
	GS3	.834	2.089	
	GS4	.828	2.481	

3.5 Measurement Model

The evaluation of the measurement model centred on assessing the psychometric properties of reliability, validity, and dimensionality for each construct. To test the unidimensionality of the measurement model, confirmatory factor analysis was employed. All constructs were conceptualised and computed as first-order reflective constructs and categorised into five groups — namely, inbound open innovation, outbound open innovation, government support, technological capability, and marketing capability. The raw data served as input for maximum likelihood-based estimation. Each item was exclusively associated with its corresponding latent construct, and correlations among latent constructs were permitted (Gerbing and Anderson, 1988).

After which this research examined the proposed model, adhering to Hair et al. (2017) two-step approach. The initial step involved assessing the reliability and validity of the measurement model, followed by the evaluation of the structural model and hypothesis testing. To appraise the measurement model, I conducted a confirmatory factor analysis (CFA). This analysis aimed to estimate and scrutinise construct validity which consists of convergent validity and discriminant validity.

Convergent validity was assessed through factor loadings, average variance extracted (AVE), and composite reliability (CR) (Hair *et al.,* 2017). Ideally, factor loadings should surpass 0.50, with 0.70 or higher considered optimal. AVE values exceeding 0.50 were recommended, and a CR value surpassing 0.70 indicated reliable measurements. Discriminant validity testing was integral to the measurement model assessment. Fornell and Larcker's (1981) method involved comparing the correlations between variables and the square root of the AVE for each variable. Notably, the square root of the AVE for each construct should exceed its highest correlation with any other construct, ensuring clear differentiation between constructs.

The next section furnishes comprehensive insights into the reliabilities and validities of the initial measurement model. Subsequently, it outlines the procedures implemented to enhance and refine the model.

3.5.1 Assessment of Initial Model Fit.

CFA was conducted with 5 latent constructs – inbound open innovation (5 items), outbound open innovation (4 items), technological capability (5 items), marketing capability (4 items) and government support (4 items) and 22 measured items. The initial measurement model was analysed for model fit. Results of the initial model fit were analysed in terms of absolute fit indices (χ^2/df, RMSEA) and incremental fit indices (CFI, TLI, IFI and GFI). Table

7 demonstrates the fit statistics from the initial CFA output. The results show that the model fit indices can be improved.

Table 7: Initial Fit Statistics - Measurement Model

Model fit indices	χ^2(df)	χ^2/df<3	RMSEA <.07	CFI > .9	TLI > .9	IFI > .9	GFI > .9
All items	498.178(199)	2.503	.086	.871	.850	.873	.821

3.5.2 Construct Validity of Initial Measurement Model.

The values of construct validity measures were analysed. Results revealed that factor loadings of the items exceed the minimum threshold of .50, except for these items; OUT3 (.22), INB1 (.37), INB (.42), and MK4 (.42). Accordingly, these items were removed due to poor factor loading. The AVE of all 5 latent constructs was calculated, and the results revealed that the AVE of two constructs (technological capability and government support) were above the acceptable value of .50 while the other remaining three constructs (inbound open innovation, marketing capability and outbound open innovation) were below the acceptable value of .50. Moreover, construct reliability (CR) was assessed for all latent constructs. The results revealed that all the constructs were above the minimum value of .70. Table 8 presented the AVE and CR values of every latent construct in the measurement model.

Table 8: Convergent Validity Results of Initial Measurement Model

Latent constructs	INB	OUT	TC	MK	GS
CR	.746	.755	.916	.742	.900
AVE	.388	.473	.686	.436	.693

Note: AVE = average variance extracted; CR = construct reliability
INB = inbound open innovation; OUT = outbound open innovation
TC = technological capability; MK = marketing capability; GS = government support

Lastly, to assess discriminant validity, I generated a Pearson correlation matrix, which is presented in Table 9. Additionally, the square root of the AVE for each construct is indicated in bold on the diagonal. This approach aligns with Fornell and Larcker's (1981) criterion. The analysis revealed that, except for inbound and outbound open innovation, the square root of the AVE for each construct exceeded the highest correlation with any other construct, as outlined in Table 9. This observation signifies the presence of discriminant validity among the latent constructs - namely, technological capability, marketing capability, and government support. For example, the square root of the AVE for technological capability is .828, while the highest correlation observed between technological capability and another construct (e.g., marketing capability) is .371. Consequently, it can be inferred that discriminant validity has been successfully established for technological capability. Applying a similar analytical approach, it can be deduced that discriminant validity has been successfully established for all the other constructs examined in this study, except for inbound open innovation and outbound open innovation.

Table 9: Discriminant Validity Results of Initial Measurement Model

Constructs	AVE	1	2	3	4	5
1. Inbound open innovation	.388	**.623**				
2. Outbound open innovation	.473	.722***	**.688**			
3. Technological capability	.686	.128	.195*	**.828**		
4. Marketing capability	.436	-.238*	-.249**	.371***	**.660**	
5. Government support	.693	.485***	.449***	.162*	.014	**.833**

Note: Correlation coefficient is significant at *p<0.05, **p<0.01, ***p<0.01 (two-tailed). The diagonal values in bold represent the square root of the AVE, while the values below the diagonals represent the inter-correlations between constructs.

3.5.3 Steps to Improve Model Fit and Construct Validity

Looking at the factor loadings from the initial measurement model, it was reported that some of the items (e., OUT3, INB1, INB2, and MK4) were below the minimum threshold of

0.5. Therefore, a CFA step-by-step process was adopted to delete items with the lowest factor loadings. Therefore, these items (i.e., OUT3, INB1, INB2, and MK4) were deleted in ascending order. After deleting these items, even though there were improvements in the modification fit, it was not enough to meet the recommendations of good incremental fit indices. From this stage, it was deemed relevant to cross-check both the factor loadings and the standardised residual covariances for each item before deciding on which items to delete. This led to a further deletion of two items (i.e., MK1, OUT4) to achieve a good model fit. Hence, the final model fit statistics for the measurement model (χ^2 = 141.426; df = 94; RMSEA = .050; CFI = .974; TLI = .967; IFI = .974; and GFI = .919) was within an acceptable range, indicating a good fit.

Furthermore, the factor loadings (standardised coefficients) of the measured items, reflecting their corresponding latent constructs were above the minimum value of .50, with most of them exceeding the ideal value of .70, with the highest value of .96 for the item OUT1 reflecting a latent construct for outbound open innovation. The internal consistency of the constructs was measured using CR and Cronbach alpha (α). The CR values of all the latent constructs were above the minimum value of .70 with the highest value of .900 shown by the construct government support. Additionally, the Cronbach alphas of each scale ranged from .718 to .915.

Moreover, the AVE values of all the latent constructs were more than the minimum value of .50, with the highest value of .754 determined by outbound open innovation. Table 10 shows the factor loadings of all the items, the α, CR, and AVE of all the latent constructs in the final measurement model.

Table 10: Final Factor Loadings of Reliability and Validity Indices

Items	**Latent Construct**	**Standardised Factor Loading**	**α**	**CR**	**AVE**
INB3 <---	Inbound	.68	.780	.779	.542
INB4 <---	open innovation	.79			
INB5 <---		.73			
OUT1 <---	Outbound	.96	.847	.858	.754
OUT2 <---	open innovation	.77			
TC1 <---	Technological	.86	.915	.916	.686
TC2 <---	capability	.83			
TC3 <---		.83			
TC4 <---		.85			
TC5		.77			
MK2 <---	Marketing	.93	.718	.754	.616
MK3 <---	capability	.60			
GS1 <---	Government	.91	.899	.900	.693
GS2 <---	support	.89			
GS3 <---		.73			
GS4 <---		.79			

Consistent with Fornell and Larcker's (1981), it is observed that the AVE value for each latent construct, as highlighted in Table 11 below surpasses its corresponding squared inter-construct correlations. This outcome serves as evidence of the presence of discriminant validity among the latent constructs.

Table 11: Descriptive Statistics, Square Root of AVE, and Inter-Correlation of Constructs

Constructs	**M**	**SD**	**Skewness**	**Kurtosis**	**AVE**	**1**	**2**	**3**	**4**	**5**
1. Inbound open innovation	9.145	4.651	.380	-.922	.542	**.736**				
2. Outbound open innovation	5.250	3.352	.759	-.567	.754	.715***	**.868**			
3. Technological capability	23.578	5.000	-.287	.726	.686	.126	.181*	**.828**		
4. Marketing capability	8.899	2.450	.033	-.465	.616	-.307***	-.272***	.333***	**.785**	
5. Government support	14.636	5.464	-.156	-.780	.693	.464***	.410***	.162*	-.002	**.832**

Note: Correlation coefficient is significant at *p<0.05, ***p<0.001 (two-tailed).

Bolded values on the diagonal represent the square root of AVE and values below this diagonal represent constructs' inter-correlation

3.5.4 Assessment of Common Method Bias (CMB)

Considering that the same informants responded to items investigating predictor and criterion variables, there is a risk of CMB (Podsakoff *et al.*, 2003). To mitigate the risks associated with CMB, this study implemented various procedural and statistical measures in accordance with recommendations by Podsakoff et al. (2003). To address method bias, respondents were provided with a guarantee of anonymity, assuring them of the confidentiality of their responses and emphasising that there were no right or wrong answers (Podsakoff et al., 2003). Furthermore, to minimise order bias, careful attention was paid to the strategic placement of predictor and criterion variables within the questionnaire (Shukla, Rosendo-Rios and Khalifa, 2022). While these strategies are effective in reducing the potential for CMB, it is important to acknowledge that they may not entirely eliminate it. Therefore, a statistical method was employed to assess any remaining issues related to method variance in the data. The study conducted Harman's single-factor test, as recommended by Podsakoff et al. (2003), to evaluate the presence of CMB. The results of Harman's single-factor test revealed that the first factor, derived from all five extracted factors, accounted for less than 50% of the variance (26.193%). This suggests that CMB is not a significant concern in this study.

3.6 Results

This study relied on maximum likelihood SEM with AMOS version 27 to estimate path coefficients and then test the hypotheses of the conceptual model. In testing the hypotheses, this study relied on a stepwise approach. The first step (Model 1) involved estimations of the control variables (number of years worked in the firm, number of full-time employees, firm’s age, and geographical market of firm), followed by Model 2 (the direct effect model) which estimated the individual effect of technological capability and marketing capability on inbound open innovation and outbound open innovation. Model 3 introduced the moderator (i.e., government support), and model 4 investigated the moderating effects by using interaction terms.

In doing so, the interactions between government support and technological capability, and government support and marketing capability on inbound and outbound open innovation were estimated. Furthermore, for the moderation analysis, the independent variables (technological capability and marketing capability) and moderating variable (government support) were changed through mean centring and creating interactive terms by multiplying the independent variables and the moderating variables (Ranaweera and Jayawardhena, 2014).

Hypotheses 1a, 1b and 2a, 2b were tested in model 2, and hypotheses 3a, 3b and 4a, 4b in model 4. Table 12 displays the estimations of the stepwise models.

Before analysing the hypotheses, the goodness-of-fit statistics of the main effect model (Model 2), the moderator model (Model 3), and the interaction effect model (Model 4) were estimated. The goodness-of-fit statistics of the main effect model (Model 2) (χ^2 = 129.597, df = 80, p = 0.000, χ^2/df = 1.620, CFI = .963; IFI = .964; TLI = .944; GFI = .926; RMSEA = .055; PRATIO = .667), the moderator model (Model 3) (χ^2 = 211.563, df = 138, p < 0.000, χ^2/df = 1.533, CFI = .962; IFI = .963; TLI = .947; GFI = .908; RMSEA = .051; PRATIO = .727), and interaction effect model (Model 4) (χ^2 = 235.219, df = 160, p < 0.000, χ^2/df = 1.470, CFI = .962; IFI = .964; TLI = .946; RMSEA = .048; PRATIO = .693) suggests acceptable fit indices.

With regards to hypothesis 1a, there was a significant positive effect of technological capability on inbound open innovation (β = .222*, p = .011). Moreover, in support of hypothesis 1b, the positive effect of technological capability on outbound open innovation was significant (β = .264***, p < .001). Furthermore, hypothesis 2a revealed marketing capability to have a significant negative impact on inbound open innovation (β = -.350**, p = .002). In addition, hypothesis 2b revealed marketing capability to have a significant negative effect on outbound open innovation (β = -.344***, p < .001).

The moderating effect of government support was reported next. In testing hypothesis 3a, the results revealed that government support positively moderates the significant positive relationship between technological capability and inbound open innovation (β = .220**, p = .007). Thus, the interaction effect of government support strengthens the influence of technological capability on inbound open innovation, as illustrated in Figure 3. Moreover, hypothesis 3b revealed that government support did not moderate the relationship between technological capability and outbound open innovation (β = .123, p = .098). Thus, hypothesis 3b is not supported.

Furthermore, in testing hypothesis 4a, government support was found to negatively moderate the significant negative relationship between marketing capability and inbound open innovation (β = -.224**, p = .005). Thus, the interaction effect of government support strengthens the negative influence of marketing capability on inbound open innovation, as illustrated in Figure 4. In addition, hypothesis 4b revealed that government support negatively moderated the significant negative relationship between marketing capability and outbound open innovation (β = -.150*, p = .039) as illustrated in Figure 5.

Table 12: Path Coefficients

Variables	**Model 1**		**Model 2**		**Model 3**		**Model 4**	
	Controls model only		Direct effects		Moderator model		Interaction effects model	
	Beta	Std Err.	Beta	Std. Err.	Beta	Std Err.	Beta	Std Err.
Controls								
Number of years worked in the firm → INB	.057	.083	-.022	.083	-.043	.077	-.032	.074
Number of years worked in the firm → OUT	.063	.102	-.017	.101	-.033	.095	-.027	.094
Number of full-time employees → INB	.136	.147	.113	.142	.156*	.133	.171*	.129
Number of full-time employees → OUT	.045	.179	.025	.171	.060	.162	.070	.161
Firm's age → INB	-.225**	.159	-.200*	.153	-.140	.142	-.137	.136
Firm's age → OUT	-.252***	.190	-.220**	.182	-.175*	.173	-.173*	.171
Firm's geographical market → INB	-.199*	.091	-.142	.089	-.083	.083	-.052	.080
Firm's geographical market → OUT	-.225	.110	-.069	.108	-.016	.102	.001	.009
Direct effects								
TC → INB			.222*	.119	.169*	.111	.233**	.113

TC → OUT			.264***	.142	.228**	.136	.264***	.141
MK → INB			-.350**	.108	-.348***	.106	-.321**	.103
MK → OUT			-.344***	.132	-.359***	.130	-.340***	.132
Moderator								
GS → INB					.420***	.073	.386***	.071
GS → OUT					.345***	.082	.327***	.083
Interaction effects								
GS * TC → INB							.220**	.087
GS * TC → OUT							.123	.108
GS * MK → INB							-.224**	.088
GS * MK → OUT							-.150*	.120

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Abbreviations: INB: inbound open innovation, OUT: outbound open innovation, TC: technological capability, MK: marketing capability, GS: government support

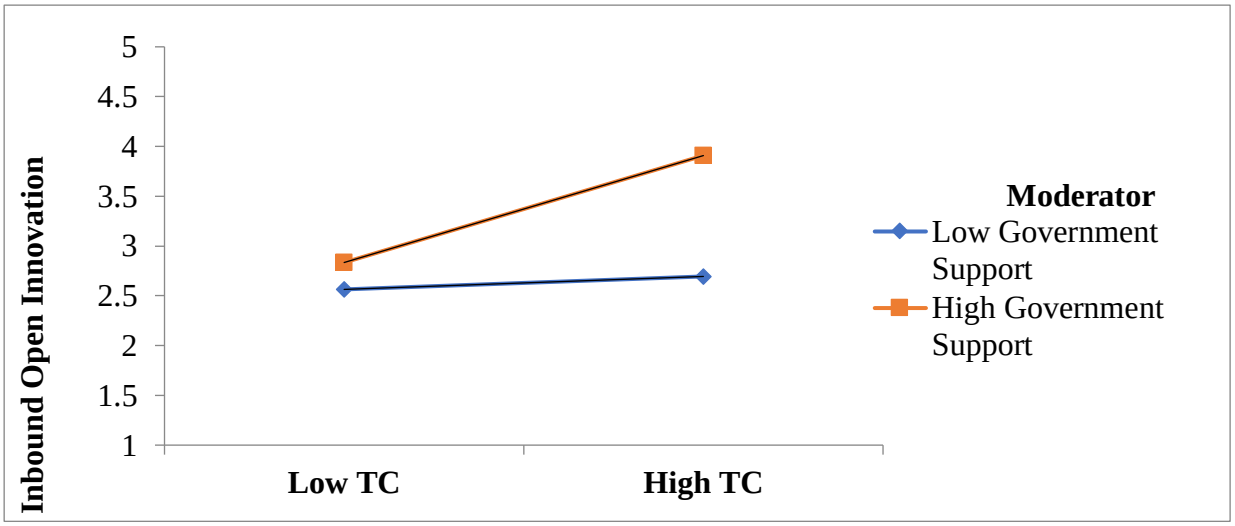


Figure 3: The Moderating Role of Government Support Between Technological Capability (TC) and Inbound Open Innovation

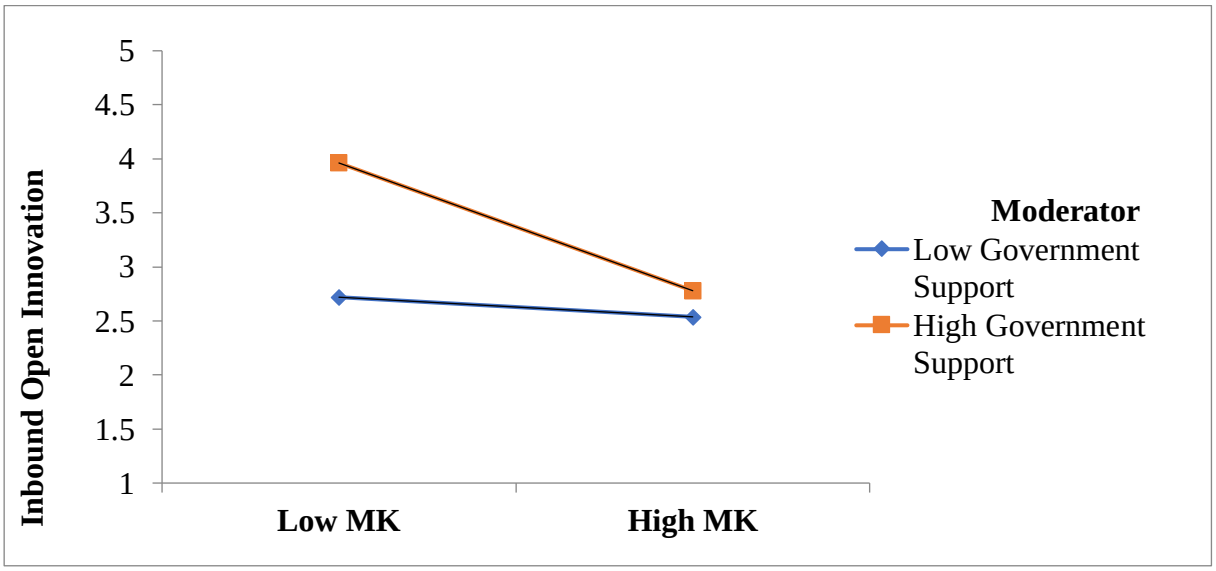


Figure 4: The Moderating Role of Government Support Between Marketing Capability (MK) and Inbound Open Innovation

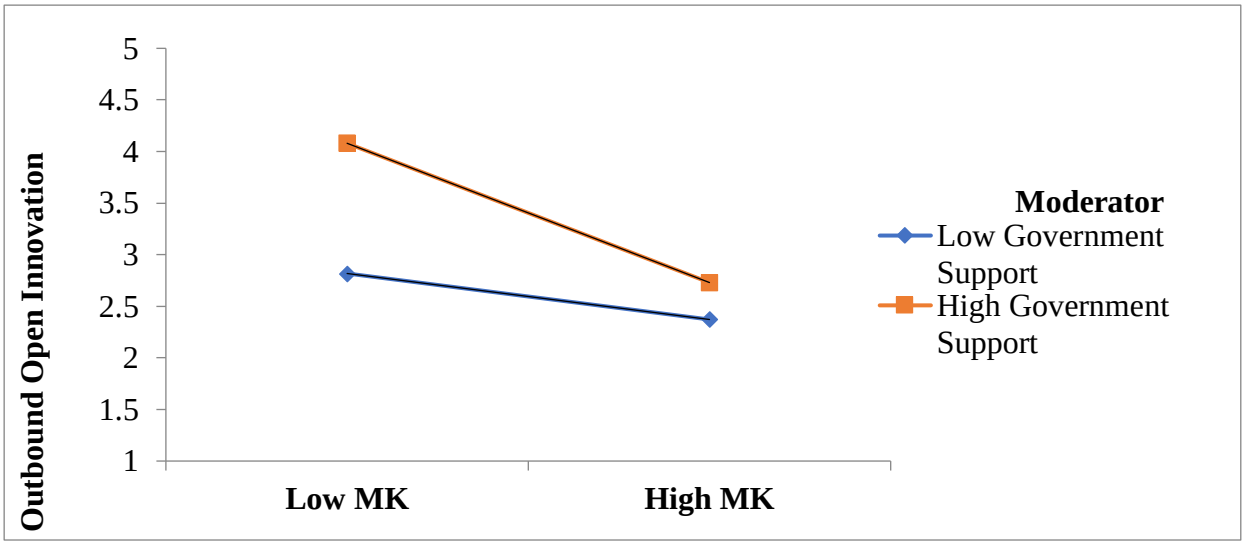


Figure 5: The Moderating Role of Government Support Between Marketing Capability (MK) and Outbound Open Innovation

Table 13: Summary of Hypotheses Results

Hypotheses	**Results**
Direct Effects	
H1(a): Technological capability → Inbound open innovation	S
H1(b): Technological capability → Outbound open innovation	S
H2(a): Marketing capability → Inbound open innovation	S
H2(b): Marketing capability → Outbound open innovation	S
Moderating Effects of Government Support	
H3(a): Government support X technological capability → Inbound open innovation	S
H3(b): Government support X technological capability → Outbound open innovation	NS
H4(a): Government support X marketing capability → Inbound open innovation	NS
H4(b): Government support X marketing capability → Outbound open innovation	NS

Notes: S = Supported; **NS** = Not Supported

3.7 Discussion

3.7.1 Introduction

This section is structured into four chapters. The initial section is dedicated to a comprehensive discussion of the summary of findings, with a particular emphasis on their alignment with the research hypothesis and previous studies. Theoretical contributions and practical implications are subsequently explored. Lastly, the study concludes by outlining its limitations and providing recommendations for future research.

3.7.2 Summary of Findings

In the first instance, bolstering hypotheses 1a and 1b, the study demonstrates a noteworthy and positive influence of technological capability on both inbound and outbound open innovation. This discovery implies that companies that employ diverse technologies are more inclined to participate in inbound open innovation practices such as buying R&D-related services such as patents, and copyrights; and outbound open innovation activities, including selling licenses such as copyrights, patents, and offering licensing agreements to other firms. This result aligns with prior research that affirmed the role of technological knowledge, which is a reflection of technological capability (Hsieh and Tsai, 2007), in facilitating firms' adoption of open innovation approaches (Dodgson, Gann and Salter, 2006).

Moreover, as hypothesised in 2a, it was observed that marketing capability had a notably adverse impact on inbound open innovation. This suggests that elevated marketing capability can impede a firm's involvement in inbound open innovation activities. Consequently, even though marketing capability has been established as a positive factor for overall firm performance (Mu *et al.*, 2018), manufacturing firms must recognise that this capability may not enhance their participation in inbound open innovation practices. This observation may be attributed to the tendency of companies possessing strong marketing capabilities to display a higher degree of risk aversion (Zang and Li, 2017). Such firms often prioritise the maintenance

and servicing of their existing customer base over the pursuit of innovative ideas (Zang and Li, 2017). Consequently, this preference for the familiar can lead to a fixation on established marketing strategies and trajectories (Liao, Fu and Liu, 2020).

As expected in hypothesis 2b, marketing capabilities were found to be significantly and negatively related to outbound open innovation. This outcome can potentially be elucidated by considering the concept of knowledge spillovers resulting from outbound open innovation (Zhou, Yao and Chen, 2018). Such knowledge spillovers may have the unintended consequence of causing companies to erode their competitive advantage (Huang *et al.*, 2014). Therefore, firms with high marketing capabilities may refrain from outbound open innovation practices to avoid losing their competitive advantage. Another possible reason is that firms with high marketing capability are known to be risk-averse (Zang and Li, 2017), and thus may be discouraged from engaging in outbound open innovation practices, which have been highlighted to be more risky compared to inbound open innovation practices (Shaikh and Randhawa, 2022; West, 2020).

Regarding the investigation into the moderating influence of government support on the relationship between technological capability and both inbound and outbound open innovation, the findings presented a variety of results. Initially, in accordance with hypothesis 3a, the study confirmed that government support serves as a positive moderator for the connection between technological capability and inbound open innovation. A potential explanation for this outcome is that although technological capability necessitates persistent investments in research and development by companies (Shou *et al.*, 2014), it can be marked by uncertainty and may require many years to yield results (Krammer, Strange and Lashitew, 2018; Teece, 1986). In such a situation, firms may seek support from external knowledge sourcing (Chung and Yeaple, 2008) to have easy access to cutting-edge technology (Krammer, Strange and Lashitew, 2018). Therefore, government support in the form of R&D subsidies and R&D support can play a

constructive role in this process (Adomako, Amankwah-Amoah and Danquah, 2022). Such support mechanisms could prove advantageous for companies engaging in inbound open innovation practices.

On the contrary, the results did not reveal a significant moderating effect of government support on the relationship between technological capability and outbound open innovation. This finding contradicts hypothesis 3b. This discovery implies that manufacturing firms operating in the UK can cultivate and enhance their technological capability for engagements in outbound open innovation activities, such as establishing royalty agreements with other firms, even in the absence of government support. A possible explanation for this finding may be that when a firm engages in outbound open innovation practices, it aims to capture value from the commercialisation of technological knowledge or together with its internal application (Cassiman and Valentini, 2016; Liao, Fu and Liu, 2020). Therefore, the benefits of outbound open innovation result from technological exploitation and innovation rather than from government support.

Additionally, hypothesis 4a, which posited a significant positive moderating effect of government support on the negative influence of marketing capability on inbound open innovation practices, was not substantiated by the study's findings. This finding suggests that the use of marketing capabilities is detrimental to the adoption of inbound open innovation even with government support. One possible explanation for the unfavourable impact of government support could be associated with the conditions attached to the support, especially with regard to the specified loan disbursement conditions (Nakku *et al.*, 2020; Odongo, 2014), which may limit the firm's ability to develop its marketing capability. Another potential explanation may be that government support cannot substitute for marketing capability; therefore, government support does not change the influence of marketing capability.

Additionally, hypothesis 4b, which proposed a significant positive moderating effect of government support on the negative impact of marketing capability on outbound open innovation practices, was not confirmed. One explanation for this discovery is that financial support is most important to firms at the beginning of new firms to build unique resources and capabilities (Saridakis, Mole and Hay, 2013). Beyond this point, the company's success predominantly hinges on its own set of resources and capabilities (Pergelova and Angulo-Ruiz, 2014). By implication, although government support may be essential in the initial stages of new firms, it may not significantly impact marketing capability's influence on outbound open innovation.

Another explanation could be due to the decrease in the firm's capital investment in their Research and Development (R&D) after receiving a government R&D subsidy (Zhao, Xu and Zhang, 2018). After receiving R&D subsidies from the government, firms tend to allocate their capital towards less risky activities and use the government's funding for high-risk R&D activities (Zhao, Xu and Zhang, 2018). While this is understandable, an excessive allocation towards less risky activities suggests that firms may not be genuinely interested in R&D and are merely attempting to mitigate financial difficulties (Zhao, Xu and Zhang, 2018). By implication, the government may not have selected the appropriate company to receive the R&D grant. Hence, its efficacy remains uncertain (Zhao, Xu and Zhang, 2018).

3.7.3 Theoretical Contributions

The study's findings furnish the following specific theoretical contributions to the marketing and entrepreneurship fields as well as the open innovation literature. Initially, the study expands on previous technological capability research by examining the influences of technological capability on both inbound and outbound open innovation, particularly given the minimal investigation into this association (Liao, Fu and Liu, 2020). This thesis was firmly grounded in the RBV and the capability-based view frameworks. Given that technological

capabilities are embedded in organisational routines over time (Taghizadeh *et al.*, 2020), internally generated technologies present a formidable challenge to replication due to the confidentiality and self-protective measures surrounding them (Zang and Li, 2017). This confers an unparalleled advantage in the context of introducing novel products and venturing into new markets (Zang and Li, 2017). As a result, this study's endorsement of the RBV and the capability-based perspective constitutes a significant contribution to the current body of literature on open innovation.

Moreover, this study makes a valuable contribution to the realm of capability literature by establishing a bridge between the burgeoning research on marketing capability and the field of open innovation. The predominant perspective has consistently shown that marketing capability positively affects firm performance (Guo *et al.*, 2018). Nonetheless, there has been a notable absence of endeavours to explore the ramifications of marketing capability within the domain of open innovation literature (Liao, Fu and Liu, 2020). In light of this, the present study enhances the existing literature by constructing an integrated model that evaluates the effects of marketing capability on both inbound and outbound open innovation practices, specifically within the context of UK manufacturing firms. In contrast to the widely accepted capability-based view, the findings reveal that marketing capability impedes a firm's involvement in both inbound and outbound open innovation activities. This study serves as a warning for companies and emphasises the significance of developing a fresh comprehension of marketing proficiency, particularly in the setting of open innovation.

Furthermore, this investigation extends the scope of the contingency approach by delving into the boundaries within which technological capability influences inbound and outbound open innovation. Specifically, it sheds light on the pivotal role of government support in shaping the relationship between technological capability and inbound open innovation. This finding implies that a heightened level of government support can amplify the favourable

influence of technological capability on inbound open innovation. Through this study, it becomes apparent that a particular facet of open innovation stands to gain more from the synergy between government support and technological capability. This underscores that while technological capability can indeed drive open innovation initiatives (Taghizadeh *et al.*, 2020), the strength of this relationship becomes more pronounced when focusing on inbound open innovation and is contingent upon government support. In essence, technological capability alone may not suffice for the successful implementation of inbound open innovation practices. Therefore, this study expands upon the literature by suggesting that companies are more likely to implement inbound open innovation successfully in the presence of significant government support.

Last, this study enhances our comprehension of the assistance offered by governments in the open innovation literature - notably when scholars such as Morgan, Feng and Whitler (2018) promote a more situation-dependent approach to marketing capability. Therefore, in response to these recommendations, the study investigates the impact of government support on the relationship between marketing capability and both inbound and outbound open innovation. While the wider marketing literature commonly recognises that government support tends to have a significant and positive impact on firm performance, the results of this study deviate from this conventional wisdom. Instead, they reveal a significant and unexpected negative moderating effect of government support on the adverse consequences of marketing capability concerning both inbound and outbound open innovation. This discovery challenges prevailing assumptions in the field. This perspective offers a new angle on the research into marketing capability and open innovation.

3.7.4 Practical Contributions

This research presents significant insights for both managers and the government. To begin, with limited resources and capabilities, firms should cautiously allocate their resources

and concentrate on developing capabilities that can enhance their engagement in both inbound and outbound open innovation practices. This will help to build and sustain long-term success. As demonstrated in this study, the cultivation of technological capabilities positively augments both inbound and outbound open innovation practices. This serves as a useful reference for managers seeking to achieve their dual objectives by identifying the appropriate capabilities to develop and implement. Similarly, this facilitates managers in assessing their competencies and obtaining the necessary expertise and knowledge to improve their involvement in inbound and outbound open innovation processes.

Additionally, it was discovered that marketing capabilities hinder participation in inbound and outbound open innovation activities. This result might be unexpected to scholars in the field of marketing, considering previous research has consistently established that marketing capability generally has a positive impact on firm performance (Morgan, Feng and Whitler, 2018; Vorhies and Morgan, 2005). However, this finding can be elucidated by suggesting that instead of solely relying on marketing capability, it would be advantageous for marketing managers to also emphasise the development of technological capabilities to enhance their engagement in both inbound and outbound open innovation practices.

Furthermore, the discovery that government support exerts a moderating influence offers valuable practical insights into which category of open innovation is more likely to gain advantages from technological capability. This study warns managers that technological capability alone is insufficient to create strong engagements in open innovation. Considering government support is an advantageous tool for inbound open innovation, companies intending to establish and enhance their technological capabilities should prioritise obtaining government support.

Lastly, it was discovered that government support strengthens the adverse impact of marketing capability on both inbound and outbound open innovation practices. This may seem counterintuitive to theory; however, empirical evidence in this regard does not exist. The finding implies that providing government support does not guarantee a successful impact on marketing capability for both inbound and outbound open innovation practices. This may arise if these government funds are not used appropriately, particularly if the firm management perceives that future government funding is conditional on reaching a specific marketing expenditure level. Hence, it is advisable that government authorities not only focus on the criteria for selecting subsidy recipients but also implement effective monitoring mechanisms to ensure that these subsidies are utilised for their intended purpose, particularly when that purpose involves the development of marketing capability.

3.7.5 Limitations and Future Directions

The present investigation has limitations that necessitate considerations in future research. In the initial analysis, while technological capability showed a positive influence on both inbound and outbound open innovation, future research could consider adopting a dyadic capability perspective (Wang, Jin and Zhou, 2023). This strategy may aid in discerning the technological proficiencies of both purchasers and providers, considering elements like the robustness of their technological capabilities, the disparities in these capabilities, and how these differences can impact the practice of open innovation. This is of significance because the strength and asymmetry of technological capability can yield various effects on a company's innovation initiatives (Wang, Jin and Zhou, 2023).

Moreover, this study contributes to the existing body of knowledge by emphasising the significance of marketing capabilities in both inbound and outbound open innovation processes. It is important to acknowledge that this study does not specify the specific aspects or categories of marketing capability that require scrutiny. Future research could delve into the nuanced

facets of marketing capability to offer more comprehensive insights into its influence on open innovation practices. Therefore, for greater clarity, upcoming studies should investigate how various forms of marketing capability, including static, dynamic, and adaptive marketing capabilities, affect the realm of open innovation.

Additionally, it is worth noting that this study solely analysed the moderating impact of government support. Future research should investigate additional external environmental factors, including market turbulence, technological dynamism, and environmental dynamism, along with other firm capabilities such as absorptive capability, as a potential moderator in this relationship.

Lastly, future studies should consider potential mediators to provide a clear explanation of the research findings.

Chapter 4: The Internal Mechanisms Between Open Innovation and Firm Performance

Abstract

Although there has been a substantial body of research exploring how both inbound and outbound open innovation impact firm performance, a significant gap exists in our understanding of the internal mechanisms that link these practices. To address this knowledge gap, this study draws upon insights from the resource-based view, capability-based theory, and contingency theory. Data were gathered from 206 manufacturing firms located in the UK. The study's findings revealed that there was no significant impact from either inbound or outbound open innovation on firm performance. Additionally, it was noted that the relationship between outbound open innovation and firm performance was negatively mediated by strategic flexibility, with no apparent mediating effect on innovation performance. Furthermore, the study highlighted that strategic flexibility and innovation performance acted as serial mediators in the relationship between outbound open innovation and firm performance. Lastly, the research identified a positive moderating effect of organisational relearning in the connection between inbound open innovation and firm performance. These findings offer valuable insights into the intricate interactions among open innovation practices, firm performance, and the underlying mechanisms within manufacturing firms in the UK.

Keywords: Firm performance, Innovation performance, Strategic flexibility, Organisational relearning, Inbound open innovation, Outbound open innovation.

4.1 Introduction

The concept of open innovation emerged in response to several compelling factors, including the need to complement internal knowledge bases (Lichtenthaler, 2011), shortened product lifecycles, rising research and development (R&D) costs, increasing competition (Yildirim *et al.*, 2022) and the pursuit of a competitive edge in an increasingly turbulent business landscape (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022). Chesbrough (2003) introduced open innovation as a novel perspective on the innovation process. It encompasses both the acquisition of external knowledge to enrich internal innovation efforts and the expansion of market reach to facilitate the external utilisation of innovation (Chesbrough, 2003). Numerous studies have substantiated the significant benefits of open innovation for organisations. These advantages include enhanced access to valuable external knowledge (Dahlander and Gann, 2010) and the generation of revenue from previously underutilised internal knowledge (Foege *et al.*, 2019).

However, there have been some negative consequences of open innovation, such as information leakage and unintended knowledge disclosure (Dahlander and Gann, 2010). These negative consequences have not diminished the interest of researchers, as evidenced by special journal issues, review articles and conferences (Dahlander and Gann, 2010; Gassmann, Enkel and Chesbrough, 2010; Huizingh, 2011; Obradović, Vlačić and Dabić, 2021). As the field evolves, our comprehension of open innovation has advanced due to the growing scholarly focus (Dahlander, Gann and Wallin, 2021). However, there seems to be an unclear understanding of whether or not open innovation affects firm performance (Zhang *et al.*, 2023).

The question of how open innovation impacts firm performance has been a persistent focus of research, yielding diverse and occasionally contradictory results. While numerous studies have documented a favourable impact of open innovation on firm performance (Cheng and Huizingh, 2014), others have identified curved relationships, such as an inverted U-shaped

relationship (Faems *et al.*, 2010), or even an S-shaped relationship (Schäper *et al.*, 2023) between these variables. The discrepancies in these findings may be attributed to the diverse nature of open innovation, encompassing both inbound and outbound dimensions, and their implementation at various phases of the innovation process (Chesbrough, 2006). Nevertheless, making a clear distinction between inbound and outbound open innovation, while crucial, may not completely address the discrepancies in the research findings. Li, Li and Wu (2022) point out that ongoing debates persist regarding the respective roles of both forms of open innovation in shaping firm performance.

Another possible reason for the inconsistent findings may be related to a limited understanding of the conditions under which firms can benefit from open innovation (Zhang *et al.*, 2023). Hence, it could be overly reductionist to presume a direct and uncomplicated correlation between open innovation and firm performance, neglecting the potential impact of internal and external factors (Sun, Liu and Ding, 2020). Despite this acknowledgement, there remains a paucity of studies that delve into the internal mechanisms linking open innovation and firm performance (Lu, Qi and Hao, 2023). To address this critical knowledge gap, the present study employs the concepts of strategic flexibility, innovation performance, and organisational relearning to explore the intricacies of how, and under what circumstances, both inbound and outbound open innovation can translate into tangible improvements in firm performance.

Previous research has indeed explored the impact of firm capabilities as potential mediators in the link between outbound open innovation and firm performance. However, despite the literature highlighting the significance of firm capabilities in the context of outbound open innovation (Liao, Fu and Liu, 2020; Lu, Qi and Hao, 2023), there has been a notable absence of empirical investigations into whether outbound open innovation triggers strategic flexibility and how this strategic flexibility may serve as a mediator in the link between

outbound open innovation and firm performance. This study places particular emphasis on strategic flexibility, even though outbound open innovation is acknowledged as the riskiest form of open innovation, primarily due to the heightened potential for R&D spillovers from incumbent firms to their competitors (Henkel, Schöberl and Alexy, 2014; Shaikh and Randhawa, 2022). The possession of strategic flexibility may prove particularly advantageous when firms encounter crises (Grewal and Tansuhaj, 2001), which, in turn, can have significant implications for firm performance.

Despite the acknowledged importance of both strategic flexibility (Combe *et al.*, 2012; Nadkarni and Narayanan, 2007) and outbound open innovation as contributors to firm performance (Liao, Fu and Liu, 2020), these two perspectives have progressed independently in scholarly research. In other words, although previous studies have individually explored the impact of strategic flexibility (as a firm's capability) and outbound open innovation (as a strategic resource) on firm performance, there is a noticeable gap in integrating these aspects into a comprehensive framework to thoroughly assess their combined influence. Building on the capability-based perspective, this study aims to bridge this gap in the literature and deepen our understanding by examining the mediating role of strategic flexibility in the link between outbound open innovation and firm performance.

There is indeed a notable gap in the open innovation literature concerning the mediating role of innovation performance. In recent years, open innovation scholars have increasingly recognised the significance of innovation performance (Lu, Qi and Hao, 2023). However, most prior studies have primarily focused on investigating the direct relationship between outbound open innovation and innovation performance (Lu, Qi and Hao, 2023). Despite these valuable findings, it can be contended that the scope of the open innovation literature has not been comprehensively extended. This is because, while it is established that outbound open innovation contributes to the enhancement of innovation performance (Lu, Qi and Hao, 2023;

Zhou, Yao and Chen, 2018), and innovation performance plays a critical role in improving firm performance (Gërguri-Rashiti *et al.*, 2017), researchers have yet to explore the potential synergistic impact of outbound open innovation and innovation performance on firm performance. This insight will be pivotal in addressing the fundamental question of how outbound open innovation can augment firm performance by leveraging innovation performance as an intermediary factor.

Furthermore, to advance the discourse within the open innovation literature, this research investigates the potential for a serial mediating effect involving both strategic flexibility and innovation performance in the relationship between outbound open innovation and firm performance. As previously noted, to my awareness, the mediating effect of either strategic flexibility or innovation performance in the context of outbound open innovation and firm performance has not yet been explored. Nonetheless, past research has indicated that strategic flexibility does exert an influence on innovation performance (Fan, Wu and Wu, 2013; Martínez-Sánchez *et al.*, 2009). This suggests the possibility that strategic flexibility and innovation performance might jointly serve as serial mediators in this relationship. Hence, this hypothesis is thoroughly scrutinised as part of this study's scope, to illuminate further the complex mechanisms linking outbound open innovation to firm performance.

In addition to exploring the direct association between inbound open innovation and firm performance, this research takes a step further by applying a contingency approach to investigate the circumstances under which inbound open innovation yields enhanced firm performance. Contingency theory posits that the effects of strategies can differ based on contextual factors (Donaldson, 2006). This implies that the impact of inbound open innovation on firm performance is contingent on contextual factors, which may originate from both external and internal sources within the organisation.

As such, previous research has pinpointed various contingency factors, including elements like open culture and the organisation's openness, which have the potential to shape the connection between inbound open innovation and firm performance (Li, Li and Wu, 2022). Nevertheless, despite the insights gained from such a study, the boundaries of this relationship and the specific conditions under which it operates remain relatively unclear. Consequently, this study enriches the existing literature by revealing the moderating influence of organisational relearning in the context of this relationship, providing a more detailed insight into how organisational factors can shape the effects of inbound open innovation on firm performance.

Although the importance of organisational learning has been acknowledged in the open innovation literature (e.g., Zhang *et al.*, 2023), researchers have yet to investigate the influence of organisational relearning in the open innovation literature. This research focused on organisational relearning because even though inbound open innovation involves the acquisition of more knowledge to expand the firm's knowledge base (Sun, Liu and Ding, 2020), the existence of organisational relearning can help firms learn to ensure the smooth flow of such new knowledge into the firm to expand the existing knowledge reservoir (Azmi, 2008; Zhao and Wang, 2020). Such an insight would be an important extension to the open innovation literature because even though benefiting from open innovation is not an easy task (Zhang *et al.*, 2023) and the degree of effectiveness in open innovation practices significantly differs among firms, "the most plausible explanation for the discrepancies in the effectiveness of open innovation is the potential contingent factors that may facilitate or constrain firms in reaping the benefits of open innovation" (Zhu *et al.,* 2019, p. 75). Therefore, the importance of organisational relearning may be relevant to academics and a guide to managerial practice.

Using quantitative data from an online survey of 206 UK manufacturing firms and drawing on RBV, capability-based theory and contingency approach, this research aims to provide answers to the following research questions:

1. Does inbound open innovation have a positive impact on firm performance?
2. Does outbound open innovation have a positive impact on firm performance?
3. Does outbound open innovation have a positive impact on strategic flexibility?
4. Does strategic flexibility have a positive impact on firm performance?
5. Does strategic flexibility mediate the influence of outbound open innovation on firm performance?
6. Does outbound open innovation have a positive impact on innovation performance?
7. Does innovation performance have a positive impact on firm performance?
8. Does innovation performance mediate the influence of outbound open innovation on firm performance?
9. Does strategic flexibility have a positive impact on innovation performance?
10. Are strategic flexibility and innovation performance serial mediators in the relationship between outbound open innovation and firm performance?
11. Does organisational relearning positively moderate the relationship between inbound open innovation and firm performance?

Overall, this study makes the following contributions. Firstly, there remains uncertainty regarding the extent to which firms derive benefits from open innovation (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022). This study not only contributes to addressing the ambiguities surrounding the connection between outbound open innovation and firm performance but also enriches the existing body of knowledge on outbound open innovation. It accomplishes this by introducing a framework that offers insights into the potential relationship

between outbound open innovation and firm performance, while also incorporating the crucial element of strategic flexibility. This holistic approach aims to provide a more thorough comprehension of the dynamics at play in the realm of outbound open innovation and its influence on firm performance. This may help to explain why some firms have more or less firm performance and how strategic flexibility may explain this difference. Without such knowledge, policymakers and practitioners risk wasting resources.

Secondly, this research significantly enriches the literature on innovation performance by delving into the indirect influence of outbound open innovation on firm performance through its impact on innovation performance. As far as my knowledge extends, this study marks the first attempt to explore such a mechanism. While the related literature does offer empirical evidence regarding the effects of outbound open innovation on innovation performance (Singh *et al.*, 2021), it has not previously connected this indirect pathway to firm performance, making this research a pioneering contribution in this regard.

Thirdly, despite the existence of limited empirical insights into the internal mechanisms linking open innovation and firm performance in the literature (Lu, Qi and Hao, 2023), the mediating functions of both strategic flexibility and innovation performance have remained largely unexamined. This study adopts a distinctive approach, where strategic flexibility and innovation performance are regarded as sequential mediators in the linkage between outbound open innovation and firm performance. To my awareness, this study represents the first attempt to explore such a complex mediating mechanism within this context, thereby contributing a novel perspective to the existing literature.

Finally, unlike previous studies, this study investigates the moderating effect of organisational relearning on inbound open innovation. Although previous findings have identified the impact of inter-organisational learning on inbound open innovation (Seo and

Park, 2022), there is no information available on whether the development of organisational relearning and engagement in inbound open innovation can contribute to firm performance. In practical terms, understanding this could help managers make informed decisions about how to allocate their resources.

4.2 Literature Review and Hypotheses Development

4.2.1 Inbound Open Innovation and Firm Performance

Previous studies have found or contended either a positive (Hung and Chou, 2013; Singh *et al.*, 2021), a negative (Faems *et al.*, 2010; Fu, Liu and Zhou, 2019), or no significant relationship between inbound open innovation and firm performance (Mazzola, Bruccoleri and Perrone, 2012); while others have found an inverted U-shaped relationship between them (Michelino *et al.*, 2015; Zhang *et al.*, 2018).

In accordance with the existing literature that has provided evidence supporting the positive influence of inbound open innovation on firm performance, a study conducted by Liao, Fu and Liu (2020) on Chinese high-tech firms revealed inbound open innovation to improve firm performance. This finding aligns with the broader understanding of the benefits of incorporating external knowledge and resources through inbound open innovation practices to enhance firm performance. In support of this finding, other scholars (e.g., Popa, Soto-Acosta and Martinez-Conesa, 2017; Singh *et al.*, 2021) have found that inbound open innovation improves firm performance. Similarly, inbound open innovation practices such as in-licensing (Sikimic *et al.*, 2016), horizontal and vertical technology collaborations (Wang, Chang and Shen, 2015) and interaction with suppliers, customers and academic institutions have been found to improve firm performance (Lichtenthaler, 2009).

Several compelling arguments support the expectation that inbound open innovation will enhance firm performance. First, inbound open innovation provides firms with a

mechanism to access valuable external knowledge (Chesbrough, 2003). This external knowledge allows firms to expedite the new product development process, bypassing the early stages and moving quickly to product implementation (Zhu *et al.*, 2023). This shortened development cycle can result in economic benefits for firms (Sisodiya, Johnson and Grégoire, 2013). Moreover, blending valuable external resources with a firm's internal capabilities enhances overall innovativeness (Dittrich and Duysters, 2007). This synergy reduces the need for extensive new product development efforts (Dittrich and Duysters, 2007). Consequently, using underutilised resources and existing R&D investments can lead to improved financial performance (Lu, Qi, and Hao, 2023). These arguments collectively underscore the critical role of inbound open innovation in driving firm performance by facilitating knowledge acquisition, expediting product development, and augmenting innovativeness through the efficient use of both internal and external resources.

Second, firms can maintain their competitive advantage through continuous innovation and updating the existing knowledge base to protect their innovation success (Devarakonda and Reuer, 2018). Inbound open innovation allows firms to quickly replenish and update their knowledge base using external knowledge and technology in a diversified manner, which can be crucial for gaining competitive advantage (Li, Li and Wu, 2022) and improving firm performance.

Despite these benefits, inbound open innovation has some limitations (Laursen and Salter, 2014). For example, over-reliance on external resources can lead to diminishing marginal returns (Laursen and Salter, 2014). As the level of innovation increases and access to available external information decreases, firms will need to spend more on searching for valuable external information and enhancing communication with partners to sustain the expansion of innovation in existing products (Faems *et al.*, 2010). Despite this limitation associated with inbound open innovation, it is hypothesised that:

Hypothesis 1: There is a significant positive relationship between inbound open innovation and firm performance.

4.2.2 Outbound Open Innovation and Firm Performance

There is a wide variety of opinions on the influence of outbound open innovation on firm performance (Li, Li and Wu, 2022). Although many firms shy away from outbound open innovation due to the risk of core technology leakage and enhancing the competitiveness of other firms through external technology transfer (Zhu *et al.*, 2023), some scholars have found that outbound open innovation enhances firm performance (Liao, Fu and Liu, 2020; Lichtenthaler, 2011). In support of these findings, studies of Chinese high-tech firms (Liao, Fu and Liu, 2020), Spanish manufacturing firms (Popa, Soto-Acosta and Martinez-Conesa, 2017) and firms in the United Arab Emirates (Singh *et al.*, 2021) have found outbound open innovation to positively influence firm performance.

The following arguments provide reasons why outbound open innovation is expected to positively influence firm performance. First, the firm's reputation is enhanced during the process of implementing outbound open innovation (Li, Li and Wu, 2022). The enhanced status brings lucrative revenues to the firm, which in turn can help the firm grow in the long run (Li, Li and Wu, 2022). In addition, the external commercialisation of valuable internal innovations through paid transfers can bring economic benefits (Lichtenthaler, 2009).

Second, by establishing links with external technology commercialisation organisations, firms can better gather information about market needs and the direction of technology development, which can be crucial for firms to identify the external technology and knowledge they need (Zhu *et al.*, 2023). In addition, by transferring technology through selling, outsourcing or sharing, firms can test the value of technology in the market in the short term and gain some insights into the future R&D direction of firms and the commercialisation of idle

technology, which in turn can help reduce sunk costs and enhance economic growth (Zhu *et al.*, 2023).

On the contrary, outbound open innovation encourages the licensing and sale of intellectual property to external firms (Dahlander and Gann, 2010). In doing so, firms risk the uniqueness of their knowledge base, which may undermine their core competitive advantage (Huang *et al.*, 2014; Mazzola, Bruccoleri and Perrone, 2012). Despite these findings, it is hypothesised that:

> **Hypothesis 2:** There is a significant positive relationship between outbound open innovation and firm performance.

4.2.3 Outbound Open Innovation and Strategic Flexibility

Despite the continued interest in strategic flexibility, scholars have taken a more theoretical approach to understanding the antecedents of strategic flexibility compared to empirical evidence (Kafetzopoulos, Psomas and Bouranta, 2022). Since Brozovic's (2018) meta-review, scholars have continued to provide insights into the antecedents of strategic flexibility. Nonetheless, the exploration of strategic flexibility within the open innovation literature remains an area largely overlooked by researchers. This represents a notable gap in the existing body of literature that this study endeavours to address. The study seeks to fill this gap by presenting compelling arguments in favour of examining the relationship between open innovation and strategic flexibility.

First and foremost, open innovation, as a contemporary development strategy, holds significant importance for firms striving to attain sustainable growth in an environment marked by intense market competition, swift technological advancements, and escalating technological intricacies (Obradović, Vlačić and Dabić, 2021). In parallel, it has been recognised that strategic flexibility equips firms with the ability to adapt to shifts in the business landscape and actively

shape their surroundings (Brozovic, 2018). Consequently, possessing strategic flexibility can empower firms to effectively navigate change (Wright and Snell, 1998; Zhou and Wu, 2010) and not only survive but thrive in such dynamic environments (Hamlin, Henry and Cuthbert, 2012).

Second, the open innovation literature recognises the importance of firm capabilities and resources (Taghizadeh *et al.*, 2020). Indeed, significant organisational resources and capabilities have been identified as necessary for open innovation contributions to firm performance (Martinez-Conesa, Soto-Acosta and Carayannis, 2017; Spithoven, Vanhaverbeke and Roijakkers, 2013). For example, Lu, Qi and Hao (2023) found open innovation to improve absorptive capacity, and absorptive capacity mediates the association between open innovation and innovation performance. Similarly, given that strategic flexibility is a firm capability (Shimizu and Hitt, 2004), open innovation can be expected to influence strategic flexibility.

However, although Chesbrough's (2003) conceptualisation of open innovation consisted of two main dimensions - inbound open innovation and outbound open innovation - some scholars (e.g., Martinez-Conesa, Soto-Acosta and Carayannis, 2017) have studied open innovation as a single element. In this section, we focus on outbound open innovation and provide reasons why it is expected to affect strategic flexibility.

First, outbound open innovation was found to have some advantages. For example, outbound open innovation helps firms to capture market information quickly (Lu, Qi and Hao, 2023) which could be crucial for strategic flexibility by allowing firms to adapt their business plan to changing market conditions to gain a competitive advantage (Brozovic, 2018; Miroshnychenko *et al.*, 2021; Zahoor and Lew, 2023).

In addition, outbound open innovation can also provide strategic advantages such as a high market position and high market reputation, which can help to easily attract excellent

collaborators, thereby reducing the cost of partner search (Lu, Qi and Hao, 2023). The researcher argues that because strategic flexibility helps firms respond quickly to changing market conditions (Grewal and Tansuhaj, 2001), it can help them achieve or maintain their higher market position and reputation. Based on these arguments, it is hypothesised that:

> **Hypothesis 3:** Outbound open innovation is significantly and positively related to strategic flexibility.

4.2.4 Strategic Flexibility and Firm Performance

Among the various outcomes of strategic flexibility, a meta-review by Brozovic (2018) revealed that financial performance is the most common outcome associated with strategic flexibility. Most scholars (e.g., Combe *et al.*, 2012; Nadkarni and Narayanan, 2007; Saini and Johnson, 2005) found that strategic flexibility improves firm financial performance. Strategic flexibility can enhance firm performance for the following reasons.

To begin, firms endowed with strategic flexibility play a pivotal role in enabling organisations to promptly identify potential threats and seize emerging opportunities (Cingöz and Akdoğan, 2013). They possess the capability to adapt and reconfigure their resource base to harness these strategic opportunities (Raff, 2000). These opportunities, once harnessed, can yield superior performance driven by various factors such as first-mover advantages (Ferrier, Smith and Grimm, 1999), heightened responsiveness to customer needs (Matusik and Hill, 1998), or other strategic advantages.

Secondly, strategic flexibility plays a critical role in enabling firms to effectively detect shifts in their operating environment (Grewal and Tansuhaj, 2001). It empowers them to efficiently reallocate resources (Sanchez, 1995) and overcome organisational inertia (Zhou and Wu, 2010). These capabilities collectively contribute to improved firm performance by ensuring adaptability and agility in response to changing circumstances.

Third, a key aspect of strategic flexibility is meeting customer needs (Celuch, Murphy and Callaway, 2007). By satisfying customer needs, firms gain enhanced customer value, which can be critical to competitive advantage and ultimately to financial performance (Celuch, Murphy and Callaway, 2007). However, even if strategic flexibility does not lead to competitive advantage, it can improve firms' ability to enter profitable markets and achieve high growth (Celuch, Murphy and Callaway, 2007).

While most studies (e.g., Combe *et al.*, 2012; Saini and Johnson, 2005) highlight a positive association between strategic flexibility and firm performance, a subset of scholars (e.g., Nadkarni and Narayanan, 2007; Pagell and Krause, 2004) have uncovered potential drawbacks associated with strategic flexibility. These drawbacks may encompass elevated costs, a potential lack of strategic focus, heightened stress levels, and adverse effects on firm performance. Despite these divergent findings, the following hypothesis is posited:

> **Hypothesis 4:** There is a significant positive relationship between strategic flexibility and firm performance.

4.2.5 Strategic Flexibility Mediating Outbound Open Innovation and Firm Performance

Strategic flexibility has been examined as an antecedent and an outcome variable (Miroshnychenko *et al.*, 2021); however, less research (Nadkarni and Herrmann, 2010; Song *et al.*, 2022; Yin *et al.*, 2022) has examined the mediating role of strategic flexibility. Therefore, this research fills the gap in the literature.

In general, the relationship between open innovation and firm performance is well-established in the literature (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022). However, the empirical evidence from previous studies remains inconclusive and contradictory (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022). Some studies have suggested that intervening mechanisms may be crucial in assessing the association between open innovation and

performance (Cuevas-Vargas, Aguirre and Parga-Montoya, 2022). Despite this, few studies have investigated the internal mechanism between open innovation and performance (Lu, Qi and Hao, 2023).

Therefore, based on the capability-based theory and the arguments in Hypotheses 2, 3 and 4, the preceding hypotheses link the relationships between outbound open innovation, strategic flexibility, and firm performance. Implicitly, the discussion suggests that outbound open innovation affects firm performance through strategic flexibility. That is, outbound open innovation may be a prerequisite for strategic flexibility, which in turn affects firm performance. Following this line of reasoning, it is hypothesised that:

> **Hypothesis 5:** Strategic flexibility mediates the relationship between outbound open innovation and firm performance.

4.2.6 Outbound Open Innovation and Innovation Performance

Scholars have conducted extensive research into the impact of open innovation on firm performance (Lu, Qi and Hao, 2023). Despite this significant scholarly attention, the influence of open innovation on innovation performance remains a subject of ongoing debate (Jugend *et al.*, 2018; Scaliza *et al.*, 2022). This debate may stem from the fact that open innovation comprises two dimensions, namely inbound and outbound open innovation (Ebersberger *et al.*, 2021), with limited empirical evidence available regarding the influence of outbound open innovation on innovation performance (Greco, Grimaldi and Cricelli, 2015; Madrid-Guijarro, Martin and García-Pérez-de-Lema, 2020). To contribute to the existing literature and advance our understanding in this domain, this section examines the impact of outbound open innovation on innovation performance.

Previous research has yielded varying and at times contradictory outcomes concerning this relationship (Zhou, Yao and Chen, 2018). Scholars have unearthed evidence supporting a

positive association (Lu, Qi and Hao, 2023; Zhou, Yao and Chen, 2018), a negative one (Mazzola, Bruccoleri and Perrone, 2012), or even no statistically significant relationship between outbound open innovation and innovation performance (Scaliza *et al.,* 2022). In alignment with the existing body of literature that has identified a positive relationship between outbound open innovation and innovation performance, the subsequent arguments present rationales for expecting such an association.

First, the RBV recognises the imperfections of the market and suggests that firms not only use external resources but also internal resources (Drechsler and Natter, 2012). Several studies have shown that the commercialisation of internal knowledge leads to huge returns such as profitability, market advantages, sales and strategic benefits (Drechsler and Natter, 2012; Hung and Chou, 2013; Lichtenthaler, 2009; Popa, Soto-Acosta and Martinez-Conesa, 2017; Rangus and Slavec, 2017). These funds can be used for R&D and the purchase of more advanced equipment to further develop new technologies and products (Lu, Qi and Hao, 2023; Zhou, Yao and Chen, 2018).

Second, from the perspective of self-worth theory, R&D employees can realise their self-worth when unused internal technologies are transformed into economic benefits (Lu, Qi and Hao, 2023). The realisation of a high level of self-worth can improve R&D employees' motivation to innovate, which can improve innovation performance (Lu, Qi and Hao, 2023). In addition, firms that sell unused internal technologies can focus on developing their core capabilities, and this can lead them to outperform their counterparts that choose to do otherwise (Hung and Chou, 2013). From these arguments, it is hypothesised that:

> **Hypothesis 6:** There is a significant positive relationship between outbound open innovation and innovation performance.

4.2.7 Innovation Performance and Firm Performance

Nowadays, companies are facing fierce competition from other companies that can easily produce the same or similar products/services in the market (Ramadani *et al.*, 2019). At the same time, consumers are changing their habits and expecting more benefits from the purchased products/services (Ramadani *et al.*, 2019). As a result, firms are required to continuously improve existing products/services or provide new products/services (Ramadani *et al.*, 2019). This is because firms that do not innovate are likely to underperform or even fail (Ramadani *et al.*, 2019).

The following arguments outline why innovation performance is expected to positively impact firm performance. First, the introduction of new products and services, along with the adoption of innovative processes and methods, can contribute to higher growth rates and increased profitability for firms (Mahmoud, Hinson and Anim, 2018). This is because when customers perceive firms as producing superior quality products, they tend to be satisfied and loyal, which drives their demand for the firm's new innovations (Tatikonda and Montoya-Weiss, 2001; Theoharakis and Hooley, 2008).

Second, high innovation performance provides firms with a first-mover advantage that keeps rivals out of competition (Chawla *et al.*, 2023), which can lead to higher returns (Andreeva and Kianto, 2012). Therefore, firms that increase their innovation faster can produce high-quality products/services at lower costs (Ramadani *et al.*, 2019), and can acquire knowledge that is not available to competitors, which in turn improves their operational efficiency and service quality (Parasuraman, 2010).

Moreover, innovative firms are more likely to have a favourable market position to increase profitability (Ramadani *et al.*, 2019) if they match their technological capabilities with demand characteristics, improve service/product quality, gain new customers and markets

(Hogan and Coote, 2014), and have a clearly designed and implemented innovation strategy (Karabulut, 2015). Based on the findings and rationale of previous studies, it is hypothesised that:

> **Hypothesis 7:** Innovation performance is significantly and positively related to firm performance.

4.2.8 Innovation Performance Mediating Outbound Open Innovation and Firm Performance

Prior research has predominantly focused on investigating the connection between outbound open innovation and innovation performance (Fu, Liu and Zhou, 2019; Lu, Qi and Hao, 2023), as well as the association between outbound open innovation and firm performance (Liao, Fu and Liu, 2020; Lichtenthaler, 2011). Nevertheless, to my awareness, there is a research gap regarding the interplay between outbound open innovation and innovation performance, and how this synergy collectively impacts firm performance, has not been empirically explored.

Building on insights from prior studies (e.g., Ferreras-Méndez *et al.*, 2015) that have concurrently examined the interconnectedness of inbound open innovation activities, innovation performance, and firm performance, albeit without delving into the mediating role of innovation performance, and drawing from other research (Chawla *et al.*, 2023; Mahmoud, Hinson and Anim, 2018) that has furnished evidence regarding the impact of innovation performance on firm performance, it is reasonable to posit that innovation performance could function as a mediator in the relationship between outbound open innovation and firm performance. In essence, this implies that outbound open innovation enhances firm performance by way of its influence on innovation performance.

The literature has explored the mediating role of innovation performance in various performance outcomes. For instance, Ince, Imamoglu and Karakose (2021) found that innovation performance mediated the relationship between social capital and firm performance, as well as between entrepreneurial orientation and firm performance in their study of Turkish firms. Additionally, innovation performance has been established as a mediator in the relationships between knowledge management capability and operational performance (Aboelmaged, 2014); technology orientation and financial performance (Lee, Dedahanov and Rhee, 2015); perceived corporate social responsibility initiatives and firm performance (Shih, 2022); network collaboration and firm economic performance (Singh *et al.*, 2022); entrepreneurial orientation and firm performance (Alegre and Chiva, 2013); and technology orientation and financial performance (Lee, Dedahanov and Rhee, 2015).

While prior studies have not specifically explored the mediating role of innovation performance in the relationship between outbound open innovation and firm performance, the hypotheses put forth earlier (Hypotheses 2, 6, and 7) establish links between outbound open innovation, innovation performance, and firm performance. Implicitly, the discussion suggests that outbound open innovation affects firm performance through innovation performance. That is, outbound open innovation may be a prerequisite for innovation performance, which in turn affects firm performance. Following this line of reasoning, it is hypothesised that:

> **Hypothesis 8:** Innovation performance mediates the relationship between outbound open innovation and firm performance.

4.2.9 Strategic Flexibility and Innovation Performance

In addition to firm performance, Brozovic's (2018) meta-review highlighted that the proactive facet of strategic flexibility is often associated with outcomes such as new product development and the exploration and expansion into new markets. This underscores that new

product development, which is a component of innovation performance, is among the most studied outcomes of strategic flexibility. Therefore, it is deemed relevant to provide a summary of the findings in this relationship. Generally, strategic flexibility has been found to positively influence innovation performance (Fan, Wu and Wu, 2013; Martínez-Sánchez *et al.*, 2009), and aspects of innovation performance including explorative innovation types (Zhou and Wu, 2010), innovation ambidexterity (Kortmann *et al.*, 2014) and new product development (Kandemir and Acur, 2012).

Given the uncertainties of the business environment due to globalisation and changing technological innovations, strategic flexibility is crucial for firms to gain a competitive advantage in a dynamic environment (Zahra *et al.*, 2008). However, building a competitive advantage in a fast-moving environment can be challenging as firms may find it difficult to protect existing products and processes (Eisenhardt and Martin, 2000). To survive, firms should regularly introduce new products and process technologies more quickly (Cottrell and Nault, 2004; Nerkar and Roberts, 2004). Hence, strategic flexibility plays a pivotal role in assisting firms in identifying new market opportunities, potential customer segments, anticipating market demands, and effectively responding to these demands through the development of innovative products and services (Martínez-Sánchez *et al.*, 2009). Following arguments from previous studies, it is argued that:

> **Hypothesis 9:** Strategic flexibility is significantly and positively related to innovation performance.

4.2.10 Serial Mediation Effects of Strategic Flexibility and Innovation Performance on Outbound Open Innovation and Firm Performance

The discussions in the previous sections make it clear that outbound open innovation is expected to influence strategic flexibility, which in turn is expected to confirm the findings of

studies indicating that strategic flexibility influences innovation performance (Combe *et al.*, 2012; Fan, Wu and Wu, 2013; Martínez-Sánchez *et al.*, 2009) and innovation performance influences firm performance (Chawla *et al.*, 2023; Mahmoud, Hinson and Anim, 2018). These firm-related outcomes have been extensively explored in the prior literature, with each of these constructs (i.e., innovation performance and firm performance apart from strategic flexibility) treated as a result or outcome due to the influence of outbound open innovation (the source/cause) (Fu, Liu and Zhou, 2019; Lu, Qi and Hao, 2023; Singh *et al.*, 2021).

In other cases, open innovation has been studied for its role in mediating these outcomes (Pundziene, Nikou and Bouwman, 2021; Roh, Lee and Yang, 2021). Another strand of research has found that strategic flexibility has an impact on innovation performance (Fan, Wu and Wu, 2013; Martínez-Sánchez *et al.*, 2009). The above strands of literature show that despite the rich individual research on the effects of these constructs, the exact mechanisms of 'how' outbound open innovation affects strategic flexibility or innovation performance, and further, whether firms benefit (i.e., firm performance) due to increased strategic flexibility and innovation performance, have yet to be explored.

The present study attempts to fill this gap by positing the following hypothesis. It is argued that strategic flexibility and innovation performance mediate the influence of outbound open innovation on firm performance. Rather than treating strategic flexibility or innovation performance as outcomes, these constructs are viewed as a necessary intermediate step in the process whereby outbound open innovation improves firm performance through strategic flexibility and innovation performance. In line with this, the researcher states that:

> **Hypothesis 10:** Strategic flexibility and innovation performance operate as serial mediators between outbound open innovation and firm performance.

4.2.11 Organisational Relearning Moderating Inbound Open Innovation and Firm Performance

Previous studies have found divergent opinions on the impact of inbound open innovation on firm performance (Lu, Qi and Hao, 2023; Seo and Park, 2022) with some scholars contending or finding a positive (Singh *et al.*, 2021), a negative (Faems *et al.*, 2010; Fu, Liu and Zhou, 2019), an inverted U-shaped relationship (Zhang *et al.*, 2018), or no relationship between them (Mazzola, Bruccoleri and Perrone, 2012). Based on these inconsistent findings, it has been suggested that sourcing external information is not enough and that supportive mechanisms are needed to help firms capture value from these external sources of innovation (Bogers, Foss and Lyngsie, 2018; Clausen, Korneliussen and Madsen, 2013; Foss, Laursen and Pedersen, 2011; Zhu *et al.*, 2019). However, few studies have explored the internal mechanism between inbound open innovation and firm performance (Lu, Qi and Hao, 2023).

Compared to research on organisational learning (Santa, 2015; Tuggle, 2016) and organisational unlearning (Nguyen, 2017; Starbuck, 2017), organisational relearning has received less attention because it is intertwined with organisational unlearning (Azmi, 2008; Zhao and Wang, 2020). However, recognising the significance of organisational relearning, the researcher leverages insights from contingency theory to explore the moderating influence of organisational relearning on the relationship between inbound open innovation and firm performance. Contingency theory posits that the impact of strategies is contingent upon various factors (Donaldson, 1996). Consequently, it is posited that as firms exhibit greater organisational relearning, they are more inclined to engage in inbound open innovation practices, ultimately enhancing their firm performance. The following arguments provide reasons why such a moderating effect is expected.

First, engaging in inbound open innovation practices allows firms to access external heterogeneous information to acquire new knowledge, develop new ways of thinking and adopt

new perspectives (Chen, Damanpour and Reilly, 2010; Sun, Liu and Ding, 2020). Organisational relearning can be instrumental because the newly acquired knowledge of firms can be integrated with the internal knowledge of firms to develop new routines to accelerate the reorientation and transformation of firms with existing resources (Azmi, 2008; Zhao and Wang, 2020), which can improve firm performance.

Second, organisational relearning can help firms to obtain valuable information at any time, which can be crucial for perceiving environmental changes (Santos-Vijande, López-Sánchez and Trespalacios, 2012; Zhao and Wang, 2020). This can be important for expanding the knowledge base of inbound open innovation for firms in proposing rapid solutions to improve firm performance (Hung and Chou, 2013). Based on the above arguments, it is hypothesised that:

Hypothesis 11: Organisational relearning positively moderates the relationship between inbound open innovation and firm performance.

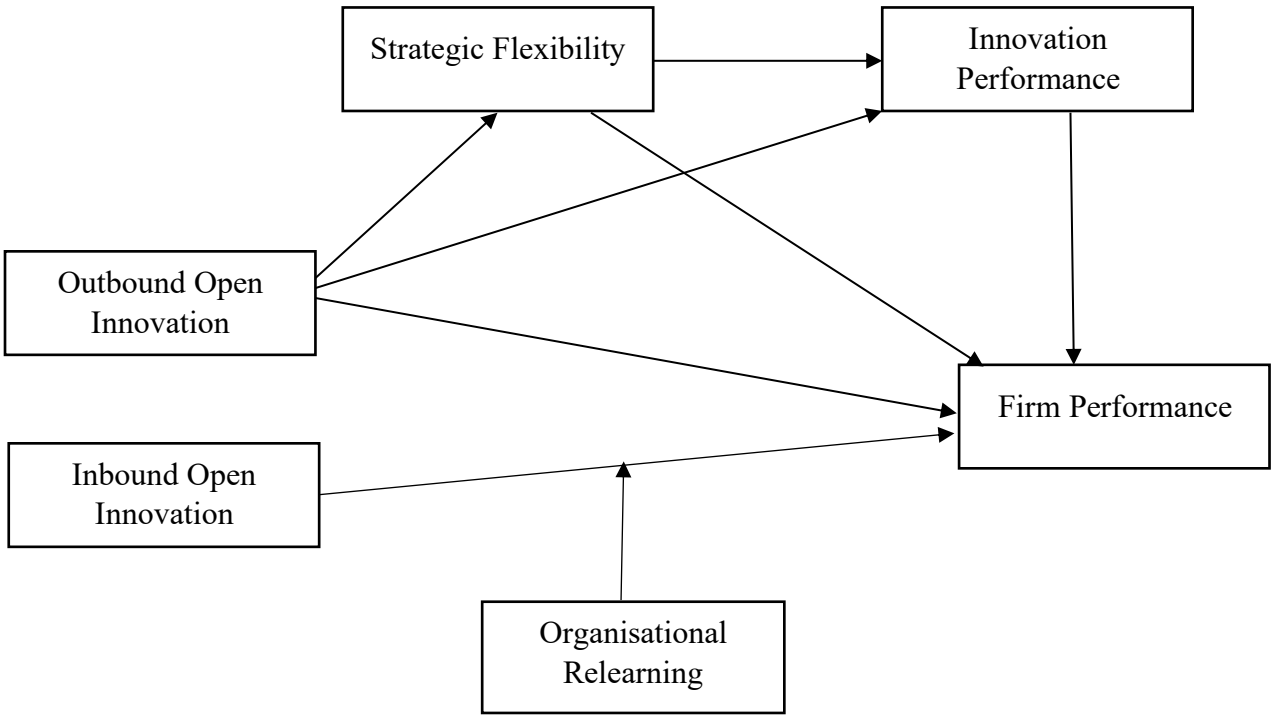


Figure 6: Conceptual Model for Paper 3

4.3 Methodological Approach

4.3.1 Sample and Data Collection

The study's sample comprised managers from various sectors of manufacturing companies in the UK. The decision to focus solely on managers from these manufacturing firms was based on the assumption that they possess the requisite knowledge of innovation and creativity within the organisation, enabling a comprehensive assessment of the study variables (Genc, Dayan and Genc, 2019). The sampling frame was developed using the ORBIS database, a widely utilised firm-level database capturing information from diverse sources (Riccaboni, Wang and Zhu, 2021). A complete list of manufacturing firms in the UK with a minimum of 10 employees was obtained through this database.

The choice of the UK as the study's geographical focus was informed by its status as a European country characterised by a high rate of technological innovation (Ciampi *et al.,* 2021). British manufacturers are noteworthy for their significant contribution to Europe's total manufacturing outputs and resource requirements (Esfahbodi *et al.,* 2017). Additionally, selecting the UK facilitates a meaningful comparison with existing studies on open innovation, which predominantly feature Western firms (Lu and Chesbrough, 2022). Moreover, open innovation is explicitly emphasised in the UK National Innovation Strategy (Audretsch and Belitski, 2023), making it an ideal context for investigating the variables of interest in this study.

After obtaining ethical approval from the University of Essex Ethics Committee, this research employed random stratified sampling to select 1000 manufacturing companies in the UK, which were then sent the online questionnaire between July 2022 and December 2022. The survey, conducted through Qualtrics, an integrated survey design and data collection platform (Thornton, Henneberg and Naudé, 2015), utilised an internet-based online social survey approach (Bryman, 2012). To address potential common method bias (CMB), recommendations from Podsakoff et al. (2003) were implemented in questionnaire design, such

as strategically positioning predictor and dependent variable items at various points, ensuring respondent confidentiality and anonymity, emphasising no right or wrong answers, and utilising well-established scale designs.

Following three rounds of reminders, the study garnered 236 completed questionnaires, with 75 responses in the first round, 83 in the second, and 78 in the third. Subsequently, a meticulous screening process was applied to eliminate unusable, incomplete, and unengaged questionnaires. As a result, 206 surveys were deemed usable and retained for analysis. This yielded a response rate of 20.6%, a figure deemed acceptable within the context of organisational studies (Greer, Chuchinprakarn and Seshadri, 2000; Scarborough, 2011).

To assess non-response bias, a t-test was examined between early and late respondents (Armstrong and Overton,1977). The final sample was divided into two groups where the first 20% of respondents were considered early respondents, and the last 20% of respondents were considered late respondents (Zahoor and Al-Tabbaa, 2020). The t-tests performed on the responses of these two groups showed no statistically significant difference between the two groups indicating that non-response bias is not an issue in this research (Armstrong and Overton, 1977).

4.3.2 Measures

All the constructs were measured using multi-item scales which were derived from previous studies. A seven-point Likert scale was used for all the items, and it was deemed appropriate since it corresponds to other studies in the open innovation literature (Gad David *et al.*, 2023; Marzi *et al.*, 2023). The measurement scale of all the constructs included in the conceptual framework is discussed below.

Firm Performance: Firm performance was assessed using Ferreras-Méndez's et al. (2015) four-item scale, which assesses the firm's goal attainment. Table 14 lists the items used to measure firm performance.

Table 14: Measuring Items - Firm Performance

Firm Performance (Ferreras-Méndez *et al.*, 2015)
Please rate the extent to which your firm was successful relative to its major competitors in terms of: (1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better). 1. Customer loyalty. 2. Sales growth. 3. Profitability. 4. Return on investment.

Innovation Performance: Innovation performance was assessed using Scaliza's et al. (2022) five-item scale. Table 15 lists the items used to measure innovation performance.

Table 15: Measuring Items - Innovation Performance

Innovation Performance (Scaliza *et al.*, 2022)
Please indicate the extent to which you agree or disagree with each of these statements about your organisation. (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. My company has developed a higher quantity and variety of products and/or services. 2. My company has developed new technologies in its production methods and/or services. 3. My company has developed new ways to organise and manage work. 4. My company has increased its market share with new and improved products and/or services. 5. My company has increased its market share with products that are new to the company.

Inbound Open Innovation: Inbound open innovation was measured using 5 items developed by Cheng and Huizingh (2014). Table 16 lists the items used to measure inbound open innovation.

Table 16: Measuring Items - Inbound Open Innovation

Inbound Open Innovation (Cheng and Huizingh, 2014)
Regarding your firm, to what extent do you agree or disagree with the following statements? (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. External partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities are directly involved in all our innovation projects. 2. All our innovation projects are highly dependent upon the contribution of external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities. 3. Our firm often buys R&D-related services from external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities. 4. Our firm often buys intellectual property, such as patents, copyrights, or trademarks, from external partners to be used in our innovation projects. 5. Our firm invests in other firms because we would like to obtain synergies that are beneficial to our innovation projects.

Outbound Open Innovation: Outbound open innovation was measured using 4 items developed by Cheng and Huizingh (2014). Table 17 lists the items used to measure outbound open innovation.

Table 17: Measuring Items - Outbound Open Innovation

Outbound Open Innovation (Cheng and Huizingh, 2014)
Regarding your firm, to what extent do you agree or disagree with the following statements? (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. Our firm often sells licenses, such as patents, copyrights, or trademarks, to other firms so as to better benefit from our innovation efforts. 2. Our firm often offers royalty agreements to other firms to better benefit from our innovation efforts. 3. Our firm strengthens every possible use of our own intellectual properties so as to better benefit our firm. 4. Our firm founds spin-offs to better benefit from our innovation efforts.

Organisational Relearning: Organisational relearning was measured using 5 items developed by Zhao and Wang (2020) from the perspective of absorbing new knowledge and developing new routines. Table 18 lists the items used to measure organisational relearning.

Table 18: Measuring Items - Organisational Relearning

Organisational Relearning (Zhao and Wang, 2020)
Please indicate your level of agreement or disagreement with the following statements about your organisation. (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. New information sharing-mechanism which further promotes the acquisition of knowledge can be established. 2. New decision-making processes which further promotes the acquisition of knowledge can be established. 3. New routines and beliefs which facilitate the acquisition of knowledge can be developed. 4. The relearning context is propitious/favourable to the acquisition of knowledge. 5. Firms can introduce new knowledge and skills which conflict with existing ones.

Strategic Flexibility: Strategic Flexibility was measured using six-items developed by Miroshnychenko et al. (2021). Table 19 lists the items used to measure strategic flexibility.

Table 19: Measuring Items - Strategic Flexibility

Strategic Flexibility (Miroshnychenko *et al.*, 2021)
Please indicate the extent to which your organisation responds to changes in the environment. (1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree) 1. If circumstances change, our organisation can easily change its current plans. 2. If circumstances change, our organisation is prepared to react in a modified and viable manner. 3. If circumstances change, our organisation has the necessary practical knowledge to make shifts in daily routines and practices. 4. If circumstances change, our organisation can pro-actively develop a new project. 5. If circumstances change, our organisation can control a shift in strategy. 6. If circumstances change, our organisation can shift projects with a probability of success.

Control Variables: The control variables included in the study are firm's demographic characteristics such as firm age, number of years worked in firm, number of full-time employees in the firm, and firm' geographical market. Firm's age was captured in terms of four levels (i.e., 1-5 years, 6-10 years, 11-20 years, 21 years and above) (Scaliza *et al.*, 2022). Number of years worked in the firm was captured in terms of four levels (i.e., 1-5 years, 6-10 years, 11-20 years, and 21 years and above) (Scaliza *et al.*, 2022). Firm size was captured by number of full-time employees in the firm, and which was measured in four levels (i.e., 1-9 employees, 10-49 employees, 50-249 employees, 250 employees and above) (Eller *et al.*, 2020). The firm's geographical market was recorded as local market, national market, European market, and global market.

4.4 Exploratory Factor Analysis (EFA)

To understand the factor structure, EFA was performed to ensure that the measurements used are psychometrically sound (Naqshbandi and Jasimuddin, 2018). This was done using principal component analysis (PCA) extraction method and Varimax with Kaiser Normalization as the rotation method. The EFA performed led to the elimination of items with low factor loadings (<0.5) resulting in obtaining a clearer factor structure (Naqshbandi and Jasimuddin, 2018). Firm performance, inbound open innovation, outbound open innovation, strategic flexibility, organisational relearning, and innovation performance lost one, two, two, three, one and two items, respectively. The six factors explained 73.237% of the variance with an eigenvalue of at least 1. The Kaiser-Meyer-Olkin (KMO) was .807 showing an acceptable sampling adequacy and Bartlett's Test of Sphericity of 1549.612 ($p < 0.001$) was significant. The six factors were reliable measurements since Cronbach's α ranged from .754 to .847. Table 20 shows the results of the EFA.

Table 20: EFA and Reliability of Constructs

Constructs	**Item**	**Factor loading**	**VIF**	**Cronbach's α**
Firm performance	FP2	.804	1.811	.799
	FP3	.847	2.077	
	FP4	.747	2.004	
Inbound open innovation	INB3	.846	1.690	.780
	INB4	.772	1.951	
	INB5	.780	1.849	
Outbound open innovation	OUT1	.792	2.954	.847
	OUT2	.876	2.411	
Strategic flexibility	SF1	.839	1.867	.838
	SF5	.807	2.035	
	SF6	.819	2.184	
Organisational relearning	RE1	.772	1.915	.838
	RE2	.789	1.936	

	RE3	.801	2.173	
	RE4	.790	2.331	
Innovation performance	IP3	.766	1.618	.754
	IP4	.776	1.968	
	IP5	.757	1.789	

4.5 Measurement Model

The evaluation of the measurement model centred on assessing the psychometric properties of reliability, validity, and dimensionality for each construct. To test the unidimensionality of the measurement model, confirmatory factor analysis was employed. All constructs were conceptualised and computed as first-order reflective constructs and categorised into six groups—namely, inbound open innovation, outbound open innovation, strategic flexibility, organisational relearning, innovation performance, and firm performance. The raw data served as input for maximum likelihood-based estimation. Each item was exclusively associated with its corresponding latent construct, and correlations among latent constructs were permitted (Gerbing and Anderson, 1988).

After which **t**his research examined the proposed model, adhering to Hair et al. (2017) two-step approach. The initial step involved assessing the reliability and validity of the measurement model, followed by the evaluation of the structural model and hypothesis testing. To appraise the measurement model, I conducted a confirmatory factor analysis (CFA). This analysis aimed to estimate and scrutinise construct validity which consists of convergent validity and discriminant validity. Convergent validity was assessed through factor loadings, average variance extracted (AVE), and composite reliability (CR) (Hair *et al.,* 2017). Ideally, factor loadings should surpass .50, with .70 or higher considered optimal. AVE values exceeding .50 were recommended, and a CR value surpassing .70 indicated reliable measurements. Discriminant validity testing was integral to the measurement model assessment. Fornell and

Larcker's (1981) method involved comparing the correlations between variables and the square root of the AVE for each variable. Notably, the square root of the AVE for each construct should exceed its highest correlation with any other construct, ensuring clear differentiation between constructs.

The next section furnishes comprehensive insights into the reliabilities and validities of the initial measurement model. Subsequently, it outlines the procedures implemented to enhance and refine the model.

4.5.1 Construct Validity of Initial Measurement Model

The values of construct validity measures were also analysed. Results revealed that factor loadings of the items are above the minimum threshold of .50, except for these items; OUT3 (.22), INB1 (.37), and INB2 (.43). Accordingly, these items were removed due to poor factor loading. The Average variance extracted (AVE) of all 6 latent constructs were calculated, and the results revealed that the AVE of two constructs (strategic flexibility and organisational relearning) were above the acceptable value of .50 while the other remaining four constructs (inbound open innovation, outbound open innovation, innovation performance, and firm performance) were below the acceptable value of .50. Moreover, construct reliability (CR) was assessed for all latent constructs. The results revealed that all the constructs were above the minimum value of .70. Table 21 presented the AVE and CR values of every latent construct in the initial measurement model.

Table 21: Convergent Validity Results of Initial Measurement Model

Latent constructs	INB	OUT	SF	RE	IP	FP
CR	.748	.757	.881	.843	.782	.796
AVE	.389	.474	.552	.520	.420	.498

Note: AVE = average variance extracted; CR = construct reliability
INB = inbound open innovation; OUT = outbound open innovation
RE = organisational relearning; SF = strategic flexibility
IP = innovation performance; FP = firm performance

To assess discriminant validity, a Pearson correlation matrix was constructed and is presented in Table 22. The square root of the Average Variance Extracted (AVE) is highlighted in bold along the diagonal. Notably, it was observed that the square root of the AVE for inbound open innovation is smaller than the absolute value of its correlation with outbound open innovation (as emphasised in Table 22), indicating potential issues with discriminant validity, in line with Fornell and Larcker (1981). Similarly, the square root of the AVE for outbound open innovation is also smaller than the absolute value of its correlation with inbound open innovation (as highlighted in Table 22), suggesting potential concerns regarding discriminant validity (Fornell and Larcker, 1981). For instance, the square root of AVE for inbound open innovation is .624, while the strongest correlation it exhibits with another construct (e.g., outbound open innovation) is .721. Hence, there were issues of discriminant validity for inbound open innovation and outbound open innovation.

Table 22: Discriminant Validity Results of Initial Measurement Model

Constructs	AVE	1	2	3	4	5	6
1. Inbound open innovation	.389	**.624**					
2. Outbound open innovation	.474	.721***	**.689**				
3. Strategic Flexibility	.552	-.235**	-.235**	**.743**			
4. Innovation performance	.420	.037	.060	.428***	**.648**		
5. Firm performance	.498	-.170†	-.168*	.431***	.626***	**.705**	
6. Organisational Relearning	.520	.005	-.056***	.560***	.589***	.401***	**.721**

Note: Correlation coefficient is significant at †p< .10, *p<0.05, **p<0.01, ***p<0.001 (two-tailed). Bolded values on the diagonal represent the square root of AVE and values below this diagonal represent constructs' inter-correlation.

4.5.2 Steps to Improve Model Fit and Construct Validity

Looking at the factor loadings from the initial measurement model, it was reported that some of the items (ie., OUT3, INB1, and INB2) were below the minimum threshold of .5. Therefore, a CFA step-by-step process was adopted to delete items with the lowest factor loadings. Therefore, these items (i.e., OUT3, INB1 and INB2) were deleted in ascending order. After deleting these items, even though there were improvements in the modification fit, it was not enough to meet the recommendations of good incremental fit indices. From this stage, it was deemed relevant to cross-check both the factor loadings and the standardised residual covariances for each item before deciding on which items to delete. This led to a further deletion of eight items (i.e., FP1, OUT4, SF4, SF3, RE5, SF2, 1P1 and IP2) to achieve a good model fit. Hence, the final model fit statistics for the measurement model (χ^2 = 164.230; df = 120; RMSEA = .042; CFI = .969; TLI = .961; IFI = .970; and GFI = .919) was within an acceptable range, indicating a good fit.

Furthermore, as shown in Table 23, convergent validity of the final model was ascertained using factor loadings, CR and AVE. The factor loadings (standardised coefficients) of the measured items, reflecting their corresponding latent constructs were above the minimum value of .50, with most of them exceeding the ideal value of .70, with the highest value of .97 for item OUT1 reflecting a latent construct for outbound open innovation. The internal consistency of the constructs was measured using CR and Cronbach alpha (α). The CR values of all the latent constructs were above the minimum value of .70 with the highest value of .861 shown by the construct outbound open innovation. Moreover, the Cronbach alphas of each scale ranged from .754 to .847.

Moreover, the AVE values of the latent constructs were more than the minimum value of .50. Thus, again, the convergent validity of the study's whole constructs was achieved. Table

23 shows the factor loadings, Cronbach alpha (α), CR, and AVE of all items of latent constructs in the final measurement model.

In determining discriminant validity, the Pearson correlation matrix was developed and presented in table 24, along with displaying the square root of AVE, bolded on the diagonal. In so doing, the researcher followed Fornell and Larcker's (1981) criterion and revealed that the square root of each construct AVE was greater than the highest correlation with any other construct (as highlighted in Table 24), thereby indicating discriminant validity among the latent constructs. For instance, the square root of AVE for strategic flexibility is .775. The highest correlation between strategic flexibility and another construct (e.g., organisational relearning) is .462. Therefore, the discriminant validity for strategic flexibility was achieved. Using the same approach, it can be concluded that discriminant validity has also been confirmed for all the constructs in the current study.

Table 23: Final Factor Loadings of Reliability and Validity Indices

Items		**Latent Construct**	**Standardised Factor Loading**	**α**	**CR**	**AVE**
INB3	<---	Inbound	.68	.780	.780	.542
INB4	<---	open innovation	.78			
INB5	<---		.74			
OUT1	<---	Outbound	.97	.847	.861	.758
OUT2	<---	open innovation	.76			
SF1	<---	Strategic	.73	.816	818	.600
SF5	<---	flexibility	.78			
SF6	<---		.81			
RE1	<---	Organisational	.72	.838	.838	.565
RE2	<---	relearning	.72			
RE3	<---		.77			
RE4	<---		.79			
IP3	<---	Innovation	.66	.754	.759	.513
IP4		performance	.77			
IP5	<---		.71			
FP2	<---	Firm performance	.72	.794	.799	.571
FP3	<---		.81			
FP4	<---		.73			

Table 24: Descriptive Statistics, Square Root of AVE, and Inter-Correlation of Constructs

Constructs	**M**	**SD**	**Skewness**	**Kurtosis**	**AVE**	**1**	**2**	**3**	**4**	**5**	**6**
1. Inbound open innovation	9.145	4.651	.380	-.922	.542	**.736**					
2. Outbound open innovation	5.250	3.352	.759	-.567	.758	.709***	**.871**				
3. Strategic flexibility	15.123	2.821	-.848	2.117	.600	-.180*	-.137†	**.775**			
4. Innovation performance	14.385	2.811	-.395	1.296	.513	.040	.032	.378***	**.716**		
5. Firm performance	14.158	2.860	.304	-.169	.571	-.159†	-.179*	.390***	.589***	**.756**	
6. Organisational Relearning	18.676	3.362	-.070	.202	.565	-.056	-.044	.462***	.509***	.353***	**.752**

Note: Correlation coefficient is significant at †p< .10, *p<0.05, ***p<0.001 (two-tailed). Bolded values on the diagonal represent square root of AVE and values below this diagonal represent constructs' inter-correlation.

4.5.3 Assessment of Common Method Bias (CMB)

Considering that the same informants responded to items investigating predictor and criterion variables, there is a risk of CMB (Podsakoff *et al.*, 2003). To reduce the risks of CMB, this study followed several procedural and statistical remedies suggested by Podsakoff et al. (2003). Respondents were guaranteed anonymity, and therefore were assured to be honest in their responses, and that there were no right or wrong responses (Podsakoff *et al.*, 2003). Moreover, order bias was controlled by ensuring that the predictor and criterion variables were strategically positioned in the questionnaire (Shukla, Rosendo-Rios and Khalifa, 2022). While these mechanisms can help minimize CMB, they will not eliminate it, therefore a statistical method was used to assess method variance issues in the data. Harman's single-factor test (Podsakoff *et al.*, 2003) was performed to assess the presence of CMB. Harman's single-factor test showed that the first factor of all six extracted factors explained < 50% of the variance (23.041%). Therefore, it can be claimed that CMB is not an issue in this study.

4.6 Results

This study relied on maximum likelihood SEM with AMOS version 27 to estimate path coefficients and then test the hypotheses of the conceptual model. In testing the hypotheses, this study relied on a stepwise approach. The first step (Model 1) involved estimations of the control variables (number of years worked in the firm, number of full-time employees, firm's age, and geographical market of firm), followed by Model 2 (the main effect model) which estimated the individual effect of inbound open innovation and outbound open innovation on firm performance. Model 3 investigated the (a) mediating role of strategic flexibility in the relationship between outbound open innovation and firm performance, and (b) mediating role of innovation performance in the relationship between outbound open innovation and firm performance. Model 4 investigated strategic flexibility and innovation performance as serial mediators in the relationship between outbound open innovation and firm performance, and

Model 6 investigated moderating effects by using interaction terms. In so doing, the interactions between inbound open innovation and organisational relearning (Model 6) were estimated on firm performance.

Furthermore, for the moderation analysis, the independent variable (inbound open innovation) and moderating variable (organisational relearning) were changed through mean centring and created interactive terms by multiplying the independent variable and the moderating variable (Ranaweera and Jayawardhena, 2014). Hypotheses 1 and 2 were tested in model 2, hypotheses 3, 4, 5, 6, 7, and 8 were tested in model 3, hypotheses 9, and 10 were tested in model 4, and hypothesis 11 was tested in model 6. Table 25 displays the estimations of the stepwise models.

Before analysing the hypotheses, the goodness-of-fit statistics of the main effect model (Model 2), single mediation model (Model 3), double mediation model (Model 4), moderator model (Model 5), and two-way interaction model (Model 6) were estimated. The goodness-of-fit statistics of the main effect model (Model 2) (χ^2 = 47.592, df = 37, p = .114, χ^2/df = 1.286, CFI = .984; IFI = .985; TLI = .972; GFI = .964; RMSEA = .037; PRATIO = .561), single mediation model (Model 3) (χ^2 = 159.869, df = 114, p = .003, χ^2/df = 1.402, CFI = .959; IFI = .961; TLI = .945; GFI = .924; RMSEA = .044; PRATIO = .745), serial mediation model (Model 4) (χ^2 = 139.774, df = 113, p = .045, χ^2/df = 1.237, CFI = .976; IFI = .977; TLI = .968; GFI = .932; RMSEA = .034; PRATIO = .739), moderator model (Model 5) (χ^2 = 291.599.632, df = 180, p<.000, χ^2/df = 1.620, CFI = .926; IFI = .929; TLI = .906; GFI = .889; RMSEA = .055; PRATIO = .779), and two-way interaction model (Model 6) (χ^2 = 323.632, df = 194, p<.000, χ^2/df = 1.668, CFI = .916; IFI = .919; TLI = .890; GFI = .884; RMSEA = .057; PRATIO = .767) suggests acceptable fit indices.

Table 25: Path Coefficients

Variables	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Controls						
Number of years worked in the firm → FP	-.111 (.051)	-.099 (.062)	-.095 (.052)	-.092 (.052)	-.088 (.052)	-.083 (.051)
Number of full-time employees → FP	-.140 (.090)	-.129 (.111)	-.095 (.092)	-.093 (.092)	-.088 (.093)	-.090 (.091)
Firm's age → FP	-.063 (.095)	-.113 (.119)	-.072 (.100)	-.071 (.100)	-.073 (.099)	-.063 (.097)
Firm's geographical market → FP	.077 (.055)	.052 (.068)	.048 (.057)	.046 (.057)	.040 (.057)	.039 (.056)
Main effects						
INB → FP		-.013 (.104)	-.015 (.089)	-.012 (.090)	-.015 (.079)	.000 (.077)
OUT → FP		-.185 (.072)	-.170 (.063)	-.176 (.064)	-.177 (.065)	-.166 (.063)
Strategic flexibility as a mediator						
OUT → SF			-.143 (.042)	-.145 (.042)	-.148 (.042)	-.148 (.042)
SF → FP			.222** (.078)	.170* (.088)	.156 (.087)	.187* (.086)
Innovation performance as a mediator						
OUT → IP			.029 (.037)	.091 (.037)	.091 (.037)	.091 (.036)
IP → FP			.525*** (.109)	.514*** (.118)	.504*** (.117)	.483*** (.115)
Serial mediation path						
OUT → SF				-.145 (.042)	-.148 (.042)	-.148 (.042)
SF → IP				.389*** (.083)	.389*** (.083)	.187*** (.083)
IP → FP				.514*** (.118)	.504*** (.117)	.483 (.115)
Moderator						
RE → FP					.056 (.096)	
Two-way interactions						
INB * RE → FP						.152* (.059)

Note: the numbers in the bracket are standard errors. * p < .05, ** p < .01, *** p < .001

Abbreviations: IP: innovation performance, FP = firm performance, RE: organisational relearning, INB = inbound open innovation, OUT = outbound open innovation
SF = strategic flexibility,

With regards to H1, there was no significant effect of inbound open innovation on firm performance (β = -.013, p = .926). Moreover, regarding hypothesis 2, there was no significant effect of outbound open innovation on firm performance (β = -.185, p = .148). Model 3 includes strategic flexibility as a mediator in the relationship between outbound open innovation and firm performance. The results demonstrate that outbound open innovation had no significant impact on strategic flexibility (β = -.143, p = .075). The results do not support hypothesis 3. Strategic flexibility was found to have a significant positive impact on firm performance (β = .222**, p = .004). The results support hypothesis 4. Moreover, bootstrapping results provide support for the indirect effect of outbound open innovation on firm performance via strategic flexibility (-.016*, bootstrap standard errors (BSE) = .011, 95% bias-corrected bootstrap confidence interval (BCBCI): [-.042; -.003]). The results support hypothesis 5. The same Model 3 includes innovation performance as a mediator in the relationship between outbound open innovation and firm performance. The results demonstrate that outbound open innovation had no significant impact on innovation performance (β = .029, p = .729). The results do not support hypothesis 6. Innovation performance was found to have a significant positive impact on firm performance (β = .525***, p < .001). The results support hypothesis 7. However, bootstrapping results do not provide support for the indirect effect of outbound open innovation on firm performance via innovation performance (.008, bootstrap standard errors (BSE) = .011, 95% bias-corrected bootstrap confidence interval (BCBCI): [-.028; .046]). The results do not support hypothesis 8.

Model 4 suggests potential serial mediating effects of strategic flexibility and innovation performance on the relationship between outbound open innovation and firm performance. The results demonstrate that outbound open innovation does not significantly impact strategic flexibility (β = -.145, p = .071). Strategic flexibility was found to have a significant positive impact on innovation performance (β = .389***, p < .001). The results support hypothesis 9.

Moreover, innovation performance had a significant positive impact on firm performance (β = .514***, p < .001). In addition, bootstrapping results provide support for the serial mediating effects of strategic flexibility and innovation performance on the relationship between outbound open innovation and firm performance (-.016*, bootstrap standard errors (BSE) = .010, 95% bias-corrected bootstrap confidence interval (BCBCI): [-.041; -.004). The results support hypothesis H10.

The moderating effect of organisational relearning was reported next (model 6). In testing hypothesis 11, the results revealed that organisational relearning positively moderates the negative relationship between inbound open innovation and firm performance (β = .152*, p = .024). The nature of this interaction suggests that organisational relearning dampens the negative influence of inbound open innovation on firm performance, as illustrated in Figure 6. The results support hypothesis 11.

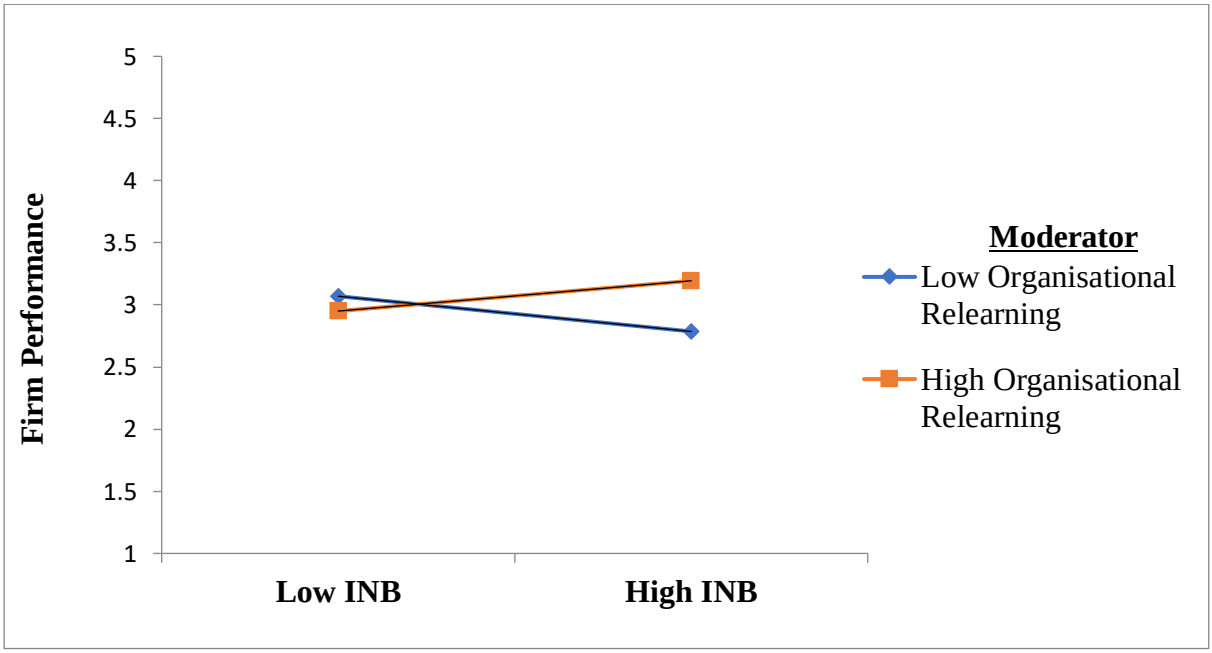


Figure 7: The Moderating Role of Organisational Relearning Between Inbound Open Innovation (INB) and Firm Performance

Table 26: Summary of Hypotheses Results

Hypotheses	**Results**
Main Effects	
H1: Inbound open innovation → Firm performance	NS
H2: Outbound open innovation → Firm performance	N S
Mediating Effect of Strategic Flexibility	
H3: Outbound open innovation → Strategic flexibility	N S
H4: Strategic flexibility → Firm performance	S
H5: Outbound open innovation → strategic flexibility → Firm performance	S
Mediating Effect of Innovation Performance	
H6: Outbound open innovation → Innovation performance	NS
H7: Innovation performance → Firm performance	S
H8: Outbound open innovation → innovation performance → Firm performance	NS
Sequential Mediating Effects of Strategic Flexibility and Innovation Performance	
H9: Strategic flexibility → Innovation performance	S
H10: Outbound open innovation → Strategic flexibility → Innovation performance → Firm performance	S
Moderating Effects of Organisational Relearning	
H11: Inbound open innovation X Organisational relearning → Firm performance	S

Notes: S = Supported; NS = Not Supported

4.7 Discussion

Despite previous studies reporting conflicting findings on the influence of open innovation on firm performance (Tsai *et al.*, 2022), there are few studies investigating the internal mechanism between them (Lu, Qi and Hao, 2023). To provide a clearer understanding of this phenomenon, this study adopts insights from RBV, capability-based view and contingency approach to investigate the relationships among inbound open innovation, outbound open innovation, strategic flexibility, organisational relearning, innovation performance and firm performance. The paper is divided into four chapters. The first chapter focuses on and discusses the summary of findings in relation to the research hypothesis and

previous research. Next, the theoretical contributions and practical implications are discussed. Finally, the study's limitations are discussed, and future recommendations are presented.

4.7.1 Summary of Findings

First, existing studies report inconsistent findings on the firm performance outcomes of inbound and outbound open innovation (Ogink *et al.*, 2023; Schäper *et al.*, 2023). In this study, it was found that both inbound and outbound open innovation have no significant impact on firm performance. This finding is consistent with other scholars (e.g., Hung and Chou, 2013; Mazzola, Bruccoleri and Perrone, 2012) who revealed similar findings. A possible reason for the insignificant relationship between inbound open innovation and firm performance could be derived from a recent report by the OECD (2020), which revealed that the UK has underinvested in R&D compared to some of its competitors. This means that given that inbound open innovation involves both the acquisition of knowledge from external parties in addition to generating it internally (Bianchi *et al.*, 2016), and internal R&D is a necessary complement or substitute for external ideas (Woods, Galbraith and Hewitt-Dundas, 2019), "identifying and acquiring innovation from external sources is only half the battle" (West and Bogers, 2014, p. 821). Therefore, firms need to have the necessary internal processes in place to reap the benefits of new knowledge (Aliasghar, Rose and Chetty, 2019).

Regarding the non-significant relationship between outbound open innovation and firm performance. One possible explanation for this finding is that outbound open innovation is a great opportunity for only a few firms (usually large firms) whose technological surplus can be marketed to other firms, but it is not a welcome practice for most firms, especially small firms with fewer technological resources (Scaliza *et al.*, 2022). Therefore, this may explain the difficulty in capturing the benefits of outbound open innovation due to the use of a quantitative survey covering a general population of firms (Scaliza *et al.*, 2022). Despite these findings, the

impact of both inbound and outbound open innovation on firm performance should not be downplayed and firms need to be aware of the internal mechanisms to benefit from them.

Secondly, the study observed that strategic flexibility played a negative mediating role in the relationship between outbound open innovation and firm performance, supporting hypothesis 5. To reach this conclusion, the study examined some direct effects. Initially, it was tested whether outbound open innovation had a direct negative impact on strategic flexibility, but this effect did not prove significant, as anticipated by hypothesis 3. A possible explanation for this outcome is that firms tend to allocate resources selectively, primarily when there are pressing circumstances necessitating their deployment (Grewal and Tansuhaj, 2001). Consequently, strategic flexibility becomes more valuable to firms in crises (Grewal and Tansuhaj, 2001). Thus, the implication here is that while the adoption of outbound open innovation involves inherent risks (Henkel, Schöberl and Alexy, 2014), these risks may not be substantial enough to trigger the allocation of resources like strategic flexibility. Even if the risks were significant, strategic flexibility may not prove particularly beneficial for addressing the challenges posed by outbound open innovation.

In addition, strategic flexibility was found to have a significant positive impact on firm performance (i.e., hypothesis 4). One possible explanation is that strategically flexible firms can perceive threats and discover opportunities in a timely manner (Cingöz and Akdoğan, 2013) and reconfigure their resource base to take advantage of emerging strategic opportunities (Raff, 2000). These opportunities can be exploited for superior performance due to first-mover advantages (Ferrier, Smith and Grimm, 1999), responsiveness to customers (Matusik and Hill, 1998) or other strategic advantages. Therefore, using the evidence from Hypotheses 2, 3 and 4, the researcher arrived at Hypothesis 5, which found that strategic flexibility negatively mediates the effect of outbound open innovation on firm performance. This finding implies that outbound open innovation indirectly mitigated firm performance by reducing strategic flexibility.

Third, innovation performance was found not to mediate the impact of outbound open innovation on firm performance. This discovery stands in contrast to other studies (e.g., Ince, Imamoglu and Karakose, 2021) that have identified the mediating role of innovation performance. While, to my awareness, there is no existing study that has empirically assessed the mediating role of innovation performance in the relationship between outbound open innovation and firm performance, a potential explanation for this finding may be that, within the context of outbound open innovation, the influence of innovation performance on firm performance necessitates an additional internal mechanism. In this context, Hypothesis 10 has unveiled strategic flexibility and innovation performance as sequential mediators between outbound open innovation and firm performance.

Lastly, the study unveiled a significant positive moderating role for organisational relearning in the relationship between inbound open innovation and firm performance. This indicates that organisational relearning effectively countered the otherwise negative and statistically insignificant connection between inbound open innovation and firm performance. A potential rationale for this outcome lies in the nature of inbound open innovation, which encompasses knowledge acquisition (Chesbrough, 2003). In this context, organisational relearning assumes a pivotal role in facilitating the integration of newly acquired knowledge with the firm's existing internal knowledge. This process aids in the development of novel routines and expedites the firm's adaptation and transformation of its resources (Azmi, 2008; Zhao and Wang, 2020), ultimately leading to improved firm performance.

4.7.2 Theoretical Contributions

The study makes the following contributions to the open innovation literature. First, although the field of open innovation has received tremendous attention from researchers and practitioners (Gad David *et al.*, 2023; Radziwon and Bogers, 2019), and scholars have now shifted their attention to how to benefit from open innovation (Li, Li and Wu, 2022), there are

few studies investigating the internal mechanism between open innovation and firm performance (Lu, Qi and Hao, 2023). Therefore, this study overcomes the limitations of previous studies by adopting the capability view to provide an understanding of how strategic flexibility might mediate the relationship between outbound open innovation and firm performance. This finding may explain why some firms that adopt outbound open innovation do not benefit from it.

Second, the absence of knowledge regarding the mediating role of innovation performance in the link between outbound open innovation and firm performance is a notable gap in the literature. Equally significant is the finding that innovation performance did not serve as a mediator. Unlike previous studies that focused on the impact of outbound open innovation on innovation performance (e.g., Lu, Qi and Hao, 2023; Zhou, Yao and Chen, 2018), this research delved into innovation performance as a potential mediator and established that it did not mediate the relationship between outbound open innovation and firm performance. This suggests that the influence of outbound open innovation on firm performance can be attributed to factors beyond innovation performance. Consequently, this study contributes to the literature by highlighting the non-mediating role of innovation performance in the context of open innovation.

Thirdly, this study enriches the open innovation literature by exploring the sequential mediating roles of strategic flexibility and innovation performance in the relationship between outbound open innovation and firm performance. While previous research has predominantly focused on innovation performance as an outcome of outbound open innovation (e.g., Lu, Qi, and Hao, 2023), and strategic flexibility has remained relatively unexamined in the open innovation literature, the underexplored synergy among outbound open innovation, strategic flexibility, innovation performance, and firm performance represents a gap in the existing literature. This research effectively addresses how outbound open innovation influences firm

performance, thereby introducing a fresh perspective for future studies. In summary, this finding offers a novel avenue for subsequent research endeavours.

Finally, in response to calls for a contingency approach to understanding how open innovation can be more effective (Carmona-Lavado *et al.*, 2021; Kobarg, Stumpf-Wollersheim and Welpe, 2019), this research investigates the conditions under which inbound open innovation facilitates firm performance. Despite the dearth of research on organisational relearning within the open innovation literature, this study unearthed that organisational relearning serves to alleviate the adverse impact of inbound open innovation on firm performance. Consequently, organisational relearning emerges as a facilitator for firms to harness the advantages of inbound open innovation. In summation, this research broadens the horizons of the open innovation literature by highlighting that firms are better positioned to reap the rewards of inbound open innovation when they possess a high degree of organisational relearning.

4.7.3 Practical Implications

This research has several practical implications for managers. The first implication drawn from this study pertains to the absence of significant relationships between inbound and outbound open innovation and firm performance. This suggests that firms should exercise caution, recognising that their participation in inbound open innovation practices (e.g., purchasing R&D activities) and outbound open practices (e.g., selling copyrights and patents) does not inherently translate into enhanced firm performance. Therefore, it is also important to consider factors in the firm's internal and external context that make it viable to reap the benefits of open innovation.

The second practical implication stems from the negative mediating role of strategic flexibility on the relationship between outbound open innovation and firm performance. This

finding explains why some firms do not benefit from outbound open innovation. However, given that firms mostly focus on how to benefit from open innovation (Li, Li and Wu, 2022), this finding may help managers understand which capabilities they do not need to focus their limited resources on to benefit from outbound open innovation.

The final practical implication drawn from this study stems from the favourable moderating effect of organisational relearning on the adverse influence of inbound open innovation on firm performance. This underscores the significance of organisational relearning and underscores the need for managers to ensure the effective integration of knowledge and technologies acquired from external sources with the firm's internal knowledge (Azmi, 2008; Zhao and Wang, 2020). In doing so, they can maximise the benefits of inbound open innovation. Therefore, to increase the benefits of inbound open innovation, firms should be willing to introduce new knowledge and ideas that conflict with existing ones, and also introduce new routines and beliefs that could facilitate the acquisition of knowledge (Zhao and Wang, 2020).

4.7.4 Limitations and Future Directions

Although the researcher took measures to address potential problems with the study, certain limitations remain. The first limitation of this study is its examination of the mediating roles of innovation performance and strategic flexibility without considering their heterogeneous nature. Future studies could focus on some classifications of innovation performance, such as process innovation performance and product innovation performance, and strategic flexibility, such as organisational flexibility and technological flexibility.

Lastly, the study concentrated on internal mechanisms, including strategic flexibility, innovation performance, and organisational relearning, to comprehend the relationship between inbound open innovation, outbound open innovation, and firm performance. Therefore, the researcher cannot predict whether the results will be valid when external factors are considered.

Chapter 5: Conclusions (Further Research and Contribution)

This section delves into a discussion of the contributions made by the thesis to the realm of knowledge. As this thesis comprises three distinct yet interconnected studies on open innovation, this research initiates a systematic review of the open innovation landscape to identify gaps in the existing literature. Subsequently, it crafts a conceptual framework that delineates the principal antecedents, moderators, mediators, and outcomes of open innovation. Within this context, the following points will be explored in this section: 1) The contributions of each of the three papers to the open innovation literature, 2) Theoretical contributions in the domain of open innovation, and 3) Limitations identified and avenues for future research.

5.1 Contributions to the Open Innovation Literature

Firstly, through the systematic review, this thesis advances knowledge in the open innovation literature. The systematic review conducted in this study has illuminated certain gaps within the existing literature. It has also clarified the role of both internal and external factors as antecedents to open innovation and its subsequent effects on performance. In this manner, this research has effectively amalgamated the disjointed body of literature, furnishing valuable insights into the antecedents, moderators, mediators, and outcomes of open innovation.

The second paper examines the influence of technological capability and marketing capability on open innovation and the moderating effect of government support. While the open innovation literature has acknowledged the significance of both marketing and technological capabilities (Liao, Fu and Liu, 2020), there remains a dearth of research that comprehensively examines the influence of both technological and marketing capabilities on open innovation. This paper aims to enhance the current framework by deconstructing open innovation into its two primary dimensions: inbound and outbound open innovation.

Additionally, it introduces government support as a potential moderating factor for these dimensions.

In addition, although the role of government in open innovation (de Jong, Kalvet and Vanhaverbeke, 2010; Wang, Vanhaverbeke and Roijakkers, 2012) and firm capability building (Adomako, Amankwah-Amoah and Danquah, 2022; Lin and Lai, 2021) has become increasingly important, the synergistic or antagonistic effects of government support, technological capability and marketing capability on inbound and outbound open innovation have yet to be explored. Therefore, this paper sheds light and provides a deeper understanding of this area.

The third paper delves deep into the underlying mechanism that connects inbound open innovation, outbound open innovation, and firm performance. One of the notable limitations in the open innovation literature is the scarcity of studies investigating the internal mechanisms between open innovation and firm performance (Lu, Qi and Hao, 2023). While previous research has identified firm capabilities as potential mediators and/or moderators in the relationship between open innovation and firm performance, the mediating role of strategic flexibility, the serial mediating roles of strategic flexibility and innovation performance, and the moderating effect of organisational relearning have remained largely unexplored. This research not only introduces novel constructs (specifically, strategic flexibility and organisational relearning) to the open innovation literature at the conceptual level but also empirically validates their significance.

5.2 Theoretical Contributions

This thesis makes a substantial contribution to the theoretical comprehension of how internal and external factors interact within the realm of open innovation. It effectively addresses the ongoing debate regarding the influence of firm capabilities and government

support on the implementation of both inbound and outbound open innovation. Furthermore, this research makes substantial contributions to the capability-based view by elucidating the distinct impacts of both technological capability and marketing capability on both inbound and outbound open innovation practices. Researchers were encouraged to take a new perspective on the role of firm capabilities, as marketing capability was not found to be useful in the context of open innovation. Moreover, by integrating the contingency-based approach, this research revealed the conditions under which government support was useful or not for firms engaged in inbound and outbound open innovation.

Furthermore, the thesis contradicts the dominant view of RBV by revealing a non-significant relationship between inbound and outbound open innovation on firm performance. This discovery underscores that having resources does not inherently guarantee a favourable outcome. Therefore, researchers can take a new perspective on RBV to explain such a finding.

Moreover, the thesis significantly enriches the literature on strategic flexibility and organisational relearning. It offers valuable insights into how strategic flexibility mediates the association between outbound open innovation and firm performance. This contribution enhances our understanding of how strategic flexibility acts as a crucial mechanism in the link between outbound open innovation and firm performance. By incorporating insights from the capability-based view, this thesis shows firms which capabilities to build and develop, as not all capabilities will help them benefit from outbound open innovation.

In addition, by integrating the contingency-based approach, the thesis shows that organisational relearning is useful when firms want to benefit from inbound open innovation. This provides validation for the contingency-based approach.

5.3 Managerial and Policy Implications

Furthermore, these findings have practical implications for managers as well as policymakers. For managers, the insights regarding the impact of government support on different aspects of open innovation can guide decision-making processes. They can make more informed choices about the type of government support to seek based on their specific open innovation strategies. Additionally, managers should not ignore the importance of organisational relearning for their firm but rather devote resources to building this capability, as it is necessary for them to benefit from inbound open innovation. Finally, this thesis also calls for managers to develop their skills, abilities, and knowledge to differentiate which firm's capabilities need to be built and developed to benefit from open innovation.

Policymakers can also derive substantial benefits from these findings by customizing their support programs to align with the requirements of firms actively involved in open innovation. Grasping the distinct impacts of government support on technological and marketing capabilities within the framework of open innovation can assist policymakers in crafting more efficient and focused support strategies. This, in turn, can lead to the more judicious allocation of resources and improved outcomes for both firms and the broader economy. Additionally, the findings emphasise the importance of monitoring the use of government support to ensure it is directed toward the intended purposes.

5.4 Limitations and Future Research

As with any research, this study possesses certain limitations that offer opportunities for future investigation. First, this research advocates investigating the different types of technological capability, marketing capability and strategic flexibility on open innovation. For example, instead of looking at their composite score, future research can focus on static marketing capability, adaptive marketing; buyer technological capability, supplier

technological capability; proactive strategic flexibility and reactive strategic flexibility in the open innovation literature.

Additionally, it is worth noting that while this research has explored the role of strategic flexibility and innovation performance as serial mediators between outbound open innovation and firm performance, there is an opportunity for future research to further investigate this aspect. Serial mediators have not been extensively examined in the open innovation literature, and exploring this concept in more depth could provide valuable insights.

References

Aboelmaged, M.G. (2014) 'Linking operations performance to knowledge management capability: The mediating role of innovation performance', *Production Planning and Control*, 25(1), pp. 44–58. Available at: https://doi.org/10.1080/09537287.2012.655802.

Acquaah, M. (2007) 'Managerial social capital, strategic orientation, and organisational performance in an emerging economy', *Strategic Management Journal*, 28(12), pp. 1235–1255.

Adomako, S., Amankwah-Amoah, J. and Danquah, J.K. (2022) 'R&D support, technological turbulence, and SMEs' degree of internationalization: The mediating role of technological capability', *Thunderbird International Business Review*, 64(3), pp. 251–262. Available at: https://doi.org/10.1002/tie.22263.

Afcha, S. and Garciá-Quevedo, J. (2016) 'The impact of R&D subsidies on R&D employment composition', *Industrial and Corporate Change*, 25(6), pp. 955–975. Available at: https://doi.org/10.1093/icc/dtw008.

Ahn, J.M. (2020) 'The hierarchical relationships between CEO characteristics, innovation strategy and firm performance in open innovation', *International Journal of Entrepreneurship and Innovation Management*, 24(1), pp. 31–52. Available at: https://doi.org/10.1504/IJEIM.2020.105275.

Ahn, J.M., Minshall, T. and Mortara, L. (2017) 'Understanding the human side of openness: the fit between open innovation modes and CEO characteristics', *R and D Management*, 47(5), pp. 727–740. Available at: https://doi.org/10.1111/radm.12264.

Alassaf, D. *et al.* (2020) 'The impact of open-border organization culture and employees' knowledge, attitudes, and rewards with regards to open innovation: an empirical study', *Journal of Knowledge Management*, 24(9), pp. 2273–2297. Available at: https://doi.org/10.1108/JKM-02-2020-0122.

Alegre, J. and Chiva, R. (2013) 'Linking entrepreneurial orientation and firm performance: The role of organizational learning capability and innovation performance', *Journal of Small Business Management*, 51(4), pp. 491–507.

Alexy, O., Bascavusoglu-Moreau, E. and Salter, A.J. (2016) 'Toward an aspiration-level theory of open innovation', *Industrial and Corporate Change*, 25(2), pp. 289–306. Available at: https://doi.org/10.1093/icc/dtw003.

Ali, M., Ng, Y.L. and Kulik, C.T. (2014) 'Board age and gender diversity: A test of competing linear and curvilinear predictions', *Journal of Business Ethics*, 125(3), pp. 497–512. Available at: https://doi.org/10.1007/s10551-013-1930-9.

Aliasghar, O. and Haar, J. (2023) 'Open innovation: Are absorptive and desorptive capabilities complementary?', *International Business Review*, 32(2), p. 101865. Available at: https://doi.org/10.1016/j.ibusrev.2021.101865.

Aliasghar, O., Rose, E.L. and Chetty, S. (2019) 'Where to search for process innovations? The mediating role of absorptive capacity and its impact on process innovation', *Industrial Marketing Management*, 82, pp. 199–212.

Amankwah-Amoah, J. (2016) 'Emerging economies, emerging challenges: Mobilising and capturing value from big data', *Technological Forecasting and Social Change*, 110, pp. 167–174. Available at: https://doi.org/10.1016/j.techfore.2015.10.022.

Amit, R. and Schoemaker, P.J.H. (1993) 'Strategic assets and organizational rent', *Strategic Management Journal*, 14(1), pp. 33–46.

Andreeva, T. and Kianto, A. (2012) 'Does knowledge management really matter? Linking knowledge management practices, competitiveness and economic performance', *Journal of Knowledge Management*, 16(4), pp. 617–636.

Anzola-Román, P., Bayona-Sáez, C. and García-Marco, T. (2018) 'Organizational innovation, internal R&D and externally sourced innovation practices: Effects on technological innovation outcomes', *Journal of Business Research*, 91, pp. 233–247. Available at: https://doi.org/10.1016/j.jbusres.2018.06.014.

Ardito, L. and Messeni Petruzzelli, A. (2017) 'Breadth of external knowledge sourcing and product innovation: The moderating role of strategic human resource practices', *European Management Journal*, 35(2), pp. 261–272.

Armstrong, J. S., and Overton, T.S. (1977) 'Estimating nonresponse bias in mail surveys', *Journal of Marketing Research,* 14(3), pp. 396-402.

Arora, A. and Nandkumar, A. (2012) 'Insecure advantage? Markets for technology and the value of resources for entrepreneurial ventures', *Strategic Management Journal*, 33, pp. 231–251.

Audretsch, B.D. and Belitski, M. (2023) 'The limits to open innovation and its impact on innovation performance', *Technovation*, 119(March 2022), p. 102519. Available at: https://doi.org/10.1016/j.technovation.2022.102519.

Azmi, F.T. (2008) 'Mapping the learn-unlearn-relearn model: Imperatives for strategic management', *European Business Review*, 20(3), pp. 240–259. Available at: https://doi.org/10.1108/09555340810871437.

Badir, Y.F., Frank, B. and Bogers, M. (2020) 'Employee-level open innovation in emerging markets: linking internal, external, and managerial resources', *Journal of the Academy of Marketing Science*, 48(5), pp. 891–913. Available at: https://doi.org/10.1007/s11747-019-00674-6.

Bagherzadeh, M. *et al.* (2020) 'How does outside-in open innovation influence innovation performance? Analyzing the mediating roles of knowledge sharing and innovation strategy', *IEEE Transactions on Engineering Management*, 67(3), pp. 740–753.

Bandura, A. (1986) *Social Foundations of Thought and Action*. NJ: Englewood Cliffs.

Barney, J. (1991) 'Firm resources and sustained competitive advantage', *Journal of Management*, 17(1), pp. 99–120.

Barrena-Martínez, J. *et al.* (2020) 'Joint forces: Towards an integration of intellectual capital theory and the open innovation paradigm', *Journal of Business Research*, 112, pp. 261–270. Available at: https://doi.org/10.1016/j.jbusres.2019.10.029.

Bengtsson, L. *et al.* (2015) 'Open to a select few? Matching partners and knowledge content for open innovation performance', *Creativity and Innovation Management*, 24(1), pp. 72–86. Available at: https://doi.org/10.1111/caim.12098.

Berkhout, G., Hartmann, D. and Trott, P. (2010) 'Connecting technological capabilities with market needs using a cyclic innovation model', *R and D Management*, 40(5), pp. 474–490. Available at: https://doi.org/10.1111/j.1467-9310.2010.00618.x.

Bianchi, M. *et al.* (2011) 'Exploring the role of human resources in technology out-licensing: An empirical analysis of biotech new technology-based firms', *Technology Analysis and Strategic Management*, 23(8), pp. 825–849.

Bianchi, M. *et al.* (2016) 'Organizing for inbound open innovation: How external consultants and a dedicated R&D unit influence product innovation performance', *Journal of Product Innovation Management*, 33(4), pp. 492–510.

Bigliardi, B. *et al.* (2020) 'The influence of open innovation on firm performance', *International Journal of Engineering Business Management*, 12, pp. 1–14. Available at: https://doi.org/10.1177/1847979020969545.

Blankson, C., Motwani, J.G. and Levenburg, N.M. (2006) 'Understanding the patterns of market orientation among small businesses', *Marketing Intelligence and Planning*, 24(6), pp. 572–590. Available at: https://doi.org/10.1108/02634500610701663.

Blau, P.M. (1964) *Exchange and Power in Social Life*. New York: John Wiley and Sons.

Bligh, M.C. *et al.* (2007) 'When the romance is over: Follower perspectives of aversive leadership', *Applied Psychology*, 56(4), pp. 528–557.

Bodlaj, M. and Čater, B. (2022) 'Responsive and proactive market orientation in relation to SMEs' export venture performance: The mediating role of marketing capabilities', *Journal of Business Research*, 138, pp. 256–265.

Bogers, M. *et al.* (2017) 'The open innovation research landscape: established perspectives and emerging themes across different levels of analysis', *Industry and Innovation*, 24(1), pp. 8–40. Available at: https://doi.org/10.1080/13662716.2016.1240068.

Bogers, M. *et al.* (2019) 'Strategic management of open innovation: A dynamic capabilities perspective', *California Management Review*, 62(1), pp. 77–94. Available at: https://doi.org/10.1177/0008125619885150.

Bogers, M., Foss, N.J. and Lyngsie, J. (2018) 'The "human side" of open innovation: The role of employee diversity in firm-level openness', *Research Policy*, 47(1), pp. 218–231. Available at: https://doi.org/10.1016/j.respol.2017.10.012.

Brem, A., Nylund, P.A. and Hitchen, E.L. (2017) 'Open innovation and intellectual property rights: How do SMEs benefit from patents, industrial designs, trademarks and copyrights?', *Management Decision*, 55(6), pp. 1285–1306. Available at: https://doi.org/10.1108/MD-04-2016-0223.

Brockman, P., Khurana, I.K. and Zhong, R. (Irene) (2018) 'Societal trust and open innovation', *Research Policy*, 47(10), pp. 2048–2065.

Brozovic, D. (2018) 'Strategic flexibility: A review of the literature', *International Journal of Management Reviews*, 20(1), pp. 3–31. Available at: https://doi.org/10.1111/ijmr.12111.

Brunswicker, S. and Chesbrough, H. (2018) 'The adoption of open innovation in large firms: practices, measures, and risks: A survey of large firms examines how firms approach open innovation strategically and manage knowledge flows at the project level.', *Research*

Technology Management, 61(1), pp. 35–45.

Bryman, A. (2012) *Social Research Methods*. New York, NY: Oxford University Press.

Burcharth, A.L.D.A., Knudsen, M.P. and Søndergaard, H.A. (2014) 'Neither invented nor shared here: The impact and management of attitudes for the adoption of open innovation practices', *Technovation*, 34(3), pp. 149–161.

Cano-Kollmann, M., Hamilton, R.D. and Mudambi, R. (2017) 'Public support for innovation and the openness of firms' innovation activities', *Industrial and Corporate Change*, 26(3), pp. 421–442. Available at: https://doi.org/10.1093/icc/dtw025.

Caputo, M. *et al.* (2016) 'Exploring the impact of open innovation on firm performances', *Management Decision*, 54(7), pp. 1788–1812. Available at: https://doi.org/10.1108/MD-02-2015-0052.

Caraça, J., Lundvall, B.Å. and Mendonça, S. (2009) 'The changing role of science in the innovation process: From Queen to Cinderella?', *Technological Forecasting and Social Change*, 76(6), pp. 861–867. Available at: https://doi.org/10.1016/j.techfore.2008.08.003.

Carmona-Lavado, A. *et al.* (2021) 'Does open innovation always work? The role of complementary assets', *Technological Forecasting and Social Change*, 162, p. 120316. Available at: https://doi.org/10.1016/j.techfore.2020.120316.

Carree, M., Lokshin, B. and Alvarez, A.H. (2019) 'Technology partnership portfolios and firm innovation performance: Further evidence', *Journal of Engineering and Technology Management*, pp. 1–11. Available at: https://doi.org/10.1016/j.jengtecman.2019.07.001.

Cassiman, B. and Valentini, G. (2016) 'Open innovation: are inbound and outbound knowledge flows really complementary?', *Strategic Management Journal*, 37(6), pp. 1034–1046.

Castillo, V. *et al.* (2020) 'Knowledge spillovers through labour mobility: An employer–employee analysis', *Journal of Development Studies*, 56(3), pp. 469–488. Available at: https://doi.org/10.1080/00220388.2019.1605057.

Celuch, K., Murphy, G.B. and Callaway, S.K. (2007) 'More bang for your buck: Small firms and the importance of aligned information technology capabilities and strategic flexibility', *Journal of High Technology Management Research*, 17(2), pp. 187–197. Available at: https://doi.org/10.1016/j.hitech.2006.11.006.

Chawla, A.S. *et al.* (2023) 'Strategic HRM and firm performance: Mediating role of knowledge management capacity and innovation performance', *Management and Labour Studies*, 48(1), pp. 98–117. Available at: https://doi.org/10.1177/0258042X221113676.

Cheah, S.L.Y. and Ho, Y.P. (2020) 'Effective industrial policy implementation for open innovation: The role of government resources and capabilities', *Technological Forecasting and Social Change*, 151(November 2019), p. 119845.

Cheah, S.L.Y. and Ho, Y.P. (2021) 'Commercialization performance of outbound open innovation projects in public research organizations: The roles of innovation potential and organizational capabilities', *Industrial Marketing Management*, 94, pp. 229–241. Available at: https://doi.org/10.1016/j.indmarman.2021.02.012.

Chen, H. *et al.* (2020) 'Complementarity in open innovation and corporate strategy: The moderating effect of ownership and location strategies', *IEEE Transactions on Engineering Management*, 67(3), pp. 754–768.

Chen, J., Chen, Y. and Vanhaverbeke, W. (2011) 'The influence of scope, depth, and orientation of external technology sources on the innovative performance of Chinese firms', *Technovation*, 31(8), pp. 362–373.

Chen, J., Damanpour, F. and Reilly, R.R. (2010) 'Understanding antecedents of new product development speed: A meta-analysis', *Journal of Operations Management*, 28(1), pp. 17–33. Available at: https://doi.org/10.1016/j.jom.2009.07.001.

Chen, Q. and Liu, Z. (2019) 'How does openness to innovation drive organizational ambidexterity? the mediating role of organizational learning goal orientation', *IEEE*

Transactions on Engineering Management, 66(2), pp. 156–169. Available at: https://doi.org/10.1109/TEM.2018.2834505.

Chen, X., Zhang, H. and Wang, B. (2022) 'How formal and informal open innovation impact innovation performance: the moderating role of appropriability', *Technology Analysis and Strategic Management*, pp. 1–13.

Chen, Y., Vanhaverbeke, W. and Du, J. (2016) 'The interaction between internal R&D and different types of external knowledge sourcing: an empirical study of Chinese innovative firms', *R and D Management*, 46, pp. 1006–1023.

Cheng, C.C.J. and Huizingh, E.K.R.E. (2014) 'When is open innovation beneficial? The role of strategic orientation', *Journal of Product Innovation Management*, 31(6), pp. 1235–1253. Available at: https://doi.org/10.1111/jpim.12148.

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

Cheng, C.C.J., Yang, C. and Sheu, C. (2016) 'Effects of open innovation and knowledge-based dynamic capabilities on radical innovation: An empirical study', *Journal of Engineering and Technology Management*, 41, pp. 79–91.

Cheng, L. *et al.* (2020) 'Inbound openness and its impact on innovation performance: an agent-based and simulation approach', *R and D Management*, 50(2), pp. 212–226. Available at: https://doi.org/10.1111/radm.12391.

Chesbrough, H. (2006) 'Open innovation: a new paradigm for understanding industrial innovation' In: Chesbrough, H.W., Vanhaverbeke, W., West, J. (Eds.), Open innovation: researching a new paradigm. Oxford University Press, Oxford, 1–12.

Chesbrough, H. and Crowther, A.K. (2006) 'Beyond high tech: Early adopters of open innovation in other industries', *R and D Management*, 36(3), pp. 229–236. Available at:

https://doi.org/10.1111/j.1467-9310.2006.00428.x.

Chesbrough, H.W. (2003) *Open innovation: the new imperative for creating and profiting from technology.* Harvard Business Press.

Chu, C.P., Li, C.R. and Lin, C.J. (2011) 'The joint effect of project-level exploratory and exploitative learning in new product development', *European Journal of Marketing*, 45(4), pp. 531–550. Available at: https://doi.org/10.1108/03090561111111325.

Chung, W. and Yeaple, S. (2008) 'International knowledge sourcing: Evidence from US firms expanding abroad.', *Strategic Management Journal*, 29, pp. 1207–1224. Available at: https://doi.org/10.1002/smj.

Ciampi, F. *et al.* (2021) 'Exploring the impact of big data analytics capabilities on business model innovation: The mediating role of entrepreneurial orientation', *Journal of Business Research,* 123, pp. 1-13.

Cingöz, A. and Akdoğan, A.A. (2013) 'Strategic flexibility, environmental dynamism, and innovation performance: An empirical study', *Procedia - Social and Behavioral Sciences*, 99, pp. 582–589. Available at: https://doi.org/10.1016/j.sbspro.2013.10.528.

Clausen, T.H., Korneliussen, T. and Madsen, E.L. (2013) 'Modes of innovation, resources and their influence on product innovation: Empirical evidence from R&D active firms in Norway', *Technovation*, 33(6–7), pp. 225–233.

Combe, I.A. *et al.* (2012) 'Antecedents to strategic flexibility: Management cognition, firm resources and strategic options', *European Journal of Marketing*, 46(10), pp. 1320–1339. Available at: https://doi.org/10.1108/03090561211248053.

Cosh, A., Cumming, D. and Hughes, A. (2009) 'Outside enterpreneurial capital', *Economic Journal*, 119(540), pp. 1494–1533. Available at: https://doi.org/10.1111/j.1468-0297.2009.02270.x.

Cottrell, T. and Nault, B.R. (2004) 'Product variety and firm survival in the microcomputer

software industry', *Strategic Management Journal*, 25(10), pp. 1005–1025. Available at: https://doi.org/10.1002/smj.408.

Coudounaris, D.N. (2018) 'Export promotion programmes for assisting SMEs', *Review of International Business and Strategy,* 28(1), pp. 77–110. Available at: https://doi.org/10.1108/RIBS-06-2017-0050.

Cruz-González, J., López-Sáez, P. and Navas-López, J.E. (2015) 'Absorbing knowledge from supply-chain, industry and science: The distinct moderating role of formal liaison devices on new product development and novelty', *Industrial Marketing Management*, 47, pp. 75–85. Available at: https://doi.org/10.1016/j.indmarman.2015.02.036.

Cuevas-Vargas, H., Aguirre, J. and Parga-Montoya, N. (2022) 'Impact of ICT adoption on absorptive capacity and open innovation for greater firm performance. The mediating role of ACAP', *Journal of Business Research*, 140, pp. 11–24.

Curran, P.J., West, S.G. and Finch, J.F. (1996) 'The robustness of test statistics to normality and specification error in confirmatory factor analysis', *Psychological Methods*, 1(1), pp. 16–29.

da Silva Meireles, F.R., Azevedo, A.C. and Boaventura, J.M.G. (2022) 'Open innovation and collaboration: A systematic literature review', *Journal of Engineering and Technology Management*, 65, p. 119985.

Dahlander, L. and Gann, D.M. (2010) 'How open is innovation?', *Research Policy*, 39(6), pp. 699–709. Available at: https://doi.org/10.1016/j.respol.2010.01.013.

Dahlander, L., Gann, D.M. and Wallin, M.W. (2021) 'How open is innovation? A retrospective and ideas forward', *Research Policy*, 50(4), p. 104218.

Davcik, N.S. *et al.* (2021) 'Exploring the role of international R&D activities in the impact of technological and marketing capabilities on SMEs' performance', *Journal of Business Research*, 128, pp. 650–660. Available at: https://doi.org/10.1016/j.jbusres.2020.04.042.

Day, G.S. (1994) ‘The capabilities of market-driven organizations’, *Journal of Marketing*, 58(4), pp. 37–52. Available at: https://doi.org/10.1177/002224299405800404.

Day, G.S. (2011) ‘Closing the marketing capabilities gap’, *Journal of Marketing*, 75(4), pp. 183–195. Available at: https://doi.org/10.1509/jmkg.75.4.183.

de Jong, J.P.J., Kalvet, T. and Vanhaverbeke, W. (2010) ‘Exploring a theoretical framework to structure the public policy implications of open innovation’, *Technology Analysis and Strategic Management*, 22(8), pp. 877–896.

De Marco, C.E., Martelli, I. and Di Minin, A. (2020) ‘European SMEs’ engagement in open innovation When the important thing is to win and not just to participate, what should innovation policy do?’, *Technological Forecasting and Social Change*, 152(December 2019), p. 119843. Available at: https://doi.org/10.1016/j.techfore.2019.119843.

de Zubielqui, G.C, Fryges, H. and Jones, J. (2019) ‘Social media, open innovation & HRM: Implications for performance’, Technological Forecasting and Social Change, 144(April 2017), pp. 334–347. Available at: https://doi.org/10.1016/j.techfore.2017.07.014.

Devarakonda, S. V. and Reuer, J.J. (2018) ‘Knowledge sharing and safeguarding in R&D collaborations: The role of steering committees in biotechnology alliances’, *Strategic Management Journal*, 39(7), pp. 1912–1934. Available at: https://doi.org/10.1002/smj.2898.

Dittrich, K. and Duysters, G. (2007) ‘Networking as a means to strategy change: The case of open innovation in mobile telephony’, *Journal of Product Innovation Management*, 24(6), pp. 510–521. Available at: https://doi.org/10.1111/j.1540-5885.2007.00268.x.

Dodgson, M., Gann, D. and Salter, A. (2006) ‘The role of technology in the shift towards open innovation: The case of Procter & Gamble’, *R and D Management*, 36(3), pp. 333–346. Available at: https://doi.org/10.1111/j.1467-9310.2006.00429.x.

Donaldson, L. (1996) 'The normal science of structural contingency theory', *Handbook of Organization Studies*, 44(20), pp. 57–76.

Donaldson, L. (2001) *The Contingency Theory of Organizations.* Thousand Oaks, CA, USA: Sage.

Donaldson, L. (2006) *The contingency theory of organizational design: challenges and opportunities.* In R. M. Burton, B. Eriksen, D. D. Hakonsson and C. C. Snow (Eds), Organization design: the evolving state-of-the-art. New York: Springer, pp. 19–40

Dong, J.Q. and Netten, J. (2017) 'Information technology and external search in the open innovation age: New findings from Germany', *Technological Forecasting and Social Change*, 120, pp. 223–231. Available at: https://doi.org/10.1016/j.techfore.2016.12.021.

Drechsler, W. and Natter, M. (2012) 'Understanding a firm's openness decisions in innovation', *Journal of Business Research*, 65(3), pp. 438–445.

Du, J., Leten, B. and Vanhaverbeke, W. (2014) 'Managing open innovation projects with science-based and market-based partners', *Research Policy*, 43(5), pp. 828–840. Available at: https://doi.org/10.1016/j.respol.2013.12.008.

Dutta, S., Narasimhan, O. and Rajiv, S. (1999) 'Success in high-technology markets: Is marketing capability critical?', *Marketing science*, 18(4), pp. 547–568. Available at: https://doi.org/10.1086/250095.

Dutta, S., Zbaracki, M.J. and Bergen, M. (2003) 'Pricing process as a capability: A resource-based perspective', *Strategic Management Journal*, 24(7), pp. 615–630. Available at: https://doi.org/10.1002/smj.323.

Ebersberger, B. *et al.* (2021) 'Inbound open innovation and innovation performance: A robustness study', *Research Policy*, 50(7), p. 104271.

Eftekhari, N. and Bogers, M. (2015) 'Open for entrepreneurship: How open innovation can foster new venture creation', *Creativity and Innovation Management*, 24(4), pp. 574–584. Available at: https://doi.org/10.1111/caim.12136.

Eisend, M., Evanschitzky, H. and Calantone, R.J. (2016) 'The relative advantage of marketing over technological capabilities in influencing new product performance: The moderating role of country institutions', *Journal of International Marketing*, 24(1), pp. 41–56. Available at: https://doi.org/10.1509/jim.15.0068.

Eisenhardt, K.M. and Martin, J.A. (2000) 'Dynamic capabilities: What are they?', *Strategic Management Journal*, 21(10–11), pp. 1105–1121.

El Maalouf, N. and Bahemia, H. (2023) 'The implementation of inbound open innovation at the firm level: A dynamic capability perspective', *Technovation*, 122, p. 102659. Available at: https://doi.org/10.1016/j.technovation.2022.102659

Eller, R. *et al.* (2020) 'Antecedents, consequences, and challenges of small and medium-sized enterprise digitalization', *Journal of Business Research*, 112, pp. 119–127. Available at: https://doi.org/10.1016/j.jbusres.2020.03.004.

Endres, H., Helm, R. and Dowling, M. (2020) 'Linking the types of market knowledge sourcing with sensing capability and revenue growth: Evidence from industrial firms', *Industrial Marketing Management*, 90, pp. 30–43.

Esfahbodi, A. *et al.* (2017) 'Governance pressures and performance outcomes of sustainable supply chain management–An empirical analysis of UK manufacturing industry', *Journal of Cleaner Production,* 155, pp. 66-78.

Expósito, A., Fernández-Serrano, J. and Liñán, F. (2019) 'The impact of open innovation on SMEs' innovation outcomes: New empirical evidence from a multidimensional approach', *Journal of Organizational Change Management*, 32(5), pp. 558–577. Available at: https://doi.org/10.1108/JOCM-09-2018-0253.

Faems, D. *et al.* (2010) 'Technology alliance portfolios and financial performance: Value-enhancing and cost-increasing effects of open innovation', *Journal of Product Innovation Management*, 27(6), pp. 785–796.

Falahat, M. *et al.* (2021) ‘Entrepreneurial, market, learning and networking orientations as determinants of business capability and international performance: the contingent role of government support’, *International Entrepreneurship and Management Journal*, 17(4), pp. 1759–1780. Available at: https://doi.org/10.1007/s11365-020-00738-y.

Fan, Z., Wu, D. and Wu, X. (2013) ‘Proactive and reactive strategic flexibility in coping with environmental change in innovation’, *Asian Journal of Technology Innovation*, 21(2), pp. 187–201. Available at: https://doi.org/10.1080/19761597.2013.866316.

Feng, H., Morgan, N. A. and Rego, L. L. (2017) 'Firm capabilities and growth: The moderating role of market conditions', *Journal of the Academy of Marketing Science,* 45, pp. 76-92.

Ferraris, A., Bogers, M.L.A.M. and Bresciani, S. (2020) ‘Subsidiary innovation performance: Balancing external knowledge sources and internal embeddedness’, *Journal of International Management*, 26(4), p. 100794. Available at: https://doi.org/10.1016/j.intman.2020.100794.

Ferreras-Méndez, J.L. *et al.* (2015) ‘Depth and breadth of external knowledge search and performance: The mediating role of absorptive capacity’, *Industrial Marketing Management*, 47, pp. 86–97.

Ferrier, W.J., Smith, K.G. and Grimm, C.M. (1999) ‘The role of competitive action in market share erosion and industry dethronement: A study of industry leaders and challengers’, *Academy of Management Journal*, 42(4), pp. 372–388.

Fishbein, M. and Ajzen, I. (1975) *Belief, Attitude, Intention and Behavior: An Introduction to Theory and Research.* Reading, MA: Addison-Wesley.

Flor, M.L., Oltra-Mestre, M.J. and Sanjurjo, E.L. (2021) ‘An analysis of open innovation strategies in firms in low and medium technology industries’, *IEEE Transactions on Engineering Management*, 68(3), pp. 853–867.

Foege, J.N. *et al.* (2019) ‘Reconceptualizing the paradox of openness: How solvers navigate sharing-protecting tensions in crowdsourcing’, *Research Policy*, 48(6), pp. 1323–1339.

Available at: https://doi.org/10.1016/j.respol.2019.01.013.

Fornell, C. and Larcker, D.F. (1981) 'Evaluating structural equation models with unobservable variables and measurement error', *Journal of Marketing Research*, 18(1), pp. 39–50. Available at: https://doi.org/10.2307/3151312.

Foss, N.J., Laursen, K. and Pedersen, T. (2011) 'Linking customer interaction and innovation: The mediating role of new organizational practices', *Organization Science*, 22(4), pp. 980–999. Available at: https://doi.org/10.1287/orsc.1100.0584.

Freel, M. and Robson, P.J. (2017) 'Appropriation strategies and open innovation in SMEs', *International Small Business Journal: Researching Entrepreneurship*, 35(5), pp. 578–596. Available at: https://doi.org/10.1177/0266242616654957.

Fu, L., Liu, Z. and Zhou, Z. (2019) 'Can open innovation improve firm performance? An investigation of financial information in the biopharmaceutical industry', *Technology Analysis and Strategic Management*, 31(7), pp. 776–790. Available at: https://doi.org/10.1080/09537325.2018.1554205.

Gad David, K. *et al.* (2023) 'Effect of transformational leadership on open innovation through innovation culture: exploring the moderating role of absorptive capacity', *Technology Analysis and Strategic Management*, 35(5), pp. 613–628.

Gassmann, O. and Enkel, E. (2004) 'Towards a theory of open innovation: three core process archetypes', *In: Proceedings of the R&D Management Conference*. Lisbon, Portugal.

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

Gelabert, L., Fosfuri, A. and TribÓ, J.A. (2009) 'Does the effect of public support for r & d depend on the degree of appropriability?', *Journal of Industrial Economics*, 57(4), pp. 736–767. Available at: https://doi.org/10.1111/j.1467-6451.2009.00396.x.

Genc, E., Dayan, M. and Genc, O. F. (2019) 'The impact of SME internationalization on innovation: The mediating role of market and entrepreneurial orientation', *Industrial Marketing Management*, 82, pp. 253-264.

Gentile-Lüdecke, S., Torres de Oliveira, R. and Paul, J. (2020) 'Does organizational structure facilitate inbound and outbound open innovation in SMEs?', *Small Business Economics*, 55(4), pp. 1091–1112. Available at: https://doi.org/10.1007/s11187-019-00175-4.

Gerbing, D. W., and Anderson, J.C. (1988) 'An updated paradigm for scale development incorporating unidimensionality and its assessment', *Journal of Marketing Research,* 25(2), pp. 186-192.

Gërguri-Rashiti, S. *et al.* (2017) 'ICT, innovation and firm performance: The transition economies context', *Thunderbird International Business Review*, 59(1), pp. 93–102. Available at: https://doi.org/10.1002/tie.21772.

Germann, F., Ebbes, P. and Grewal, R. (2015) 'The chief marketing officer matters!', *Journal of Marketing*, 79(3), pp. 1–22. Available at: https://doi.org/10.1509/jm.14.0244.

Ghisetti, C., Marzucchi, A. and Montresor, S. (2015) 'The open eco-innovation mode. An empirical investigation of eleven European countries', *Research Policy*, 44(5), pp. 1080–1093. Available at: https://doi.org/10.1016/j.respol.2014.12.001.

Gilmore, A., Carson, D. and Grant, K. (2001) 'SME marketing in practice', *Market Intelligence & Planning*, 19(1), pp. 6–11.

Gimenez-Fernandez, E.M. and Sandulli, F.D. (2017) 'Modes of inbound knowledge flows: are cooperation and outsourcing really complementary?', *Industry and Innovation*, 24(8), pp. 795–816. Available at: https://doi.org/10.1080/13662716.2016.1266928.

Ginsberg, A. and Venkatraman, N. (1985) 'Contingency perspectives of organizational strategy: A critical review of the empirical research', *Academy of Management Review*, 10(3), p. 421. Available at: https://doi.org/10.2307/258125.

Goodman, J. K., Cryder, C. E. and Cheema, A. (2013) 'Data collection in a flat world: The strengths and weaknesses of mechanical Turk samples', *Journal of Behavioral Decision Making*, 26(3), pp. 213-224.

Greco, M., Grimaldi, M. and Cricelli, L. (2015) 'Open innovation actions and innovation performance: A literature review of European empirical evidence', *European Journal of Innovation Management*, 18(2), pp. 150–171. Available at: https://doi.org/10.1108/EJIM-07-2013-0074.

Greco, M., Grimaldi, M. and Cricelli, L. (2016) 'An analysis of the open innovation effect on firm performance', *European Management Journal*, 34(5), pp. 501–516. Available at: https://doi.org/10.1016/j.emj.2016.02.008.

Greer, T. V., Chuchinprakarn, N. and Seshadri, S. (2000) 'Likelihood of participating in mail survey research: Business respondents' perspectives', *Industrial Marketing Management,* 29(2), pp. 97-109.

Grewal, R. and Tansuhaj, P. (2001) 'Building organizational capabilities for managing economic crisis: The role of market orientation and strategic flexibility', *Journal of Marketing*, 65(1), pp. 67–80.

Guo, H. *et al.* (2018) 'Comparing the impact of different marketing capabilities: Empirical evidence from B2B firms in China', *Journal of Business Research*, 93, pp. 79–89. Available at: https://doi.org/10.1016/j.jbusres.2018.04.010.

Hagedoorn, J. and Zobel, A.K. (2015) 'The role of contracts and intellectual property rights in open innovation', *Technology Analysis and Strategic Management*, 27(9), pp. 1050–1067. Available at: https://doi.org/10.1080/09537325.2015.1056134.

Hahn, D., Minola, T. and Eddleston, K.A. (2019) 'How do scientists contribute to the performance of innovative start-ups? An imprinting perspective on open Innovation', *Journal of Management Studies*, 56(5), pp. 895–928.

Hair, J.F. *et al.* (2014) *Multivariate Data Analysis.* England. England: Pearson Education Limited.

Hair, J.F. *et al.* (2017) *A Primer on Partial Least Squares Structural Equation Modeling*. Sage: Thousand Oaks, CA.

Hambrick, D.C. (2007) 'Upper echelons theory: An update', *Academy of Management Review*, 32(2), pp. 334–343. Available at: https://doi.org/10.5465/AMR.2007.24345254.

Hamlin, R., Henry, J. and Cuthbert, R. (2012) 'Acquiring market flexibility via niche portfolios: The case of Fisher & Paykel Appliance Holdings Ltd', *European Journal of Marketing*, 46(10), pp. 1302–1319. Available at: https://doi.org/10.1108/03090561211248044.

Hansen, U.E. and Lema, R. (2019) 'The co-evolution of learning mechanisms and technological capabilities: Lessons from energy technologies in emerging economies', *Technological Forecasting and Social Change*, 140, pp. 241–257.

Helfat, C.E. (1997) 'Know-how and asset complementarity and dynamic capability accumulation: The case of R&D', *Strategic Management Journal*, 18(5), pp. 339–360.

Helfat, C.E. and Peteraf, M.A. (2003) 'The dynamic resource-based view: Capability lifecycles', *Strategic Management Journal*, 24, pp. 997–1010.

Helfat, C.E. and Winter, S.G. (2011) 'Untangling dynamic and operational capabilities: Strategy for the (N) ever-changing world', *Strategic Management Journal*, 32(11), pp. 1243–1250.

Hellström, A. *et al.* (2015) 'Adopting a management innovation in a professional organization: The case of improvement knowledge in healthcare', *Business Process Management Journal*, 21(5), pp. 1186–1203. Available at: https://doi.org/10.1108/BPMJ-05-2014-0041.

Henkel, J., Schöberl, S. and Alexy, O. (2014) 'The emergence of openness: How and why firms adopt selective revealing in open innovation', *Research Policy*, 43(5), pp. 879–890. Available at: https://doi.org/10.1016/j.respol.2013.08.014.

Hirschi, T. (1969) *Causes of Delinquency*. Berkeley: University of California Press.

Hitt, M.A., Keats, B.W. and DeMarie, S.M. (1998) 'Navigating in the new competitive landscape: Building strategic flexibility and competitive advantage in the 21st century', *Academy of Management Perspectives*, 12(4), pp. 22–42. Available at: https://doi.org/10.5465/ame.1998.1333922.

Ho, F.N. and Huang, C. wei (2020) 'The interdependencies of marketing capabilities and operations efficiency in hospitals', *Journal of Business Research*, 113, pp. 337–347. Available at: https://doi.org/10.1016/j.jbusres.2019.09.037.

Hobfoll, S.E. (1989) 'Conservation of resources: A new attempt at conceptualizing stress', *American Psychologist*, 44(3), pp. 513–524. Available at: https://doi.org/10.1037/0003-066X.44.3.513.

Hobfoll, S.E. (2002) 'Social and psychological resources and adaptation', *Review of General Psychology*, 6(4), pp. 307–324. Available at: https://doi.org/10.1037/1089-2680.6.4.307.

Hogan, S.J. and Coote, L. V. (2014) 'Organizational culture, innovation, and performance: A test of Schein's model', *Journal of Business Research*, 67(8), pp. 1609–1621. Available at: https://doi.org/10.1016/j.jbusres.2013.09.007.

Holgersson, M., Granstrand, O. and Bogers, M. (2018) 'The evolution of intellectual property strategy in innovation ecosystems: Uncovering complementary and substitute appropriability regimes', *Long Range Planning*, 51(2), pp. 303–319. Available at: https://doi.org/10.1016/j.lrp.2017.08.007.

Hsieh, M. and Tsai, K. (2007) 'Technological capability, social capital and the launch strategy for innovative products', *Industrial Marketing Management,* 36, pp. 493–502. Available at: https://doi.org/10.1016/j.indmarman.2006.01.002.

Hu, Y., McNamara, P. and McLoughlin, D. (2015) 'Outbound open innovation in bio-pharmaceutical out-licensing', *Technovation*, 35, pp. 46–58.

Huang, F. *et al.* (2014) 'Openness and appropriation: Empirical evidence from Australian businesses', *IEEE Transactions on Engineering Management*, 61(3), pp. 488–498. Available at: https://doi.org/10.1109/TEM.2014.2320995.

Huang, S. *et al.* (2015) 'External heterogeneity and its impact on open innovation performance', *Technology Analysis and Strategic Management*, 27(2), pp. 182–197. Available at: https://doi.org/10.1080/09537325.2014.957664.

Huang, S. *et al.* (2019) 'The effect of external partner heterogeneity on open innovation: The moderating role of the technological regime', *Technology Analysis and Strategic Management*, 31(5), pp. 593–605.

Huizingh, E.K.R.E. (2011) 'Open innovation: State of the art and future perspectives', *Technovation*, 31(1), pp. 2–9.

Hult, G.T.M., Ketchen, D.J. and Slater, S.F. (2005) 'Market orientation and performance: An integration of disparate approaches', *Strategic Management Journal*, 26(12), pp. 1173–1181. Available at: https://doi.org/10.1002/smj.494.

Hung, K.P. and 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), pp. 368–380. Available at: https://doi.org/10.1016/j.technovation.2013.06.006.

Ince, H., Imamoglu, S.Z. and Karakose, M.A. (2021) 'Entrepreneurial orientation, social capital, and firm performance: The mediating role of innovation performance', *International Journal of Entrepreneurship and Innovation,* 24(1), pp. 32–43.

Jang, S. and von Zedtwitz, M. (2023) 'Opening up early or late? The effect of open innovation before and after product launch on new product market performance', *Industrial Marketing Management*, 112, pp. 113–127.

Jin, J., Guo, M. and Zhang, Z. (2022) 'Selective adoption of open innovation for new product development in high-tech SMEs in emerging economies', *IEEE Transactions on*

Engineering Management, 69(2), pp. 329–337.

Ju, M., Jin, J.L. and Zhou, K.Z. (2018) 'How can international ventures utilize marketing capability in Emerging markets? Its contingent effect on new product development', *Journal of International Marketing*, 26(4), pp. 1–17.

Jugend, D. *et al.* (2018) 'Relationships among open innovation, innovative performance, government support and firm size: Comparing Brazilian firms embracing different levels of radicalism in innovation', *Technovation*, 74, pp. 54–65.

Kafetzopoulos, D., Psomas, E. and Bouranta, N. (2022) 'The influence of leadership on strategic flexibility and business performance: The mediating role of talent management', *Management Decision*, 60(9), pp. 2532–2551. Available at: https://doi.org/10.1108/MD-10-2021-1310.

Kaleka, A. and Morgan, N.A. (2019) 'How marketing capabilities and current performance drive strategic intentions in international markets', *Industrial Marketing Management*, 78, pp. 108–121. Available at: https://doi.org/10.1016/j.indmarman.2017.02.001.

Kandemir, D. and Acur, N. (2012) 'Examining proactive strategic decision-making flexibility in new product development', *Journal of Product Innovation Management*, 29(4), pp. 608–622. Available at: https://doi.org/10.1111/j.1540-5885.2012.00928.x.

Kang, T., Baek, C. and Lee, J.D. (2017) 'The persistency and volatility of the firm R&D investment: Revisited from the perspective of technological capability', *Research Policy*, 46(9), pp. 1570–1579. Available at: https://doi.org/10.1016/j.respol.2017.07.006.

Karabulut, A.T. (2015) 'Effects of Innovation Strategy on Firm Performance: A Study Conducted on Manufacturing Firms in Turkey', *Procedia - Social and Behavioral Sciences*, 195, pp. 1338–1347. Available at: https://doi.org/10.1016/j.sbspro.2015.06.314.

Katila, R. and Ahuja, G. (2002) 'Something old, something new: A longitudinal study of search behavior and new product introduction', *Academy of Management Journal*, 45(6), pp. 1183–

1194. Available at: https://doi.org/10.2307/3069433.

Keinz, P. and Marhold, K. (2020) 'Technological competence leveraging projects via intermediaries: Viable means to outbound open innovation and mediated capability building?', *International Journal of Project Management* 39, pp. 196-208. Available at: https://doi.org/10.1016/j.ijproman.2020.10.006.

Kellerman, B. (2004) *Bad leadership: What it is, how it happens, why it matters*. Harvard Business Press.

Keupp, M.M. and Gassmann, O. (2009) 'Determinants and archetype users of open innovation', *R and D Management*, 39(4), pp. 331–341. Available at: https://doi.org/10.1111/j.1467-9310.2009.00563.x.

Kian, T.S. and Yusoff, W.F.W. (2015) 'Motivation and promotion opportunity of academic citizens towards open innovation: Proposed model', *Procedia - Social and Behavioral Sciences*, 204, pp. 29–35. Available at: https://doi.org/10.1016/j.sbspro.2015.08.106.

Kirschbaum, R. (2005) 'Open innovation in practice', *Research Technology Management*, 48(4), pp. 24–28. Available at: https://doi.org/10.1080/08956308.2005.11657321.

Kobarg, S., Stumpf-Wollersheim, J. and Welpe, I.M. (2019) 'More is not always better: Effects of collaboration breadth and depth on radical and incremental innovation performance at the project level', *Research Policy*, 48(1), pp. 1–10.

Kortmann, S. *et al.* (2014) 'Linking strategic flexibility and operational efficiency: The mediating role of ambidextrous operational capabilities', *Journal of Operations Management*, 32(7–8), pp. 475–490.

Kozlenkova, I. V., Samaha, S.A. and Palmatier, R.W. (2014) 'Resource-based theory in marketing', *Journal of the Academy of Marketing Science*, 42(1), pp. 1–21. Available at: https://doi.org/10.1007/s11747-013-0336-7.

Krammer, S.M.S., Strange, R. and Lashitew, A. (2018) 'The export performance of emerging

economy firms: The influence of firm capabilities and institutional environments', *International Business Review*, 27(1), pp. 218–230.

Krasnikov, A. and Jayachandran, S. (2008) 'The relative impact of marketing, research-and-development, and operations capabilities on firm performance', *Journal of Marketing*, 72(4), pp. 1–11. Available at: https://doi.org/10.1509/jmkg.72.4.1.

Kyriakopoulos, K., Hughes, M. and Hughes, P. (2016) 'The role of marketing resources in radical innovation activity: Antecedents and payoffs', *Journal of Product Innovation Management*, 33(4), pp. 398–417. Available at: https://doi.org/10.1111/jpim.12285.

Lages, L.F. and Styles, C. (2009) 'Relationship capabilities, quality, and innovation as determinants of export performance', *Journal of international Marketing*, 17(4), pp. 47–70.

Laursen, K. and Salter, A. (2006) 'Open for innovation: The role of openness in explaining innovation performance among U.K. manufacturing firms', *Strategic Management Journal*, 27(2), pp. 131–150. Available at: https://doi.org/10.1002/smj.507.

Laursen, K. and Salter, A.J. (2014) 'The paradox of openness: Appropriability, external search and collaboration', *Research Policy*, 43(5), pp. 867–878.

Lazzarotti, V. *et al.* (2017) 'Innovation ambidexterity of open firms. The role of internal relational social capital', *Technology Analysis and Strategic Management*, 29(1), pp. 105–118. Available at: https://doi.org/10.1080/09537325.2016.1210119.

Leckel, A., Veilleux, S. and Dana, L.P. (2020) 'Local open innovation: A means for public policy to increase collaboration for innovation in SMEs', *Technological Forecasting and Social Change*, 153, p. 119891.

Lee, D.H., Dedahanov, A.T. and Rhee, J. (2015) 'Moderating role of external networks and mediating effect of innovation performance on the relationship between technology orientation and firm performance', *Asian Journal of Technology Innovation*, 23(3), pp. 321–334. Available at: https://doi.org/10.1080/19761597.2015.1120498.

Lent, R., Brown, S.D. and Hackett, G. (1994) 'Toward a unifying social cognitive theory of career and academic interest, choice and performance', *Journal of Vocational Behavior*, 45(1), pp. 79–122.

Leonard-Barton, D. (1992) 'Core capabilities and core rigidities : A paradox in managing new product development', *Strategic Management Journal*, 13, pp. 111–125.

Li, Y., Li, L. and Wu, Z. (2022) 'How to benefit from open innovation? The moderating effect of open culture and open organization', *IEEE Transactions on Engineering Management*, pp. 1–14. Available at: https://doi.org/10.1109/TEM.2022.3218748.

Liao, S., Fu, L. and Liu, Z. (2020) 'Investigating open innovation strategies and firm performance : the moderating role of technological capability and market information management capability', 35(1), pp. 23–39. Available at: https://doi.org/10.1108/JBIM-01-2018-0051.

Lichtenthaler, U. (2008) 'Integrated roadmaps for open innovation', *Research Technology Management*, 51(3), pp. 45–49.

Lichtenthaler, U. (2009) 'Outbound open innovation and its effect on firm performance: Examining environmental influences', *R and D Management*, 39(4), pp. 317–330. Available at: https://doi.org/10.1111/j.1467-9310.2009.00561.x.

Lichtenthaler, U. (2011) 'Open innovation: Past research, current debates, and future directions', *Academy of Management Perspectives*, 25(1), pp. 75–93. Available at: https://doi.org/10.5465/AMP.2011.59198451.

Lichtenthaler, U. and Lichtenthaler, E. (2009) 'A capability-based framework for open innovation: Complementing absorptive capacity', *Journal of Management Studies*, 46(8), pp. 1315–1338. Available at: https://doi.org/10.1111/j.1467-6486.2009.00854.x.

Lichtenthaler, U. and Lichtenthaler, E. (2010) 'Technology transfer across organizational boundaries: absorptive capacity and desorptive capacity', *California Management Review*,

53, pp. 154–170.

Lifshitz-Assaf, H. (2018) 'Dismantling knowledge boundaries at NASA: The critical role of professional identity in open innovation', *Administrative Science Quarterly,*63(4), pp. 746-782. Available at: https://doi.org/10.1177/0001839217747876.

Lin, F.J. and Lai, C.F. (2021) 'Key factors affecting technological capabilities in small and medium-sized Enterprises in Taiwan', *International Entrepreneurship and Management Journal*, 17(1), pp. 131–143. Available at: https://doi.org/10.1007/s11365-019-00632-2.

Lin, W.L. *et al.* (2021) 'Influence of green innovation strategy on brand value: The role of marketing capability and R&D intensity', *Technological Forecasting and Social Change*, 171, p. 120946. Available at: https://doi.org/10.1016/j.techfore.2021.120946.

Liu, A., Gu, J. and Liu, H. (2022) 'The fit between firm capability and business model for SME growth: a resource orchestration perspective', *R and D Management*, 52(4), pp. 670–684. Available at: https://doi.org/10.1111/radm.12513.

Liu, G., Tsui, E. and Kianto, A. (2021) 'Knowledge-friendly organisational culture and performance: A meta-analysis', *Journal of Business Research*, 134, pp. 738–753. Available at: https://doi.org/10.1016/j.jbusres.2021.05.048.

Liu, H. *et al.* (2013) 'Strategic flexibility and international venturing by emerging market firms: The moderating effects of institutional and relational factors', *Journal of International Marketing*, 21(2), pp. 79–98. Available at: https://doi.org/10.1509/jim.12.0047.

Liu, Y., Ying, Y. and Wu, X. (2017) 'Catch-up through collaborative innovation: Evidence from China.', *Thunderbird International Business Review*, 59(4), pp. 533–545. Available at: https://doi.org/10.1002/tie.

Lopes, A.P.V.B.V. and de Carvalho, M.M. (2018) 'Evolution of the open innovation paradigm: Towards a contingent conceptual model', *Technological Forecasting and Social Change*, 132, pp. 284–298. Available at: https://doi.org/10.1016/j.techfore.2018.02.014.

Lorenz, R. *et al.* (2020) ‘Digitization of manufacturing: the role of external search’, *International Journal of Operations and Production Management*, 40(7–8), pp. 1129–1152. Available at: https://doi.org/10.1108/IJOPM-06-2019-0498.

Lu, Q., and Chesbrough, H. (2022) 'Measuring open innovation practices through topic modelling: Revisiting their impact on firm financial performance', *Technovation,* 114, p. 102434.

Lu, C., Qi, Y. and Hao, S. (2023) ‘Enhancing innovation performance of SMEs through open innovation and absorptive capacity: the moderating effect of business model’, *Technology Analysis and Strategic Management*, pp. 1–17.

Luca, L. M., and Atuahene-Gima, K. (2007) 'Market knowledge dimensions and cross-functional collaboration: Examining the different routes to product innovation performance', *Journal of Marketing,* 71(1), pp. 95-112.

Mackey, J.D. *et al.* (2021) ‘The dark side of leadership: A systematic literature review and meta-analysis of destructive leadership research’, *Journal of Business Research*, 132, pp. 705–718. Available at: https://doi.org/10.1016/j.jbusres.2020.10.037.

Madrid-Guijarro, A., Martin, D.P. and García-Pérez-de-Lema, D. (2020) ‘Capacity of open innovation activities in fostering product and process innovation in manufacturing SMEs’, *Review of Managerial Science*, 15, pp. 2137–2164.

Magnusson, P. and Boggs, D.J. (2006) ‘International experience and CEO selection: An empirical study’, *Journal of International Management*, 12(1), pp. 107–125. Available at: https://doi.org/10.1016/j.intman.2006.01.002.

Mahmoud, M.A., Hinson, R.E. and Anim, P.A. (2018) ‘Service innovation and customer satisfaction: the role of customer value creation’, *European Journal of Innovation Management*, 21(3), pp. 402–422. Available at: https://doi.org/10.1108/EJIM-09-2017-0117.

Manzini, R., Lazzarotti, V. and Pellegrini, L. (2017) 'How to remain as closed as possible in the open innovation : The case of Lindt & Sprüngli', *Long Range Planning*, 50(2), pp. 260–281. Available at: https://doi.org/10.1016/j.lrp.2015.12.011.

Mendoza, G. *et al.* (2021) 'Entrepreneurship as seen by entrepreneurs in a developing country', *Journal of Business Research,* 123, pp. 547-556.

Markovic, S. *et al.* (2020) 'Do not miss the boat to outside-in open innovation: Enable your employees', *Industrial Marketing Management*, 91, pp. 152–161. Available at: https://doi.org/10.1016/j.indmarman.2020.09.003.

Marquez-Illescas, G., Zebedee, A.A. and Zhou, L. (2019) 'Hear me write: Does CEO narcissism affect disclosure?', *Journal of Business Ethics*, 159(2), pp. 401–417. Available at: https://doi.org/10.1007/s10551-018-3796-3.

Martin, S.L., Javalgi, R. (Raj) G. and Ciravegna, L. (2020) 'Marketing capabilities and international new venture performance: The mediation role of marketing communication and the moderation effect of technological turbulence', *Journal of Business Research*, 107, pp. 25–37. Available at: https://doi.org/10.1016/j.jbusres.2019.09.044.

Martin, S.L., Raj, R. and Javalgi, G. (2016) 'Entrepreneurial orientation , marketing capabilities and performance : The moderating role of competitive intensity on Latin American International new ventures', *Journal of Business Research*, 69(6), pp. 2040–2051. Available at: https://doi.org/10.1016/j.jbusres.2015.10.

Martinez-Conesa, Soto-Acosta, P. and Carayannis, E.G. (2017) 'On the paths towards open innovation: assessing the role of knowledge management capability and environmental dynamism in SMEs', *Journal of Knowledge Management*, 21(3), pp. 553–570.

Martínez-Sánchez, A. *et al.* (2009) 'Inter-organizational cooperation and environmental change: Moderating effects between flexibility and innovation performance', *British Journal of Management*, 20(4), pp. 537–561. Available at: https://doi.org/10.1111/j.1467-

8551.2008.00605.x.

Martinez, Garcia, M. *et al.* (2019) 'What drives business failure? Exploring the role of internal and external knowledge capabilities during the global financial crisis', *Journal of Business Research*, 98, pp. 441–449. Available at: https://doi.org/10.1016/j.jbusres.2018.07.032.

Marzi, G. *et al.* (2023) 'Do or do not. Cognitive configurations affecting open innovation adoption in SMEs', *Technovation*, 119. p. 102585.

Matusik, S.F. and Hill, C.W.L. (1998) 'The utilization of contingent work, knowledge creation, and competitive advantage', *Academy of Management Review*, 23(4), p. 680. Available at: https://doi.org/10.2307/259057.

Mazzola, E., Bruccoleri, M. and Perrone, G. (2012) 'The effect of inbound, outbound and coupled innovation on performance', *International Journal of Innovation Management*, 16(6). Available at: https://doi.org/10.1142/S1363919612400087.

Mc Cartan-Quinn, D. and Carson, D. (2003) 'Issues which Impact upon marketing in the small firm', *Small Business Economics*, 21(2), pp. 201–213.

Mei, L., Zhang, T. and Chen, J. (2019) 'Exploring the effects of inter-firm linkages on SMEs' open innovation from an ecosystem perspective: An empirical study of Chinese manufacturing SMEs', *Technological Forecasting and Social Change*, 144, pp. 118–128. Available at: https://doi.org/10.1016/j.techfore.2019.04.010.

Michelino, F. *et al.* (2015) 'Open innovation in the pharmaceutical industry: An empirical analysis on context features, internal R&D, and financial performances', *IEEE Transactions on Engineering Management*, 62(3), pp. 421–435.

Miroshnychenko, I. *et al.* (2021) 'Absorptive capacity, strategic flexibility, and business model innovation: Empirical evidence from Italian SMEs', *Journal of Business Research*, 130, pp. 670–682. Available at: https://doi.org/10.1016/j.jbusres.2020.02.015.

Monteiro, F., Mol, M. and Birkinshaw, J. (2017) 'Ready to be open? Explaining the firm level

barriers to benefiting from openness to external knowledge', *Long Range Planning*, 50(2), pp. 282–295. Available at: https://doi.org/10.1016/j.lrp.2015.12.008.

Morgan, N.A., Feng, H. and Whitler, K.A. (2018) 'Marketing capabilities in international marketing', *Journal of Marketing*, 26(1), pp. 61–95.

Morgan, N.A., Katsikeas, C.S. and Vorhies, D.W. (2012) 'Export marketing strategy implementation, export marketing capabilities, and export venture performance', *Journal of the Academy of Marketing Science*, 40(2), pp. 271–289.

Morgan, N.A. and Rego, L.L. (2006) 'The value of different customer satisfaction and loyalty metrics in predicting business performance', *Marketing Science*, 25(5), pp. 426–439. Available at: https://doi.org/10.1287/mksc.1050.0180.

Mount, M. and Martinez, M.G. (2014) 'Social media: A tool for open innovation', *California Management Review*, 56(4), pp. 124–143.

Mu, J. (2015) 'Marketing capability , organizational adaptation and new product development performance', *Industrial Marketing Management*, 49, pp. 151–166.

Mu, J. *et al.* (2018) 'Outside-in marketing capability and firm performance', *Industrial Marketing Management*, 75, pp. 37–54.

Nadkarni, S. and Herrmann, P. (2010) 'CEO personality, strategic flexibility, and firm performance: The case of the Indian business process outsourcing industry', *Academy of Management Journal*, 53(5), pp. 1050–1073.

Nadkarni, S. and Narayanan, V.K. (2007) 'Strategic schemas, strategic flexibility, and firm performance: The moderating role of industry clockspeed', *Strategic Management Journal*, 28, pp. 243–270. Available at: https://doi.org/10.1002/smj.

Nakku, V.B. *et al.* (2020) 'The interrelationship between SME government support programs, entrepreneurial orientation, and performance: A developing economy perspective', *Journal of Small Business Management*, 58(1), pp. 2–31.

Naqshbandi, M.M. and Jasimuddin, S.M. (2018) 'Knowledge-oriented leadership and open innovation: Role of knowledge management capability in France-based multinationals', *International Business Review*, 27(3), pp. 701–713.

Naqshbandi, M.M. and Tabche, I. (2018) 'The interplay of leadership, absorptive capacity, and organizational learning culture in open innovation: Testing a moderated mediation model', *Technological Forecasting and Social Change*, 133, pp. 156–167. Available at: https://doi.org/10.1016/j.techfore.2018.03.017.

Narasimhan, O., Rajiv, S. and Dutta, S. (2006) 'Absorptive capacity in high-technology markets: The competitive advantage of the haves', *Marketing Science*, 25(5), pp. 510–524. Available at: https://doi.org/10.1287/mksc.1060.0219.

Nath, P., Nachiappan, S. and Ramanathan, R. (2010) 'The impact of marketing capability, operations capability and diversification strategy on performance : A resource-based view', *Industrial Marketing Management*, 39(2), pp. 317–329.

Nerkar, A. and Roberts, P.W. (2004) 'Technological and product-market experience and the success of new product introductions in the pharmaceutical industry', *Strategic Management Journal*, 25(8–9), pp. 779–799. Available at: https://doi.org/10.1002/smj.417.

Newbert, S.L. (2007) 'Empirical research on the resource-based view of the firm: an assessment and suggestions for future research', *Strategic Management Journal*, 28, pp. 121–146. Available at: https://doi.org/10.1002/smj.

Newman, A. *et al.* (2021) 'Entrepreneurial passion: A review, synthesis, and agenda for future research', *Applied Psychology*, 70(2), pp. 816–860.

Nguyen, N. (2017) 'The journey of organizational unlearning: a conversation with William H. Starbuck', *Learning Organization*, 24(1), pp. 58–66.

Nguyen, T.P.T., Huang, F. and Tian, X. (2023a) 'Intellectual property protection need as a driver for open innovation: Empirical evidence from Vietnam', *Technovation*, 123, p.

102714. Available at: https://doi.org/10.1016/j.technovation.2023.102714.

Nguyen, T.P.T., Huang, F. and Tian, X. (2023b) 'When and how does open innovation enhance innovation output? A meta-analysis', *IEEE Transactions on Engineering Management*, 70(5), pp. 1838–1852. Available at: https://doi.org/10.1109/TEM.2021.3061155.

Nielsen, B.B., Asmussen, C.G. and Weatherall, C.D. (2017) 'The location choice of foreign direct investments: Empirical evidence and methodological challenges', *Journal of World Business*, 52(1), pp. 62–82. Available at: https://doi.org/10.1016/j.jwb.2016.10.006.

Nobakht, M. *et al.* (2020) 'Exploring the relationship between open innovation and organisational ambidexterity: the moderating effect of entrepreneurial orientation', *Innovation: Organization and Management*, 23(1), pp. 71–92. Available at: https://doi.org/10.1080/14479338.2020.1758566.

Nofal, A.M. *et al.* (2018) 'Biology and management: A review, critique, and research agenda', *Journal of Management*, 44(1), pp. 7–31.

Obradović, T., Vlačić, B. and Dabić, M. (2021) 'Open innovation in the manufacturing industry: A review and research agenda', *Technovation*, 102, p. 102221 Available at: https://doi.org/10.1016/j.technovation.2021.102221.

Odongo, J. (2014) 'Lending terms and financial performance Of small medium enterprises In Uganda : Case of Soroti District', *Research Journal of Finance and Accounting*, 5(2), pp. 78–91.

OECD (2020) *Gross domestic spending on R&D*. Retrieved from https://data.oecd.org/rd/gross-domestic-spending-on-r-d.htm

Ogink, R.H.A.J. *et al.* (2023) 'Mechanisms in open innovation: A review and synthesis of the literature', *Technovation*, 119, p. 102621.

Oh, I. *et al.* (2009) 'Evaluation of credit guarantee policy using propensity score matching', *Small Business Economics*, 33(3), pp. 335–351.

Ollila, S. and Yström, A. (2017) 'An investigation into the roles of open innovation collaboration managers', *R and D Management*, 47(2), pp. 236–252. Available at: https://doi.org/10.1111/radm.12197.

Oltra, M.J., Flor, M.L. and Alfaro, J.A. (2018) 'Open innovation and firm performance: the role of organizational mechanisms', *Business Process Management Journal*, 24(3), pp. 814–836. Available at: https://doi.org/10.1108/BPMJ-05-2016-0098.

Ortega, M.J.R. (2010) 'Competitive strategies and firm performance: Technological capabilities' moderating roles', *Journal of Business Research*, 63(12), pp. 1273–1281. Available at: https://doi.org/10.1016/j.jbusres.2009.09.007.

Ovuakporie, O.D. *et al.* (2021) 'Differential moderating effects of strategic and operational reconfiguration on the relationship between open innovation practices and innovation performance', *Research Policy*, 50(1), p. 104146.

Pagell, M. and Krause, D.R. (2004) 'Re-exploring the relationship between flexibility and the external environment', *Journal of Operations Management*, 21(6), pp. 629–649. Available at: https://doi.org/10.1016/j.jom.2003.11.002.

Paik, J. and Chang, H.J. (2015) 'Post-catch-up strategy for medium-sized South Korean firms: Improving technological capabilities by balancing R&D intensity and open innovation', *Engineering Management Journal*, 27(4), pp. 164–176.

Papa, A. *et al.* (2020) 'Improving innovation performance through knowledge acquisition: the moderating role of employee retention and human resource management practices', *Journal of Knowledge Management*, 24(3), pp. 589–605. Available at: https://doi.org/10.1108/JKM-09-2017-0391.

Papa, A. *et al.* (2021) 'Harvesting reflective knowledge exchange for inbound open innovation in complex collaborative networks: an empirical verification in Europe', *Journal of Knowledge Management*, 25(4), pp. 669–692. Available at: https://doi.org/10.1108/JKM-

04-2020-0300.

Parasuraman, A. (2010) 'Service productivity, quality and innovation: Implications for service-design practice and research', *International Journal of Quality and Service Sciences*, 2(3), pp. 277–286. Available at: https://doi.org/10.1108/17566691011090026.

Pergelova, A. and Angulo-Ruiz, F. (2014) 'The impact of government financial support on the performance of new firms: the role of competitive advantage as an intermediate outcome', *Entrepreneurship and Regional Development*, 26(9–10), pp. 663–705. Available at: https://doi.org/10.1080/08985626.2014.980757.

Podsakoff, P.M. *et al.* (2003) 'Common method biases in behavioral research: A critical review of the literature and recommended remedies', *Journal of Applied Psychology*, 88(5), pp. 879–903. Available at: https://doi.org/10.1037/0021-9010.88.5.879.

Popa, S., Soto-Acosta, P. and Martinez-Conesa, I. (2017) 'Antecedents, moderators, and outcomes of innovation climate and open innovation: An empirical study in SMEs', *Technological Forecasting and Social Change*, 118, pp. 134–142. Available at: https://doi.org/10.1016/j.techfore.2017.02.014.

Porter, M.E. (2008) *Competitive advantage: Creating and sustaining superior performance*. New York: Free Press.

PricewaterhouseCoopers (2017) *Reinventing innovation: five findings to guide strategy through execution*. Available at: https://www.pwc.com/us/en/advisory-se%0Arvices/business-innovation/assets/2017-innovation-benchmark-findings.pdf%0A.

Priem, R.L. and Butler, J.E. (2001) 'Is the resource-based "view" a useful perspective for strategic management research?', *Academy of Management Review*, 26(1), pp. 22–40.

Pundziene, A., Nikou, S. and Bouwman, H. (2021) 'The nexus between dynamic capabilities and competitive firm performance: the mediating role of open innovation', *European Journal of Innovation Management*, 25(6), pp. 152–177. Available at:

https://doi.org/10.1108/EJIM-09-2020-0356.

Purdy, L. *et al.* (2023) 'Technology sourcing and the dark side of open innovation: Evidence from the biopharmaceutical sector', *Technovation*, 119, p. 102521.

Radnejad, A.B., Vredenburg, H. and Woiceshyn, J. (2017) 'Meta-organizing for open innovation under environmental and social pressures in the oil industry', *Technovation*, 66–67, pp. 14–27. Available at: https://doi.org/10.1016/j.technovation.2017.01.002.

Radziwon, A. and Bogers, M. (2019) 'Open innovation in SMEs: Exploring inter-organizational relationships in an ecosystem', *Technological Forecasting and Social Change*, 146, pp. 573–587. Available at: https://doi.org/10.1016/j.techfore.2018.04.021.

Raff, D.M.G. (2000) 'Superstores and the evolution of firm capabilities in American bookselling', *Strategic Management Journal*, 21(10–11), pp. 1043–1059. Available at: https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1043::aid-smj137>3.0.co;2-7.

Ramadani, V. *et al.* (2019) 'Product innovation and firm performance in transition economies: A multi-stage estimation approach', *Technological Forecasting and Social Change*, 140, pp. 271–280. Available at: https://doi.org/10.1016/j.techfore.2018.12.010.

Ranaweera, C. and Jayawardhena, C. (2014) 'Talk up or criticize? Customer responses to WOM about competitors during social interactions', *Journal of Business Research*, 67(12), pp. 2645–2656. Available at: https://doi.org/10.1016/j.jbusres.2014.04.002.

Randhawa, K., Wilden, R. and Hohberger, J. (2016) 'A Bibliometric Review of Open Innovation: Setting a Research Agenda', *Journal of Product Innovation Management*, 33(6), pp. 750–772. Available at: https://doi.org/10.1111/jpim.12312.

Rangus, K. and Černe, M. (2019) 'The impact of leadership influence tactics and employee openness toward others on innovation performance', *R and D Management*, 49(2), pp. 168–179. Available at: https://doi.org/10.1111/radm.12298.

Rangus, K. and Slavec, A. (2017) 'The interplay of decentralization, employee involvement

and absorptive capacity on firms' innovation and business performance', *Technological Forecasting and Social Change*, 120, pp. 195–203.

Riccaboni, M., Wang, X. and Zhu, Z. (2021) 'Firm performance in networks: The interplay between firm centrality and corporate group size', *Journal of Business Research,* 129, pp. 641-653.

Rodgers, C.S. (1992) 'The flexible workplace: What have we learned?', *Human Resource Management*, 31(3), pp. 183–199.

Roh, T., Lee, K. and Yang, J.Y. (2021) 'How do intellectual property rights and government support drive a firm's green innovation? The mediating role of open innovation', *Journal of Cleaner Production*, 317(July), pp. 128422.

Roper, S., Vahter, P. and Love, J.H. (2013) 'Externalities of openness in innovation', *Research Policy*, 42(9), pp. 1544–1554. Available at: https://doi.org/10.1016/j.respol.2013.05.006.

Rotger, G.P., Gørtz, M. and Storey, D.J. (2012) 'Assessing the effectiveness of guided preparation for new venture creation and performance: Theory and practice', *Journal of Business Venturing*, 27(4), pp. 506–521.

Rouyre, A. and Fernandez, A.S. (2019) 'Managing knowledge sharing-protecting tensions in coupled innovation projects among several competitors', *California Management Review*, 62(1), pp. 95–120. Available at: https://doi.org/10.1177/0008125619885151.

Rumanti, A.A. *et al.* (2020) 'Cleaner production through open innovation in Indonesian batik small and medium enterprises (SME)', *TQM Journal*. 33(6), pp. 1347–1372. Available at: https://doi.org/10.1108/TQM-04-2020-0086.

Saini, A. and Johnson, J.L. (2005) 'Organizational capabilities in e-commerce: An empirical investigation of e-brokerage service providers', *Journal of the Academy of Marketing Science*, 33(3), pp. 360–375. Available at: https://doi.org/10.1177/0092070305276150.

Salampasis, D. and Mention, A.L. (2019) 'From a-value to value-multiplication: leveraging

outbound open innovation practices for unrelated diversification in the sensor industry', *Technology Analysis and Strategic Management*, 31(11), pp. 1327–1340.

Salge, T.O. *et al.* (2013) 'When does search openness really matter? A contingency study of health-care innovation projects', *Journal of Product Innovation Management*, 30(4), pp. 659–676. Available at: https://doi.org/10.1111/jpim.12015.

Salter, A. *et al.* (2015) 'Open for ideation: Individual-level openness and idea generation in R&D', *Journal of Product Innovation Management*, 32(4), pp. 488–504. Available at: https://doi.org/10.1111/jpim.12214.

Sanchez, R. (1995) 'Strategic flexibility in product competition', *Strategic Management Journal*, 16, pp. 135–159.

Santa, M. (2015) 'Learning organisation review – a "good" theory perspective', *Learning Organization*, 22(5), pp. 242–270. Available at: https://doi.org/10.1108/TLO-12-2014-0067.

Santoro, G. *et al.* (2018) 'How SMEs engage in open innovation: A survey', *Journal of the Knowledge Economy*, 9(2), pp. 561–574. Available at: https://doi.org/10.1007/s13132-015-0350-8.

Santoro, G. *et al.* (2020) 'The interplay among entrepreneur, employees, and firm level factors in explaining SMEs openness: A qualitative micro-foundational approach', *Technological Forecasting and Social Change*, 151, p. 119820.

Santos-Vijande, M.L., López-Sánchez, J.Á. and Trespalacios, J.A. (2012) 'How organizational learning affects a firm's flexibility, competitive strategy, and performance', *Journal of Business Research*, 65(8), pp. 1079–1089.

Saridakis, G., Mole, K. and Hay, G. (2013) 'Liquidity constraints in the first year of trading and firm performance', *International Small Business Journal*, 31(5), pp. 520–535. Available at: https://doi.org/10.1177/0266242611410091.

Saunders, M., Lewis, P. and Thornhill, A. (2007) *Research methods*. 4th edition. England: Business Students Pearson Education Limited.

Scaliza, J.A.A. *et al.* (2022) 'Relationships among organizational culture, open innovation, innovative ecosystems, and performance of firms: Evidence from an emerging economy context', *Journal of Business Research*, 140, pp. 264–279. Available at: https://doi.org/10.1016/j.jbusres.2021.10.065.

Scarborough, N. M. (2011). *Essentials of Entrepreneurship and Small Business Management.* Upper Saddle River, NJ: Pearson Prentice-Hall

Schäper, T. *et al.* (2023) 'The s-shaped relationship between open innovation and financial performance: A longitudinal perspective using a novel text-based measure', *Research Policy*, 52(6). Available at: https://doi.org/10.1016/j.respol.2023.104764.

Scott, R. (1987) *Organizations: Rational, Natural and Open Systems*. Upper Saddle River, NJ, USA: Prentice-Hall.

Sears, J. and Hoetker, G. (2014) 'Technological overlap, technological capabilities, and resource recombination in technological acquisitions', *Strategic Management Journal*, 35, pp. 48–67. Available at: https://doi.org/10.1002/smj.

Sengupta, A. and Sena, V. (2020) 'Impact of open innovation on industries and firms – A dynamic complex systems view', *Technological Forecasting and Social Change*, 159(June), p. 120199. Available at: https://doi.org/10.1016/j.techfore.2020.120199.

Seo, E., Song, J. and Jin, C. (2023) 'Heterogeneity of optimal balance between exploration and exploitation:the moderating roles of firm technological capability and industry alliance network position', *Industry and Innovation*, 30(4), pp. 423–451.

Seo, R. and Park, J.H. (2022) 'When is interorganizational learning beneficial for inbound open innovation of ventures? A contingent role of entrepreneurial orientation', *Technovation*, 116, p. 102514. Available at: https://doi.org/10.1016/j.technovation.2022.102514.

Shaikh, I. and Randhawa, K. (2022) 'Managing the risks and motivations of technology managers in open innovation: Bringing stakeholder-centric corporate governance into focus', *Technovation*, 114, p. 102437.

Sheehan, M., Garavan, T.N. and Morley, M.J. (2020) 'Transformational leadership and work unit innovation: A dyadic two-wave investigation', *Journal of Business Research*, 109, pp. 399–412. Available at: https://doi.org/10.1016/j.jbusres.2019.10.072.

Shih, T.Y. (2022) 'Exploring the effects of prospective corporate social responsibility on firm performance: the mediating role of innovation', *Technology Analysis and Strategic Management*, pp. 1–13. Available at: https://doi.org/10.1080/09537325.2022.2033201.

Shimizu, K. and Hitt, M.A. (2004) 'Strategic flexibility: Organizational preparedness to reverse ineffective strategic decisions', *Academy of Management Executive*, 18(4), pp. 44–59. Available at: https://doi.org/10.5465/AME.2004.15268683.

Short, J. (2009) 'The art of writing a review article', *Journal of Management*, 35(6), pp. 1312–1317. Available at: https://doi.org/10.1177/0149206309337489.

Shou, Z. *et al.* (2014) 'Firm capability and performance in China: The moderating role of guanxi and institutional forces in domestic and foreign contexts', *Journal of Business Research*, 67(2), pp. 77–82. Available at: https://doi.org/10.1016/j.jbusres.2012.11.014.

Shukla, P., Rosendo-Rios, V. and Khalifa, D. (2022) 'Is luxury democratization impactful? Its moderating effect between value perceptions and consumer purchase intentions', *Journal of Business Research*, 139, pp. 782–793. A

Sikimic, U. *et al.* (2016) 'Investigating the influence of technology inflows on technology outflows in open innovation processes: A longitudinal analysis', *Journal of Product Innovation Management*, 33(6), pp. 652–669.

Silva, S.E. *et al.* (2020) 'Open innovation in science parks: The role of public policies', *Technological Forecasting and Social Change*, 151, p. 119844. Available at:

https://doi.org/10.1016/j.techfore.2019.119844.

Singh, R. *et al.* (2022) 'Network cooperation and economic performance of SMEs: Direct and mediating impacts of innovation and internationalisation', *Journal of Business Research*, 148, pp. 116–130. Available at: https://doi.org/10.1016/j.jbusres.2022.04.032.

Singh, S.K. *et al.* (2021) 'Top management knowledge value, knowledge sharing practices, open innovation and organizational performance', *Journal of Business Research*, 128, pp. 788–798. Available at: https://doi.org/10.1016/j.jbusres.2019.04.040.

Sisodiya, S.R., Johnson, J.L. and Grégoire, Y. (2013) 'Inbound open innovation for enhanced performance: Enablers and opportunities', *Industrial Marketing Management*, 42(5), pp. 836–849. Available at: https://doi.org/10.1016/j.indmarman.2013.02.018.

Sivadas, E. and Dwyer, F.R. (2000) 'An examination of organizational factors influencing new product success in internal and alliance-based processes', *Journal of Marketing*, 64(1), pp. 31–49. Available at: https://doi.org/10.1509/jmkg.64.1.31.17985.

Sofka, W. and Grimpe, C. (2010) 'Specialized search and innovation performance - evidence across Europe', *R and D Management*, 40(3), pp. 310–323.

Song, J. *et al.* (2022) 'The choice and acquisition of external knowledge in startups: matching improvisation to strategic flexibility', *Management Decision*, 60(11), pp. 2928–2951. Available at: https://doi.org/10.1108/MD-04-2021-0467.

Song, M., Wang, T. and Parry, M.E. (2010) 'Do market information processes improve new venture performance?', *Journal of Business Venturing*, 25(6), pp. 556–568. Available at: https://doi.org/10.1016/j.jbusvent.2009.03.003.

Spithoven, A. and Teirlinck, P. (2015) 'Internal capabilities, network resources and appropriation mechanisms as determinants of R&D outsourcing', *Research Policy*, 44(3), pp. 711–725. Available at: https://doi.org/10.1016/j.respol.2014.10.013.

Spithoven, A., Vanhaverbeke, W. and Roijakkers, N. (2013) 'Open innovation practices in

SMEs and large enterprises', *Small Business Economics*, 41(3), pp. 537–562. Available at: https://doi.org/10.1007/s11187-012-9453-9.

Starbuck, W.H. (2017) 'Organizational learning and unlearning', *Learning Organization*, 24(1), pp. 30–38. Available at: https://doi.org/10.1108/TLO-11-2016-0073.

Stephan, U., Andries, P. and Daou, A. (2019) 'Goal multiplicity and innovation: How social and economic goals affect open innovation and innovation performance', *Journal of Product Innovation Management*, 36(6), pp. 721–743.

Su, Z. *et al.* (2013) 'Technological capability, marketing capability, and firm performance in turbulent conditions', 9(1), pp. 115–137. Available at: https://doi.org/10.1111/j.l.

Sun, W., Ding, Z. and Price, J. (2020) 'Board structure and fi rm capability : An environment-embedded relationship between board diversity and marketing capability', *Industrial Marketing Management*, 90, pp. 14–29.

Sun, Y., Liu, J. and Ding, Y. (2020) 'Analysis of the relationship between open innovation, knowledge management capability and dual innovation', *Technology Analysis and Strategic Management*, 32(1), pp. 15–28.

Taghizadeh, S.K. *et al.* (2020) 'Technological capabilities, open innovation and perceived operational performance in SMEs: the moderating role of environmental dynamism', *Journal of Knowledge Management,* 25(6), pp. 1486–1507.

Tatikonda, M. V. and Montoya-Weiss, M.M. (2001) 'Integrating operations and marketing perspectives of product innovation: The influence of organizational process factors and capabilities on development performance', *Management Science*, 47(1), pp. 151–172.

Teece, D.J. (1986) 'Profiting from technological innovation: Implications for integration, collaboration, licensing and public policy', *Research policy*, 15, pp. 285–305.

Teece, D.J. (2007) 'Explicating dynamic capabilities: the nature and microfoundations of (sustainable) enterprise performance', *Strategic management journal*, 28, pp. 1319–1350.

Available at: https://doi.org/10.1002/smj.

Teece, D.J., Pisano, G. and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Managent Journal*, 18(7), pp. 509–533.

Tett, R.P. and Guterman, H.A. (2000) 'Situation trait relevance, trait expression, and cross-situational consistency: Testing a principle of trait activation', *Journal of Research in Personality*, 34(4), pp. 397–423. Available at: https://doi.org/10.1006/jrpe.2000.2292.

Theoharakis, V. and Hooley, G. (2008) 'Customer orientation and innovativeness: Differing roles in New and Old Europe', *International Journal of Research in Marketing*, 25(1), pp. 69–79. Available at: https://doi.org/10.1016/j.ijresmar.2007.09.007.

Thong, R. and Lotta, T. (2015) 'Creating a culture of productivity and collaborative innovation: Orion's R&D transformation', *Research Technology Management*, 58(3), pp. 41–50. Available at: https://doi.org/10.5437/08956308X5803309.

Thornton, S.C., Henneberg, S.C. and Naudé, P. (2015) 'An empirical investigation of network-oriented behaviors in business-to-business markets', *Industrial Marketing Management*, 49, pp. 167–180. Available at: https://doi.org/10.1016/j.indmarman.2015.05.013.

Tsai, F.S. *et al.* (2022) 'Open innovation and SME performance: The roles of reverse knowledge sharing and stakeholder relationships', *Journal of Business Research*, 148, pp. 433–443. Available at: https://doi.org/10.1016/j.jbusres.2022.03.051.

Tuggle, F.D. (2016) 'Gaps and progress in our knowledge of learning organizations', *Learning Organization*, 23(6), pp. 444–457. Available at: https://doi.org/10.1108/TLO-09-2016-0059.

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

Vanino, E., Roper, S. and Becker, B. (2019) 'Knowledge to money: Assessing the business

performance effects of publicly-funded R&D grants', *Research Policy*, 48(7), pp. 1714–1737. Available at: https://doi.org/10.1016/j.respol.2019.04.001.

Varadarajan, P.R. (1992) 'Marketing's contribution to strategy: The view from a different looking glass.', *Journal of the Academy of Marketing Science*, 20(4), pp. 335–343.

Vorhies, D.W. and Morgan, N.A. (2005) 'Benchmarking marketing capabilities for sustainable', *Journal of Marketing*, 69(1), pp. 80–94.

Vorhies, D.W., Morgan, R.E. and Autry, C.W. (2009) 'Product-market strategy and the marketing capabilities of the firm: impact on market effectiveness and cash flow performance', *Strategic Management Journal*, 30, pp. 1310–1334.

van de Vrande, V. *et al.* (2009) 'Open innovation in SMEs: Trends, motives and management challenges', *Technovation*, 29(6–7), pp. 423–437.

van de Vrande, V., Vanhaverbeke, W. and Duysters, G. (2011) 'Additivity and complementarity in external technology sourcing: The added value of corporate venture capital investments', *IEEE Transactions on Engineering Management*, 58(3), pp. 483–496. Available at: https://doi.org/10.1109/TEM.2010.2091134.

Wadhwa, A., Freitas, I.M.B. and Sarkar, M.B. (2017) 'The paradox of openness and value protection strategies: Effect of extramural R & D on innovative performance', *Organization Science*, 28(5), pp. 873–893. Available at: https://doi.org/10.1287/orsc.2017.1145.

Wang, C., Chin, T. and Lin, J.H. (2020) 'Openness and firm innovation performance: the moderating effect of ambidextrous knowledge search strategy', *Journal of Knowledge Management*, 24(2), pp. 301–323. Available at: https://doi.org/10.1108/JKM-04-2019-0198.

Wang, C.H., Chang, C.H. and Shen, G.C. (2015) 'The effect of inbound open innovation on firm performance: Evidence from high-tech industry', *Technological Forecasting and Social Change*, 99, pp. 222–230. Available at: https://doi.org/10.1016/j.techfore.2015.07.006.

Wang, L., Jin, J.L. and Zhou, K.Z. (2023) 'Technological capability strength/asymmetry and

supply chain process innovation: The contingent roles of institutional environments', *Research Policy*, 52(4), p. 104724.

Wang, Y. and Guo, B. (2020) 'Managing external knowledge search: the multiple and contingent roles of absorptive capacity', *Technology Analysis and Strategic Management*, 32(1), pp. 29–43. Available at: https://doi.org/10.1080/09537325.2019.1632821.

Wang, Y., Guo, B. and Yin, Y. (2017) 'Open innovation search in manufacturing firms: the role of organizational slack and absorptive capacity', *Journal of Knowledge Management*, 21(3), pp. 656–674. Available at: https://doi.org/10.1108/JKM-09-2016-0368.

Wang, Y. and Li-Ying, J. (2014) 'When does inward technology licensing facilitate firms' NPD performance? A contingency perspective', *Technovation*, 34(1), pp. 44–53. Available at: https://doi.org/10.1016/j.technovation.2013.09.002.

Wang, Y., Vanhaverbeke, W. and Roijakkers, N. (2012) 'Exploring the impact of open innovation on national systems of innovation - A theoretical analysis', *Technological Forecasting and Social Change*, 79(3), pp. 419–428.

Weerawardena, J. (2003) 'The role of marketing capability in innovation-based competitive strategy', *Journal of Strategic Marketing*, 11(1), pp. 15–35.

Wei, J. and Liu, Y. (2015) 'Government support and firm innovation performance: Empirical analysis of 343 innovative enterprises in China', *Chinese Management Studies*, 9(1), pp. 38–55. Available at: https://doi.org/10.1108/CMS-01-2015-0018.

West, J. (2020) 'Localized knowledge flows and asymmetric motivations in open innovation', *Journal of Innovation Economics and Management*, 32(2), pp. 181–196. Available at: https://doi.org/10.3917/jie.032.0181.

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

Wiklund, J. and Shepherd, D. (2003) ‘Knowledge-based resources, entrepreneurial orientation, and the performance of small and medium-sized businesses’, *Strategic Management Journal*, 24(13), pp. 1307–1314. Available at: https://doi.org/10.1002/smj.360.

Woods, J., Galbraith, B. and Hewitt-Dundas, N. (2019) ‘Network centrality and open innovation: A social network analysis of an SME manufacturing cluster’, *IEEE Transactions on Engineering Management*, pp. 1–14.

Wright, P.M. and Snell, S.A. (1998) ‘Toward a unifying framework for exploring fit and flexibility in strategic human resource Mmnagement’, *Academy of Management Review*, 23(4), pp. 756–772.

Wu, Y.C., Lin, B.W. and Chen, C.J. (2013) ‘How do internal openness and external openness affect innovation capabilities and firm performance?’, *IEEE Transactions on Engineering Management*, 60(4), pp. 704–716.

Xia, T. and Roper, S. (2016) ‘Unpacking open innovation: Absorptive capacity, exploratory and exploitative openness, and the growth of entrepreneurial biopharmaceutical firms’, *Journal of Small Business Management*, 54(3), pp. 931–952.

Yang, D. *et al.* (2020) 'The fit between market learning and organizational capabilities for management innovation', *Industrial Marketing Management,* 86, pp. 223-232.

Yi, J., Wang, C. and Kafouros, M. (2013) ‘The effects of innovative capabilities on exporting: Do institutional forces matter?’, *International Business Review*, 22(2), pp. 392–406. Available at: https://doi.org/10.1016/j.ibusrev.2012.05.006.

Yildirim, E. *et al.* (2022) ‘A multi-stage decision making model for determining a suitable innovation structure using an open innovation approach’, *Journal of Business Research*, 147(April), pp. 379–391. Available at: https://doi.org/10.1016/j.jbusres.2022.03.063.

Yin, K. *et al.* (2022) ‘CEO transformational leadership and firm innovation: the role of strategic flexibility and top management team knowledge diversity’, *Chinese Management Studies*

[Preprint], (71802019). Available at: https://doi.org/10.1108/CMS-10-2021-0440.

Zacharias, N.A., Daldere, D. and Winter, C.G.H. (2020) 'Variety is the spice of life: How much partner alignment is preferable in open innovation activities to enhance firms' adaptiveness and innovation success?', *Journal of Business Research*, 117(June), pp. 290–301. Available at: https://doi.org/10.1016/j.jbusres.2020.05.055.

Zahoor, N., and Al-Tabbaa, O. (2020) 'Inter-organizational collaboration and SMEs' innovation: A systematic review and future research directions', *Scandinavian Journal of Management,* 36(2), p. 101109

Zahoor, N. and Lew, Y.K. (2023) 'Enhancing international marketing capability and export performance of emerging market SMEs in crises: strategic flexibility and digital technologies', *International Marketing Review* [Preprint]. Available at: https://doi.org/10.1108/IMR-12-2021-0350.

Zahra, S.A. *et al.* (2008) 'Culture of family commitment and strategic flexibility: The moderating effect of stewardship.', *Entrepreneurship: Theory and Practice*, 32(6), pp. 1035–1054.

Zang, J. *et al.* (2014) 'How open search strategies align with firms' radical and incremental innovation: evidence from China', *Technology Analysis and Strategic Management*, 26(7), pp. 781–795. Available at: https://doi.org/10.1080/09537325.2014.899345.

Zang, J. and Li, Y. (2017) 'Technology capabilities, marketing capabilities and innovation ambidexterity', *Technology Analysis and Strategic Management*, 29(1), pp. 23–37. Available at: https://doi.org/10.1080/09537325.2016.1194972.

Zhang *et al.* (2018) 'Sustainable supply chain management: Confirmation of a higher-order model', *Resources, Conservation and Recycling*, 128, pp. 206–221. Available at: https://doi.org/10.1016/j.resconrec.2016.06.015.

Zhang, J. (2016) 'Facilitating exploration alliances in multiple dimensions: The influences of

firm technological knowledge breadth', *R and D Management*, 46, pp. 159–173. Available at: https://doi.org/10.1111/radm.12127.

Zhang, M. and Merchant, H. (2020) 'A causal analysis of the role of institutions and organizational proficiencies on the innovation capability of Chinese SMEs', *International Business Review*, 29(2), p. 101638.

Zhang, S. *et al.* (2018) 'Open innovation and firm performance: Evidence from the Chinese mechanical manufacturing industry', *Journal of Engineering and Technology Management*, 48, pp. 76–86. Available at: https://doi.org/10.1016/j.jengtecman.2018.04.004.

Zhang, X. *et al.* (2023) 'Open innovation and sustainable competitive advantage: The role of organizational learning', *Technological Forecasting and Social Change*, 186, p. 122114. Available at: https://doi.org/10.1016/j.techfore.2022.122114.

Zhao, S., Xu, B. and Zhang, W. (2018) 'Government R&D subsidy policy in China: An empirical examination of effect, priority, and specifics', *Technological Forecasting and Social Change*, 135, pp. 75–82. Available at: https://doi.org/10.1016/j.techfore.2017.10.004.

Zhao, Y., Lu, Y. and Wang, X. (2013) 'Organizational unlearning and organizational relearning: A dynamic process of knowledge management', *Journal of Knowledge Management*, 17(6), pp. 902–912. Available at: https://doi.org/10.1108/JKM-06-2013-0242.

Zhao, Y. and Wang, X. (2020) 'Organisational unlearning, relearning and strategic flexibility: from the perspective of updating routines and knowledge', *Technology Analysis and Strategic Management*, 32(11), pp. 1251–1263.

Zhou, H. *et al.* (2019) 'The moderating role of knowledge structure in the open innovation effect', *Management Decision*, 57(9), pp. 2223–2238.

Zhou, H., Yao, Y. and Chen, H. (2018) 'How does open innovation affect firms' innovative performance : The roles of knowledge attributes and partner opportunism', *Chinese Management Studies*, 12(4), pp. 720–740. Available at: https://doi.org/10.1108/CMS-05-

2017-0137.

Zhou, K.Z. *et al.* (2007) 'The effects of customer and competitor orientations on performance in global markets: A contingency analysis', *Journal of International Business Studies*, 38(2), pp. 303–319. Available at: https://doi.org/10.1057/palgrave.jibs.8400259.

Zhou, K.Z. *et al.* (2014) 'The evolving role of managerial ties and firm capabilities in an emerging economy: evidence from China', *Journal of the Academy of Marketing Science*, 42(6), pp. 581–595. Available at: https://doi.org/10.1007/s11747-014-0371-z.

Zhou, K.Z. and Wu, F. (2010) 'Technological capability, strategic flexibility, and product innovation', *Strategic Management Journal*, 31, pp. 547–561.

Zhu, H. *et al.* (2023) 'The effect of open innovation on manufacturing firms' performnce in China: The moderating Role of social capital', *Sustainability (Switzerland)*, 15(7), pp. 1–15. Available at: https://doi.org/10.3390/su15075854.

Zhu, X. *et al.* (2017) 'How do informal ties drive open innovation? the contingency role of market dynamism', *IEEE Transactions on Engineering Management*, 64(2), pp. 208–219. Available at: https://doi.org/10.1109/TEM.2017.2654362.

Zhu, X. *et al.* (2019) 'The fit between firms' open innovation and business model for new product development speed: A contingent perspective', *Technovation*, 86–87 pp. 75–85. Available at: https://doi.org/10.1016/j.technovation.2019.05.005.

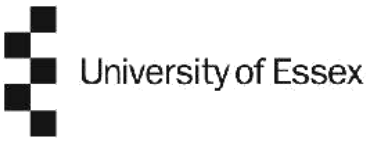
Zobel, A.K. (2017) 'Benefiting from open innovation: A multidimensional model of absorptive capacity*', *Journal of Product Innovation Management*, 34(3), pp. 269–288. Available at: https://doi.org/10.1111/jpim.12361.

Zobel, A.K., Balsmeier, B. and Chesbrough, H. (2016) 'Does patenting help or hinder open innovation? Evidence from new entrants in the solar industry', *Industrial and Corporate Change*, 25(2), pp. 307–331. Available at: https://doi.org/10.1093/icc/dtw005.

Zobel, A.K., Lokshin, B. and Hagedoorn, J. (2017) ‘Formal and informal appropriation mechanisms: The role of openness and innovativeness’, *Technovation*, 59, pp. 44–54. Available at: https://doi.org/10.1016/j.technovation.2016.10.001.

Appendices

Appendix A: Ethical Approval



01/07/2022

Mr Cephas Tetteh

Essex Business School

University of Essex

Dear Cephas,

Ethics Committee Decision

Application: ETH2122-1561

I am pleased to inform you that the research proposal entitled "Antecedents and Outcome of Open Innovation" has been reviewed on behalf of the Ethics Sub Committee 3, and, based on the information provided, it has been awarded a favourable opinion.

The application was awarded a favourable opinion subject to the following **conditions**:

Extensions and Amendments:

If you propose to introduce an amendment to the research after approval or extend the duration of the study, an amendment should be submitted in ERAMS for further approval in advance of the expiry date listed in the ethics application form. Please note that it is not possible to make any amendments, including extending the duration of the study, once the expiry date has passed.

Covid-19:

Please note that the current Government guidelines in relation to Covid-19 must be adhered to and are subject to change and it is your responsibility to keep yourself informed and bear in mind the possibility of change when planning your research. You will be kept informed if there are any changes in the University guidelines.

Yours sincerely,

Casper Hoedemaekers

Appendix B: Survey Questionnaire

Technological Capability (Zhou and Wu, 2010)

Compared to your major competitors, how would you evaluate your firm's capabilities in the following areas. **(1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better).**								
		1	2	3	4	5	6	7
TC1	Acquiring important technological information							
TC2	Identifying new technology opportunities							
TC3	Responding to technological changes							
TC4	Mastering the state-of-art technologies							
TC5	Developing a series of innovation constantly							

Marketing Capability (Zhou *et al.,* 2014)

Compared to your major competitors, how would you evaluate your firm's capabilities in the following areas. **(1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better).**								
		1	2	3	4	5	6	7
MK1	We devote substantial resources to understanding customer needs							
MK2	All of our business functions are integrated in serving the needs of our target market							
MK3	We frequently launch new advertising campaigns to promote our products							
MK4	We have extensive distribution channel coverage to make our products widely available							

Government Support (Zhang and Merchant, 2020).

Please indicate the extent to which you agree or disagree with each of these statements about your organisation. **(1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)**								
		1	2	3	4	5	6	7
	In supporting of local business, the government and its agencies have...							
GS1	…provided needed technology information and other technical support							
GS2	…provided important market information							
GS3	…played a significant role in providing financial support							

GS4	…helped firms obtain licenses for import of technology, manufacturing and raw material, and other equipment							

Organisational Relearning (Zhao and Wang, 2020).

Please indicate your level of agreement or disagreement with the following statements about your organisation. **(1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)**								
RE1	New information sharing-mechanism which further promotes the acquisition of knowledge can be established	1	2	3	4	5	6	7
RE2	New decision-making processes which further promotes the acquisition of knowledge can be established							
RE3	New routines and beliefs which facilitate the acquisition of knowledge can be developed							
RE4	The relearning context is propitious/favourable to the acquisition of knowledge							
RE5	Firms can introduce new knowledge and skills which conflict with existing ones							

Strategic Flexibility (Miroshnychenko *et al.*, 2021)

Please indicate the extent to which your organisation responds to changes in the environment. **(1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)**								
SF1	If circumstances change, our organisation can easily change its current plans	1	2	3	4	5	6	7
SF2	If circumstances change, our organisation is prepared to react in a modified and viable manner							
SF3	If circumstances change, our organisation has the necessary practical knowledge to make shifts in daily routines and practices							
SF4	If circumstances change, our organisation can pro-actively develop a new project							
SF5	If circumstances change, our organisation can control a shift in strategy							
SF6	If circumstances change, our organisation can shift projects with a probability of success.							

Open Innovation (Cheng and Huizingh, 2014)

IO = Inbound Open Innovation

OI = Outbound Open Innovation

Regarding your firm, to what extent do you agree or disagree with the following statements? **(1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)**								
		1	2	3	4	5	6	7
INB1	External partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities are directly involved in all our innovation projects.							
INB2	All our innovation projects are highly dependent upon the contribution of external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities							
INB3	Our firm often buys R&D-related services from external partners, such as customers, competitors, research institutes, consultants, suppliers, government, or universities							
INB4	Our firm often buys intellectual property, such as patents, copyrights, or trademarks, from external partners to be used in our innovation projects							
INB5	Our firm invests in other firms because we would like to obtain synergies that are beneficial to our innovation projects							
OUT1	Our firm often sells licenses, such as patents, copyrights, or trademarks, to other firms so as to better benefit from our innovation efforts							
OUT2	Our firm often offers royalty agreements to other firms to better benefit from our innovation efforts							
OUT3	Our firm strengthens every possible use of our own intellectual properties so as to better benefit our firm							
OUT4	Our firm founds spin-offs to better benefit from our innovation efforts							

Innovation Performance (Scaliza *et al.* 2022)

Please indicate the extent to which you agree or disagree with each of these statements about your organisation. **(1 = Strongly Disagree, 2 = Disagree, 3 = Somewhat Disagree, 4 = Neutral, 5 = Somewhat Agree, 6 = Agree, 7 = Strongly Agree)**								
		1	2	3	4	5	6	7
IP1	My company has developed a higher quantity and variety of products and/or services							
IP2	My company has developed new technologies in its production methods and/or services							
IP3	My company has developed new ways to organise and manage work							
IP4	My company has increased its market share with new and improved products and/or services							
IP5	My company has increased its market share with products that are new to the company							

Firm Performance (Ferreras-Méndez *et al.*, 2015)

Please rate the extent to which your firm was successful relative to its major competitors in terms of: **(1 = Much Worse, 2 = Worse, 3 = Slightly Worse, 4 = About the Same, 5 = Slightly Better, 6 = Better, 7 = Much Better).**								
		1	2	3	4	5	6	7
FP1	Customer loyalty							
FP2	Sales growth							
FP3	Profitability							
FP4	Return on investment							