Locational Benefits and Innovation Performance: The Contingency Value of Ambidexterity in Inbound and Outbound Open Innovation, and Absorptive Capacity

by

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A Doctoral Thesis
Submitted in partial fulfilment of the requirements
for the award of
Doctor of Philosophy of Loughborough University

2018

Abstract

Open innovation (OI) is currently being applied as a new mode for firms to utilise both internal and external resources for R&D and new product developments. Investigating the impact of OI on China's high-tech firms is becoming increasingly important. Under the guidance of China's national innovation policy and the rise of innovation in high-tech industries, OI is regarded as having a positive impact on the competitiveness of Chinese firms and as bringing a significant innovation outcome. By utilising and integrating external knowledge and resources, OI can promote high-tech firms' R&D development in China's current transitional environment. A key objective of this thesis is to examine the overall relationship between locational factors, ambidexterity in OI and innovation performance given absorptive capacity (ACAP).

The thesis reviews the current literature regarding OI, ambidexterity in OI, the cluster effect and ACAP and then integrates these lenses to build links for constructing a new model of the research. This includes the relationships between locational factors, ambidexterity in OI and innovation performance. It also examines the moderating effect of ACAP and, more importantly, the mediation effect of ambidexterity in OI on the relationship between locational factors and innovation performance. The findings of the thesis reveal that locational factors positively affect ambidexterity in OI, while ACAP positively moderates the relationship between the two factors. In addition, ambidexterity in OI — an optimal combination of inbound and outbound OI — can significantly influence innovation performance and is crucial to the ambidextrous conduction of firms. ACAP also positively moderates the relationship between ambidexterity in OI and innovation performance. Finally, ambidexterity in OI can mediate the relationship between locational factors and innovation performance, and ACAP moderates the overall relationship between locational factors, ambidexterity in OI and innovation performance.

This thesis makes a number of contributions to the existing OI literature. First, building on the cluster perspective, the thesis contributes to the literature on OI by recognising the influence of locational factors on the balance in OI. The examination of ACAP also contributes to the literature by highlighting the contingent value of ACAP on the relationship between locational factors and the balance in OI. Second, the thesis contributes to the OI literature by bringing a greater conceptual clarity to the view of balance. A more balanced portfolio can bring better innovation performance than those that are less balanced. The thesis also enriches the knowledge in the relationship between the balance in OI and innovation performance, which demonstrates the moderating effect of ACAP on this relationship. Third, the study conceptualises the balance in OI that mediates the relationship between locational factors and innovation performance. It is a key contribution to the existing OI literature by advancing our understanding of the overall relationship among locational factors, the balance in OI and innovation performance.

Key Words Open Innovation Ambidexterity in Open Innovation Locational Factors Innovation Performance Absorptive Capacity

Acknowledgement

I would like to express my sincere gratitude to my supervisors, Dr Helen Xia and Professor Xiaohui Liu, for their excellent guidance, supervision and unconditional support during my doctoral study. This is crucial in completing this thesis. During my studies, Dr Xia has given me great guidance both related to the framework's development and fieldwork design, supporting me to have a systematic consideration of how to penetrate research gaps and address them with appropriate empirical research. Dr Xia also has given me a lot of support when it comes to enhancing my writing, helping push my writing to a greater level for this doctoral study. During Professor Liu' supervisions, she provided a lot of comments that guided me to take a broader perspective regarding the associations and implications among the different theories in this area, supporting me to reach a higher level for the thesis. The contributions and novelty of this research are inseparable from this supervision and academic training I have been given. Both Professor Liu and Dr Xia have cultivated me a lot, which has helped me not only become an excellent doctoral student, but also has enriched my knowledge and skills to guide me in forming a comprehensive perspective and practice to address these research questions and future ones as well. This is a significant contribution to my future studies and career.

I would like to thank Professor Xiaming Liu and Dr João Oliveira for reviewing and commenting on my thesis; they inspired me to further cognise what significant theoretical knowledge I should fully understand and show mastery of in the thesis. I have benefited and learned from their reviews and have come to better understand the topic in-depth thanks to them. I also would like to extend my gratitude to the teachers who were teaching the fundamental knowledge for the doctoral study. The support provided by the staff of the Research Office is also gratefully acknowledged for their kind and conducive help.

I would like to express my deep and sincere gratitude to my parents, who encouraged and supported me in addressing the problems I encountered during the whole study and who gave me confidence to complete the thesis to a high standard. I dedicate this thesis to them. I appreciate their endless support and sacrifices that allowed me to reach this stage – the doctorate degree. Without them, the road to success would be difficult. I am honoured to express my deep gratitude and appreciation for this love.

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Acronym List

ACAP	Absorptive Capacity
CFA	Confirmatory Factor Analysis
LIST	the List of High-Tech Enterprises in Zhongguancun Science Park
MNC	Multinational Corporation
OI	Open Innovation
PCA	Principal Component Analysis
SEM	Structural Equation Modelling
SME	Small-Medium Enterprise
SOE	State-Owned Enterprise
VIF	Variance Inflation Factor
ZSP	Zhongguancun Science Park

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Chapter 1 Introduction

1.1 Introduction

Innovation in the form of new technology and product relies on businesses' and individuals' capabilities to perform successful research and development (R&D). As the awareness of external knowledge acquisition and utilisation has grown, more enterprises have shifted their innovation modes from traditional 'closed' models to 'open' strategies that combine outward knowledge with internal sources to innovate and commercialise new ideas (Enkel et al., 2009). The concept of open innovation (OI) was introduced by Chesbrough, and the concept is described as "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external use of innovation" (Chesbrough, 2006, p1). In response to research on non-pecuniary knowledge flows (Chesbrough and Di Minin, 2014; Dahlander and Gann, 2010), the definition has further developed: "open innovation is a distributed innovation process based on purposively managed knowledge flows across organisational boundaries, using pecuniary and non-pecuniary mechanisms in line with the organisation's business model" (Chesbrough and Bogers, 2014).

The OI paradigm (Chesbrough, 2006, p3) is recognised as a model for applying OI activities in actual R&D. OI activities can be divided into two categories, inbound OI and outbound OI. The former refers to the practice of exploring and integrating external knowledge to facilitate technology development and technology exploitation, while outbound OI refers to the practice of exploiting technological capabilities by utilising a mix of internal and external paths to commercialisation (Chesbrough 2003a; 2003b; Chesbrough and Crowther 2006). Enkel et al. (2009) contrasted several forms of OI and introduced three core processes related to inbound and outbound OI, and their combinations: outside-in, inside-out, and coupled processes. The outside-in process is that firms increase their own knowledge via cooperation and connections with collaborators such as competitors and universities, a process often linked to inbound OI. The inside-out process, in contrast, refers to a firm generating and accelerating profits by transferring innovative ideas directly to the market, which relates to the practice of outbound OI. Coupled processes refer to strategies that are complemented or joined by both processes of innovative behaviours.

In recent years, OI has received increasing attention in academic research, and the topic has been developed in many aspects. For instance, the focus has been on the relationship between OI activities and innovation performance (relevant to the effect of inbound and outbound OI) (Bianchi et al., 2010; Bianchi et al., 2016; Chesbrough, 2003a,b; Chesbrough, 2006; Chesbrough and Crowther 2006; Dahlander and Gann, 2010; Greco et al., 2016; Hu et al., 2015; Laursen and Salter, 2006; Lichtenthaler, 2009; Parida et al., 2012), the influence of ambidexterity in OI on innovation performance (Brunswicker and Vanhaverbeke, 2015; Camerani et al., 2015; Hung and Chou, 2013; Mazzola et al., 2012; Sikimic et al., 2016) and the cluster effect on OI adoption and innovation performance (Bocquet and Mothe, 2015; Cantner, 2015; Chyi et al., 2012; Ferrary, 2011; Roper et al., 2017). In the existing literature, inbound OI's influence has been widely examined, and the majority of studies have demonstrated its positive effect on innovation performance (e.g., Bianchi et al., 2010; Chesbrough, 2003a,b; Parida et al., 2012), whereas outbound OI has been less investigated. Even if works such as Hu et al. (2015), Lichtenthaler (2009) revealed that outbound OI can act a positive influence on innovation outcome, there still needs more explanation of the topic by testing various outbound OI practices (because most of the existing literature often concerns out-licensing) on innovation performance and how firms combine it with inbound OI to achieve ideal innovation performance. More importantly, regarding the investigation of ambidexterity in OI on innovation performance, the existing literature mainly has indicated that firms should emphasise both inbound and outbound OI at a high level concurrently (e.g., Hung and Chou, 2013; Mazzola et al., 2012; Sikimic et al., 2016); however, what has been less suggested and empirically tested is whether firms can maintain an optimal level of inbound and outbound OI and a clarification on what kinds of OI combinations can stand the balance in OI (instead of equalising inbound and outbound OI as a dominated adoption). A representative work by Dahlander and Gann (2010) indicated the advantages and disadvantages and effect of inbound and outbound OI, suggesting that a potential synergy could be achieved by combining the two kinds of OI appropriately. This implies a consideration on the balance in OI, which relates to what extent the optimal combination of inbound and outbound OI contribute to innovation performance while suggesting that there may be different OI combinations relying on firms' own innovation demands (see also Mazzola et al. 2012). However, although these studies have indicated that the ambidextrous conduction of inbound and outbound OI could act on innovation performance and firms could pursue ambidexterity in OI by applying inbound and outbound OI at high levels, those studies were mainly concentrated on what advantages or disadvantages firms can achieve under a concurrent conduction, here overlooking a clarification and determination of the balance in OI. That is, how to reach a relative balance (an appropriate combination) of the two kinds of OI and how this balance contributes to innovation performance still needs further demonstrations and empirical evidence. A significant gap regarding the clarity of the balance in OI and its influence on innovation performance needs to be addressed.

On the other hand, regarding the link between cluster and OI, the existing literature often is concerned with the science park/cluster as an environment to apply OI activities (e.g., Bocquet and Mothe, 2015; Cantner, 2015; Chyi et al., 2012; Ferrary, 2001). These works mainly are focused on how firms apply OI activities in the cluster and what outcome can be achieved. For instance, Chyi et al. (2012) showed the impact of external and internal spillovers on innovation outcomes in a high-tech cluster, one where the external R&D spillover is statistically significant in explaining the new product sales of the firms. Ferrary (2011) pointed out that the acquisition and development (A&D) strategy among large firms (Cisco and Lucent) reinforced OI adoption by increasing incentives for other organisations' networks to explore new knowledge in the cluster. Although these studies indicated a link between cluster and innovation outcome, few studies have examined how locational factors can affect the pursuit of the balance in OI and how firms utilise locational benefits to adopt inbound and outbound OI into an appropriate level. This implies a lack of research concerning the influence of locational factors on the balance in OI, a gap that needs to be addressed in OI literature. Moreover, regarding the relationship between locational factors and the balance in OI and for the balance in OI and innovation performance, firms may have strength variations because of their different internal conditions that process and transform external knowledge into their existing knowledge. Thus arises the presence of absorptive capacity (ACAP), which reflects a moderation effect. Although some previous studies have applied the role of ACAP into OI adoption (e.g., Escribano et al., 2009; Huang and Rice, 2009; Miguélez and Moreno, 2015; Xia and Roper, 2016), how to target the moderating effect on the specific relationships among locational factors, the balance in OI and innovation performance remains unclear. This implies a need to use ACAP as internal capacity to explain the reasons why firms may have different strengths in these conditions (locational factors and the balance in OI; the balance in OI and innovation performance); hence, the lack of research needs to be enriched in OI literature.

In addition, when integrating locational factors, the balance in OI and innovation performance as an overall picture, the understanding of the balance in OI as a middle factor needs further examination. Because prior literature often has tested the separate relationships between locational factors and the balance in OI and the balance in OI and innovation performance (e.g., Cantner, 2015; Jansen, et al., 2009; Li et al., 2013), few studies have examined the overall relationship of these factors, especially when it comes to ambidexterity in OI as a mediator. Although studies such as Lai et al. (2014) indicated that a cluster could be directly influencing a firm's innovation performance, these studies did not consider the role of ambidexterity (the balance) in OI for the relationship between cluster and innovation performance. Lin et al. (2017) explored how firms achieve ambidexterity in OI in high-tech science parks (while acting on innovation performance), but the authors lacked an investigation into the utilisation of locational factors to lead ambidexterity in OI (the cluster is only regarded as a background). Also, Ozer and Zhang (2015) demonstrated that the use of locational factors can lead to ambidexterity in OI in a cluster, but they did not explain whether locational factors could be linked to innovation performance through the role of ambidexterity in OI; they overlooked what role ambidexterity in OI may play in the middle of locational factors and innovation performance. Accordingly, the current literature has offered partial pictures relating to locational factors, ambidexterity in OI and innovation performance, but the potential role and function ambidexterity in OI may play needs further demonstration with empirical tests. A gap exists in whether ambidexterity in OI is a mediator for the relationship between locational factors and innovation performance, while needs to be addressed.

Therefore, the study is motivated by three main reasons that are based on existing research on OI. First, to extend the understanding of a cluster on the balance in OI, the study tests the association between locational factors and the balance in OI, that is, filling in the literature gap by revealing whether, and if so how, firms utilise locational factors to achieve the balance of inbound and outbound OI (Bocquet and Mothe, 2015; Sack, 2015). Also, because there is a lack of studies using ACAP to test the strength variations for the relationship between locational factors and the balance in OI (Ferrary, 2011; Lai et al., 2014), the study examines ACAP as an internal capacity to reveal ACAP's moderating effect in this relationship. The study intends to enrich the theoretical understanding of locational factors' influence on the balance in OI and reveal ACAP's moderating effect on the relationship between locational factors and the balance in OI. From a practical point of view, studying the influence of locational factors on firms' OI conduction can guide firms to effectively use locational factors to achieve an optimal balance in OI.

Second, this study intends to bring greater conceptual clarity to the notion of the balance in OI and how this balance affects innovation performance. From a theoretical point of view, the literature lacks a clear explanation of the balance in OI, with most of the studies still regarding the ambidexterity (the balance) in OI as an equal adoption between inbound and outbound OI (e.g., Hung and Chou, 2013; Sikimic et al., 2016; see also Cao et al., 2009). To address this gap and bring greater clarity using empirical evidence, this study clarifies how a balance of inbound and outbound OI can lead to better innovation performance and how an appropriate combination of inbound and outbound OI supports OI adoption. Meanwhile, by using ACAP as boundary condition to examine the strength of the balance in OI and innovation performance, this study intends to enrich the understanding of ACAP's moderation effect in this relationship, which has been scarcely studied (see Brunswicker and Vanhaverbeke, 2015; Camerani et al., 2015; Mazzola et al., 2012). From a practical view, there is a need to support firms to adopt inbound and outbound OI into an appropriate level, which can be accomplished by combining appropriate OI practices to attain a relative balance in actual adoption (e.g., for growing high-tech firms, they may conduct more inbound OI to absorb external knowledge, leading to ideal innovation performance instead of providing an equal level of internal sources to outsiders). Hence, by extending the knowledge of the balance in OI and ACAP's moderating effect of the balance in OI and innovation performance, this study can help managers to improve their innovation performance.

Third, to gain an in-depth understanding of the ambidexterity (the balance) in OI, this study intends to show the mediation effect for the overall relationship among locational factors, the balance in OI and innovation performance. That is, having an understanding of the mediating effect of ambidexterity in OI is significant to enrich the knowledge, especially when ambidexterity in OI is a middle factor that can bridge the link between locational factors and innovation performance. Also, because ACAP is regarded as having moderating effects on the relationships between locational factors and the balance in OI and the balance in OI and innovation performance, ACAP is also regarded as having a moderating effect for this mediation model. In theory, the literature has not documented the implications of the mediation effect of ambidexterity (the balance) in OI (e.g., Jansen, et al., 2009; Li and Huang, 2012; Lin et al., 2017), which needs to examine what potentials or contingencies of a variable that may produce a mediating effect. It thus needs an in-depth study to conceptualise, interpret the role of ambidexterity (the balance) in OI when firms locate in the cluster to achieve innovation performance. In practice, there is a need to help firms engage in the mediation effect arising from the balance in OI — between locational benefits and innovation performance — to avoid the adverse effects that result from improperly engaging in OI activity, which can in turn be caused by ignoring the balance between inbound and outbound OI. In addition, new empirical evidence from China's high-tech firms has new implications for this transition economy, which can add new data to the literature that differs from the findings relevant to developed economies or Western firms.

1.2 Research Context

1.2.1 SMEs in Transition Economy — China

Compared with previous research about large firms' OI adoption in developed economies (e.g., Chesbrough and Brunswicker, 2013; Christensen et al., 2005; Laursen and Salter, 2006; Parida et al., 2012), SMEs' studies have their own characteristics to be investigated. First, they have less ability to access external resources and fewer technological assets (Narula, 2004) than MNCs — as such, differentiation between SMEs and large firms as to OI is needed. Second, SMEs often combine outward ways with innovation by alliances/networks extension to support their own technological competences (Edwards et al., 2005; Rothwell and Dodgson, 1991). Because of their flexibilities, they can more easily to be involved in multiple innovative approaches than larger firms (Powell et al., 1996). In addition, SMEs consider external sources not only relevant to technology, source channels but gaining access to marketing and sales channels, which links to the commercialisation stage of innovation. It means that SMEs often focus more on commercialisation than inside OI efforts of MNCs. This is because SMEs sometimes lack the capacity in terms of manufacturing facilities, global-based partners to introduce new-tech effectively, while via marketing channels to promote new markets (Narula, 2004). Hence, when OI supports them to decrease those vulnerabilities and provide more opportunities to engage in large scale business activities, they could benefit beyond processing and marketing (Lee et al., 2010; Mowery and Rosenberg, 1978). Therefore, high-tech SMEs in China also tend to apply more OI activities to promote their innovations, rather than purely using 'closed' innovation. From that, associating OI with SMEs is regarded as a context in this study.

1.2.2 Comparison between SMEs and SOEs

Currently, China is still regarded as a transition economy, still to transfer some traditional market systems and firm regulations to modern status. In this respect, state-owned enterprises (SOEs) as a representative enterprise type and private SMEs are necessary to be categorised, analysed, and make a comparison to indicate the differences in R&D and OI conduction.

Traditionally, SOEs are dominant in China's market and economy development, but as China has now experienced significant institutional change in terms of ownership structures (Ralston et al., 2006) across several periods, having evolved from large numbers SOEs in the earlier era to the development of Chinese private-owned enterprises. This transition indicates that governmental and social institutions offer normative guidelines for firms, designed to improve social employment while imposing regulatory constraints upon outsiders (Knutsen et al., 2011). China built the fundamental base and promoted the development of private firms, and increased the contribution from the private sector in economic growth. Given the considerable heterogeneity within the country, especially as an emerging economy (Zhao and Zou, 2002), there is a need to better understand how different institutional arrangements at the regional level affects the performance of those firms. In this study, the differences of transition are represented via the comparison between SOEs and SMEs in Zhongguancun Science Park (ZSP) as a representative cluster in China, and revealing under this different ownership how firms react to locational factors and thus apply OI practices to achieve expected innovative performance.

In addition, emerging or transition economies encompass a distinct yet diverse institutional environment that has evolved, in part, through the design of ownership structures (Li et al., 2013). From a political point of view, ownership structures are defined at the national level, through formal mechanisms that influence organisational identities (North, 1990). From a sociological standpoint, the geographic concentration of firms — even if they have different forms of ownership — tends to create a distinct set of understandings and practices (Li et al., 2007), the development of distinct social identity codes (Park et al., 2006), and the establishment of heterogeneous human resources and social networks (Tan et al., 2013). Specifically, firms within a cluster characterised by a specific ownership structure may tend to engage in similar behaviour patterns, modes of strategic thinking, and collective sense-making (Porac and Rosa, 1996), all of which are likely to lead to the formation of related cognitive identities which in turn define the boundaries of legitimation.

As such, in this context, the categorisation of SOEs and private SMEs is designed to present different social codes, and therefore develop correspondingly differentiated social identities. While the comparison is to indicate how firms differently apply OI to conduct innovation activities, whether firms' attributes have affected innovation performance and their progress regarding R&D. Also, locational factors are considered to influence innovation performance, diverse business situations and strategy selections will reveal firms' characteristics in the interaction with locational factors. That is to represent a comprehensive market condition under the macro-environment transition, highlighting some unique features in the Chinese context.

1.3 Research Aim

The main aim of the research is to investigate the determinants that influence the overall relationships between OI and innovation performance. In doing so, this study integrates the OI paradigm (inbound and outbound OI activities), ambidexterity in OI (combination of inbound and outbound OI), locational factors (cluster) and the moderating effects of ACAP into a new framework that explains how locational factors affect ambidexterity (the balance) in OI, how ambidexterity in OI affects innovation performance and the mediation effect that ambidexterity in OI can produce. Thus, the study regards these factors as a whole picture to interpret their interconnections in the actual innovation process.

1.4 Research Questions and Objectives

Based on the research aim outlined above, research questions and objectives are as follows:

Research Question 1: To what extent does ambidexterity in OI mediate the relationship between locational factors and firms' innovation performance?
Research Objective 1: To reveal the mediating effect of ambidexterity in OI for the relationship between locational factors and innovation performance.

Research Question 1.1: What locational factors (in cluster) affect firms' ambidexterity in OI?
Research Objective 1.1: To identify locational factors influence and implications on firms' ambidexterity in OI.

Research Question 1.2: What balance of inbound and outbound OI contributes to innovation performance?
Research Objective 1.2: To reveal what is a relative balance of inbound and outbound OI contributing to firms' innovation performance.

Research Question 2: To what extent does ACAP moderate the relationship between locational factors and ambidexterity in OI?
Research Objective 2: To reveal the moderating effect of ACAP and examine the relationship between locational factors and ambidexterity in OI.

Research Question 2.1: To what extent does ACAP moderate the relationship between ambidexterity in OI and innovation performance?
Research Objective 2.1: To reveal the moderating effect of ACAP and examine the relationship between ambidexterity in OI and innovation performance.

1.5 Theoretical Contributions

The study makes three main theoretical contributions to the OI literature. First, the study provides a contribution to the literature on OI by bringing a greater conceptual clarity to the view of balance, which the balance in OI is contingent on innovation performance. The study conceptualises the balance in OI as a contingent factor that enables firms to generate ideal innovation performance (Cao et al., 2009; Dahlander and Gann, 2010). A more balanced portfolio can bring better innovation performance than those that are less balanced. Meanwhile, building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP in the relationship between the balance in OI and innovation performance. This study shows that when there is a higher level of ACAP, there is a stronger relationship between the balance in OI and innovation performance.

Second, by adopting a cluster perspective, the study contributes to the literature on OI by recognising the influence of locational factors on the balance in OI; it enriches the knowledge regarding the environmental influence on OI, especially showing that firms that pursue a balance of inbound and outbound OI rely on the utilisation of locational benefits. Meanwhile, building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between locational factors and the balance in OI. This study shows that when there is a higher level of ACAP, there is a stronger relationship between locational factors and the balance in OI.

Third, a distinct contribution to the prior literature on OI is the study's advancement of the understanding of the overall relationship among locational factors, the balance in OI and innovation performance. The study conceptualises the balance in OI as a mediator that mediates in the relationship between locational factors and innovation performance; while a moderated mediation effect of the balance in OI with ACAP is demonstrated in the relationship as well. The study shows that the balance in OI not only produces a (direct) effect on innovation performance, but also when firms apply a balancing conduction in OI under the influence of locational benefits, the balance in OI could mediate this relationship. By enriching this understanding of OI, the study builds on the existing literature, showing that locational factors have an indirect effect on innovation performance through the mediation influence of the balance in OI.

1.6 Structure of the Thesis

The study is organised into nine chapters as follows:

Chapter 2: Theories and Theoretical Framework. This chapter firstly discusses the main theories that apply to the framework, which are related to OI paradigm, ambidexterity in OI, cluster and ACAP. By integrating cluster as the environmental factor and ACAP as the moderating factor, the chapter constructs a new model which reveals the entire relationship in OI. This chapter reviews key theories and constructs a new framework, while indicates the linkages of the factors in the framework.

Chapter 3: Research Methodology and Fieldwork. This chapter provides the research approach and fieldwork used for designing the research and data collection. It aims to interpret the reasons for data investigation and the process of the research. It analyses the reasons for using an appropriate research method which links data collection to research questions, thus building the research method for the fieldwork and data investigation.

Chapter 4: Research and Historical Background. This chapter provides the historical background and characteristics of ZSP. It introduces the relationship between OI adoption and locational factors. By studying high-tech firms in ZSP, knowledge about SOEs and private firms during the development of ZSP has been gained, and an understanding of how the science park was established and its linkages with current firms was identified. It indicates the features of two kinds of firms and shows the basis for the comparison relating to data description in the context.

Chapter 5: Descriptive Overview. This chapter analyses, summarises the empirical results relating to the ownership factor of firms (stated-owned and private owned), which indicates the data differences based on this criterion. It assesses and compares the details of stated-owned and privately-owned firms, in terms of general business information, OI conduction, locational factors, innovation performance, and alliance activities.

Chapter 6: Locational Factors and Ambidexterity in OI. This chapter empirically analyses the effects of locational factors on the ambidexterity (balance) in OI and examines and demonstrates the hypotheses related to the framework. It reveals that locational factors could be positive to the balance in OI; ACAP as a moderator positively affects the relationship between locational factors and the balance in OI. The chapter thus supports the propositions of OI by revealing locational factors to achieve the balance in OI.

Chapter 7: Ambidexterity in OI and Innovation Performance. This chapter examines the hypotheses regarding OI activity and the effects of balance in OI on innovation performance, as well as ACAP's moderation role in this relationship. The analysis indicates that inbound OI may not always be positive to innovation performance, whereas outbound OI can have a positive effect on performance; an improper balance of inbound and outbound OI may negatively impact innovation performance. ACAP can be the moderator positively affecting the relationship between the balance in OI and innovation performance. The chapter thus supports the propositions by providing new empirical evidence for revealing the effect of inbound and outbound OI, the balance in OI on innovation performance, and ACAP's moderating role.

Chapter 8: Mediation Effect of Ambidexterity in OI for the Relationship between Locational Factors and Innovation Performance. This chapter integrates all factors as a whole to examine the mediation effect of the balance in OI. It demonstrates that the balance in OI can be a mediator channelled through the locational factors and innovation performance that indirectly affects the relationship. The interaction with ACAP positively affects the relationship. The chapter thus extends the understanding of ambidexterity in OI for the entire relationship among three factors, and provides a distinct finding from the new framework which stresses the implications for OI studies.

Chapter 9: Conclusion and Recommendations. The final chapter summarises the main findings and main contributions of the study. Managerial implications are also discussed. The chapter draws attention to potential limitations of the empirical work and recommends some suggestions for further research.

Chapter 2 Theories and Theoretical Framework

2.1 Introduction

Research on OI is mainly derived from Chesbrough's OI paradigm, which involves integrating both internal and external resources for new product development (Chesbrough et al., 2006). A key method for examining the engagement of OI is testing other factors that may affect and connect with innovation performance. For this reason, the new framework is provided to construct locational factors, ambidexterity in OI, innovation performance and ACAP as a new model to reveal their associations. This chapter reviews key theories and proposes a new framework to address the research questions.

2.2 Theories

2.2.1 OI Paradigm

The OI paradigm was developed from the antithesis of traditional vertical integration for a firm's R&D and innovation, which states that companies should apply external knowledge with internal technology to accelerate R&D activities. Chesbrough (2003a; 2006) indicated the importance of OI in that a company's internal ideas can be applied via external channels to generate additional values, while the implementation of external strategies can capture more knowledge to create potential value and innovation. Contrasting it with traditional innovation, OI helps firms to make extra profit from other markets (Chesbrough, 2006), mitigate vertical mode pressures (Langlois, 2003), confront the growth of specialised technology markets (Brusoni et al., 2001), and reduce the difficulties of internal technology upgrades (Chesbrough, 2003a). Chesbrough and Crowther (2006) also used the expression 'open innovation practice' to refer to a set of inbound and outbound OI. Inbound OI practices are often linked to ground-breaking developments that require significant resources to achieve innovation. These practices could enable a firm (especially a SME) to establish a dominant position and provide more opportunities to earn profits. Outbound OI practices, on the other hand, provide a strong base for incremental innovation of existing products, which can be fulfilled by collaborating with partners from the value chain (e.g., customers, suppliers).

Regarding OI adoption, the literature shows that firms are more likely to apply inbound OI (Laursen and Salter, 2006; Bianchi et al., 2010; Cheng and Huizingh, 2010; Parida et al., 2012; Lakemond et al., 2016), while those activities may significantly affect the innovation outcome.

On the other hand, there are less studies that aim to capture the potential benefits of outbound OI. This may reflect the fact that outbound OI is likely to impose a higher level of managerial challenge that links to the imperfections in the markets for technologies (Lichtenthaler and Ernst, 2007). Although some recent studies (Helfat et al., 2007; Lichtenthaler, 2009; van de Vrande et al., 2009; Arora and Gambardella, 2010; Hu et al., 2015) have emphasised the increasing importance of outbound OI, for example, deepening the understanding of outward technology transfer (e.g., Arora and Ceccagnoli, 2006; Nagaoka and Kwon, 2006), those concentrated on the outcome of technology transactions instead of examining the ambidexterity in OI on innovation performance (see Gambardella et al., 2007). Hence, there is a need for further investigation to provide in-depth understanding of the balance in OI and extend our knowledge in the OI literature.

2.2.2 Review of OI Studies

Studies on OI have seen a significant surge since the concept of OI was introduced by Chesbrough (2003). Most of the studies analysed inbound OI as their main focus (Bianchi et al., 2016; Chiang and Hung, 2010; Inauen and Schenker-Wicki, 2011; Parida et al., 2012; Laursen and Salter, 2006; Suh and Kim, 2012), and a few studies examined the influence of outbound OI on innovation performance (e.g., Bianchi et al., 2010; Hu et al., 2015; Lichtenthaler and Ernst, 2007). Later came an integrated view of both OI activities, one which Enkel et al. (2009) introduced as a coupled process in OI and presented as a combined use of both technology inflows and outflows. Some studies examined the effect of this process on innovation performance. For instance, by observing R&D collaborations (enable firms to scan their environment for new windows of opportunity and technologies) and collaborative patents (patents with more than one assignee), Mazzola et al. (2012) demonstrated its positive significant effect (as the coupled process) on innovation performance while highlighting the importance of a concurrent OI adoption. Suh and Kim (2012), by examining the effects of technology acquisition, R&D collaboration and networking — another kind of coupled OI process on innovation performance, showed that technology acquisition and R&D collaboration were positively related to product innovation, but they noted that networking was not significantly related to innovation performance. Also, Vega-Jurado et al. (2009) indicated that coupled inbound and outbound OI could significantly affect manufacturing firms' innovation outcome while a synergistic effect on innovation performance might not be found if it is simply conducting the two kinds of OI activities. However, even if these studies have shown some different coupled OI processes' influence on innovation performance, they still only tested the separate effects of coupled OI, meaning that they observed the effect of inbound and outbound OI, respectively, and then put them together. This implies that there still is a lack of research that observes the relationship from an ambidextrous view — specifically the ambidexterity in OI on innovation performance, one where inbound and outbound OI is regarded as a whole, presenting a relatively balanced effect on innovation performance.

Regarding the ambidexterity in OI, or a relative balance of inbound and outbound OI influence on innovation performance, although the relationship between technology inflows and outflows has been emphasised in theoretical OI research (Chesbrough, 2003; Enkel et al., 2009; Lichtenthaler and Lichtenthaler, 2009), it still needs clarification and empirical support. As an example of one conceptual work in discussing ambidexterity and the combination of inbound and outbound OI, Dahlander and Gann (2010) indicated both the advantages and disadvantages of inbound and outbound OI, suggesting that a potential synergy could be achieved by combining the two kinds of OI appropriately. This implies that when it comes to the concern over how firms can combine different ways of managing openness, there may be different combinations of OI seen in the ambidextrous conductions that enable firms to achieve innovation performance. From a conceptual view, the work indicated the importance of investigating the form of openness — ambidexterity in OI — and it provided insights regarding ambidexterity in OI. They observed that the ambidexterity of inbound and outbound OI should not only be applied simultaneously but should be formed into an appropriate level to form a balance in OI. Despite that, their work concentrated on proposing a theoretical view of ambidexterity in OI and how firms could combine inbound and outbound OI to reflect their advantages on innovation performance; empirical evidence supporting the proposition and of what a balance can improve innovation performance was lacking. A theoretical discussion of this work needs actual data to demonstrate and support the conclusions. Some studies also built on this view. Cassiman and Valentini (2015) showed that engaging simultaneously in buying and selling knowledge allows firms to increase innovation outcomes but at the expense of a proportional increase in R&D costs. From the view of ambidexterity in OI, although the authors examined the joint effect of inbound and outbound OI on a firm's innovation and financial performance, the possible relationship between the two kinds of OI activities was less explored. Specifically, Cassiman and Valentini (2015) examined inbound and outbound OI (on R&D productivity) by using different practices (BUY and SELL of inbound and outbound OI), but they focused on the individual impact on R&D productivity (e.g., only BUY, BUY and SELL) and whether inbound and outbound OI could complement each other, rather than observing how an appropriate balance affects innovation performance. Therefore, even though the authors indicated a positive effect of BUY and SELL practice on innovation performance, a better understanding of an appropriate combination of inbound and outbound OI was not examined fully and still needs further study. Moreover, Sikimic et al. (2016) showed the existence of the positive interaction between inbound and outbound OI, indicating that technology in-licensing positively influences the volume of technology out-licensing. Walter (2012) also investigated both in-licensing and out-licensing transactions and their distinct potential to generate superior financial returns in OI. Regarding these two works that observed OI practices' interactions and benefits on innovation outcomes, although they both showed the influence of OI balance by simultaneously applying inbound and outbound OI practices (licensing) on innovation performance, they did not examine to what extent firms should apply these two OI activities to reach an appropriate level; particularly, they did not mention how firms should combine in-licensing and out-licensing appropriately (because ambidexterity in OI affects innovation performance). The licensing-based studies thus only captured one aspect to examine the relationship between ambidexterity in OI and innovation performance, but the balanced effect should have been extended.

Therefore, regarding the studies on ambidexterity of inbound and outbound OI, how to reach a relative balance (an appropriate combination) of the two kinds of OI and how this balance contributes to innovation performance needs further clarity and empirical evidence. It is crucial to investigate the forms of ambidexterity in OI to understand how different but appropriate inbound and outbound OI adoptions act on innovation performance. An investigation of high-tech firms can help provide new empirical evidence to enhance this theoretical understanding.

2.2.3 Ambidexterity and the Balance of Firms' OI Activity

Adopting the concept of ambidexterity into innovation research can be traced back to the seminal work of March (1991), who suggested that superior innovation performance can be gained by simultaneously performing both exploitative and explorative learning (see also Cao et al., 2009; Gibson and Birkinshaw, 2004; He and Wong, 2004; Tushman and O'Reilly, 1996). In this work, March (1991, p. 85) indicated the essence of exploration is 'experimentation with new alternatives', whereas the essence of exploitation is 'the refinement and extension of existing competences, technologies, and paradigms'. The conceptual distinction between exploration and exploitation has been used as an analytical construct or a rationale for innovation researchers to analyse the pursuit of exploration and exploitation simultaneously, which drives the study of ambidexterity of exploration and exploitation traditionally (e.g., He and Wong, 2004; Katila and Ahuja, 2002; Lin et al., 2013; Lubatkin et al., 2006). There is a potential inherent tension between exploration and exploitation because they compete for scarce organisational resources (Auh and Menguc, 2005; March, 1991; Smith and Tushman, 2005; Tushman and O'Reilly, 1996). That is, achieving an appropriate balance between the two, which allows firms to develop both activities simultaneously for their long-term survival, becomes a key issue (e.g., Benner and Tushman, 2003; Raisch et al., 2009). Tushman and O'Reilly (1996) were the first to propose the idea of pursuing ambidexterity, which allows a firm to simultaneously develop exploration and exploitation to achieve superior performance. March (1991) also suggested that maintaining an appropriate balance between exploration and exploitation is critical for firm survival and prosperity. Furthermore, Cao et al. (2009) advanced the understanding of ambidexterity by unpacking it into balanced and combined dimensions, suggesting that finding a balance is more beneficial to resource-constrained firms (e.g., SMEs), whereas having a combination is more beneficial to firms with greater access to internal and/or external resources (see also He and Wong, 2004). Their work indicates that a balanced view corresponds to a firm's orientation to maintain a relative balance between exploratory and exploitative activities, while a combined view corresponds to their combined magnitude. Therefore, this provides a rationale that can be further applied to the context of OI, that is, a balance of ambidexterity in OI represents a relative balance of inbound and outbound OI.

Regarding OI adoption and the ability to apply inbound and outbound OI at an ambidextrous level, the rationale of ambidexterity can be applied in this context. Because inbound and outbound OI also each have their own mechanisms and practices to achieve innovation performance and advance firms' R&D (Chesbrough, 2003, 2006; Chesbrough and Brunswicker, 2013; Chesbrough and Crowthesr, 2006), there is a need to appropriately use internal and external ideas for OI activity to pursue ambidexterity which is a balance between inbound and outbound OI. Concerning the current OI research, two perspectives are often applied to analyse the ambidexterity in OI. One stream of OI literature mainly focuses on the conflicting aspects of inbound and outbound OI, such as their competition for resources and separate effects on innovation performance (e.g., Bianchi et al., 2011; Chesbrough and Brunswicker, 2013; Michelino et al., 2014; Mortara and Minshall, 2011; Schroll and Mild, 2011; Zhang et al., 2015). For instance, Michelino et al. (2014) examined both the effects of inbound and outbound OI on the R&D outcome, where inbound OI was substituted for internal R&D while outbound OI was complementary to internal development. This study offered a new finding that relates to the positive effect of inbound OI and how it acts on outbound OI. Firms that rely on more inbound OI adoptions to generate additional products leverage their available resources to outsiders to obtain potential benefits via outbound OI. Although the study tested an integrated effect of both inbound and outbound OI and added new evidence on the impact between inbound and outbound OI, the mechanism behind this positive influence and how firms apply inbound and outbound OI to an appropriate level to create innovation performance requires more explanation. For instance, if one firm applies more outbound than inbound OI, in this condition, it is unclear whether inbound OI still can affect and promote the adoption of outbound OI and what the combination is that determines this reinforcement. Therefore, although these studies examined the simultaneous effects of inbound and outbound OI on innovation performance, they did not integrate the two kinds of OI activities into an ambidextrous conduction to examine the influence on R&D and innovation outcome. To simply engage with inbound and outbound OI together may not represent the influence of ambidexterity in OI on innovation performance.

The other stream of OI literature mainly focuses on the interaction of inbound and outbound OI such that firms can engage in high levels of both OI activities at the same time. In this view, the studies have suggested that firms could emphasise ambidexterity in OI as a way to pursue both high levels of inbound and outbound OI concurrently (e.g., Brunswicker and Vanhaverbeke, 2015; Camerani et al., 2015; Cassiman and Valentini, 2015; Hung and Chou, 2013; Mazzola et al., 2012; Sikimic et al., 2016) rather than maintaining a balance to find the most appropriate adoption between the two. For instance, Mazzola et al. (2012) tested inbound OI, outbound OI and coupled OI practices on innovation and financial performance, indicating that coupled OI could be either positive (of co-patents) or negative (of manufacturing alliances). Through testing inbound and outbound OI practices (e.g., supplier collaboration and in-licensing; external technology commercialisation and out-licensing), their study showed that a high adoption of inbound and outbound OI can significantly lead to innovation performance and that the coupled effects could better act on innovation performance under the same emphasis on inbound and outbound OI. Also, by testing the interaction between inbound and outbound OI, Camerani et al. (2015) showed there is a synergy that may foster firm performance by applying high levels of inbound openness; they indicated that firms need to pursue high levels of OI and achieve synergies among their inbound and outbound OI. Compared to prior studies, this study extended the understanding on the interactions between inbound and outbound OI and showed a synergy could exist because of having both high levels of OI adoption. Despite this, the debate on whether a potential synergy only exists by applying high levels of inbound and outbound OI remains unclear, and the authors did not mention how a balance or ambidextrous conduction drives this synergy and leads to innovation performance. Similar studies mainly highlighted the sense of 'simultaneous conduction' (apply two kinds of OI together), which built on an equal, high adoption of inbound and outbound OI, but they neglected to consider the balance of ambidexterity in OI. That is, the ambidexterity — the balance in OI — does not only represent inbound and outbound OI that must be equally applied (e.g., a 50-50 engagement); but more importantly, it represents the combination of inbound and outbound OI at an optimal level to lead to innovation performance (Dahlander and Gann, 2010). A high or equal level of inbound and outbound OI conduction is not sufficient to explain and clarify other possible combinations of ambidexterity in OI, the literature regarding the balanced view thus still needs further evidence.

To summarise, even though there are different studies that discuss firms' ambidexterity in OI and how it somehow relates to the simultaneous pursuit of inbound and outbound OI, there still is a lack of conceptual clarity regarding the extent to which ambidexterity in OI can match the level of inbound and outbound OI on a relative basis, especially when it comes to how a relative balance of inbound and outbound OI can act on innovation performance. Therefore, to address this theoretical gap, this study notes that the term 'ambidexterity in OI' first denotes a simultaneous adoption of inbound and outbound OI, while 'the balance in OI' is used to further argue an appropriate combination or an optimal level of inbound and outbound OI (Dahlander and Gann, 2010). This suggests that ambidexterity in OI (the balance) may support firms in meeting their potential innovation demands that come from both internal and external ideas, enabling firms to flexibly apply both OI activities and bring about ideal innovation performance (Cao et al., 2009; Dahlander and Gann, 2010).

2.2.4 Organisational Learning and ACAP

Organisational learning theory indicates that both exploitative and exploratory learning are crucial for new product development and innovation (Atuahene-Gima and Murray, 2007; March, 1991). Exploitative learning refers to the learning activities carried out via local searches per current knowledge for the refinement and extension of existing competencies and technologies, whereas exploratory learning refers to learning activities carried out beyond the current knowledge base for experimentation with new alternatives (March, 1991). In order to access and learn about more knowledge and sources beyond firms' boundaries, firms need to grow their knowledge by acquiring external knowledge via an organisational learning process (Benner and Tushman, 2003; Lavie et al., 2010). That is, firms can reinforce their technological competence by accessing new technologies and then diffusing, assimilating and absorbing them into their base (Hamel and Prahalad, 1990). The depth of the technological knowledge and organisational learning process of a firm underpins that firm's ACAP, which Cohen and Levinthal (1990, p128) initially defined as 'a firm's capacity to recognise the value of new information, assimilate it, and apply it to commercial ends'. The ability of a firm to acquire, utilise and develop valuable resources is related to the learning process of accessing external knowledge and integrating both external and internal knowledge for innovation (Teece, 2007). For instance, because organisational learning represents a firm's learning and searching process for knowledge and sources (March, 1991), when a firm intends to utilise and absorb new ideas from other organisations during the learning activity, the firm needs to have a capacity to identify, understand and assimilate those external ideas into its own (Lewin et al., 2011). This implies that the use of ACAP is fulfilled during the learning process; firms' ACAP can be built on organisational learning because ACAP can help firms recognise, assimilate and apply the new knowledge derived from the learning process (Cohen and Levinthal, 1990). Moreover, the literature on organisational learning also indicates that a firm's innovation performance is an outcome of its knowledge base (Dodgson, 1993; Griliches, 1990). Linking this to the OI paradigm, which stresses the use of internal and external ideas to accelerate internal innovation and expand the markets for external use of innovation (Chesbrough et al., 2006), ACAP thus can be regarded as an internal capacity to help firms recognise the value of new information and apply it to create business value. Hence, building on the perspective of organisational learning, ACAP is able to use in the context of OI. To be noted, Zahra and George (2002) also extended the concept and further defined it as being made of two different ACAPs: potential ACAP and realised ACAP, which is 'a set of organisational routines and processes by which firms acquire, assimilate, transform and exploit knowledge to produce a dynamic organizational capability' (p. 186). Based on that, both ACAP's conceptualisations have been used in OI literature (e.g., Rothaermel and Alexandre, 2009 and Huang and Rice, 2009 used Cohen and Levinthal's; Ferreras-Méndez et al., 2016 and Jansen et al., 2005 used Zahra and George's). In this study, it applies the original concept to construct the framework and test relationships.

In OI literature, prior studies have explored the relationship between OI and ACAP by applying different approaches. As for the literature on ACAP and knowledge learning, some researchers have relied on the notion that ACAP is determined primarily by prior related knowledge, suggesting that OI provides the environment used to exert ACAP (e.g., Ferreras-Méndez et al., 2016; Fosfuri and Tribó, 2008; Sun and Anderson, 2010). Their reasoning is that by searching for and accessing both internal and ideas under an openness condition, firms can connect with external environments in pursuing diverse knowledge across organisational boundaries to reflect ACAP's function, which is one of the reasons why ACAP may build a relationship with innovation performance (e.g., a direct link, see Ferreras-Méndez et al., 2016). Meanwhile, a moderating idea is followed by a second group of scholars who draw on Cohen and Levinthal's (1990) model of a firm's technological sources, the central logic of which is that the firm's ACAP determines the extent to which internal and external knowledge is utilised, hence examining the moderating role of ACAP in the relationship between OI and innovation performance (e.g., Clausen, 2013; Escribano et al., 2009; Fernald et al., 2017; Ghisetti et al., 2015; Huang and Rice, 2012; Rothaermel and Alexandre, 2009; Sofka and Grimpe, 2010). These studies mainly examined the moderating effect of ACAP on external search strategies, which can be linked to the framework in this study — the presence of moderator (for the strength of ambidexterity in OI and innovation performance). For instance, Rothaermel and Alexandre (2009) demonstrated ACAP's moderating effect on the relationship between the technology sourcing mix (of known and new technology) and firm performance; higher levels of ACAP allow a firm to more fully capture the benefits that result from ambidexterity in technology sourcing. By testing the interactions between networking and ACAP on innovation performance, Huang and Rice (2009) also demonstrated ACAP's moderating role for the relationship between networking and innovation performance. However, although those prior works have indicated ACAP's moderating role on some relationships, for the particular relationship between ambidexterity in OI and innovation performance has not received much attention, which considers ACAP as internal capacity to explain why firms may have various strengths in this relationship. Thus, this study examines ACAP as a boundary condition to observe its influence on the relationships between ambidexterity in OI and innovation performance and locational factors and ambidexterity in OI.

2.3 Framework Development

2.3.1 Locational Factors and Ambidexterity in OI

Depending on the utilisation of locational benefits, a cluster or science park can enable firms to achieve ambidexterity in OI for three main reasons. First, locational benefits can affect the ambidexterity in OI by influencing a firm's external knowledge acquisition, by which clustering in a given geographical area results in benefits, such as the diversity of firms and knowledge resources. These resources make it easier for firms to use external sources of knowledge, which is one aspect needed for the ambidexterity of inbound and outbound OI. Although the core of the knowledge base lies within individual firms, sourcing activities play a key role in the development of internal knowledge and acquisitions on external valuable knowledge (Cantner et al., 2015). Chesbrough and Appleyard (2007) indicate that innovation often results from an inter-organisational process, and when located in a cluster, utilising the knowledge and ideas coming from outside the firm is one way to lead to an ambidexterity in OI (Ferrary and Granovetter, 2009; Porter, 1998). Accordingly, when firms are agglomerated in a science park or cluster, they are able to find other similar companies to integrate, reconfigure and acquire new resources to match their innovations (Eisenhardt and Martin, 2000; Ranft and Lord, 2002). The locational factors reflect the advantages of a geographical proximity, one that provides more opportunities for firms to conduct external R&D and facilitates the transmission of knowledge among the firms (Bell and Zaheer, 2007). Regarding OI conduction, firms can more smoothly learn about and access new developments in this clustering environment, exploring useful ideas; external knowledge from different actors can be acquired and applied to inbound OI, thus leading to the ambidexterity in OI (Bell and Zaheer, 2007).

Second, locational benefits also affect ambidexterity in OI by impacting a firm's internal knowledge diffusion, which enables it to more effectively use its internal ideas to expand its markets for external use of innovation. Compared to individually located firms in isolation or those having difficulty accessing partners (Lazzeretti and Capone, 2016), clustered firms can more easily establish joint ventures or create spin-offs. In this way, some of the internal ideas that are diffused by firms can result in commercial benefits in the cluster. Regarding the influence on ambidexterity in OI, this can be explained by two points. Firstly, for firms that have common knowledge and mutual learning activities (by locating together), geographical proximity promotes knowledge diffusions that enable the firms to conduct outbound OI in parallel to form the ambidexterity in OI (see Boschma, 2005). It is because of the many actors in the cluster that engage knowledge transmissions and professional contacts (e.g., the focal firm, research centres and universities; Bell and Zaheer, 2007) and the sharing of formal or informal ideas that increase the likelihood of the firms interacting with each other and externalising some available sources for innovation (e.g., form a partnership; Lazzeretti and Capone, 2016). Secondly, from a broader view of macro environment, the proliferation of social and industry event is another influence that provides firms with more opportunities to access target parties, thus making it easier to facilitate the rapid diffusion of knowledge spill-overs (Audretsch and Feldman, 1996; Lazzeretti and Capone, 2016). By communicating with potential parties, firms in the cluster thus can easily utilise their internal sources, which also enhance their knowledge diffusion (via outbound OI practices to gain commercial benefits). Accordingly, knowledge diffusions in these conditions are promoted by inter-organisational networks formed by locational factors (Lazzeretti and Capone, 2016), which are leading to outbound OI alongside inbound OI, thus achieving ambidexterity in OI.

Third, compared to firms that are individually located, clustered firms can utilise locational benefits to engage in ambidexterity in OI by influencing the purposive inflows and outflows of knowledge (acquisitions and diffusions) in parallel, accelerating internal innovation and expanding their markets for external use of innovation (Chesbrough et al., 2006). The influence of various resources (for knowledge acquisitions and diffusions) and geographical proximity thus reflect the influence of locational factors on ambidexterity in OI that not only lets firms engage with the various external resources they need to acquire, but also enables them to diffuse some internal ideas to promote the external use of innovation for commercial purposes (Lazzeretti and Capone, 2016). Thus, considering the influence of locational benefits, firms are more likely to engage in both inbound and outbound OI activities because of the basis of ambidexterity in OI, using external and internal ideas for OI practices under an openness condition can be satisfied and affected.

2.3.2 Ambidexterity in OI and Innovation Performance

Prior OI studies showed that an ambidextrous firm is capable of simultaneously applying inbound and outbound OI to obtain new opportunities and achieve innovation performance (Cassiman and Valentini, 2015; Chesbrough and Brunswicker, 2013; Hung and Chou, 2013). Thus, there is an association between ambidexterity in OI and innovation performance. The study proposes that ambidexterity (the balance) in OI affects innovation performance.

The study argues that ambidexterity in OI affects a firm's innovation performance because an appropriate combination of inbound and outbound OI enables the firm to enhance innovation performance by reflecting its own strengths. First, some high-tech firms may already have a strong internal R&D capability or new products that are mainly invented within the company. In actual operations, these firms may not often need to conduct too much inbound OI to acquire ideas or resources from outsiders; if they were to conduct too much inbound OI, these firms could obstruct their own developments. Incorporating external knowledge similar to what the firm already knows may hamper the positive effect on innovation performance (Sapienza et al., 2004). In this case, a firm may apply more outbound than inbound OI, which would be done by diffusing or externalising some suitable internal ideas to gain more financial benefits for the next stage of development. This indicates that ambidexterity in OI represents a firm's own OI demand, one that combines inbound and outbound OI into an appropriate level to reflect the firm's internal strengths on innovation performance (Cao et al., 2009; Dahlander and Gann, 2010). Second, many firms still cannot mainly rely on themselves to develop new creations, that is, by utilising sufficient external sources with internal ideas — to combine inbound and outbound OI into an appropriate level is an important way to lead innovation performance (Chesbrough et al., 2006; Dahlander and Gann, 2010). For instance, for consumer electronics firms (e.g., smartphone, laptop industry; see Christensen et al., 2005), the combination of inbound and outbound OI to form the ambidexterity in OI may present more inbound than outbound OI. One explanation is that because of the development of a market where consumers' demands vary rapidly, firms always need to work or take external ideas from suppliers, consumers and market research institutions to discover the latest technology trends (Laursen and Salter, 2014; see also Huawei, 2017). Although some firms have a sufficient R&D capability, they still need to seek external resources to make their products popular and well-innovated by integrating those internal and external valuable ideas. In this sense, the way that ambidexterity in OI affects innovation performance could be thought of as 'a relative high inbound OI', meaning the firms do not need to outflow too many internal ideas in the market; instead, they acquire more external knowledge. This indicates that even if the combination of this kind of ambidexterity in OI is not equally applied, it is still optimised in a flexible way, which reflects the strengths of combining more valuable external sources with internal sources to affect innovation performance. By enabling firms to pursue inbound and outbound OI at an appropriate level, the study proposes that ambidexterity in OI affects innovation performance.

The study also argues that a synergistic benefit may arise from ambidexterity in OI, contributing to a firm's innovation performance by producing a greater effect than is possible when only using either inbound OI or outbound OI (see Dahlander and Gann, 2010). Maintaining a well-controlled and balanced inbound and outbound OI conduction may have a synergistic effect on innovation performance (Dahlander and Gann, 2010). First, in achieving a synergy, both kinds of OI can reinforce each other and make firms to obtain a greater innovation performance than if only one type was used. One reason is that two kinds of OI activities can mutually affect each other as delivered by the synergistic benefit. For instance, licenses or patents that are out-licensed or sold to outsiders via outbound OI are linked to inbound OI and vice versa. That is, the products and patents that are developed through external R&D acquisitions (acquiring ideas and sourcing resources) of inbound OI can be 'recycled' or 'reused' by outbound OI, which enable some inventions to have a beneficial commercial effect on innovation performance. Michelino et al. (2014) indicated that the adoption of inbound OI influences the adoption of outbound OI. It implies that if a firm uses inbound OI to lead new creations, it is probable that it would leverage the available ideas of its internal sources of innovations by the means of outbound OI. Thus, the adoption of inbound OI reinforces outbound OI. Another reason is that outbound OI can enhance the adoption of inbound OI as well. Specifically, if a firm already has possessed some new products or licenses, it intends to provide these internal ideas to increase its financial benefits through engaging outbound OI, such as out-licensing. In this condition, the commercial benefits derived from outbound OI enable the firm to actively apply inbound OI in order to acquire external core knowledge that may improve a firm's innovation performance (Michelino et al., 2014). Thus, if a firm conducts both inbound OI and outbound OI at an appropriate level, there is a greater advantage than if the two activities are separated.

Second, having a synergy can also help the firm offset the disadvantages of excessively applying one type of OI. On the one hand, if a firm's inbound OI is exclusively applied or if there is a lack of outbound OI adoption, the firm may not obtain the potential benefits that it should, such as via outsiders' support to commercialise some 'ready-made' products for financial interests (Chesbrough and Brunswicker, 2013). Some potential opportunities should be engaged in to obtain valuable resources via the commercialisation of technological knowledge or in addition to the firm's internal applications (Dahlander and Gann, 2010). Also, regarding imbalanced or non-ambidextrous conduction, Ahuja and Katila (2001) note that knowledge relatedness between acquiring and acquired firms may curvilinearly relate to innovation performance. Katila and Ahuja (2002) also reveal that an external knowledge search is built into a firm's understanding of the limits and contingent effects of innovation. This indicates that if the firm's inbound OI level is too high and cannot attain an appropriate conduction in OI, its innovation performance may decrease (Levinthal and March, 1993). On the other hand, when a firm is applying outbound OI to an extreme level, it cannot mould ambidexterity in OI into an optimal level. Due to it may lose the opportunities to meet and gain new ideas or technologies, which usually support innovation performance. Because even if the firm possesses strong internal R&D and products, all the possible valuable knowledge cannot be possessed within one firm (Cao et al., 2009; Chesbrough and Crowther, 2006). The firm still needs to apply inbound OI to a certain extent to gain external knowledge, which can help avoid the disadvantages of excessively applying outbound OI (externalising internal ideas) and cause the firm to fail to spot new opportunities or respond to emerging technologies (Laursen and Salter, 2006; Savino et al., 2017). In this condition, a synergy delivered by an appropriate inbound OI with outbound OI (as an ambidextrous conduction) can support the firm in discovering new resources and integrating them into the firm's own innovation, offsetting some potential disadvantages when using only one type of OI. Therefore, a synergy delivered by ambidexterity in OI can also offset the disadvantages of exclusively applying one type of OI, thus generating greater innovation performance.

Meanwhile, ambidexterity in OI may contribute to innovation performance by mitigating the potential risks that may arise from overemphasising either inbound or outbound OI. First, if inbound OI is overemphasised (more than outbound OI), a firm's marginal benefits may decline as the marginal cost and risk increase (Wei et al., 2014). Due to firms often applying inbound OI for obtaining essential external ideas that this OI activity mainly focuses on, if too many new external ideas have been obtained, the firm may have difficulties appropriately integrating those ideas into its own knowledge base. That is, inbound OI requires firms to use more time and costs (e.g., purchase-in practice), where the amount of new ideas may still be too complicated to absorb, which would require more time to predict and observe the contributions on innovation performance (and may affect the efficiency and increase potential difficulties; see Katila and Ahuja, 2002; Laursen and Salter, 2006). Therefore, when inbound OI is overemphasised, firms' marginal benefits may decline because of the increasing marginal cost and risk (Wei et al., 2014). Second, if firms focus solely on outbound OI, they may become myopic (Cao et al., 2009; Wei et al., 2014). Because the benefits delivered by outbound OI relate to externalising internal ideas to gain commercial benefits, when firms obtain some interests from this activity, they may tend to single-loop learning and reduce new product development (Cao et al., 2009; Gibson and Birkinshaw, 2004). That is, when firms excessively rely on outbound OI to gain benefits, they may slight the use of internal ides for innovation (much higher than inbound OI); these firms tend to only enjoy short-term success while being reluctant to upgrade current or innovate new products (Wei et al., 2014). This may increase the risks for the firms' long-term development and market survival, which firms need when launching competitive products with new features rather than only gaining interest because of their prior products (Chesbrough et al., 2006). Therefore, regarding these two conditions, if there is not an appropriate ambidextrous conduction in OI, innovation performance may be weakened. An appropriate ambidextrous conduction of inbound and outbound OI thus can help firms reducing the risks of excessive conductions on innovation performance.

Overall, the study predicts that ambidexterity in OI may have a significant effect on innovation performance. Moreover, when ambidexterity in OI is maintained at a balance level, firms can leverage more beneficial effect on innovation performance.

2.3.3 Moderating Effect of ACAP on the Relationship between Locational Factors, Ambidexterity in OI and Innovation Performance

The study proposes that ACAP may moderate the relationship between locational factors and ambidexterity in OI. Because ACAP allows firms to identify, screen, evaluate and take advantage of newly generated knowledge (Cohen and Levinthal, 1990), it may influence a firm's knowledge acquisitions and diffusions, which further strengthens or weakens the extent of the relationship between locational benefits and ambidexterity in OI. Thus, the study proposes that ACAP moderates the relationship between locational factors and ambidexterity in OI by facilitating knowledge acquisition and diffusion in the cluster.

The utilisation or acquisition of external knowledge is one reason why locational factors affect the pursuit of ambidexterity in OI. With locational benefits, a firm either acquires sources of new technologies/ideas by itself or through its R&D alliances in order to explore new technological opportunities. Obtaining those external valuable ideas is based on a firm's ability to recognise the value of new external ideas, and then screen and apply them to own innovation adoption (Cohen and Levinthal, 1990; Ferreras-Méndez et al., 2016). Learning and the capacity to process external ideas is core mechanism of this process, which may be linked to a firm's ACAP level. When combining the function and ideas of ACAP with organisational learning theory, it can be argued that the absorption of different sources of knowledge into a firm's innovation should be based on leveraging and expediting its learning process (see Cohen and Levinthal, 1990; Zahra and Hayton, 2008). Applying the learning process to external knowledge acquisitions under the condition of locational factors (to lead ambidexterity in OI), ACAP functions to help a firm facilitate the process on analyse and acquire external knowledge, which is derived from the cluster (Ferreras-Méndez et al., 2016). Learning, understanding and processing useful ideas from outsiders may provide a firm with a higher level of ACAP, it thus can more effectively assimilate and exploit the external knowledge and strengthen the relationship between locational factors and ambidexterity in OI. However, if a firm has a lower level of ACAP, it may be less able to acquire valuable external knowledge from locational factors (e.g., suppliers, universities and individual R&D firms), thus weakening the relationship between locational factors and ambidexterity in OI.

Meanwhile, ACAP may also moderate the relationship between locational factors and ambidexterity in OI by facilitating the diffusion of knowledge. Because ambidexterity in OI indicates that a firm can use both internal and external ideas, its use of internal ideas for OI conduction is a key aspect of its performance. As the cluster provides an environment for knowledge diffusion, locational factors can also enable firms to effectively use their internal ideas to pursue ambidexterity in OI. Knowledge diffusion is often observed by firms in a highly localised area, so a cluster is regarded as an ideal environment (Hippel, 1994; Jaffe et al., 1993). Prior studies have also demonstrated that a firm's skilled R&D personnel and patents (its mobility) are key elements of knowledge diffusion, and they support the linkage of these two factors (Boschma et al., 2009; Rosenkopf and Almeida, 2003; Singh and Agrawal, 2011). Furthermore, because there are many skilled R&D personnel, and patents from diverse firms or institutions in the cluster due to geographical proximity or co-location (Bell and Zaheer, 2007), the prerequisite for knowledge diffusion can be satisfied. The link between locational factors and ambidexterity in OI implies that a firm has the capacity to process its existing knowledge stock, much of which is embedded in its products, processes and R&D team, for knowledge diffusion (such as out-licensing, external R&D contrast and joint-ventures). This suggests that ACAP plays a role in this process (Escribano et al., 2009). Specifically, ACAP affects a firm's internal R&D capability and professionals (Cohen and Levinthal, 1990) and the number of patents or internal R&D investments it has, which leads to knowledge diffusion under the environment of locational factors. Thus, ACAP may facilitate the extent of the relationship between locational factors and ambidexterity in OI. A higher level of ACAP may affect a firm's knowledge diffusion based on these internal indictors, strengthening the extent of the relationship between locational factors and ambidexterity in OI. A lower level of ACAP may weaken the extent of locational factors and ambidexterity in OI because less knowledge diffusion might occur. To summarise, the study thus predicts that ACAP as a moderator affects the relationship between locational factors and ambidexterity in OI.

In the second respect, regarding the relationship between ambidexterity in OI and innovation performance, the study proposes that ACAP also moderates the strength of the relationship between ambidexterity in OI and innovation performance. First, by utilising and combining the internal and external sources into an appropriate level, ACAP enhances the extent of ambidexterity in OI and innovation performance. On the one hand, when a firm has a stronger internal knowledge base of ACAP (e.g., conducts continuous R&D and has a high number of patents, technologies; see Zahra and George, 2002), ACAP not only enables the firm to recognise the value of external knowledge and further assimilate it (Vanhaverbeke et al., 2008), but also increases the firm's ability to more smoothly externalise or diffuse its internal available knowledge to outsiders — either to gain commercial benefits or with the support of external firms to develop new creations (Cohen and Levinthal 1990). Importantly, in addition to supporting the firm in acquiring the necessary external sources beyond its boundaries, ACAP allows the firm to apply internal sources to gain potential benefits from the external environment, thus optimising the combination of internal and external ideas (Zahra and George, 2002). One reason for this is because if the internal sources of the firm are sufficient and well-developed, the firm will be more likely to be active and provide those ideas to outsiders for recombination and coordination (Fosfuri, 2006; Gassmann and Enkel, 2006). This means that ACAP can appropriately combine internal and external sources, enhancing the extent of the balance in OI and innovation performance. On the other hand, firms mostly engage in more external sources than they diffuse internal sources, which tends to create a stronger relationship between ambidexterity in OI and innovation performance (Christensen et al., 2005; Fernald et al., 2017). When it comes to the function of ACAP, which allows firms to effectively recognise, assimilate and integrate new knowledge with their own base, that is, dealing with external sources more effectively by using internal knowledge (Cohen and Levinthal 1990), ACAP used across a firm's boundaries optimises both sources' utilisation, thus strengthening the level of ambidexterity in OI and innovation performance. In this sense, an appropriate combination of internal and external sources can be used to acquire external ideas into the firm; this contrasts simply equalising or outflowing internal sources to meet external acquisitions. For those firms that are relatively lacking in internal R&D strength and sources and that need external resources to support R&D, effectively using external knowledge is the priority, rather than having the same emphasis on the output of internal sources. Thus, the processing of ACAP represents its function via the outside environment to screen and assimilate new knowledge, combining both internal and external sources into a relatively balanced level (Cohen and Levinthal, 1990; Zahra and George, 2002). That is, ACAP not only encompasses a firm's ability to process knowledge internally, but also focuses on the acquisition and assimilation of external knowledge (Rothaermel and Alexandre, 2009). Here, ACAP facilitates the combination of internal and external sources appropriately, which aligns with Cohen and Levinthal (1990, p. 133), indicating that there is a 'balance between inward-looking and outward-looking absorptive capacities' due to 'the efficiency of internal communication against the ability to assimilate and exploit information from other subunits or the external environment'. Therefore, by allowing firms to flexibly utilise both internal and external sources across their boundaries — combining to a balancing point, ACAP strengthens the extent of the relationship between ambidexterity in OI and innovation performance.

Second, to explain the moderating role of ACAP on the relationship between the ambidexterity in OI and innovation performance based on synergy, the study argues that ACAP can facilitate the reinforcement between inbound and outbound OI. Affecting a firm's mutual effect between internal and external knowledge utilisation is the key way to enable inbound and outbound OI to reinforce each other (Hagedoorn and Wang, 2012; Lokshin et al., 2008). Specifically, through knowledge stock and its indicators (e.g., continuous R&D, the number of patents), ACAP helps firms process internal and external knowledge mutually, thus influencing inbound and outbound OI reinforcement (Flor et al., 2017; Higgins and Rodriguez, 2006). On the one hand, a firm's internal knowledge processing can promote its external knowledge processing (sourcing or acquisitions). Here, ACAP contains the function to search and absorb valuable external knowledge, relying on a firm's internal demand and knowledge processing to evaluate the quality of technological know-how possessed by partners or acquisition targets. That is, when engaging in continuous R&D and learning with the objective to detect market and technology trends and translate them into pre-emptive actions (Sofka and Grimpe, 2010), the presence of ACAP may increase the firm's capability to better process external knowledge based on in-house or internal activities (Barge-Gil, 2010). This indicates that developed ACAP can be a key determinant in fostering the effects of a broad use of external sources from a firm's internal experience and knowledge (Flor et al., 2017). Therefore, the interrelated effect between internal and external sources can lead to inbound and outbound OI to reinforce each other. On the other hand, external knowledge processing also can enhance the use of inside ideas, depending on the influence of ACAP. When a firm engages in external acquisition, it is more likely to communicate and integrate its internal sources with external parties, and ACAP in this sense can enable inbound and outbound OI to enhance each other as well (Laursen and Salter, 2006). One possible reason is that due to external sources being required to effectively achieve internal coordination, facilitate knowledge transfer and make new insights compatible with existing ones, the firm's ability to combine and exploit external knowledge thus is a driver to enhance the benefits of external knowledge in its internal innovation process (Flor et al., 2017). By combining and assimilating the new knowledge inside the firm, ACAP enables the firm to externalise some inside ideas/products for commercial use, that is, to get more financial benefits for acquiring significant external sources that result from the external acquisitions (Cohen and Levinthal, 1990). By affecting the firm's internal and external mutual effect (from external side), ACAP drives inbound and outbound OI to reinforce each other. The prior literature also offers a consensus on this (e.g., Huang and Rice, 2009; Lokshin et al., 2008; Rothaermel and Hess, 2007); for example, Lokshin et al. (2008) provide evidence of internal and external knowledge searching, suggesting that ACAP may, as an internal factor, facilitate the impact between internal and external sources. Hence, by affecting the mutual effect between internal and external sources on the reinforcement between inbound and outbound OI, ACAP can moderate the relationship between ambidexterity in OI and innovation performance.

2.3.4 Mediation Effect of Ambidexterity in OI on Locational Factors and Innovation Performance

Prior literature has demonstrated that innovation performance is to be directly influenced by ambidexterity in OI (e.g., Chesbrough, 2003; Chesbrough and Brunswicker, 2013; Dahlander and Gann, 2010) and that utilising locational factors in a cluster can, in turn, affect ambidexterity in OI (e.g., Lee et al. 2010; Bocquet and Mothe, 2015). However, literature based on the OI paradigm that aims to investigate the potential functions and linkages of ambidexterity in OI in terms of the relationship between clusters and innovation performance remains sparse. Thus, there is a need to examine the possible mediation effect of ambidexterity in OI which treats the linkages among locational factors, ambidexterity in OI, and innovation performance as a whole picture.

Regarding the relationship between locational factors and ambidexterity in OI, locational factors enable firms to achieve ambidexterity in OI by providing the benefits which can be applied to both inbound and outbound OI (Bocquet and Mothe, 2015), where firms can effectively utilise external ideas as well as internal ideas (knowledge acquisitions and diffusions), thus advance OI activity in a relatively balanced level (Chesbrough et al., 2006). On the contrary, if firms locating individually or in isolation, they may find it difficult to engage both inward and outward technology transfer in an appropriate balance, given that the environment lacks resources to allow firms to conduct both inbound and outbound OI. Therefore, by co-location or clustering in a science park, the environmental benefits enable firms to utilise external knowledge and interact with other parties which help the focal firm to apply both types of OI in a relatively balancing level (Jaffe et al., 1993; Almeida et al., 2003). For instance, by taking part in industry events or cross-firm communications, a firm can form cooperative links with other parties that can bring in external knowledge for new product development as well as allowing the provision and licensing-out of appropriate internal knowledge to other parties for further development, thus ambidextrous OI conduction in the cluster is enabled (Ozer and Zhang, 2015).

Regarding the relationship between ambidexterity in OI and innovation performance, this study indicates that ambidexterity in OI can affect innovation performance by delivering a synergy on innovation outcome. This synergistic effect on innovation performance builds on the notion that the concurrent adoption of inbound and outbound OI can bring a greater effect than their separate individual effects or solely applied either type of OI (Dahlander and Gann, 2010). It implies that, by conducting inbound and outbound OI at a balanced level, a synergy may be achieved via building an indirect path between locational factors and innovation performance, which is reflected by the role of ambidexterity in OI. Such ambidexterity in OI delivers a benefit (a synergy) derived from locational factors to innovation performance, implying that ambidexterity in OI could have a mediation effect between locational factors and innovation performance. Therefore, this study states that ambidexterity in OI as an intermediate factor may mediate the relationship between locational factors and innovation performance.

Based on the arguments for the effects of locational factors on ambidexterity in OI and ambidexterity in OI on innovation performance, it can be seen that locational benefits enable firms to be appropriately conduct inbound and outbound OI, thus forming a balance to create a synergy (Dahlander and Gann, 2010). This synergy of ambidexterity in OI may influence innovation performance. That is, ambidexterity in OI acts as a mediating factor to facilitate the indirect relationship between locational factors and innovation performance. Hence, based on the linkages among locational factors, ambidexterity in OI and innovation performance, the study proposes a new framework to examine the overall relationship of these three factors and explain the effect between locational factors and innovation performance, which is channeling through ambidexterity in OI. Regarding these relationships as a whole, this study predicts that ambidexterity in OI may have a mediation effect between locational factors and innovation performance in the OI conduction.

2.4 Theoretical Framework

Based on the discussion above, the study develops a theoretical framework which reveals that locational factors affect the level of ambidexterity in OI and that ambidexterity in OI influences the outcome of innovation performance, while ACAP, as the moderating factor, moderates the relationships between locational factors, ambidexterity in OI and innovation performance. This indicates, therefore, that ACAP moderates the relationships in such a way that the positive link between locational factors, ambidexterity in OI and innovation performance is stronger when the firm possesses higher levels of ACAP. Furthermore, ambidexterity in OI is the mediating factor for the relationship between locational factors and innovation performance. Figure 2.1 illustrates the interactions and linkages in the framework.

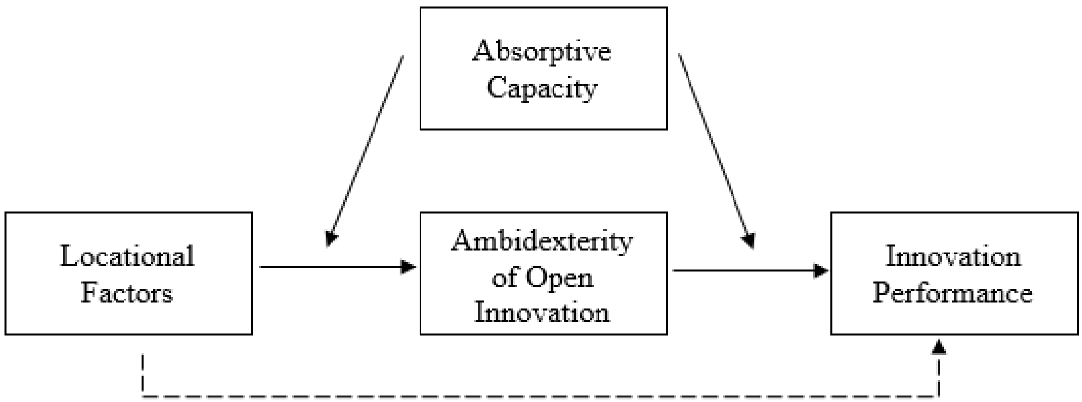

Figure 2.1 the Framework of OI Relationships

The OI paradigm, as the fundamental theory, assumes that firms can and should use external ideas as well as internal ideas, and internal and external paths to market, as they look to advance and commercialise their technology (Chesbrough, 2003a,b; Chesbrough and Crowther, 2006). In OI conduction, firms pursuing inbound and outbound OI in the meantime may not attain a balance in the sense of doing two things appropriately, as the imbalanced pursuit of both OI may be inherently challenging because of competition for scarce resources that often leads to conflicts, contradictions and inconsistencies (Simsek et al., 2009). To address these potential issues, firms need to find a relative balance level of two kinds of OI activities, so that both inbound and outbound OI can be implemented appropriately.

Regarding OI conduction in SMEs, Cao et al. (2009) indicated that SMEs can benefit from the use of a balanced dimension of ambidexterity in innovation, whereby the latter can enhance innovation performance by reducing the performance-damaging effects of over-engagement in exploitation to the detriment of exploration, or vice versa (Cao et al., 2009). Therefore, it is also significant to link ambidexterity in OI to identify the appropriate balance for inbound and outbound practices. Hence, this study draws a theoretical linkage between OI practices, ambidexterity (the balance) in OI and innovation performance, and notes that firms with a balanced portfolio of inbound and outbound OI perform better in innovation performance than those with the same but a less balanced portfolio. This suggests that a proper balance (of ambidexterity) in OI also has a positive effect on innovation performance.

Regarding locational factors, a cluster may provide the environment where firms can form networks to use the benefits for achieving ambidexterity in OI (Porter, 1998; Breschi and Malerba, 2001). A cluster enhances the acquisition and diffusion of knowledge, provides an ideal environment for OI conduction, which affects the balancing engagement. Therefore, a verity of advanced knowledge and resources are regarded as the locational benefits that firms could be utilising to promote both inbound and outbound practices to form their own balance. These two aspects, interact to explain the linkages in the framework. In another respect, the theoretical context could also be linked to organisational learning and supported the relationship between locational factors and ambidexterity in OI. From a theoretical perspective, organisational learning explains the reason and demand for a firm's acquiring and transferring knowledge (for example, learning from outsiders by cooperation or joint-venture; Barringer and Harrison, 2000), which is achieved by creating and retaining processes to obtain valuable resources for innovation. Therefore, it promotes the possibility of firms applying both OI activities in an ambidextrous view to utilise both internal and external resources, and the benefits achieved may link to a balance adoption in OI. Hence, when ambidexterity in OI is derived from a variety of internal and external sources, according to organisational learning theory, firms should find and rely on more resources from the external environment where they benefit more from those relationships (Filatotchev et al., 2011). Thus, within the framework, organisational learning also underpins the moderating role of ACAP among locational factors, ambidexterity in OI and innovation performance.

Regarding the relationship between ambidexterity in OI and innovation performance, it also links to the moderating effect of ACAP. With an appropriate balance in OI, firms could avoid some disadvantages associated with becoming overly focused on one or the other (Han et al., 2001), which is more likely to generate a positive innovation outcome (Lin et al., 2013). As ACAP allows a firm to identify valuable knowledge that originates from beyond its boundaries, and to integrate this internally (Arora and Gambardella, 1994), it thus encompasses a firm's ability to process knowledge internally, which enables it to assimilate and apply knowledge to new R&D by providing internal sources to external. This reflects its function in resource acquisition and knowledge assimilation that facilitates the strength between the balance in OI and innovation performance. Therefore, this suggests that the relationship between ambidexterity in OI and innovation performance is stronger when the firm possesses higher levels of ACAP.

For the relationship between locational factors and ambidexterity in OI, ACAP reflects its moderating role as well. Combined with previous discussions, it implies that ACAP represents the capacity to locate and acquire external knowledge that can be assimilated to the notion of competitive scanning (McEvily and Zaheer, 1999). It corresponds with the characteristics of the cluster, where firms are located closely together to access, exchange and transform internal and external knowledge for innovation (Lin et al., 2012). Based on the different level of ACAP, firms may achieve diverse strength of the relationship between locational factors and ambidexterity in OI, that the extent of this relationship may be facilitated by how well firms can utilise the benefits and how strong their ACAPs are. Hence, ACAP as a moderation factor affects the strength of the relationship between locational factors and ambidexterity in OI, and the relationship may be stronger when firms possess higher levels of ACAP.

Overall, ambidexterity in OI can deliver a mediating effect on the relationship between locational factors and innovation performance. This interpretation is built upon the theoretical linkage from knowledge transfer in the cluster via ambidexterity in OI to achieve the innovation outcome. As ambidexterity in OI leads to firms' innovation performance and it is affected by the benefits derived from locational factors, ambidexterity in OI in this condition as an indirect path connects and reveals the relationship between locational factors and innovation performance. This implies, therefore, that ambidexterity in OI is a channel in the middle of the cluster and innovation performance, and that it bridges the relationship between locational factors and innovation performance. The framework suggests that ambidexterity in OI is not only influenced by locational factors and influencing innovation performance, but is a mediator that affects the relationship between the two.

2.5 Conclusion

By constructing a new framework based on various theories related to OI, this chapter aims to explain the relationship between locational factors, ambidexterity in OI and innovation performance that integrate all relevant factors to reveal potential linkages in this model. This study provides a further discussion and observation in the context of OI regarding ambidexterity in OI, locational factors and their effects on innovation performance. It not only examines the direct effects among these three factors, but also proposes a mediating effect of ambidexterity in OI on the relationship between locational factors and innovation performance. The study thus enriches the understanding of ambidexterity in OI and provides a new framework to the existing OI literature.

Chapter 3 Research Methodology and Field Work

3.1 Introduction

This chapter outlines the research approach and field work that have been applied during data collection. It aims to discuss the reasons for method adoption and investigation. This chapter indicates the theoretical reasons of the appropriate research method for data collection that properly links its collection to the examination of the research questions. This establishes the research method as the fundamental base for field work and data investigation.

3.2 Research Approach

The *deductive approach* (Saunders et al., 2009) is applied for examining research questions and hypotheses testing. This method is primarily based on research questions to employ a deductive approach to test propositions that links ambidexterity in OI with location factors and innovation performance; while demonstrates ACAP's moderating effect and ambidexterity in OI's mediation effect within the entire framework. This entails associating a theoretical framework with the eventual investigation to test research hypotheses.

3.3 Quantitative Vs Qualitative Research

Quantitative and qualitative research have different focuses for the collection and analysis of data. The nature of quantitative research involves the empirical investigation of observable phenomena. This involves the application of statistical, mathematical/numerical techniques. It is applied through the posing of specific, narrow questions to collect a sample of numerical data from observable phenomena or participants (Saunders et al., 2009). This approach is appropriate for this study where the hypotheses and framework testing is based on a questionnaire to collect data that is then used to examine the relationship between variables. Therefore, using statistical techniques to quantitatively reveal variables relationships (of the new framework) can be used to demonstrate firms' innovation conditions, thus interpreting and justifying hypotheses and framework construction.

Qualitative research, on the other hand, asks more generic questions to collect word data from phenomena or participants. It focuses on themes and patterns to examine the exclusive condition of participants (Saunders et al., 2009). This approach is in not appropriate for model generation, or for numerical data analysis. This method, although it mainly examines large-scale data samples and uses questions and specific methods like interviews (used in the pilot study) to test predictions, is still appropriate to identify firms' operational situation. In other words, it can summarise some key points from face-to-face interaction and interviews.

In addition, previous OI studies were largely qualitative studies that used case studies and interviews to collect data and construct their frameworks. However, in this study, as the research questions need to be examined via relation analysis and the need to generalise/ examine results from a larger sample population, questionnaire-based data is suitable to formulate facts and deduce results. As such, interviews (a qualitative methodology) are used to supplement the quantitative data to deepen potential understanding, while framework and hypotheses verification is mainly based on the questionnaire data. Therefore, the quantitative method is used to address and reveal how firms implement OI activities and identify firms' practical operations in innovation. The qualitative method provides insights to support the measurable data to understand and interpret the relationship between factors and to examine variables.

Table 3.1 Comparison of Pros and Cons between Quantitative and Qualitative Research

Quantitative Method		**Qualitative Method**	
Survey and Questionnaire		Interviews	
Pros	Cons	Pros	Cons
1. Data collected via questionnaires are standardised and numeric. 2. Quantitative method is used to get statistics and relationship penetration. 3. Large scale data is collected via same format and presented different firms' situation.	1. May ignore the data that cannot be presented by numbers/ digits (e.g., participants descriptive data). 2. Some numeric data presented might be vague that answers only revealed by digits were incomprehensive.	1. Qualitative method is used to summarising, categorising, and structuring managers' oral data. 2. Managers' ideas are supplemented to main survey design and reflected information from reality.	1. Data are non-standardised and need to be categorised. 2. Not applicable to deal with large scale based data analysis and collection.

Source: Adapted from Saunders et al. (2009)

3.4 Research Context

The research and data investigation was carried out in ZSP, Beijing, China. The target firms in the sample were high-tech SMEs located in the cluster. According to *Chinese SMEs type and standard* (MITT, 2011), in general industries (firm types in the science park) an SME is defined as a "firm [that] has more than 300 employees, and operating income of 20 million yuan and above as the medium-sized enterprises; firm has 20 employees and above, and operating income of 3 million yuan and above as the small-sized enterprises". In the UK, the *Companies Act 2006* (LEG, 2006) defines SMEs for the purpose of accounting requirements. According to the Act, an SME is a company that has a turnover of not more than £6.5 million, a balance sheet total of no more than £3.26 million, and no more than 50 employees. A medium-sized company has a turnover of not more than £25.9 million, a balance sheet total of no more than £12.9 million and no more than 250 employees. These definitions show that the UK and China have similar formulations relating to SME employee numbers, while due to different financial environments and currencies, UK SMEs have higher turnover requirements. As this study examines OI among Chinese SMEs and their operating environment, it thus follows Chinese standards and screens firms.

Reasons for focusing on China and its high-tech firms are as follows. First, the innovation environment of firms is worthy of analysis. As China's economy is still growing rapidly, R&D capability is regarded as a key factor and motivator to industry to support continued economic expansion (MOST, 2015); while supporting high-tech firms to create more 'China Creates' product is a key policy focus of central and local governments. In this sense, ZSP represents a typical science cluster of Beijing and China (Chen et al., 2014; He et al., 2010) that integrates the resources of talent, technology, information and universities, and values innovation and creativity. In the science park, various investment channels such as government policy support, venture and foreign capital provide a flexible environment for firms to attract investment and financial supports.

Further, established universities located in this area provide technological innovation and business incubation conditions for R&D conduction and high-tech development (Chen et al., 2014; Zhang et al., 2009). Therefore, it is an ideal area for high-tech SMEs to conduct their business and cooperate with various partners for innovation. Research on ZSP can show how high-tech firms conduct OI activities and respond to location factors. A key aspect to be identified is how high-tech firms perform OI practices to achieve innovation performances.

This can establish differences with Western studies while summarising the implications that are unique to these firms' innovation. The limitations of research of Chinese OI require consideration. Previous studies have mainly focused on Western high-tech firms' innovation environments, which are related to OI and clusters. As such, those studies lack a focus on the Chinese high-tech firm environment. Examining the existing framework and addressing this research gap is another key motivation for this research. This will reveal the current status of Chinese high-tech firms' innovation to provide eventual recommendations of how OI practices could be adopted under different macro innovation/locational environments. These may include policies, firm status, and operation ideas, as a current view on China's situation.

3.5 Pilot Interviews

Prior to commencing the pilot online survey, in order to understand the latest information and dynamics of high-tech firms' OI adoption, seven pilot interviews with innovation/R&D managers were conducted. The purpose of these interviews is to gather basic information of how firms applied OI and their results, while identifying the difficulties/barriers that exist and whether firms' conduct showed contradictions with their innovation strategies.

3.5.1 Interview Design

Structured interviews were conducted with departmental managers (innovation/R&D) or chef technology officers of seven firms within ZSP. These managers came from the key industries within the cluster (four managers from manufacturing and software firms, three managers from pharmaceutical, electronic, and telecommunication firms respectively), and each firm provided its innovation conditions and feedback to improve the questionnaire. The seven firms were included in the seventy firms for the pilot online survey, because the obtained information could be used to analyse the results for all firms.

To gain access to the R&D managers, email and phone communications were conducted to acquire permission and explain the research purpose. Their contact details were gathered from firms' websites and personal contacts with people working at the cluster. After gaining the permission of firms, the interviews focused on each individual's professional knowledge and attitudes towards OI and R&D conditions. Specifically, the interview questions had to broad categories: the first section examined the fundamental innovation background, posing questions such as 'What kind of innovation activities has your firm applied?', 'What are the key drivers that make your firm conduct open innovation practices?' (Chesbrough and

Crowther, 2006). The second section was linked to particular OI practices that investigated inbound and outbound OI practices, and the types of partner firms they had cooperated with to promote innovation activities (Rohrbeck et al. 2009). It was also connected with related questions from the questionnaire (full interview questions at Appendix 1.1). Each interview was approximately 45 minutes in duration and managers provided some information in the interview questionnaires.

3.5.2 Results and Implications

Two important results were provided by managers to further improve the questionnaire. The first one was to improve with the definition and categorisation of OI practices, which suggested more activities that should be classified as OI practices, such as contracting R&D activities, project-based innovation and external programme cooperation with other parties. This gave a boarder picture of the actual OI practices already undertaken by firms, also directly pointed out examples from the questionnaire that could be letting managers more clearly to express their conditions and information. The second was the improvement of the innovation performance description, which was relevant to a question concerning how turnover growth variables contributed to new products. Initially, the word 'sales' had been used ('new products' contribution to sales and their growth') but one manager pointed out that as many Chinese firms (SMEs) actually do not distinguish between turnover and sales (compared to UK firms), they may misunderstand this concept. As a result, instead of using 'sales' as a generic word in this question, 'turnover and turnover growth' is used and is consistent with other questions that ask about financial performance. Therefore, the wording was altered to allow managers more easily express their information while corresponding to similar questions related to performance variables.

Regarding OI implementation, all seven firms had applied it to operate innovation projects. One key driver is the acquisition of more external knowledge via alliances and cooperation to accelerate and support the firms' own R&D. For specific practices, manufacturing, electronic and telecommunication firms had applied more inbound OI practices than outbound, while 'conducting external R&D contracting' was frequently used. The three industries held relatively conservative attitudes to outbound OI practices, primarily due to the efficiency of implementing processes for achieving innovation outcomes, for which managers stressed technology protection and competition as key factors. On the other hand, software and pharmaceutical firms were more open to the adoption of outbound OI practices, as software managers considered project interaction with cooperators/third parties to be a positive, helping them to develop more software innovations. 'Open-source' can sometimes achieve unexpected outcomes for R&D while also promoting innovation. As a result, communication and spin-offs from outbound OI practices (e.g., 'providing R&D contracting to partners') were more frequently conducted. Therefore, traditional industries were more likely to apply both inbound and outbound OI practices; conversely, software and pharmaceutical firms prefer relatively open, in-depth cooperation with external parties via outbound OI practices.

Further, in-house (close) innovation was considered to be the core R&D capacity and competence for firms' development and maintaining market share. In-house R&D was considered fundamental to market survival and profit generation (Chesbrough et al., 2006). This indicates that close innovation is involved in every key progress in product development and improvement, and the majority of innovation projects are reliant on internal innovation. As such, internal R&D capability is the decisive factor for product innovation. This suggests that without a strong, solid in-house innovation team, firms cannot sustainably develop new products and will struggle to compete effectively (Chesbrough, 2003a). In both traditional industries and emerging industries (e.g., networks), close innovation plays a crucial role in firms' overall R&D capacity, in that OI activities are considered to be complementary activities by managers that support and prefect core R&D conduction, while valuable external knowledge, information and cooperation is used to supplement firms to develop products that they cannot research independently. It was also suggested in the interviews that engaging in OI must be coherent with a firm's key close innovation objectives. Therefore, linking open and close innovation as a whole is complementary and close innovation cannot be deemed less important as it remains fundamental for innovation.

Hence, the main goals of the interviews were to test in how deeply managers understood the concept and sense of OI practices, and what factors motivated them to use this new model. The results demonstrated that the majority of participating firms had applied OI and preferred to engage in OI practices under actual operations. They also identified potential issues of concern for managers/firms related to the actual process (e.g., what factors affected the relationship between innovation performance and ambidexterity in OI), which were related to policy guidance and funding support to R&D projects. Modifications were made to the pilot questionnaire to address certain ambiguous questions.

3.6 Pilot Online Survey

During the pilot online survey, 140 firms were selected from the LIST (*the List of High-Tech Enterprises in Zhongguancun Science Park*) according to the firms' industries. Similar to the interviews, in approaching the main industries' firms to participate in the survey, innovation/R&D department personnel were the key respondents. The pilot survey tried to apply an adapted *quota sampling* (Saunders et al., 2009) method in which participants were equally selected from industrial realms whereby every sector had the same number of firms to be investigated. Specifically, forty firms were selected from software and electronic industries, while an additional 100 firms were all equally drawn from manufacturing, bioengineering, telecommunications, network and pharmaceutical engineering.

3.6.1 Online Questionnaire Design

The design of the questions was connected to the theoretical framework whereby independent variables including OI practices had been classified into three dimensions as one section. The first was based on firms' entire innovation activities and asked; 'What approximate percentage of the firm conducts OI practices within the entire percentage of innovation activities?' The second question asked about the percentage of inbound OI practices within the percentage of OI conduction, while three specific practice percentages (of inbound OI) were also asked about. The third aspect asked about the percentage of outbound OI practices within the percentage of OI conduction, and also about three specific practice percentages. It was therefore based on three levels of OI practice percentages to analyse how firms implement OI according to the specific conditions. The percentages were used to examine the balance (ambidexterity) in OI to reveal the level that led to innovation performance. Also, locational factors as independent variables on innovation were set as one section. The factors were examined by designing ten five-level Likert-scale questions to find out which factors firms consider most important to their innovation activities. It included elements like talent access within the cluster, cooperation with upstream and downstream to lower costs, suppliers' support in innovation, alliance establishment, and gaining government support and venture/foreign capital within the cluster environment. Meanwhile, to test the dependent variables, innovation performance was set as one section which included three kinds of indicators to examine innovation results. It included three questions about how new products contribute (new to market and firm, new to firm, and significantly improved) to turnover, three questions about turnover growth by product contribution, and two questions to reveal new product R&D and launch results. These questions were focused on turnover and turnover growth to identify how new products contributed to financial performance, and new product creations to identify their actual R&D capacity simultaneously. In addition, alliance activities were tested in one section that was related to the cooperation of alliances (cooperation with different kinds of partners) and these alliances' importance and support to firms' R&D and market activities (quality and importance to R&D and market operations) to compare what differences might exist between firms. To be noted, the first section, including general business information and questions related to ACAP, is used to test the strength variations of the relationship (e.g., locational factors and ambidexterity in OI). Hence, the five sections include key variables of the theoretical framework and contain business information to analyse the eventual condition of high-tech firms' OI engagement.

In summary, the questions were divided into five sections which were linked to the research questions on inbound and outbound OI practices (section B), cluster effect on innovation activities (section C), innovation performance (section D), alliance activities (section E), and section A on the firms' general business information. The arrangement of the five sections was based on online questionnaires (on *sojump.com*), which provided templates and styles for presenting questions. For example, section B's questions were presented as blanks and selections (list questions), while section C's questions were based on five-level multiple-choice selection of the Likert-scale (rating questions). When all of the questions had been designed and finished, the survey system generated an Internet link to invite external participators to open and complete the questionnaire. This was the method by which questionnaires were sent to participants via email and online communications.

3.6.2 Pilot Survey Conduction

When the online design was completed, phone calls were made to confirm whether participating firms were available to join the study (emails were sent before phone contact was made, to express ideas and check availability). Meanwhile, to contact some firms, personal contacts/relations were used to gain access. Firms' contact details were acquired from their websites and the official site of ZSP (ZSP, 2014).

Approximately 140 questionnaires were sent to get 70 valid questionnaires for the pilot survey in two rounds. The first round entailed sending 70 questionnaires as prepared from the LIST, which covered the main industries of the cluster equally. As all of the firms were sent emails with links, the return date was also included (no more than ten days) to ensure timely questionnaire review and completion. Around 30 completed questionnaires were returned in time, therefore another approach was needed. As with the first time, a further 70 firms were selected, which were combined with the results of the first round (an inclination of firm participation: e.g. more network firms had been selected due to insufficient numbers). This was to ensure a balanced set of results. After contacting the new 70 firms, the questionnaires were sent with a time limit of ten days. This second round secured 45 completed questionnaires. 40 well-completed questionnaires were selected and added to the previous 30 to form 70 valid questionnaires. This ensured a balance of industry distribution and representativeness.

3.6.3 Results and Implications

The 70 firms' results demonstrate that regarding OI adoption's test, manufacturing, electronic and software firms had better performances than other industries, where their average OI percentages were 37%, 33%, and 29% respectively within their entire innovation activities. The inbound OI percentage was higher than for outbound OI. Firms' mean was 63%, and 'conducting external R&D contracting for innovation activities' was the highest (62%) in inbound practice engagement. Also, 'providing R&D contracting to partners or others for innovation activities (61%)' was the most frequent approach employed by firms for their outbound practices. Regardless of whether OI practices were inbound or outbound, the activities cooperating with or related to partners were still the first choice for firms when assigning their innovation resources and conducting activities — possibly due to the protection and guarantee of self-core technology. While these 'contract-based activities' had also been mentioned during pilot interviews, managers explained this as 'mutual market competition and observation of rivals R&D capacity', which was linked to firms' own profit-making and product development.

Compared to in-licensing activities, high-tech firms still prefer to conduct low risk and safe out-licensing activities due to the highly competitive Chinese environment, where funds, talent and experience demands were higher and crucial to SMEs' survival in the market. That made them likely to locate at the science park rather than an alternative area where their overall competence is weak. It might also indicate another set of alliance activities of the survey, that most firms consider SOEs and large firms' cooperation to be 'important or very important' to R&D and market activities'. They also tended to partner with universities/government research institutions to enhance weak points in their own innovation. Hence, that was the key result indicated from the pilot survey, and because of that, their financial performance was still differentiated. This demonstrates that those points linked to OI implementations, the cluster effect on innovation and alliance activities consideration (leading to performance variables), should be further observed in the main survey.

On the other hand, related to questionnaire expression, there were additional points provided to ensure the questions were well understood. Accurate understanding was important to respondents and helps to guarantee the validity of the questions. In order to acquire high-quality data in the main survey, validity and correctness is demanded to minimise confusing questions. That is to identify consistent questions and that they delivery information clearly. Hence, the pilot survey data reflected how firms participated in the study and what results could be achieved.

3.7 Main Survey

3.7.1 Sampling

At first, the LIST was obtained from the official website of the science park (ZSP, 2014), which provided firms' names and industry information. The initial sampling frame included all 18,000 firms from the LIST. In order to make the sample representative, the sample size in the main survey was 800 firms (equally distributed among key industry sectors in the science park). The following criteria were used to select the sample: (1) the firms must be private SMEs or small-medium SOEs that meet the criterion of *Chinese SME types and standards*, and be located in the science park; (2) the firms must be high-tech certified, having capacity to manufacture or invent new products, and not be solely focused on servicing or marketing activities; (3) the firms should be conducting OI activities, not only concentrating on in-house R&D and innovation. Following these criteria, several steps were conducted to select firms which met the requirements for investigation.

First, the study excluded large SOEs and multinational corporations (MNCs, from the LIST) beyond the standard of Chinese SMEs. This was based on firms' website information (e.g., business scale, financial income, employee numbers) and knowledge of industry, which was linked to the names of MNCs and SOEs, such as Lenovo, Huawei, and Sohu. Following this, 12,600 firms remained. Second, the researcher screened product servicing and marketing (selling) firms from the LIST, as they may not undertake innovation activities and create new products. This information was obtained from the firms' operation information on their websites and names from the LIST introduction (such as indications that some firms are providing product solutions or consultations that mainly focus on after-sell services). This excluded half of the remaining firms, leaving 6,300. Third, according to the certification and quality standards of the *Beijing Municipal Science & Technology Commission* (BJKW, 2016), firms must meet the definition of a 'certified high-tech firm'. The researcher selected the valid and qualified firms via certification (available on their websites) to ensure the qualification applied. Any firms that did not possess or reveal this qualification were excluded from the sampling. Also, the OI conduction of firms was confirmed via their websites and LIST introduction, which indicated their innovation activities and R&D conditions. All of the participating firms undertake innovation activities, have an R&D/innovation department, and launch/update their products regularly. Further, although some firms were located in the science park and had their names on the LIST, their official websites presented no information or details for investigating. Such firms were also excluded. Moreover, despite the fact that some firms were recognisable as 'high-tech' firms, they are still project-based rather than actively conducting their own R&D and innovation. Where R&D and manufacturing capacity (for products) could not be shown, firms were excluded as participants.

Therefore, the qualified firms were 3,300. Because some firms (whether private SMEs or small-medium SOEs) were still mainly conducting in-house R&D and there was less information about OI activities, while combined with their practical willingness to participate this survey these firms were also excluded. Based on these factors, 800 high-tech firms were finally selected from key industries as the sample. The number was linked to time considerations and the likely response rate of firms, which allowed the researcher to collect data more effectively within that specific and limited time range to obtain maximum available data from the LIST.

In order to ensure the representativeness of the sample and investigate typical firms during the sample selection process, screening was conducted according to two steps. First the firms were categorised into relevant industries such as software, manufacturing, electronics, bioengineering, pharmaceutical engineering, network engineering and telecommunications. These categories comprise the seven key areas within the science park. A balance representation of the target firms was the objective to minimise industrial differences that could impact the research data. Firms from every industry were represented (as with the pilot survey). Second, it was necessary to confirm the firms' contact details were available. This meant screening out the unwilling firms even where they met the requirements for participation (to guarantee the process of the survey). Therefore, sample bias was minimised by balancing the selection of firms from all kinds of industries, which minimised the one-sidedness of participants (see Bryman and Bell, 2011).

3.7.2 Online and On-site Questionnaire

The main survey used both *online* and *on-site (delivered in-person)* questionnaires, both of which belong in the *self-administered* category (Saunders et al., 2009). The key reasons for using online questionnaires can be summarised as follows. First, it allowed the researcher to optimise response times and communication convenience. As all of the participating firms' email addresses had been obtained from the LIST, and the good response rate and results from emailing questionnaires n the pilot survey, convenience and efficiency (of responses) were key reasons for using this approach. Email made it easier to send the questionnaire to target firms and minimised the possibility of errors compared with postal mail. In addition, based on the pilot survey's experiences and communication with managers, it was hard to guarantee the timely return of postal mail, and firms' attitudes towards replying to a mail survey indicated that they would be less likely to participate in surveys and would ignore postal mail from unknown senders. Second, administration efficiency of the questionnaire was key. As online questionnaire websites (*sojump.com* in this survey) provide models or templates to design questionnaires that can be fully managed by users, improvements based on feedback from the pilot study were easily updated on the E-questionnaire, which increased design efficiency and delivery time (one Internet link brought participants to the survey). Further, when receiving and counting the number of returned questionnaires, the website automatically counts the number of replies. As such, when a firm had filled in and submitted the questionnaire, the result would directly be added to the database, and therefore the user (questionnaire manager) could view and track the data immediately. This offered a more efficient process than sending postal mail questionnaires.

In the context of the Chinese study, it is also essential to conduct an on-site questionnaire for the following reasons. First, the importance of the researcher's interpretations and to gain a real sense of the firms. Previous research and personal experience of conducting surveys in China, indicate that it is better to deliver the questionnaires in-person to gain firms' permission and explain the objectives of the study (see Guan et al., 2009). Firms often prefer not to provide information or participate in surveys without adequate explanations (like postal mails only), it is important that an explanation of the investigation is provided. This means explaining the reasons and motivations for participating in this investigation. The second reason to use on-site questionnaires is to control the answering conditions rather than relying on the 'one-sided' postal mail method. Compared with postal mail method, on-site interaction and communication allows greater tracking and control of the questionnaire process (Bryman and Bell, 2011). This provides opportunities to identify and explore additional issues that are important to the research but have not been fully addressed in the fieldwork design. Face-to-face communication also gives researchers the opportunity to clarify certain questions, which effectively avoids incomplete observations and helps to develop rapport with R&D managers to increase the final response rate.

To be noted, combined with the pilot survey's feedback, there were further improvements to be made to the layout of the online questionnaire. The rating questions selection (section C, cluster) was located separately and added notes for agreement level selection, such as from levels 1 to 5. Meanwhile, fill-in questions regarding OI practices (section B) had added notes to explain interpretations of specific practices so that programme, project, contract-based innovation activities could also be presented within the realm of OI conduction. This allowed managers to more easily indicate how they engaged in this new mode. Also, due to the fact that some firms might not engage in OI at present, a 'jump-to-next' choice was included to decrease the missing and or misinterpreted replies. Word modifications linked to innovation performance (section D) was sorted so that the main online survey directly indicated the data related to new products' contributions was linked to 'turnover and turnover growth', which unified the questions between the pilot study and main survey. There was a change made to the order of section A's questions as well. Some general innovation questions (Q7 to 11) were given at first, while financial performance questions (Q12 to 16) were given later. Moreover, sections E's questions design proved acceptable and performed well, as shown by the results of the pilot survey. Therefore, the original format remained for main investigation. Hence, after addressing these structural and layout points, the newly designed online questionnaire was sent via email to 800 high-tech firms as sorted from the LIST of ZSP.

3.7.3 Survey Conduction

During the actual collection period of the survey, respondents were mainly from R&D and innovation departments where the personnel were familiar with firms' innovation strategy and current performance. R&D managers/CTOs had participated as well, and these managers were well-informed about innovation strategies, processes, and had sufficient knowledge about OI adoption. It should be noted that participants were assured that their individual responses were reported only in an aggregated form, so that no individual firm's information would be disclosed (this applied across the pilot test and formal survey — all respondents' information was held in strict confidentiality).

During the survey period, several methods were applied. Questionnaires were distributed in four rounds by email at first. Due to the relatively slow response rate at the beginning of the survey, more firms were notified about the survey. As such, both the early rounds of email distribution and the later rounds were accompanied with a cover letter on the university's official letterhead with a background explanation of OI study. Further, the first and second rounds were fundamental to gathering and motivating firms to collect data. The third and fourth round enhanced the response rate and increased the motivation of firms to reply to the questionnaires. Also, telephone follow-ups were used throughout the rounds to optimise replies. As firms might not answer the questionnaire the first time, reminding them over multiple rounds can be an effective way to increase replies.

To minimise non-response bias in the early rounds (first and second), the respondents were asked to submit the completed questionnaires within two weeks via in-person delivery and online submission. This was to let firms have a clear timeframe in which to complete the questionnaire and increase their awareness about the survey. Also, reminder emails were sent throughout both rounds. The initial reminder email was sent midway through the collection, and the second reminder was sent towards the end of the collection. The reminder emails resulted in an increased rate of questionnaire returns. Telephone communication was used to explain the survey objectives in the later stage of both rounds. Firms who ignored reminder emails and did not respond were the main focus. Following this communication, forty firms returned their questionnaires and filled in all of the survey questions. At the beginning of the main survey, the early rounds' response rates were improved using these methods. Firms needed further contact and information about the purpose of the research.

On the other hand, in the third and fourth rounds, reminder emails were used to increase the response rate along with telephone communications conducted in parallel. An on-site questionnaire and personal contact were used in these rounds to ensure a valid response rate. As with the pilot online survey process, and combined with on-site delivering, the author conducted fifty on-site surveys of firms who failed to respond to the initial email and telephone follow-up in later rounds (for those who ignored reminder emails). These firms were approached through telephone communication with follow-up contact before an actual on-site visit. The outcome from the study showed that on-site questionnaire delivery and completion achieved a better response rate than pure email communications, which effectively avoided some missing observations and minimised the potential for misinterpretation of the survey questions. Therefore, a combination of methods used in the early rounds, including on-site questionnaire and personal delivering, achieved an improved and better result in the later rounds and effectively minimised the non-response rate.

3.8 Response Rate and Representativeness

Based on the original questionnaires prepared for the survey (800 firms), actual valid questionnaires as obtained at the end of collection were 302. According to the formula of Neumann (2005), the response was computed as:

Total response rate = total number of responses / numbers in sample – ineligible

Hence, the response rate was 37.75%.

While from the analysis of response and firms' distribution, each industry's firms had replied the questionnaire differently, represented as:

Table 3.2 Percentage and Number of Firms' Participation

Industries	Number/Percentage of Response (%)	
Manufacturing	90	29.8
Electronic	74	24.5
Telecommunications	23	7.6
Network	37	12.3
Software	28	9.3
Bioengineering	23	7.6
Pharmaceutical	10	3.3
Other Industries	17	5.6
Total	302	100

Source: Author's Research Data

To be noted, at the beginning of the main survey the research design entailed sending an equal number of questionnaires to different industries, so that 100 firms would participate from each industry. This would ideally mean 800 questionnaires evenly distributed across eight categories. Following the investigation, only manufacturing and electronic firms delivered a high response rate that was close to an ideal level. Network, software, telecommunication, and bioengineering firms had relatively normal response rates and represented the actual investigative condition of the survey. Pharmaceutical and other industries' responses were lower than average. Hence, the six industries/firms' responses could still be representative of the overall condition of each industry within the science park.

The reasons for the non-response rate of pharmaceutical and 'Other Industries' (their lower replies) could be as follows. First, the uncompleted and invalid questionnaires from those two categories. All of the submitted questionnaires of pharmaceutical firms were reviewed, and there were thirty firms participated in the main survey. However, twenty of them did not complete all of the questions and some important points were missed (like OI practices percentages and financial data). Therefore, other than ten well-completed questionnaires, twenty were excluded due to invalid and misleading data (e.g., some firms gave ALL of the same data for section D's questions and ALL of the same replies such as 'Not Very Important' on cluster effect). Hence, these questionnaires, whether provided by pharmaceutical firms or

Other Industries, were excluded.

Second, firms' replies and attitudes to the survey. Even if the questionnaire was conducted in four rounds and the delivery was based on a balanced standard, every firm's response time was different. It was hard to accurately control firms' replying time and whether they truly engaged with the survey. Despite adjustments to sending methods, the overall response rate of pharmaceutical firms was still lower than other industries (e.g., fifty questionnaires received from the network firms, although excluded some invalid ones), which means the average reply rate was low.

Third, survey condition and external factors. As the survey needed to investigate firms' innovation and financial data within a time limit, some steps may have been insufficient and missed industry characteristics that would impact the results and outcome of collection, such as pharmaceutical firms' OI practices and innovation strategy. Also, external factors like Chinese firms' surveying characteristics might affect the response rate and make the collection process complicated and unpredictable.

Overall, although pharmaceutical firms and 'Other Industries' did not show the expected response rate, participants from other main industries presented the ideal response rate, which contained useful information and sufficient data for the investigation and study. Hence, the representativeness and final response rate is accepted.

3.9 Time Scale

For the time scale, pilot interviews were taken two weeks which included pre-contact and formal meetings with seven firms' managers. The questionnaire design, test and improvements of pilot survey was taken two weeks. That meant that the pilot study was finished in June.

The main survey was conducted as four rounds from July to the first week of September (see table below).

Contents	**Time/Week (2015, 4 weeks division of each month)**															
Data Collection Progress	June				July				August				September			
1. Pilot interview questionnaire design and firms contacts	■															
Meeting with managers and data recording		■	■													
Interview results analysis and questionnaire improving				■												
2. Pilot online survey questionnaire design				■	■											
Firms contacts and 70 firms screen					■	■										
Confirmation and questionnaire delivering					■	■	■									
Questionnaire collection and analysis							■	■								
Improvement and adaption of questionnaire								■								
3. Firms screening, contacts confirmation for main survey							■	■	■							
Questionnaire confirmation and review									■							
First round questionnaire delivering and collection (email sending, telephone chasing)									■	■						
Second round questionnaire delivering and collection (email sending, telephone chasing)										■	■					
Third round questionnaire delivering and collection (email sending, telephone chasing, and on-site delivering)											■	■				
Fourth round questionnaire delivering and collection (email sending, telephone chasing, and on-site delivering)												■	■	Data collection had been finished		

3.10 Conclusion

The discussion above shows that a quantitative approach is appropriate. The findings show that a survey via questionnaire (for the main data collection), combined with interviews, represents the most suitable strategy for investigating high-tech firms' OI practices and innovation performance. This is based on practical consideration and environmental influences to select the most applicable methodology. Some studies have applied other approaches for OI research but in this context, the above approach is more rational for field work design and actual investigation. The results and data analysis yielded the following conclusions.

First, the data was gathered using both quantitative and qualitative methods, making the collection process more comprehensive. This approach identified the eventual forms of OI activities. The main survey was developed to facilitate firms to easily provide data and highlight the relationship among variables to influence innovation performance (e.g., OI practices, locational factors).

Second, the majority of high-tech firms located in the science park are conducting OI activities. Among traditional industries, electronic firms have the highest rate of engagement in OI activities and frequently conducted both inbound and outbound OI practices. Software, network and telecommunication and emerging high-tech firms also showed high adoption of OI practices. Some specific engagements stressed their motivations and considerations to promote R&D by OI activities.

From that, it is clear that the fundamental analysis of firms' OI implementation reveals some concerns from managers' practical operation, while other key results relevant to the study and model testing are given in descriptive overview and regression analysis.

Chapter 4 Research and Historical Background

4.1 Introduction

Industrial clusters and science parks play key roles in modern firms' technological development. They aim to enhance firms' R&D capabilities and accelerate regional development (Lai et al., 2014). By forming a cluster, firms can lower their investment costs and facilitate the acquisition of trained professionals and sector-specific knowledge and techniques (Lai et al., 2014). Thus, clusters and science parks with advanced knowledge and techniques are attractive to firms because they reinforce the local industry's capabilities and knowledge base (Maskell, 2001). In this study, the cluster is used as a background to investigate how high-tech firms engage with locational factors to conduct OI activities. In order to observe OI adoption and locational factors' influence, the ZSP has been selected to act as a representative place to examine how locational factors affect firms' OI adoption in such an environment.

4.2 The History and Characteristics of the Science Park

4.2.1 The Establishment and Development of ZSP

As Saxenian (1994) indicated, clusters of firms generally originate from a single new, fast-growing and successful start-up firm, one that wants to develop scientific strength and technological innovation in a given region or nation (Tan, 2009). Regarding China, after the 1978 'Reform and Opening' policy was implemented, profound changes fundamentally transformed the economic landscape in the country, leading it toward the gradual and incremental development of the economy (Tan, 2009). Following this evolutionary approach, China has gradually developed a set of programmes that have provided the conditions needed for liberalising the economy and developing its scientific practices by encouraging the growth of privately owned firms, which has accelerated the country's overall manufacturing, production, and R&D capabilities (Guan et al., 2009; Tong, 2009). These profound changes have led to the emergence of entrepreneurship and the birth and growth of a range of more flexible, self-financed, technology-based private firms. The search for the best way to integrate these firms in certain places, especially in Beijing, has led to the establishment of ZSP (Tan, 2006; ZGC, 2017).

Over the last 30 years, the development of the ZSP has undergone four major stages: (1) institutional innovation, which took place from the early 1980s to the late 1980s; (2) technological innovation, which took place from the late 1980s to the early 1990s; (3) market innovation, which took place from the early 1990s to the late 1990s; and (4) transition and reorientation, which took place from 1998 to 2009. A fifth stage, represented by current development, is also emerging under the new national innovation policy (Tan, 2006; ZGC, 2017). In the two earliest stages, one of the key aims of the science park was transferring the traditional planned economy to a more open market economy, thus encouraging local- or national-based high-tech firms (with offices in the ZSP) to generate fast technology growth and better innovation outcomes. A key event occurred in May of 1988 when the ZSP was named the *Beijing Experimental Zone for New Technology Industries*, acting as a predecessor of the science park (ZGC, 2017). The first certified high-tech private firm started working there in 1993 (ZGC, 2017), and more new start-ups, led by research scientists and professors, developed throughout the 1980s into the mid-1990s. Many national leading universities are located in this area, offering an advantage in terms of supporting firms' growth and enhancing their R&D capacity; this process is encouraged by university spin-offs, such as the Founder Group of Peking University, Ziguang Group and Tongfang Group of Tsinghua University and the Legend Group (now the Lenovo Group) of the Institute of Computer Technology of Chinese Academy of Sciences. These firms have made contributions to China's high-tech industries' growth and development, affecting fields such as computer science, semiconductor development and telecommunications.

From the middle of the 1990s, a significant change was made that elevated the ZSP to a new level: as entrepreneurship became the driving force of the ZSP and the number of private firms registered there reached 3,769 (Tan, 2009; ZGC, 2017), a 'new blood' emerged in the park that promoted and extended the high-tech firms' positive competition and industrial connectivity. By the late 1990s, more ZSP-based firms had expanded from being in only local markets to national markets, and some of them had even aimed at overseas markets due to the innovation boom and product upgrades made possible by the park's growth (Guan et al., 2009; Tan, 2009). A key factor in the late 1990s and the beginning of the 2000s was the research strength of universities and institutions, which created improved innovation outcomes thanks in part to private entrepreneurs' rapid growth creating a new era of technological innovation. Chinese processors, software and platforms (both computer and information science related) were part of a wave of innovations that triggered the growth of the Chinese IT industry (Tan, 2009). A key reason for this rapid development was the clustering and convergence in the region (Guan et al., 2009). From the middle of the 2000s, the science park became a National Innovation Demonstration Area (ZGC, 2017), with the goal of becoming a global influence in terms of science and technology innovation parks. Currently, there are around 18,000 firms in the ZSP, including many in key industries such as software, manufacturing, electronics, bioengineering, pharmaceutical engineering, network engineering and telecommunications. Private firms currently hold the majority in the cluster, and leading large firms or state-owned enterprises (SOEs) such as Tsinghua Group, Lenovo and Huawei contribute to the diversity of the cluster (ZGC, 2017).

On the other hand, although the cluster has achieved much since its establishment, it also faces a complex situation in which opportunities and challenges co-exist thanks to globalisation and modern technology advancement. New technologies and paradigms, such as cloud computing big data, nanotechnology and biopharmaceutical technology, require relevant firms that possess strong technology skills and R&D backgrounds to sustain the competitive advantages required for market survival. These demands highlight the necessity of OI, where activities can absorb and utilise valuable internal and external resources in the cluster. This process is also connected to the significance of clusters in this new environment in that they promote novel knowledge flows and resource exchanges. This implies that clusters not only gather firms together, allowing research institutions and universities to support companies to externally acquire and assimilate knowledge, but also may need to produce polices to address the issues arising from the growing influence of these firms.

In its early stages, the ZSP had a significant impact on the functioning of SOEs (or state-private joint venture firms), which provided a base for locational R&D and innovation and that allowed SOEs to support the development of pure private firms; this allowed the market and the industry as a whole to mature, accelerating the overall scientific strength of both Beijing and China as a whole. In its later stages, some of the SOEs located in the science park remained the drivers and engines of innovation; however, more private high-tech firms have been implementing significant innovations in this area. Based on the OI study, those private SMEs also apply OI activities widely and are more willing to accept and apply novel ideas and technologies in this clustering environment. This practical and adventurous spirit drives and supports the sustainable development of the ZSP and its innovation advancement, as it does in many other clusters as well. Currently, these industries are the major force behind the high-speed development and innovation that supports China's economy today.

4.2.2 The Characteristics of ZSP

Every science park or cluster often has its own characteristics in terms of developing and sustaining competitive advantages. One unique characteristic of the ZSP is its SOEs, which give it a different composition compared with Western parks; thus, SOEs' development, interaction with other parties and innovative activities are worth exploring in more detail.

First, in the early stages, almost every innovation venture or high-tech firm was government related or owned, and the objective of the cluster was to concentrate on the research duties designated by research institutions or universities; thus, the cluster's consumer-led innovation products were few (Tan, 2009; ZGC, 2017). The different-sized SOEs and R&D firms mainly focused on governmental innovation projects that supported the official technological demand for economic development and industrial upgrades (Guan et al., 2009). Hence, the crucial force driving the ZSP's development and what directed its local policies was SOEs. This lasted until the middle of the 1990s when private high-tech firms were gradually credited with being innovative ventures, and their treatment began to reflect their contributions to the ZSP. Unlike other global clusters such as Silicon Valley, for historical reasons and because of the park's initial construction by the government, SOEs were, and to some extent remain, the backbones that supported and accelerated the development of the ZSP (Tan, 2009). Many influential and significant scientific innovation outcomes were developed by SOEs in this cluster, despite how different their structures were compared with typical Western companies (Henley and Nyaw, 1986). Nevertheless, because of the public nature of these enterprises, SOEs were commonly loaded with objectives related to national requirements (Guan et al., 2009). Therefore, unlike Western private firms that are generally led by capital and the market, the SOEs located in the cluster were more responsible for institutional decisions derived from general public demand or key industry advancements, such as the electronics and IT enterprises from Tsinghua Uni-group of Tsinghua University. This format clearly does bring some advantages and benefits for the firms' and science park's growth while making contributions to the industry as a whole.

Second, OI engagement between SOEs and private high-tech firms should be regarded as another characteristic of this cluster. Although some differences exist because of status in terms of the locational factors' effects, both SOEs and non-SOEs display high consistency regarding OI practices. This indicates that whether state or privately owned, firms in clusters acknowledge the benefits that they can obtain from 'opening conduction': resource and knowledge flows are promoted via OI for better outcomes. Locational factors in a science park are promoting firms' willingness to apply innovative activities, whether state or privately owned. This also reveals that under the development between state and private capitals, today's high-tech firms in the ZSP are more likely to accept novel innovation modes to support R&D and new product development (Guan et al., 2009). This can be explained by the transformation and 'market convergence' that is brought about by the cluster (Tong, 2009), along with the fact that governmental policies have driven the attitudes and interactions between these two kinds of firms. Therefore, this is a consistent characteristic of ZSP.

4.3 Conclusion

This chapter discussed the historical evolution and characteristics of ZSP. An OI perspective was used to analyse the interaction between the ZSP and OI conduction. By focusing on high-tech firms in the ZSP, additional knowledge about SOEs' role and function in the development of the ZSP has been examined, and an understanding of how the ZSP was established and its links with current firms was developed, including the ways in which the ZSP supports China's research in the context of OI.

By examining OI conduction as part of the relationship between SOEs and private firms in the ZSP, it is possible to see that locational factors in the science park can promote and lead to the transformation of SOEs, and this condition is a positive one for the growth of firms, as well as promoting cooperation and creating positive growth opportunities within the science park. Hence, this examination of ZSP's firms in the context of OI provides new insights in terms of studying the cluster effect and OI.

Chapter 5 Descriptive Overview

5.1 Introduction

This chapter provides an overview of how firms engage with OI practices and how other factors influence innovation performance, informed by the questionnaire results. It contains a generic discussion of indicators related to industrial differences, an analysis to compare and justify how ownership factors influence innovation performance, and an assessment of locational factors. It is to illustrate a comprehensive influence on innovation outcome.

The aim of this chapter is to analyse firms' data to indicate the relationships among variables and hypotheses that identify major differences among firms' OI and their characteristics.

5.2 Rationale for Comparison

The questionnaire includes five sections which were related to general firm information, OI practices, cluster (locational factors), innovation performance and alliance activities. In order to indicate what differences existed in each industry, the analysis focuses on firms' status (SOE or non-SOE firms) to compare their differences while also revealing their main features. To observe the innovation performance and OI implementation of differently owned firms, these are classified as SOE and non-SOE for the following reasons.

First, after Chinese economic transformation and reform in the 1990s, excepting some large national enterprises that are still mainly state-owned (e.g., China Unicom, Sinopec), nowadays small-medium firms are increasingly co-share-held or privatised by public funding. This restructuring of high-tech SMEs means that they are differently operated to traditional large SOEs or purely private firms. The decision-making is becoming more varied and characterised. Existing literature indicates that some stated-owned SMEs are still less efficient than and different to private firms in R&D and business operation (Tong, 2009). It needs to make a comparison between those SOEs and private firms to examine their differences in the context of OI (in the cluster). This can demonstrate the uniqueness of China's SOEs and their features relating to innovation performance.

Second, the influence of market liberalisation and competition on SOEs and non-SOEs needs to be investigated, to reveal how SOEs address competition and self-operation after transformation in the new market environment. As the current Chinese market becomes more liberalised, motivation to support small SOEs is relatively weakened. This was due to the relative importance of local employment and budgetary revenue continuing to decrease (Tong, 2009). Tian (2001) indicated that public ownership decreased when the market became more competitive and high-tech industries/markets were regarded as the most intensively competitive market in the current transition economy. Thus it is important to examine the effects of market liberalisation on state-owned firms, private firms and foreign enterprises, to reveal how diverse industrial indicators affect those firms' operation and innovation performance.

Third, there is limited exploration of differences in firm status within existing literature. This is relevant to OI and cluster study. Previous literature (e.g., Arikan, 2009; Casanueva et al., 2013; Gnyawali and Srivastava, 2013) discussed some specific influences on firms' innovation performance, but ignored how locational factors may affect SOEs and non-SOEs firms' performance and innovation. This indicates that the examination of clusters will help to identify whether all kinds of ownership have the same benefits or differences in this environment. Hence, the main reasons for the comparison between ownership factors are to provide a contrast between SOEs and private firms relevant to OI practices, alliances and partnerships, R&D activities, and innovation performance. The questionnaire was analysed to indicate what differences and characteristics both types of firms have in relation to OI.

5.3 Results

5.3.1 Comparison of Basic Information between SOEs and non-SMEs

First, general business information about all participants was gathered. The sample firm was 302. From the analysis of section A, on average, firms had been established for 13 years and there were 152 state-owned SMEs and 150 non-state-owned SMEs. Regarding product markets, 283 firms focused on the domestic market, while other main markets were Asia (118), Europe (60), America (38), and other areas (10). Firms, on average, purchased 19 licenses (in-licensing) and sold 20 licenses (out-licensing) in last three years. Regarding founders' overseas study experience, 202 firms' founders had overseas degrees. A Master was the most common degree (101 respondents), with 22 holding a Bachelor degree and 68 having a PhD. The majority of firms (86%) had secured government support (e.g., tax reduction, capital subsidy). 283 firms considered that they would continuously invest in innovation and R&D.

Turning to financial indicators, firms had achieved turnover growth of 19%, export sales represented 23% of total turnover, and innovation expenditure represented 30% of internal and 24% of external turnover, on average during the last three years. The most frequently used funding sources were bank loans (66% of respondents), personal savings (52%), and government funding (48%), followed by money from other firms/institutions (45%), venture capital (37%), foreign investment (27%) and money from family or friends (25%).

Concerning firms' strategic focus, innovation and R&D was regarded as the most significant focus, by 87% of respondents, followed by product manufacturing and processing (66%), while marketing (52%) and distribution (25%) were less of a focus. For firms' motivation to apply OI, most firms (74%) considered 'identifying potential business opportunities was the primary motivator, followed by 'exploring new technological trends' (71%), 'accelerating time to complete R&D' (58%); 'reducing R&D costs for projects' (54%), 'establishing new partnerships (53%), and 'mitigating risks of innovation projects' (52%). Participants presented as the following industries: manufacturing (90), electronic (74), network engineering (37), software (28), telecommunication and bioengineering (both 23), other industries (17), and pharmaceutical (10).

When comparing SOEs and non-SOEs, the T-test was used to indicate firms' differences. The majority of SOEs were university spin-offs (65%), whereas only a minority of private firms were university spin-offs (7%). Because the majority of China's universities are nationally founded and government managed, spin-offs from universities are different from private firms, which means most of the 'Uni-firms' are still nationally owned, or universities are their key shareholders (Du and Song, 2008; Yu, 2009).

SOEs had a greater inclination to operate in the Asian markets (48%) and American markets (28%) than non-SOEs. This suggests that nationally owned firms had more business engagements in overseas markets, due to sufficient financial support and foreign relationship building based on their international strategies and expansion.

Also, SOEs conducted more licensing activities (both in-licensing and out-licensing) than private firms, in that they were more actively absorbed in and expanded licenses to conduct innovation activities and R&D works. SOEs founders were better educated, with more people having studied or worked overseas than private firm founders (see table 5.1). This result was consistent with Cui and Wang (2014)'s study, which suggested that founders/CEOs of SOEs had more overseas study experience than non-SOEs. One possible reason was due to different expectations and environmental realities, with some talented people who wanted to establish their own businesses entering SOEs or large firms to start their careers, because those enterprises could offer them an acceptable salary and working-learning environment, instead of the high risk and market competition faced by self-started ventures (Fan et al., 2015).

Not surprisingly, SOEs obtained more governmental support than private firms during the last three years. However, the results also indicated that non-SOEs grew faster than SOEs, according to the average turnover growth during last three years (see table 5.1). This is similar to results indicated by Tong (2009) and Zhang (2011), i.e. due to the privatisation (of nationally owned firms) and competition under market economy, some national-share-held SMEs lacked core competitiveness and many deep-rooted contradictions were exposed. These included inefficient allocation of resources, weak R&D capability and declining competitiveness, which seriously affected the firms' financial efficiency and profits. Therefore, those SOEs could not achieve higher turnover growth and make more profits than private firms. SOEs had invested more in both internal and external innovation activities and had spent more funding on innovation development.

Regarding funding sources, SOEs received more funding from the government, venture capital and foreign investment, whereas private firms obtained more funding from founders' personal savings and corporate investments (see table 5.1). This corresponds with Zhu (2003), i.e. due to the funding available from venture and foreign capitals for SMEs being relatively small, they were not sufficiently attractive and lacked investment channels to acquire venture and foreign capitals. Therefore, the overall quality of foreign capital was inadequate (see also Zhu, 2005). SOEs' funding was mainly from government support and bank loans, while funding support from foreign investment might be due to capital cooperation. Hence, this funding composition had influenced their R&D and innovation activities, which might affect other factors relating to innovation performance.

Regarding the strategic focus of business, SOEs generally had a greater focus on specific activities than private firms who were experienced in 'general product manufacturing', 'distribution', and 'marketing and sales'. This corresponds with Lee et al.'s argument (2010) that SMEs might lack resources and capabilities in manufacturing, distribution, and marketing, which were essential for transforming inventions into products or processes. Some studies also showed that SMEs tended to have higher R&D productivity than larger firms (Audretsch and Vivarelli, 1996).

Finally, regarding the motivation for OI practices, SOEs mainly relied on OI practices to establish partnerships and explore new technological trends, whilst private firms tended to engage in OI practices to reduce R&D project costs. A key reason for firms to engage in OI practices is to seek external sources of knowledge to enhance their innovation (Mansfield, 1988), national-owned SMEs also need to find more ways to achieve production economies of scale and market their products effectively, therefore providing satisfactory support services. Thus, establishing more partnerships and exploring new technological trends via OI were effective ways to develop solid technology bases that allowed firms to both produce new knowledge and better evaluate the knowledge offered by the external environment (Berchicci, 2013). The main reason for private SMEs preferring to reduce R&D costs (of OI) might be due to few of them having sufficient capacity to manage the whole innovation process by themselves. This may have encouraged private SMEs to find more ways to reduce the costs of R&D and new product development (e.g., via collaborations with other firms). During this progress, their flexibility and specificity could be advantageous (Lee et al., 2010).

Table 5.1 Differences in Basic Information between SOEs and non-SOEs

Section A/Variables	T value	MEAN/(SD)		
		SOE (N=152)	Non-SOE (N=150)	All Sample (N=302)
Type of firm (University spin-off)	-13.055***	.65 (.48)	.07 (.26)	.36 (.48)
Product Market				
Asia	-3.257***	.48 (.50)	.30 (.46)	.39 (.49)
America	-3.467***	.28 (.45)	.12 (.33)	.20 (.40)
in-licensing activities	-4.732***	24.9 (23.90)	12.95 (20.18)	19.01 (22.90)
out-licensing activities	-5.171***	27.55 (26.38)	12.93 (22.63)	20.29 (25.62)
founder oversea study degree	-6.596***	.84 (.37)	.50 (.50)	.67 (.47)

The degree level of founders	-6.513***	1.86 (1.01)	1.04 (1.18)	1.45 (1.17)
Government support for business	-3.628***	.93 (.25)	.79 (.41)	.86 (.34)
Turnover growth of firms	2.069*	15.959 (13.27)	22.111 (33.95)	19.014 (25.85)
Exporting percentage of sales	-3.178***	27.47 (21.26)	19.13 (24.24)	23.33 (23.13)
Internal innovation expenditure of firms	-3.975***	34.27 (21.88)	24.87 (19.06)	29.60 (21.03)
External innovation expenditure of firms	-4.494***	29.98 (22.24)	19.06 (19.93)	24.56 (21.78)
Funding Sources Personal savings	7.813***	.32 (.47)	.73 (.45)	.52 (.50)
Venture capital	-2.799**	.45 (.50)	.29 (.46)	.37 (.48)
Government funding	-7.969***	.68 (.47)	.27 (.44)	.48 (.50)
Foreign investment	-3.076***	.35 (.48)	.19 (.40)	.27 (.45)
Money from other firms	3.764***	.34 (.48)	.55 (.50)	.45 (.50)
Strategic Focus General product manufacturing	-4.048***	.76 (.43)	.55 (.50)	.66 (.48)
Distribution	-3.599***	.34 (.47)	.16 (.37)	.25 (.43)
Marketing and sales	-2.667**	.59 (.49)	.44 (.50)	.52 (.50)
Open Innovation Motivation Establishing new partnerships	-2.076*	.59 (.49)	.47 (.50)	.53 (.50)
Exploring new technological trends	-3.416***	.80 (.40)	.62 (.49)	.71 (.46)
Reducing R&D costs for projects	2.808**	.46 (.50)	.62 (.49)	.54 (.50)
* p<.05 ** p<.01 *** p<.001				

Source: Author's Survey

5.3.2 Comparison of OI Practices between SOEs and non-SOEs

On average, OI represented 27% of the entire innovation activities of the firms. Inbound OI practice, on average accounted for 51% of this 27%, and outbound OI practice, on average, accounted for 49% of this 27%. 'External R&D contracting (43%) was the leading inbound OI practice, followed by 'external R&D consulting' (37%) and 'in-licensing activities' (20%). Consistent with the pilot study results, firms were more likely to engage in 'contract-based' innovation activities to access external resources or via cooperation, to develop new ideas in the dimension of OI.

On the other hand, the main outbound OI practice was 'Providing R&D contracting to partners' (43%), followed by 'conducting R&D consulting' (35%) and 'out-licensing activities' (22%). Linking to interview results, firms often applied outbound practices ('inside-out' activities) as programmes/projects to reduce and evade risks. Thus, consulting and contracting were recognised as indirect financial actions to achieve innovation outcomes and maintain balance, instead of large capital investment. Rather than out-licensing activities to establish extra spin-offs, firms concentrating on outbound practices undertook a similar amount of contract-related activities as firms focussing on inbound practices (80% of inbound and 78% of outbound). This also demonstrated the operational characteristics of SMEs, i.e. reducing risks and sustaining development were their priorities.

Concerning two categories' comparison, SOEs and non-SOEs were similar in their application of OI and in specific practices of inbound and outbound OI practices. There was only one significant difference relating to 'out-licensing activities'. Hence, whether state or private owned, firms applied OI as an important approach for supporting R&D activities, that were not affected by differentiation of motivation or strategic focus. This also reflected the results relating to all sampled firms' OI implementation.

Table 5.2 Differences in OI Practices between SOEs and non-SOEs

Section B/Variables	T value	MEAN/(SD)		
out-licensing activities	-2.147*	SOE (N=152)	Non-SOE (N=150)	All Sample (N=302)
		17.34 (13.41)	13.97 (13.86)	15.66 (13.72)
* p<.05 ** p<.01 *** p<.001				

Source: Author's Survey

5.3.3 Comparison of Cluster Effects between SOEs and non-SOEs

Firms' consideration of locational factors reflected the idea that 'a firm can obtain innovation opportunities via technical/resources interaction from employees' flow' (4.19). In contrast with external parties or partners' cooperation on innovation, firms focused more on internal innovation motivators and capacity, and self-driven R&D capacity was a decisive factor affecting innovation and market competition, while locational factors were considered as complementary. Relevant to other locational factors, similar results were found among all variables regarding how cluster elements affect innovation activities and implementation. Accessing resources such as advanced technologies, highly-educated, experienced individuals, and cost reduction were highly ranked motivations for locating within a cluster (see also Tan, 2006). The respondent firms also showed very similar interests in accessing investment, benefitting from government subsidies, networking, and knowledge sharing.

When comparing SOEs and non-SOEs, there were four significant differences relating to the status of firms. First, SOEs and non-SOEs offered different considerations related to ‘access to highly-educated people for innovation’, while disagreeing that firms ‘can easily develop alliances within the cluster’ and ‘network relations can support firms to meet market dynamics’. SOEs and non-SOEs also thought differently about whether ‘firms can easily obtain government support within the cluster’ (see table 5.3). Hence, it can be seen that state and private owned firms still had significant differences in achieving identical ideas related to government supports that might be due to policy focus and ownership status (Tong, 2009). While different approaches were applied to accessing talent people or alliances within the cluster, resource shortages had affected private firms’ options and operation (meaning their own development level may limit them in attracting resources; see also Lee et al., 2010).

Table 5.3 Differences in Cluster Effect between SOEs and non-SOEs

Section C/Variables	T value	MEAN/(SD)		
		SOE (N=152)	Non-SOE (N=150)	All Sample (N=302)
access high-educated, experienced people for product/processing innovation	-2.290*	4.13 (.78)	3.90 (.93)	4.01 (.86)
can easily develop strategic alliances within the cluster	-2.213*	4.09 (.87)	3.87 (.85)	3.98 (.86)
network relations can support the firm to easily meet market dynamics	-3.871***	4.03 (.91)	3.60 (1.03)	3.82 (.99)
can easily obtain government grants, tax reductions, and policy support within the cluster	-2.871***	4.05 (.84)	3.76 (.93)	3.91 (.90)
* p<.05 ** p<.01 *** p<.001				

Source: Author’s Survey

5.3.4 Comparison of Innovation Performance between SOEs and non-SOEs

Analysing firms’ innovation performance, ‘products that were new to the market and firm’ had contributed the highest percentage to the turnover on average (27%). The sampled firms had achieved more returns by conducting innovation activities to develop brand new products rather than process/incremental innovation activities to contribute to turnover (‘products were significantly improved’ contributed 23% of turnover). Brand new products also contributed the highest percentage to sales growth - 27% arose from ‘sales growth from brand new products, while 24% was contributed by ‘sales growth from improving existing products/process’ and 20% related to ‘sales growth from significantly improved processes for producing products’.

These results reflected a strong market demand and consumer attitudes to new product innovation, which were apparently the major revenue stream for most of respondent firms in the science park. One way to interpret this could be linked to consumers' attitudes towards new product development and launch speed. Sun et al. (2013) indicated that communication with consumers and consumers' involvement during development could have a positive impact on new product promotions and sales; new products launch speed and technological improvement had positive influence on financial performance as well; while the relationship between new product development and consumer engagement had a positive impact on business performance. While consumer involvement actually is an important practice of OI (Chesbrough and Brunswicker, 2013), the interaction with consumers reflected and linked OI practices with innovation performance, which means that the growth of indicators are connected with OI conduction, the attitudes of consumers, and market to new products.

Meanwhile, the innovation performance comparison also indicated that SOEs performed better than private firms, in that they were able to achieve more returns from 'products new to market and firm' and launched more new products in the last three years. These differences revealed significant differences in R&D capacity for new product launches and turnover between the two kinds of firms. This could be due to less internal and external R&D expenditure and shortage of sources acquisition by private SMEs. Highly innovative products can help firms with greater opportunities for growth, differentiation, and competitive advantage (McNally et al., 2010; Seebode et al., 2012). Key factors for achieving this are linking to new knowledge acquisition from both internal and external sources (Enkell et al., 2009; Sofka and Grimpe, 2010), which both represent knowledge creation capabilities for new product development. This specifically reflects the level of R&D expenditure and a firm's abilities to innovate new knowledge internally (Smith et al., 2005).

Therefore, the comparison demonstrated the same logical results that indicated by Chen et al. (2009) and Su et al. (2013): there is a positive relationship between internal learning (internal R&D), capacity to absorb external knowledge (external R&D) and innovation performance — the stronger these R&D capacities, the better the performance. Hence, as SOEs performed stronger in these respects, they achieved better innovation performance than non-SOEs.

Table 5.4 Differences in Innovation Performance between SOEs and non-SOEs

Section D/Variables	Sig. (2-tailed)	MEAN/(SD)		
		SOE (N=152)	Non-SOE (N=150)	All Sample (N=302)
percentage of products introduced were new to the market and firm	-2.399**	29.31 (16.75)	24.86 (15.44)	27.10 (16.24)
new products in the market launching by your firm during the last three years	-2.371**	26.25 (51.61)	14.77 (29.83)	20.55 (42.54)
* p<.05 ** p<.01 *** p<.001				

Source: Author's Survey

5.3.5 Comparison of Alliance Activities between SOEs and non-SOEs

Concerning alliance activities, a typical firm was engaged in 17 R&D partnerships, each of them lasting for four years on average. Firms were more likely to collaborate with suppliers (53% of respondents) and commercial laboratories or R&D firms (53%) than other types of partners. Collaboration with universities/academic institutions proved to be another attractive option, for 47% of the sampled firms.

Regarding the quality of relationships with these partners, a partnership with commercial laboratories or R&D firms (3.86) was strongly recognised by firms as being the best quality relationship, whilst the relationship with universities/academic institutions (3.74) was ranked second. This reflects findings from Cassiman and Veugelers (2006) that firms actively search for knowledge outside their boundaries, since they cannot rely purely on internal knowledge sources to develop their innovations. Dyer and Hatch (2006) and Laursen and Salter (2006) also indicated that firms could gain access to external knowledge from universities and suppliers through inter-firm R&D collaboration agreements. These agreements prove efficient in obtaining access to external knowledge to complement existing capabilities, lever existing knowledge and resources, and increase the productivity of R&D activities (Powell, 1990; Sampson, 2007). Therefore, this demonstrates the importance of collaborating with R&D partners and breaking inter-firm boundaries.

Meanwhile, a typical respondent firm had 13 partners collaborating in marketing and sales activities downstream in its value chain, and the average collaboration period with each partner was five years. While large established firms were identified as the best partner to collaborate with for marketing and sales activities, by 65% of respondents, distributors were recognised as the second most favourable partners, by 62%. Reasons for SMEs establishing these kinds of partnerships are explained below.

First, SMEs often need market partners that have expertise and knowledge in the latest technologies and channels that are available in the market. Partnerships with large established firms (e.g., large scale suppliers from upstream) enable R&D teams to identify potential technical problems in the process before market promotion (Kessler and Chakrabarti, 1996), therefore preventing problems occurring during formal marketing activities (Langerak and Hultink, 2005).

Second, the cooperation with distributors offers more opportunities to access the newest information and requirements, whether from consumers or the market. The partnership helps SMEs to establish a channel and foothold by eliminating the likelihood of product failures (Harrison and Waluszewski, 2008), thereby better satisfying customers' demand through marketing activities (Gruner and Homburg, 2000). These points stress the importance of cooperating with large established firms and distributors in conducting marketing activities. Moreover, the quality of relationships varies with each type of partner, as the sample firms had the best relationship with large established firms (3.89), whilst their relationship with distributors (3.77) was ranked as second best. This quality ranking indicates that if SMEs' innovation and product distribution is successful, they will need more external resources and distribution channels to enhance their product competitiveness and market share, and large established firms and distributors can help SMEs to achieve this (Chen et al., 2011). Firms also require market partners to help them to manage know-how, market knowledge and access external sources (Rothaermel and Deeds, 2006). Thus, the contribution and quality of these downstream partners (distributors or large firms) is significant to the focal firms.

Further, comparison between the two types of firms revealed six significant differences in selecting R&D partners (see table 5.5). Specifically, SOEs mostly cooperated with universities (60% of respondents) to support and enhance R&D activities, whereas non-SOEs much preferred to collaborate with suppliers (62%) to enhance their R&D capacity and achieve innovation. In terms of assessing R&D partners' quality when supporting innovation, there were four significant differences relating to other firms within the firm group, universities, government institutions, and commercial laboratories (see table 5.5). The results showed that SOEs had close cooperative relations with universities (some firms were university spin-offs) and the key reasons might be due to the benefits achieved from university-industry collaboration programmes (Franco and Haase, 2015; Perkmann et al., 2011; Soh and Subramanian, 2014). Collaboration between universities and industry (i.e. the firms) is largely seen as one approach to improve innovation in the economy, by facilitating the flow and utilisation of technology-related knowledge and experience from the university to individual firms (Inzelt, 2004; Perkmann et al., 2011). From a firm's perspective, collaborations with universities are important, not only for accessing and leveraging valuable resources such as famous researchers and advanced research facilities, but also for exploiting scientific knowledge and novel discoveries (Audretsch et al., 2012; Liebeskind et al., 1996; Subramanian et al., 2013), which promote innovation and creative ideas. Therefore, as it is advantageous for SOEs to accessing university resources to gain these benefits, regular cooperation is indispensable. This could also be evidenced by the success of 'Uni-Enterprise Cooperation' policy programme in China (Xiao et al., 2012).

In terms of market partnerships, both types of firms closely cooperated with large established firms (70% of SOEs and 59% of non-SOEs) and distributors (57% of SOEs and 67% of non-SOEs). SOEs had engaged in more partnerships with other SOEs (51%), whereas non-SOEs preferred to cooperate more with competitors (44%) as their third market partner. In terms of non-SOEs' cooperation with competitors, although they were rivals in the same industry, this had not obstructed them to co-developing products and developing innovations. When the main types of innovation activities consisted of 'contract-based' activities, competitors could still be partners, because mutual benefits were achieved through a 'win-win situation'. These would of pivotal importance to the non-SOEs if they could not outperform rivals with greater benefits. Competitors' influence on overall business performance is also demonstrated by Belderbos et al. (2004), in that their cooperation has a considerable impact on labour productivity growth, and positively affects growth in sales of products and services new to the market. Therefore, non-SOEs' preference for cooperating with competitors was reasonable (see also de Faria et al., 2010).

On the other hand, the quality assessment of the relationship with market partners, indicated differences in terms of cooperation with (other) SOEs', other firm within the firm's group and market consultants. The reasons can be explained as follows. First, most of the non-SOEs are private and individually based, they do not belong to any firm groups but independently exist in the market. Conversely, some SOEs are university-based or subsidiaries of a large SOE group. Thus, they have achieved more support and benefits from the group and they consider other firms in the group to be more important or offer more quality than private firms.

Second, market consultants do not generally provide similar benefits to large firms or distributors (Du et al., 2014), they are considered less effective by non-SOEs. However, some market consultant companies are government institutions, SOEs thus have better relationships with them than private firms.

Third, key reasons affecting cooperation with 'SOEs' (i.e. between national and private owned firms) could be as follows. Internally, barriers may include imperfect structure and governance of property rights, uncoordinated management systems between firms, non-conformance of technology and R&D capacity, and the conflict of different corporate cultures and values (Li, 2015; Liu, 2011). Externally, barriers are mainly presented as the traditional values and legacy of the original market system, policy failures and government intervention, equal treatment of different forms of ownership, and an insufficient legal system for classifying national-private collaborations (Li, 2015; Liu, 2011). Therefore, non-SOEs still hesitate to fully collaborate with SOEs; as they are small-medium firms, maintaining self-development is crucial to CEOs and top managers (linked to market survival and competition). Hence, the factors described above are the main ones leading to significant differences in the quality assessment of market partners.

Table 5.5 Differences in Alliance Activities between SOEs and non-SOEs

Section E/Variables	T value	MEAN/(SD)		
		SOE (N=152)	Non-SOE (N=150)	All Sample (N=302)
R&D Partners Other firms within the firm group for supporting R&D activities	-4.501***	.47 (.50)	.23 (.42)	.35 (.48)
Uni for supporting R&D activities	-4.517***	.60 (.49)	.35 (.48)	.47 (.50)
Consultants for supporting R&D activities	-4.050***	.55 (.50)	.33 (.47)	.44 (.50)
Suppliers for supporting R&D activities	3.161***	.44 (.50)	.62 (.49)	.53 (.50)
Government or private research institutions for supporting R&D activities	-2.755**	.47 (.50)	.32 (.47)	.40 (.49)
Commercial laboratories or R&D firms for supporting R&D activities	-2.312*	.59 (.49)	.46 (.50)	.53 (.50)
R&D Partners Quality				
Other firms within the firm group	-3.665***	3.72 (1.08)	3.27 (1.06)	3.49 (1.09)
Universities	-2.280*	3.88 (1.07)	3.59 (1.12)	3.74 (1.11)
Government research institutions	-2.139*	3.84 (1.02)	3.59 (1.00)	3.72 (1.02)
Commercial laboratories or R&D firms	-2.993***	4.03 (1.03)	3.69 (.98)	3.86 (1.02)
Market Partners				
other firms within the firm group for supporting market activities	-4.198***	.48 (.50)	.25 (.44)	.37 (.48)
SOE for supporting market activities	-4.968***	.51 (.50)	.24 (.43)	.37 (.49)

Market Partners Quality Other firms within the firm group	-3.418***	3.76 (1.05)	3.34 (1.10)	3.55 (1.10)
Market consultants	-3.017***	3.73 (1.05)	3.38 (.97)	3.56 (1.02)
Other SOEs	-2.822**	3.85 (1.07)	3.49 (1.12)	3.67 (1.11)
* p<.05 ** p<.01 *** p<.001				

Source: Author's Survey

5.4 Conclusion

The comparison between SOEs and non-SOEs revealed some differences. First, market differences were shown; although the domestic market was significant for all firms, international market expansion differed among these firms. This could be linked to the business strategy employed, in that the overseas market was not always considered by all high-tech SMEs located at the science park, whereas SOEs had more power to operate internationally. Second, the founders' overseas experience was another key difference, in that senior managers' internationalisation and the extent of their overseas study had become a new asset for high-tech SMEs' innovation and R&D. Applying their knowledge to state-owned firms or establishing their own businesses has an impact on business operation and innovation performance. Third, noting that non-SOEs were more likely to use personal savings and SOEs were more likely to receive government funding, the construction of funding sources for firms can impact SME ownership or the scale of R&D. This means that different raw capital formations have co-existed among every industry and the firms within an industry, and it should be considered whether local policy can support all kinds of business in a balanced way. The differences associated with in-licensing and out-licensing and internal and external innovation expenditure (as a percentage of turnover) demonstrated that due to their different funding sources, SOEs have spent more resources on R&D.

Also, OI implementation was shown as the extent of engagement in outbound OI practices. Regardless of whether firms were SOEs or non-SOEs, all of them still engaged in more inbound than outbound OI. This suggests that firms wanted to protect their own technologies and were uncertain about conducting an appropriate outbound OI with inbound OI to find a balance in OI (most of the firms tried to equalise both kinds of OI).

The comparison between SOEs and non-SOEs highlighted the extent to which networks and external parties have a positive influence on innovation performance (being linked to locational factors). Due to private firms sometimes not possessing the resources or ability to access more talented people or strategic alliances within the cluster, these firms tended to rely on their own

R&D capacity to develop and find the support from external parties.

Moreover, regarding innovation performance assessment, there were differences relating to 'products new to the market and firm' and 'the number of products launching'. This indicates that regarding how well firms can contribute brand new products to the market and firm, SMEs and SOEs still are different, which could be linked to their prior product knowledge, R&D experiences and their experience in conducting OI. If the internal R&D and OI conduction is different, innovation performance may vary.

In addition, the indicators of alliance activities revealed differences regarding large firms/SOEs and university support for R&D activities. Effective engagement with SOEs and universities was a challenge for both SOEs and non-SOEs, meaning acquiring positive support differs according to the business channels (ownership), network/relation building and characteristics of R&D demands. Therefore, the differences between SOEs and non-SOEs were shown to have an influence on the operating situation of high-tech SMEs in relation to market competition and innovation.

Chapter 6 Locational Factors and Ambidexterity in OI

6.1 Introduction

The study of OI often relates to industrial clusters and science parks, where enterprises are located close to one another to develop new technologies and facilitate knowledge flow. Cluster is often regarded as a reservoir of knowledge that supports firms to apply resources and drive innovation (Fleming, 2001; Porter, 1998; Tallman et al., 2004). Prior literature has defined them as 'innovative environments' (Aydalot, 1985), 'clusters' (Porter, 1990), and 'regional innovation systems' (Cooke, 1992). In terms of OI in a science park, examining locational benefits on the balance in OI is crucial to know how firms achieve ideal innovation outcomes. When firms locate in a cluster, they aim to facilitate the acquisition of professional labour and gain more valuable resources to enhance their competitiveness (Connell and Voola, 2013; Lai et al., 2014). The specific factors associate with inbound and outbound OI activities may relate to 'buying the rights to use the inventions of others' of inbound OI, and 'selling the rights to use internal inventions' of outbound OI (Cassiman and Valentini, 2015). As clusters provide more opportunities to acquire and utilise resources for both inbound and outbound OI, balancing these two kinds of activities is critical for achieving ambidexterity in OI under the effect of the cluster.

Prior literature have discussed several relationships between cluster and OI activities, such as cluster's effect on competitive advantages (e.g., Bell et al., 2009; Gertler, 2003; Zhang and Li, 2010), and managing OI based on locational factors (e.g., Casanueva et al., 2013; Tallman et al., 2004). Although those studies captured some of the phenomena affecting locational factors and OI activities (see also Chen et al., 2009; Filatotchev et al., 2011; Guan et al., 2009), few focused on to explore the linkage between locational factors and the balance in OI. For instance, Cantner et al. (2015) indicated that the relationship between cluster and firms' ambidexterity can be built on firms' innovation demand, which drives the adoption of ambidexterity in OI and the activities can be applied. Despite the authors argued clustered firms' innovation demand affected the adoption of ambidexterity in OI, how firms utilise locational factors to lead ambidexterity in OI was unexplored, the reason and influence of cluster was neglected. Also, through a case study to compare Cisco and Lucent in Silicon Valley, Ferrary (2011) pointed out that the acquisition and development (A&D) strategy among large firms reinforced OI adoption by increasing incentives for other organisations and individuals of the network to explore new knowledge. Although this work mentioned ambidexterity in OI with the perspective of cluster, it mainly highlighted the influence of A&D strategy, less evidence being revealed to discuss how ambidexterity in OI was formed in cluster. That is, the author only contrasted the outcome of ambidexterity with A&D strategy, but rather to examine the mechanisms derived from the cluster to lead ambidexterity in OI. The extant literature thus lacks considerations by interpreting the balance of inbound and outbound OI based on the perspective of locational factors. This represents a gap that needs to be filled through analysing locational benefits on the balance in OI. On the other hand, regarding the use of ACAP in OI and cluster, although prior literature such as Lai et al. (2014) indicated an positive association between knowledge flows (use of internal and external knowledge) and cluster (see also Cantner, 2015; Roper et al., 2017), they had not integrated ACAP to test the variation of this relationship, and which factor may indirectly affect the strength of the utilisation of locational factors to lead firms' knowledge flows. Also, Miguélez and Moreno (2015) indicated a moderating effect of ACAP for knowledge flows' impact on regional innovation, but the authors focused on a regional-level ACAP to analyse clustered firms' knowledge utilisations on innovation outcome (see also Escribano et al., 2009; Xia and Roper, 2016). Even if they showed that a region's (cluster-level) ACAP critically adds a premium to tap into remote knowledge pools conveyed by mobility and networks, there was less evidence which explains whether ACAP can moderate the extent of utilising regional knowledge lead to an ambidextrous adoption at the firm-level. Thus, prior studies still show an incomplete picture regarding the function of ACAP applied to the particular relationship between locational factors and the balance (ambidexterity) in OI. The understanding to regard ACAP as a boundary condition to influence the extent of locational factors and the balance in OI needs to be enhanced, a gap should be filled in literature.

In order to extend the understanding of clusters on the balance in OI, this study proposes a link between locational factors and the balance in OI, such that locational factors have a significant effect on the balance in OI, which in turn can further create a synergy of inbound and outbound OI. Meanwhile, the study states that a firm's ACAP moderates the relationship between locational factors and the balance in OI, where firms possess stronger ACAP, the relationship is stronger. Thus, the study indicates that understanding the effect of locational factors helps gain new insight into the relationship among those factors, revealing that by properly engaging the knowledge acquisitions and diffusions, firms can achieve a balance in OI. On the other hand, from a practical point of view, there is also a need to explore the importance of locational factors on firms' OI conduction in cluster, and whether clusters affect the balance in OI. This supports managers to select an ideal way to pursue the balance of inbound and outbound OI by utilising locational benefits.

The study makes two main contributions to the literature on OI. First, although previous studies have discussed the adoption of OI activities in a cluster (e.g., Cantner et al., 2015; Bocquet and Mothe, 2015; Ferrary, 2011; Sack, 2015), most of the studies focus on what OI activities could be conducted and their effects, rather than on how ambidexterity — the balance in OI would be affected and whether locational factors can positively affect this balance. Thus, the knowledge between the locational factors and the balance in OI still requires enhancing, which is an important gap in OI literature. Theoretically, there needs to be an explanation of how locational factors may affect the balance in OI, one that can help to interpret the mechanisms in a cluster that lead to the pursuit of the balance in OI. In particular, the study highlights and empirically tests the extent to which locational factors affect the balance in OI by exploring knowledge acquisitions and diffusions, which are viewed as the mechanisms driving this association. From a practical view, understanding and demonstrating what factors in the cluster can be utilised for firms to achieve the balance in OI will guide firms to gain the benefits from locational factors, thus promoting their inbound and outbound OI toward a balanced level. Therefore, by exploring the effect of locational factors on OI balance, the study reveals that locational factors positively affect the balance in OI. Building on the cluster perspective, the study contributes to the literature on OI by showing that locational factors are able to lead to a balance in OI.

Second, even though the link between clusters and ambidexterity in OI has been examined by some previous studies (e.g., Cantner et al., 2015; Ferrary, 2011; Sack, 2015), few studies examined ACAP as a boundary condition for the relationship between locational factors and the balance in OI. A gap remains in OI literature. In addressing that, from a theoretical view, when clusters are applied to OI, firms with similar OI adoption may still present different strengths for the relationship between locational factors and the balance in OI. ACAP thus can help to explain the strength variation for those firms under the utilisation of locational factors in achieving the balance in OI. In practice, within the cluster, firms sometimes still struggle regarding how to effectively utilise locational factors to attain the balance in OI and strengthen the positive impact between these two factors. To reveal what capacity can help firms strengthen this positive relationship is one practical reason behind the current study. When examining ACAP as an internal capacity, it helps firms find how to facilitate the strength of the relationship internally and autonomously. Building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between locational factors and the balance in OI.

The structure of this chapter is organised in several sections: the following two sections include theoretical discussion and develop relevant hypotheses associated with the research predictions. Section four describes the research method and variable development, while section five illustrates the results of the study. Section six provides a check of robustness and demonstrates the correctness and validity of the study. Section seven discusses both the theoretical and empirical implications. Section eight makes a conclusion in this chapter.

6.2 Review of Cluster on OI

Prior cluster and innovation studies have built direct associations with the effect of cluster and innovation outcome, which included the discussions on the relationships/effects between innovation activities and clusters (e.g., Bell, 2005; Gnyawali and Srivastava, 2013; Phelps, 2010; Porter and Stern, 2001; White and Bruton, 2007), the knowledge management of cluster firms, the influence on innovation performance (e.g., Arikan, 2009; Casanueva et al., 2013; Lissoni, 2001; Tallman et al., 2004) and the effect of an industry cluster on corporate competitive advantages (e.g., Amin and Thrift, 1995; Bell et al., 2009; Gertler, 2003; Porter, 1990; Zhang and Li, 2010). Many of these studies are built on the ideas of Michael Porter, who is a representative scholar and who stated the influence of cluster on innovation and how firms could drive their innovations in this environment. In his book, *The Competitive Advantage of Nations* (1990), Porter used the term ‘cluster’ to describe the high concentrations of actors of various industries located within a limited geographic area, such as high-tech companies in Silicon Valley. Porter indicated that economies that succeed within a certain market are made up of groups of interconnected successful firms, not single, isolated actors (Porter, 1990). Porter (1998) indicated that the cluster is a new type of organisational form between markets and hierarchies; firms in that environment should compete to foster innovation and keep the cluster competitive with other environments. From this view, Porter indicated the function and benefits that a cluster can bring to high-tech firms by locating in a specific area include access a verity of resources, establishing partnerships and applying their innovation activities, all of which lead to ideal innovation performance. Accordingly, the perception of a cluster, its routine and rationale also can be applied to OI adoption, which in the context of OI is done to examine the relationship between locational factors and the pursuit of the balance in OI.

Regarding the direct relationship between cluster and OI, some studies have looked at the science park/cluster as an environment for applying OI activities (e.g., Bocquet and Mothe, 2015; Cantner, 2015; Chyi et al., 2012; Ferrary, 2011; Roper et al., 2017); these works often focused on how firms apply OI activities in the cluster and what outcome can be achieved. For instance, Roper et al. (2017) indicated that local initiatives have support on innovation partnering and can counter illegal copying or counterfeiting, gaining the positive externalities of openness resulting from the intensity of a local interactive knowledge search. Although they showed there is an influence of locational factors on external knowledge acquisition, only one mechanism that affects OI practice has been revealed; here, the utilisation of locational factors that drive a relative balance in OI was lacking, especially when firms were conducting both OI activities in cluster. Chyi et al. (2012) showed the impact of external and internal spillovers on innovation outcomes in high-tech clusters, where the external R&D spillover is statistically significant in explaining the new product sales of firms. Still, their work indicated that knowledge spillovers contribute to innovation performance in the cluster, but they did not examine the reasons behind why firms utilise locational factors to form an ambidexterity in OI (or how firms engage a balance in OI); this is a lack of investigation for the relationship between locational factors and the balance in OI. Similar works, such as Bocquet and Mothe (2015) and Sack (2015), indicated that a cluster governance structure — 'the intended, collective actions of cluster players in view of upgrading a cluster' (Gilsing, 2000, p. 7) can facilitate knowledge management to encourage firms' ambidexterity in OI. They indicated that firms can achieve different forms of ambidexterity in OI depending on the governance structure's role (of the cluster) and priorities in terms of knowledge management. However, these studies overlooked observing the mechanisms of locational factors that affect the formation of ambidexterity in OI. Locational factors also influence firms' internal knowledge due to firms absorbing and recombining external knowledge with internal knowledge into new ideas and technologies for innovation (Lai et al., 2014; Tallman et al., 2004). For the research on OI, especially the pursuit of the balance in OI, locational factors should be studied to better understand what mechanisms enable firms to achieve a balance in OI. That is, to explain the processes and drivers that lead to the balance in OI.

6.3 Hypotheses

6.3.1 Locational Factors and the Balance in OI

Clusters consist of a variety of knowledge; internal and external knowledge sourcing within this environment can promote firms' knowledge flows. When conducting OI activities, by utilising locational factors to promote valuable knowledge flows can be regarded as a key to achieve the balance of inbound and outbound OI. Prior studies (e.g., Cao et al., 2009; Jansen et al., 2012; Wei et al., 2014) proposed some methods to address the engagement of innovation activities, but the investigation in the context of OI and linking to locational factors were few (e.g., Bocquet and Mothe, 2015; Ferrary, 2011). In order to know the influence of locational factors on the balance of inbound and outbound OI, this study linked these two elements as a whole and argues that locational factors can lead the balance in OI.

First, locational benefits can affect the balance in OI through the firms' external knowledge acquisition, where more valuable and supportive factors in the cluster provide regional supportive infrastructures and knowledge resources that enable firms to more easily utilise external knowledge (Asheim and Coenen, 2005; Porter, 1990). This resource diversity of locational factors is one aspect of the balancing of inbound and outbound OI. Regarding specific locational factors, by helping firms access new developments from highly educated and experienced people and aiding them in collaborating with a variety of partners (e.g., universities, suppliers or competitors), external knowledge acquisitions is promoted, leading firms' OI conduction to a proper level. That is, thanks to geographical proximity and close interactions, knowledge flows between different actors can be more easily utilised (Bell and Zaheer, 2007). In this condition, utilising locational factors for knowledge acquisitions means that firms can enhance their own technology capabilities and knowledge base by meeting, sourcing new external ideas and incorporating them into the firms' own innovations (Breschi and Malerba, 2001). Meanwhile, locational factors such as the firms can connect with suppliers to devote, upgrade their products or technologies and form networks to easily meet market dynamics (Lai et al., 2014), facilitate the external knowledge inflows in this environment so that specific OI practices such as in-licensing and external R&D contracts can be conducted more effectively. By co-locating in a cluster environment, firms can more easily acquire and utilise external factors' sources and apply it to their own OI conduction (Bell and Zaheer, 2007). This is regarded as one aspect of balancing inbound and outbound OI that is affected by locational factors.

Second, locational benefits affect the balance in OI by promoting firms' internal knowledge diffusions, enabling them to more effectively use their internal ideas to expand the markets for external use of innovation. Compared to locating individually or numerous difficult-to-meet actors in R&D or innovation (Ozer and Zhang, 2015), a cluster helps firms easily establish joint ventures or create spin-offs, which by using internal ideas to obtain commercial benefits, fit the use of external ideas (with inbound OI). Specifically, by highly co-locating in a specific area (Lazzeretti and Capone, 2016), locational factors such as social or industry events joined by universities, R&D firms and competitors with the collaboration with R&D alliances provide more opportunities for firms to interact with more target parties, and this makes it easier to facilitate the rapid diffusion of ideas and knowledge spill-overs (Audretsch and Feldman, 1996; Lazzeretti and Capone, 2016). Also, establishing collaborations with upstream and downstream firms for commercial purposes is another locational factor that helps firms smoothly use their available internal ideas or knowledge for outside use, gaining potential financial or innovative interests (Lai et al., 2014). Maskell (2001) indicates that the cooperation of both upstream and downstream firms effectively lowers mutual transaction costs and develops fixed contracts. This cooperation enables firms to actively use internal sources that specific OI practices such as out-licensing, R&D consultation and participation in the standardisation of this condition can be conducted more smoothly (Chesbrough and Brunswicker, 2013). By affecting firms' knowledge diffusions by easily forming co-operations with upstream and downstream firms, enhancing the interactions of internal sources with target parties in industrial or social events and forming joint-ventures with R&D alliances, locational factors lead to the balancing adoption of inbound and outbound OI. That is, through the engagement of relevant locational factors, firms can achieve an optimal balance of inbound and outbound OI that relies on their own OI demands and cluster's benefits.

Third, by influencing firms' knowledge acquisitions and diffusions in the cluster (the basis for inbound and outbound OI), locational benefits provide the necessary external resources to satisfy firms' internal demands while also diffusing some internal ideas to meet an increased number of target outsiders for the external use of innovation or commercial purposes. Firms can easily establish R&D partnerships and inter-organisational networks to obtain external knowledge to use inside the firm, and can also commercialise new products to achieve financial benefits (Audretsch and Feldman, 1996; Lazzeretti and Capone, 2016). In this condition, firms are more likely to utilise relevant ideas to apply inbound and outbound OI at a relative balance level, due to inflows and outflows of knowledge are promoted by locational factors (Ozer and

Zhang, 2015). The study further argues that the balance in OI as achieved could be contingent that a relative equal conduction between inbound and outbound OI just represents one special case of the balance, firms can also attain a flexible, proper point for the balance of inbound and outbound OI, which is based their own OI demand to utilise those local benefits (Ozer and Wang, 2015; Wei et al., 2014). The study thus proposes that:

H6.1: Locational factors have a positive effect on the balance of inbound and outbound OI for firms.

6.3.2 Moderating Effect of ACAP on Locational Factors and the Balance in OI

The ACAP is the crucial capacity for using external resources; it is defined as a set of organisational routines through which firms acquire, assimilate, transform, and exploit knowledge to produce their dynamic capability (Zahra and George, 2002). It allows firms to screen, evaluate, and take advantage of externally-generated knowledge for their own development (Helfat, 1994). Regarding the relationship between locational factors and the balance in OI, the study proposes that a firm's ACAP moderates this relationship; a higher level of ACAP leads to a stronger level of the relationship.

The study argues that ACAP moderates the relationship between locational factors and the balance in OI by facilitating the knowledge acquisitions and diffusions in the cluster of firms for two main reasons. First, locational factors affect the balance in OI because of the utilisation or acquisition of external knowledge. When firms develop new technologies through acquiring external sources from locational benefits, for instance, accessing high-educated, experienced people for product innovation, and buying licenses from R&D firms or institutions in the cluster, the approach built on this external utilisation is the ability to recognise the value of new external ideas and apply it for innovation (Cohen and Levinthal, 1990; Ferreras-Méndez et al., 2016). A mechanism behind this acquisition from others is a firm's learning and the capacity to process knowledge, which links to the function of ACAP. It argues that ACAP's indicators such as the spent on acquisition of external knowledge, the number of licenses bought from other parties, and the number of own patents facilitate a firm's process on analyse and acquire external knowledge (Ferreras-Méndez et al., 2016; Zahra and George, 2002). Applied to the condition of locational factors and OI balance, the strength of ACAP thus helps a firm to facilitate the process of searching, analysing and acquiring external knowledge, where a stronger learning and knowledge processing capacity of ACAP may support firms to be more effectively using external sources to lead OI conduction, thus from one aspect enhances the extent of the locational factors and the balance in OI.

Second, by facilitating knowledge diffusion, ACAP may moderate the relationship between locational factors and the balance in OI. Knowledge diffusion is often based on the environment of the cluster — in a highly localised area as knowledge diffusion tends to be largely happened (Hippel, 1994; Jaffe et al., 1993). Prior theoretical and empirical evidence offers support for the link between skilled R&D people, patents (its mobility) and knowledge diffusion (e.g., Boschma et al., 2009; Rosenkopf and Almeida, 2003; Singh and Agrawal, 2011). When it comes to the condition between locational factors and OI balance, to obtain a stronger relationship between locational factors and the balance of inbound and outbound OI, a firm's existing knowledge stock, much of which is embedded in its products, processes and R&D team (used for knowledge diffusion, like out-licensing, external R&D contrasts, and joint-ventures), can be built up; this indicates the role of the ACAP (Escribano et al., 2009). That is, the effective diffusion of a firm's internal knowledge by OI activity in the cluster, a firm's internal R&D level, professionals and the number of patents or internal R&D investments will be influenced by ACAP (for the indicators of ACAP, see Cohen and Levinthal, 1990). For instance, a stronger level of ACAP may be regarded as a key element of a firm's ability to make the most out of outflowing knowledge and information in the condition of forming joint-ventures with partners or by understanding the demands of target parties in the industrial events to better diffuse the ideas to keep a strong extent between the utilisation of locational factors and the balance in OI. It is built on well-recognising prior-knowledge and own R&D experiences/ideas, which allows the firm to have a stronger connection between the utilisation of locational factors and OI balance (Miguélez and Moreno, 2015). When the firm has a higher level of ACAP, this may facilitate knowledge diffusion, that is, the higher level of ACAP can strengthen the extent of the relationship between locational factors and OI balance.

Taken together, as an internal capacity to influence two factors — knowledge acquisitions and diffusions — ACAP reflects its function on coping with the relationship between locational factors and OI balance. It indicates that no matter firms utilise what kind of locational factors to pursue the balance in OI (e.g., obtain and apply resources from external parties for innovation and forming joint-ventures with partners for commercial purpose), by facilitating the knowledge acquisitions and diffusion behind those specific factors, ACAP enhances the extent of this relationship due to its capability and understanding on processing the knowledge and ideas (Lazzeretti and Capone, 2016). Thus, the study proposes that the effort to achieve OI balance can be influenced by the firm's ACAP when in the environment of a cluster. The following hypothesis is given:

H6.2: ACAP moderates the relationship between locating in the science park and the balance of inbound and outbound OI such that the positive relationship is stronger when firms possess higher levels of ACAP.

6.4 Data and Methods

6.4.1 Introduction of Sample and Data Collection

This study regards China's innovation environment as a background for studying firms' OI. The participants come from ZSP, where high-tech SMEs provide their R&D and OI information for the data and research. There are 800 firms participated the research, and its response rate was recorded as 37.75%. The specific research process and data collection are derived from the same steps of one survey that indicated in chapter 3. In this chapter, it applies relevant data for demonstrating the cluster effect and its relationship with the balance in OI.

6.4.2 Variables

6.4.2.1 Dependent Variable

The dependent variable is the balance of inbound and outbound OI (ambidexterity in OI), which is measured by the formula below. Both OI activities values are direct measured and adapted from He and Wong (2004), so here constructs a new formula:

$$the\ balance\ in\ OI = \frac{IB^2 + OB^2}{2 * IB * OB}$$

In the expression, IB and OB squares represent the percentages squares of inbound and outbound OI activities; the divisor is multiplication of two activities percentage. It considers that the ambidexterity of each firm can be computed by the squares sum divide their multiplication, which enhances the mathematical accuracy and item construction compared to simply multiply inbound and outbound OI as one factor in prior literature (He and Wong, 2004). It thus extends the observation resulted from the balance in OI (e.g., Cao et al., 2009).

6.4.2.2 Independent Variable

First, based on the theoretical model, it assessed locational factors by 10 items in the survey, which included the firm can access high-educated, experienced people for product/processing innovation, the firm can obtain and apply resources from external parties for innovation, the firm can obtain technical/resources interaction from employees' flow, the firm have cooperation with upstream and downstream parties to lower costs, the firm can easily connect with suppliers and be devoted to innovative techniques, the firm can easily enhance information exchange and sharing within the cluster, the firm can easily develop strategic alliances within the cluster, the network relations can support the firm to easily meet market dynamics, the firm can easily obtain government grants, tax reductions, and policy support within the cluster, and the firm can easily obtain venture capital, angel investment and private investment within the cluster. Items are adapted from Lai et al. (2014) and March (1991), and assessed by five-level Likert scales. In factor analysis, principal component analysis (PCA) was ran to identify key variable based on those items, that is to generate one factor extracted from six items (Cronbach's alpha = .85). This factor's loading value is greater than 1 and applied in models.

In order to test the construct validity of the data, here applies discriminant validity (measurement) by using confirmatory factor analysis (CFA) method. Two-factor CFA was used to compare whether one-factor locational construct is appropriate to apply in the regression model. It conducted one factor at first, and two-factor test, which was a correlated estimated freely for locational constructs. According tests results, it showed that in each case a two-factor model (chi-square/df=4.863, RMSEA=0.069, CFI=0.996, NNFI=0.966, IFI=0.924) had a better fit than a single-factor model (chi-square/df=23.282, RMSEA=0.072, CFI=0.978, NNFI=0.963, IFI=0.932), which indicates good discriminant validity (Anderson and Gerbing, 1988), therefore measurement validity was approved.

6.4.2.3 Moderating Variable

Following Cohen and Levinthal's (1990) original contribution, a firm's ACAP was measured by R&D intensity. This item is also used to measure a firm's ACAP in this study, which is to examine the moderating effect for the relationship between locational factors and the balance in OI. Questions in the survey were adapted from Xia and Roper (2008). Specifically, R&D intensity is combined the amount (percentage) of internal and external innovation expenditure of firms' turnover in last three years, which indicates firms' overall R&D expenditures. From that, it uses this item as one variable in the model, that is used to test the moderating effect of

ACAP on the relationship between locational factors and ambidexterity in OI. ACAP is included in all regressions.

6.4.2.4 Control Variables

As innovation can be influenced by firm and industry attributes, it is necessary to control for these effects. Accordingly, firm-level specific factors: age and size, as well as industry factors were included as control variables, as prior studies have documented their potential effects on organisational innovation (Lai et al., 204; Xia and Roper, 2008). The age and size item were directly controlled by continuous variables, which were the number of age and total number of employees in the firm. While industries may differ in terms of technological orientations and innovation types, so the industry idiosyncratic effects were controlled for by including dummy variables. The sample was distributed across seven sectors: (1) Manufacturing, (2) Electronics, (3) Telecommunications, (4) Network, (5) Software, (6) Bioengineering, (7) Pharmaceutical. Thus, seven industry dummy variables were constructed.

On the other hand, for revealing all possible effects in OI study, strategic focus of OI, also represents as four items (dummy variables) were controlled into the models, that is from strategic level to examine what kind of factors having correlation with dependent variables and contributing to the results of framework. Both inbound and outbound OI items are also controlled in the model for observing the results of ambidexterity in OI. That is comprehensively to examine relevant variables effect to the DV and regression.

6.4.3 Analytical Approach

To test the theoretical model has been developed, it applied generalised linear model (GLM, with moderator) to examine hypotheses and relations between variables. An interaction item within the model is presenting locational factor and ACAP's relation to the balance in OI. Instead of using an ordinary least squares method or structural equation modelling (SEM), which are often applied to test linear variables but would not be fit to examine the interaction term (as a nonlinear variable) in this framework, the GLM is therefore used to test the relationship (McCullagh and Nelder, 1983).

SEM is a type of statistical model that takes the form of a set of linear simultaneous equations (Hox and Bechger, 1998), and the estimation methods of SEM (e.g., two-stages of the least squares method) are calculated through a general linear model to examine the variables (Bentler, 2010), whereas in the framework of this study (here testing the balance in OI as a dependent variable), different estimation methods, such as the GLM, are required to test diverse dependent variables with varied characteristics separately. Thus, it is more reasonable to use GLM rather than SEM to examine the hypotheses and variables' relationships (also in Chapters 7 and 8). Because the dependent variable of 'the balance in OI' is a ratio variable and the interaction item is generated by multiplication (a nonlinear variable), for predicting the relationship among independent variable, interactive item, and dependent variable. GLM is regarded as a better method to use. The GLM includes multiple linear models in the form of $y_i \sim N(x_i^T \beta, \sigma^2)$, where x_i contains the known covariates and β contains the coefficients that will be estimated (McCullagh and Nelder, 1983). Hence, following the hypothesis and proposed models, in the GLM, the dependent variable (the balance in OI, y_i) is independently distributed and does not need to be normally distributed, but it typically assumes a distribution from an exponential family. Although the GLM does not assume a linear relationship between the dependent variable and the independent variables, it does assume a linear relationship between the transformed response in terms of the link function and the explanatory variables. Thus, the GLM is applicable when examining the interaction item and other variables' effect on the dependent variable.

6.5 Results

Table 6.1 reports the descriptive statistics and correlation matrix among essential variables. In order to identify whether there is a multicollinearity issue in regression models, a variance inflation factor (VIF) test has been conducted. The average score of all variables is always below 4 (see Pan and Jackson, 2008), so there is no multicollinearity issue. Table 6.2 presents the results of GLM regression of locational factors, ACAP, and the interaction item effect on the balance in OI. Model 1 includes all control variables, model 2 includes the locational factor as an independent variable, and model 3 is the full model with interaction item. Model 4 is the model with two instruments to observe robustness.

Hypothesis 1 predicts that locating at the science park has a positive effect on the balance in OI, while the results in Model 3 show that the coefficient for the locational factor is significant and positive ($\beta=0.055$, $p<.05$), providing the support for hypothesis 1. It implies that there is a positive effect resulting from locational factors on the balance in OI, thus hypothesis 1 is supported.

The result also finds a support for hypothesis 2, which predicts a positive moderating effect of ACAP on the relationship between locational factor and the balance in OI. It reveals that the coefficient for the interaction item is significant and positive ($\beta=0.259$, $p<.05$) on the balance in OI. It implies that the relationship between locational factors and the balance in OI is moderated by ACAP, that is, ACAP strengthens the relationship in such a way that a stronger effect between two factors could be achieved when higher ACAP is engaged in this interaction. Therefore, as predicted, ACAP moderates this relationship in such a fashion that the positive effect of locational factors on the balance in OI is stronger when the firm possesses higher levels of ACAP, hypothesis 2 is therefore supported and accepted.

6.6 Robustness Check

For checking the robustness of results, an alternative test is conducted regarding the hypotheses by using a different dependent variable. It keeps current locational factor as the independent variable but a new ratio variable (inbound divides outbound) as the balance in OI. A new GLM regression was conducted and showed that locational factors have a significant result ($\beta=-0.684$, $p<.01$); and the interaction with ACAP is still positive and significant ($\beta=0.009$, $p<.05$). Hence, although locational factors showed a negative significant result on new dependent variable, due to this factor is reflecting the combination of the balance in OI that the negative relationship explained locational factors are negative correlated with inbound OI 'over-applying' in cluster. Firms should avoid the inclination of inbound OI from locational factors due to the negative result. It thus from another respect indicates the importance of proper OI combination. Therefore, the validity of the data and model is still appropriate, and keeping consistence.

In order to control the potential endogeneity bias, instrumental variables are used to test the relationship between locational factors and the balance in OI. The instruments are instrumented for an independent variable, the locational factor, which is tested in the full model. There are two items, the 'founder's oversea experience' and the 'exporting percentage of turnover' used as instruments. To locational factors, 'founder's oversea experience' is one factor related to the practical process and benefits that can be achieved from the founder's different view in the science park. This international view is not only absorbing benefits from local engagement, but combining foreign knowledge via external business experience in the overseas market. As the cluster also contains large firms like MNCs, the experience/managerial method may support firms to broaden their own development and provide various considerations for using more locational factors to complement their own research and development. Thus, a comprehensive business perspective may be beneficial to achieve advantages in the cluster. 'Exporting percentage of turnover' is also affected by locational factors in the environment because export-oriented firms in the cluster reflect consumer behaviour in different areas and how product can access the international markets. This indicates a reason for cooperating with upstream and downstream firms in the cluster to obtain more opportunities to sell products overseas, thus promoting the turnover not only in the domestic market. Therefore, these two variables have connections and correlations with locational factors. Following this consideration, Durbin and Hausman's test is applied first to examine whether there is an endogeneity issue, and Sargan's test will be applied to check the validity of these instruments (whether instruments are valid).

According to the results, two regression tests are conducted to examine whether they are consistent with or without instruments, and the estimated results of the probability value (between tests) is 0.99 that two models are consistent with each other. While the score of the Hausman test is 0.01, which means the model is not affected by the instruments for the relationship between independent and dependent variable. Also, the result of the Sargan test indicates that these instruments are valid (1.07, p=0.30) for demonstrating whether there is no significant endogeneity between locational factors and the balance in OI in the model. Thus, there is no significant endogeneity for the regressions by using instruments to verify and demonstrate.

6.7 Discussion

The study investigates the relationship between locational factors and the balance in OI, while examines the moderating role of ACAP in this association. The study shows that firms that pursue a balance of inbound and outbound OI rely on the utilisation of locational benefits (Bocquet and Mothe, 2015; Ferrary, 2011). A firm's ACAP plays a moderating role that can affect the strength of the relationship between locational factors and the balance in OI.

First, the study shows that locational factors have a positive effect on the balance in OI. That is, under industrial clustering, locational factors can directly influence the level of OI balance because the cluster provides an environment within which firms can properly engage in knowledge acquisitions and diffusions. Clustering together, compared to being far from relevant parties, helps a firm use essential external resources. Locational factors also enable the firm to diffuse some internal ideas for further commercialisation or obtain financial benefits, which can occur by meeting target firms or potential partners via interactions at social or industrial events in the cluster (Lazzeretti and Capone, 2016). This indicates that under the influence of locational factors, an environment that facilitates a firm's diffusion of ideas and knowledge spill-overs is created (Audretsch and Feldman, 1996), which affects the firm's balancing or applying of inbound and outbound OI, bringing this balance to an appropriate level. As locational factors influence the basis of inbound and outbound OI — knowledge acquisitions and diffusions, firms are more likely to pursue a balance conduction of inbound and outbound OI, effectively using internal and external ideas to realise their own balanced OI conduction.

Compared to prior studies, the findings of this study provide a more accurate theoretical explanation of the relationship between locational factors and the balance in OI. For instance, Cantner et al. (2015) argue that a cluster could provide support to firms and help them become ambidextrous in innovation (between exploitation and exploration); but the study was not from the mode of OI and did not explain how firms may achieve ambidexterity by using locational factors in the cluster, thus need to be enhanced by developing the knowledge in OI and revealing the relationship between locational factors and the balance in OI. Sack (2015) indicates that firms should have an awareness of achieving ambidexterity in innovation in the cluster; this is important when managing the differences in conducting innovation activities. By considering the effect of the cluster on large firms' ambidexterity in OI, Ferrary (2011) also indicates that outsourced exploration and exploitation specialisation can be more innovative and competitive than other ambidextrous firms in this environment. However, although the links between locational factors and ambidexterity in OI can be observed from these studies, knowledge of how locational factors act on the balance of inbound and outbound OI and whether locational factors can promote this balance still need to be systematically examined. Linking to this study, the findings further extend previous studies and confirm that locational factors enable firms to differentiate capabilities and focus on adoption to and reconfiguration of both internal and external knowledge bases, thus utilising the locational benefits to realise their balance in OI (Teece, 2007). By integrating locational factors with the balance in OI — the study shows that locational factors have an important impact on facilitating knowledge acquisitions and diffusions, thus enabling firms to attain a balance in inbound and outbound OI.

Second, the findings indicate that ACAP has a positive moderating effect on the relationship between locational factors and the balance in OI. This shows that there is a positive and significant association between the interaction terms (locational factors and ACAP) and OI balance. This also implies that a firm's ACAP, which is characterised by R&D intensity in the study, is a contingent variable that moderates the relationship between locational factors and OI balance. From the results, it can be seen that ACAP influences the facilitation of knowledge acquisitions and diffusions and that indicators such as R&D intensity, the number of patents and the amount spent on in-house and external R&D reflect ACAP's capacity to promote the use of internal and external ideas. That is, a firm located in a cluster with a higher level of ACAP is capable of obtaining more locational benefits, thus achieving a stronger relationship between locational factors and OI balance. The extent (stronger or weaker) of this relationship varies given levels of ACAP: when firms possess a higher level of ACAP, the strength of this relationship is stronger.

Compared to prior studies that consider the role of ACAP in OI conduction (e.g., Enkel et al., 2009; Escribano et al., 2009; Ferreras-Méndez et al., 2016; Filatotchev et al., 2011), the present findings provide a more accurate theoretical understanding of the moderating role of ACAP in this specific condition (locational factors and OI balance), which support the organisational learning theory and advance the research of OI. That is, firms depend on different levels of ACAP to achieve diverse magnitudes for the relationship between locational factors and OI balance. The research fills in the theoretical deficits of prior OI research, which had a limited understanding of what factors may help firms facilitate a stronger relationship between locational factors and the balance in OI. Based on the findings, the study shows the importance of ACAP in the relationship between the two factors.

The study makes two key contributions to the OI literature. First, building on the cluster perspective, the study contributes to the OI literature by recognising the influence of locational factors on the balance in OI. Even though some studies discuss the phenomena between cluster and OI activities (e.g., Bocquet and Mothe, 2015; Cantner et al., 2015; Sack, 2015), most of them analyse what OI activities could be conducted in this environment or a cluster's ambidexterity; they have not discussed the firms' ambidexterity in OI. These studies thus neglect to examine how locational factors as the environmental elements influence the pursuit of the balance in OI in this context and, importantly, the mechanisms behind this association. To interpret and fill in the gap, the study shows that it is necessary to provide a clearer understanding of how firms achieve the balance in OI by utilising locational factors as the antecedents to lead the firms' balancing conduction in OI. A proper balance of inbound and outbound OI is affected by the actors, parties and policy elements in the cluster (e.g., research universities, R&D institutions, rival firms, venture capital and government funding), which provide firms with sufficient opportunities and advantages to promote knowledge acquisitions and diffusions, thus positively leading to a balance in OI. From a practical view, understanding and demonstrating the influence of locational factors on the balance in OI guides firms that already have found their location in the cluster and can help them attain a proper balance and can help those new firms that intend to use locational factors properly. By indicating the benefits that they can achieve in this condition, the study supports firms their attempts to effectively engage with internal and external knowledge that communicate with and use valuable resources in the cluster. The study highlights useful knowledge for managers so that these ideas can be applied to achieve a balance in OI. Therefore, by exploring the effect of locational factors on OI balance, the study contributes that firms can realise a balance of inbound and outbound OI under the influence of locational benefits.

Second, building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between locational factors and the balance in OI. Although prior studies have provided several theoretical models with which to explicate a link between cluster and ambidexterity in OI (e.g., Ferreras-Méndez et al., 2016; Lazzeretti and Capone, 2016; Ozer and Zhang, 2015), few empirical studies have examined the relationship between locational factors and the balance in OI and have specifically looked at ACAP as a boundary condition for this relationship. The evidence for explaining this association thus is lacking, and more importantly, how ACAP influences the strength of the relationship between locational factors and the balance in OI has been ignored. This is a significant gap in the OI literature. To address this, by looking at the role of ACAP as an internal capacity helps show why firms may have variations in achieving the balance in OI by utilising locational factors similarly and in the same environment, that is, to indicate how ACAP (through its functions) affects the strength of this relationship. In practice, firms may intend to strengthen the positive impact of utilising locational factors on the balance of inbound and outbound OI. Accordingly, to identify the capacity needed to strengthen this positive relationship is one point that needs to be solved. Examining how ACAP acts on this relationship thus can support firms in facilitating the strength of this relationship in practical OI adoption. Therefore, based on organisational learning and showing the moderating effect of ACAP, the current study shows that for the relationship between locational factors and OI balance, ACAP has a moderating function; when there is a higher level of ACAP, there is a stronger connection between the two factors.

6.8 Conclusion

In this chapter, the study tested the association between locational factors and OI balance, showing the moderating role of ACAP in such a relationship. Based on a cluster perspective in the relationship between locational factors and OI balance, the study found that locational factors can positively affect OI balance. Also, the study showed that ACAP has a positive moderating effect on the strength of the relationship between locational factors and OI balance; when firms possess a higher level of ACAP, the stronger this relationship is. With new evidence to support the framework and propositions developed in Chapter 2, the study indicates that when firms conduct OI activities in a cluster, locational factors should be regarded as a key dimension that affect the ways in which firms balance inbound and outbound OI. Firms should also possess a higher level of ACAP to achieve a stronger relationship between locational factors and balanced OI in this environment.

Chapter 7 Ambidexterity in OI and Innovation Performance

7.1 Introduction

The concept of OI was introduced by Chesbrough (2006, p.1): "the use of purposive inflows and outflows of knowledge to accelerate internal innovation and expand the markets for external innovation''. The OI paradigm (Chesbrough, 2006) is recognised as the illustration for applying and upgrading firms' traditional models. Specifically, firms can apply OI in one or more ways: inbound OI, which describes internal use of external knowledge, outbound OI, which describes external use of internal knowledge (Cheng and Huizingh, 2014; Gassmann and Enkel, 2004). Ideally, an appropriate balance of inbound and outbound OI is conducive to innovation performance (Gassmann and Enkel, 2004).

Prior studies on OI have indicated that firms generally perform more inbound than outbound OI (Chesbrough and Crowther, 2006; Cheng and Huizingh, 2010; Lakemond et al., 2016; Laursen et al., 2006; Parida et al., 2012), suggesting that outbound OI may impose more of a managerial challenge because of key internal resources may leak to competitors during technology exchange (Chesbrough, 2003; Laursen and Salter, 2006). Regarding the comparison between these two kinds of OI activities, there lacks a systematic analysis that can capture the potential benefits of both inbound and outbound OI (Lichtenthaler and Ernst 2007). This may be because of an uncertainty within firms in terms of using existing sources to conduct 'inside-out' outbound OI and the resulting fear of diffusing relevant knowledge (Rivette and Kline, 2000). Also, not only the research on outbound OI needs to enhanced, regarding the ambidextrous conduction — the balance of inbound and outbound OI (on innovation performance) demands further study as well. The literature often has stressed that firms should apply ambidexterity in OI to pursue both high levels of inbound and outbound OI concurrently (e.g., Brunswicker and Vanhaverbeke, 2015; Hung and Chou, 2013; Mazzola et al., 2012), but this lacks an analysis that can clarify whether firms can use their own OI demand to adopt both inbound and outbound OI, hence achieving an optimal level of the balance in OI. For instance, Bianchi et al. (2011) examined the inbound and outbound OI practices (i.e., licensing agreements, non-equity alliance, purchase/supply of technical and scientific services) adopted by bio-pharmaceutical firms and showed there was a link with innovation performance, where through OI adoption, the firms exchanged technologies and knowledge with different types of partners along the phases of the drug discovery and development process (as their innovation outcome). From the view of achieving a balance in OI, although their work suggested that firms should apply inbound and outbound OI in parallel to reflect the advantages on innovation outcome (drug discovery and new product launching), the analysis still was restricted to highlighting the influence of particular OI practices on innovation performance and neglected to examine how a relative balance level of inbound and outbound OI, that is, their combination, could affect innovation performance and whether the firms could achieve better innovation performance by adopting different combinations of inbound and outbound OI. Similar works, such as Schroll and Mild (2011) and Mazzola et al. (2012), also ignored the influence of combining inbound and outbound OI into an optimal level (they simply emphasised applying a higher inbound OI or less outbound OI) and only provided the concurrent effect of inbound and outbound OI on innovation performance, thus limiting the understanding of a balance in OI. On the other hand, regarding the strength variations of the balance in OI and innovation performance, few studies have examined the role of ACAP in this relationship, especially to test whether ACAP has a moderating effect here. Specifically, although Rothaermel and Alexandre (2009) demonstrated that ACAP has a moderating effect on the relationship between the technology sourcing mix (of known and new technology) and firms' performance, showing here that higher levels of ACAP allow a firm to more fully capture the benefits that result from ambidexterity in technology sourcing, the authors neglected to test the relationship between ambidextrous conduction — the balance in OI and innovation performance — because the technology sourcing mix in their study was mainly related to inbound OI. Thus, the relationship of the balance in OI and innovation performance needs deeper examination by linking it to the function of ACAP. Also, studies such as Brunswicker and Vanhaverbeke (2015) and Zhang et al. (2015) only demonstrated the relationship of ambidexterity in OI and innovation performance (they have a direct link) but overlooked why the strengths of the relationship were presented differently, which ACAP could explain regarding the extent of the variations. From this, even though prior OI studies indicated some phenomena relating to the ambidexterity in OI and its association with innovation performance, the understanding of how an appropriate combination of inbound and outbound OI (the balance) acts on innovation performance still needs further clarification. This is also linked to the function of ACAP, which is a boundary condition that can explain the strength variations of this particular relationship. Therefore, by examining the relationship between the balance in OI and innovation performance while integrating it with the role of ACAP, the study can address these gaps by providing new evidence for this relationship.

The study therefore is motivated to explore the effect of both inbound and outbound OI, and the possible influence of the balance in OI on innovation performance. From a theoretical view, the study proposes that both inbound and outbound OI could positively act on innovation performance, and ambidexterity in OI (the balance) has significant effect on innovation performance. It also postulates that firm's ACAP moderates the relationship between the balance in OI and innovation outcome, when firms possess stronger ACAP, the stronger the relationship. Thus, the study indicates that the understanding of the balance in OI into a greater conceptual charity is important to enrich the observation and knowledge of the relationships among such factors and their impacts on how firms engage OI activity to lead better performance, which is critical for elaborating on existing theories of OI. Further, from a practical view, there is a need to penetrate and explain the actual OI conduction influences that guide firms to achieve better innovation outcomes, thus avoiding adverse effects from improper OI activity adoption. It allows managers to pursue, apply an appropriate OI conduction, basing implementation on the firm's condition to engage ACAP in terms of combining internal and external sources. Hence, by filling these gaps in literature and practice, this study provides new insights into the ways that OI activities can enhance innovation performance, discovering the balance in OI contribute to innovation performance, and ACAP's moderation effect.

The study makes two contributions to the literature on OI. First, this study enhances the understanding of ambidexterity in OI by bringing greater conceptual clarity to the notion of balance, which highlights the contingency of the balance in OI and how it acts on innovation performance. Although some literature has shown that the notion of balance means the extent to which the inbound and outbound OI are equal (e.g., Hung and Chou, 2013; Schroll and Mild, 2011; Sikimic et al., 2016; see Cao et al., 2009), these studies have neglected to specify what, and even whether, other combinations of inbound and outbound OI can be regarded as a balance in OI and how these combinations may affect firms' innovation performance. This points to a significant gap in the OI literature. From a theoretical view, there needs to be clarification on what combinations of inbound and outbound OI represent the balance in OI as these combinations act on innovation performance. The study shows that the balance in OI could be a contingent value: an optimal balance level that enables firms to achieve ideal innovation performance. In practice, to further clarify and demonstrate a balanced point not only means having an equivalent adoption of inbound and outbound OI, but also obtaining an appropriate point where the firms' actual OI conduction is relied on; this can guide firms to more effectively match inbound and outbound OI to achieve innovation performance, that is, to provide a broader view of the balance in OI and give firms more flexible OI conduction from a managerial perspective. Therefore, by developing a greater clarity of OI balance and how it relates to innovation performance, the study shows that an optimal balance between inbound and outbound OI enhances innovation performance while a more balanced conduction in OI brings better innovation performance (Dahlander and Gann, 2010).

Second, building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between the balance in OI and innovation performance. Although prior studies have shown the association between ambidexterity in OI and innovation performance (e.g., Camerani et al., 2015; Mazzola et al., 2012; Michelino et al., 2014; Sikimic et al., 2016), these studies have not documented the implications and function of ACAP (as a firm's internal capacity) in the relationship between the balance in OI and innovation performance, especially when explaining ACAP's contingent effect on the strength of this relationship. This is regarded as a significant gap in OI literature. From a theoretical view, there needs to be a clearer understanding of why firms perform at various levels when it comes to the relationship between OI balance and innovation performance, which by considering ACAP to be a contingent factor of an internal firm's characteristics can explain the different extents of the relationship. In practice, firms still face challenges regarding how they can achieve a stronger relationship between the balance in OI and innovation performance via OI adoption. The understanding of ACAP can guide firms to effectively facilitate the strength of this relationship in practical operation. By building on the organisational learning theory, the study shows that ACAP moderates the relationship between balancing inbound and outbound OI and innovation performance. When firms possess higher levels of ACAP, there is a better relationship between these factors.

The study is structured as follows. The next section develops hypotheses associated with theoretical discussions, while section three describes a research method linking data collection and developing variables. Section four illustrates the results of the study, with section five providing a check of robustness and demonstrating the correctness and validity of the study. Section six discusses both the theoretical and empirical results of the research. Section seven draws a conclusion in this chapter.

7.2 Hypotheses

7.2.1 OI Activities and Innovation Performance

In the literature, OI has been proposed as a new paradigm for the adoption of innovation, inbound OI, is related to activities such as collaborating with other firms for internal product development, and involving end users in the new product development processes, as well as licensing-in of intellectual property from other organisations. Outbound OI is related to activities such as the spin-off of new ventures based on existing products, technological development, and licensing-out technologies (Chesbrough, 2003; Chesbrough and Crowther 2006; Gassmann, 2006). The study thus predicts that inbound and outbound OI can positively affect innovation performance.

When firms obtain innovation outcomes via inbound OI, some studies have shown a positive relationship between inward knowledge transfer (of inbound OI) and innovation performance (Enkel et al., 2005; Parida et al., 2006; Van de Vrande et al., 2006). According to Chesbrough et al. (2006) and Parida et al. (2006), external technological collaboration could increase firms' ability to innovate and create more valuable innovations due to them becoming more aware of market needs and expectations. Moreover, involving vertical relationships (e.g., end users, suppliers) in innovation may significantly reduce development risks and improve the likelihood of innovation success (Ragatz et al., 2002). This indicates that inbound OI could be significantly associated with innovation performance through inward technology transfer (Chesbrough et al., 2006), while diverse inbound OI practices may also lead to positive innovation performance (Parida et al.,2006). As such, it suggests that inbound OI allows firms to use external sources of innovation or acquire it through license-in and bringing expertise, resources inside the firms, thus affecting and supporting their own innovation performance (Dahlander and Gann, 2010).

On the other hand, outbound OI may also lead to a positive effect on innovation performance by outward knowledge transfer (Chesbrough, 2003; Chesbrough and Brunswicker, 2013). For instance, Lichtenthaler (2009) indicates that outbound OI can affect innovation performance by leveraging its benefits on achieving financial advantages and innovation opportunities. By providing licenses outside the firm, this practice can support them to gain more funding that may be applied to obtain valuable innovation further. For instance, Texas Instruments, it generated hundreds of millions of dollars in annual licensing revenues which applied to R&D and new product realise (Rivette and Kline, 2000). Regarding innovation opportunities generation, by enabling internal ideas, technologies to go outside to utilise (for other parties), the firm may establish its technologies as industry standards that lead new innovations built on that features and being regarded as an exemplar; and it increases the possibilities for firms to gain more access to external technology (Gassmann and Reepmeyer, 2005). Therefore, regarding both inbound and outbound OI's influence on innovation performance, the study proposes that:

H7.1a: Engagement with inbound OI has a positive effect on firms' innovation performance.
H7.1b: Engagement with outbound OI has a positive effect on firms' innovation performance.

7.2.2 the Balance in OI and Innovation Performance

In the context of OI, the study argues that the balance of inbound and outbound OI can affect innovation performance. A synergistic effect of OI balance is also predicted as another reason that can affect innovation performance (see Dahlander and Gann, 2010).

A balance in OI contributes to innovation performance by matching both the inbound and outbound OI at the appropriate level (Dahlander and Gann, 2010). A key reason for this is that a relatively balanced OI optimises a firm's inbound and outbound OI adoption and enables the firm to enhance its innovation performance by leveraging its own strengths. It indicates that firms may not always need to equalise inbound and outbound OI, but should find an optimal combination of the two kinds of OI activities that lead to innovation performance. On the one hand, in the actual OI operation, leading high-tech firms already have strong internal R&D sources that they can mainly innovate new products relying on self-development, whilst by exploiting more commercial benefits support own innovations (e.g., sell 'market-ready' products/licenses via outbound OI). In this condition, the firms may not need to apply too much inbound OI to bring a variety of external sources inside the firms instead of selectively applying some inbound OI practices to gain valuable knowledge (e.g., purchase other key licenses from related firms; Chesbrough and Brunswicker, 2013). A high adoption may even obstruct or defer a product's development. That is, when absorbing too much external sources inside the firm, the firm needs more time to incorporate these sources, and if those ideas or technologies are too similar, it is difficult to produce novel products (Sapienza et al., 2004). Accordingly, a relative balance in OI for this kind of firm may present as outbound OI being higher than inbound OI, which highlights the firm's in-house R&D strengths and where the adoption of outbound OI is used to gain more commercial or financial support for innovation. On the other hand, in more general conditions, high-tech firms often need to engage in more external sources (via sufficient inbound OI) to achieve better innovation performance (Parida et al., 2012). Because the market and consumers' demands change very rapidly, the firms need to use valuable ideas from suppliers, consumers and R&D firms to discover the latest technology trends to supplement their own innovations (Laursen and Salter, 2014). In this condition, inbound OI is often applied more than outbound OI because firms need to search and integrate new knowledge for technological development, therefore increasing the opportunities to make novel innovations (e.g., via in-licensing and external R&D contracts). For instance, the software firms in ZSP can contribute to innovation performance by matching inbound and outbound OI for a balanced benefit. This is fulfilled through the firms' sourcing, purchasing useful licenses or resources from collaborators and the firms through open sourcing and forming joint ventures with other parties, which two kinds of OI activities are applied at an appropriate level to lead greater benefits on innovation performance (Zhao, 2016). That is, a relative balance of inbound and outbound OI may vary, and inbound OI can be conducted more than outbound OI. The argument here is according to a firm's own OI demand to match inbound and outbound OI rather than simply keeping one OI activity equal to another, the balance in OI optimises inbound and outbound OI adoption and provides flexibility, allowing firms to apply more valuable external sources (with internal ideas) to achieve greater innovation performance.

The study also argues that a synergistic benefit may arise under a balanced OI, and it can act on innovation performance. That is, the effect derived from the balance between inbound and outbound OI produces a greater effect than the sum of the individual effects (see Dahlander and Gann, 2010). First, a synergistic effect may enhance innovation performance by providing a greater potential with which to develop new products and leverage commercial returns through inbound and outbound OI efforts, thus generating a greater influence to take advantage of the firm's internal and external competencies (Chesbrough et al., 2006). To explain this synergistic benefit based on OI balance, the two kinds of OI are used to reinforce each other and let firms leverage a greater outcome than if only one type was used. One reason is that licenses or patents are sold via outbound OI and can be applied via inbound OI because the external ideas acquired and utilised via inbound OI to develop new products or patents could be 'recycled' or 'reused' by outbound OI to gain more commercial benefits on innovation performance. For instance, Schroll and Mild (2011) find that the more a firm applies inbound OI, the more it will also apply outbound OI. That is, if a firm is using inbound OI for the additional creation of innovations, it is probable that it would leverage unused parts of its increased pool of innovations and licenses through outbound OI. Accordingly, inbound OI may enhance outbound OI when creating this synergy. Another reason is, in some conditions, outbound OI can enhance or promote the adoption of inbound OI. For instance, a firm that already possesses some strong products or licenses may use an outbound OI license or form a joint-venture to provide internal ideas to obtain more financial benefits that can then be used to buy other key technologies. That is, the commercial benefits derived from outbound OI are applied to inbound OI for acquiring external core knowledge that may improve innovation performance (Michelino et al., 2014). Thus, if a firm conducts inbound OI by following outbound OI at a balanced level, there is a greater synergy between the two activities than if each would have been conducted in a silo. Under this balancing conduction, inbound and outbound OI can enhance each other mutually; therefore, a synergy has a greater influence on innovation performance.

Second, a synergistic benefit not only reinforces the benefit of each type of OI, but it also helps firms offset the disadvantage of exclusively engaging in each type of OI. On the one hand, if a firm's inbound OI is exclusively applied or if there is a lack of outbound OI adoption, the firm may not reap all the potential benefits, such as finding ways to market ideas developed in internal projects (Chesbrough and Brunswicker, 2013). A firm may lack opportunities to obtain valuable resources via the commercialisation of technological knowledge or in addition to its internal application (Dahlander and Gann, 2010). If the firm's inbound OI level is too high and cannot attain an optimal balance of outbound and inbound OI, its innovation performance may decrease because of the increasing difficulties of integrating too much new external knowledge for innovation (Katila and Ahuja, 2002; Levinthal and March, 1993). On the other hand, when a firm is solely or extremely applying outbound OI, it may lose opportunities to acquire the latest ideas and technologies, some of which may be needed to enhance its own innovation performance. Excessive outbound OI may reduce firms from spotting new opportunities or responding to emerging technologies (Parida et al., 2012). However, an appropriate inbound OI adoption (if applies with outbound) involves the search for new knowledge that firms can use to find the appropriate solutions to technological problems, deepening the firm's understanding of future trends of technology and the competition (Cao et al., 2009; Katila and Ahuja, 2002). Hence, a synergy delivered by the balance in OI can help firms offset the disadvantages of solely applying each kind of OI.

Meanwhile, the balance in OI may enhance innovation performance by mitigating the potential risks that can arise from the overemphasising or excessively applying either inbound or outbound OI. First, if firms focus solely on outbound OI, they may succumb to inertia and become somewhat myopic (Wei et al., 2014) because they may be more likely to rely on outflowing internal ideas to gain commercial or financial benefits that trend to single-loop learning, local searches and a reduction in new product development (Cao et al., 2009; Gibson and Birkinshaw, 2004). In this condition, when outbound OI is much higher than inbound OI, firms tend to only enjoy short-term success while being reluctant to upgrade product designs in the face of significant technological and market changes (Wei et al., 2014). Second, when inbound OI is much higher than outbound OI, the firm's marginal benefits may decline because of the increasing marginal cost and risk. Because inbound OI focuses on sourcing and acquiring external knowledge to deepen new knowledge for a firm's innovation and R&D, if the firm's inbound OI level is too high, its effect on innovation performance can decrease because of the vast amounts of new external knowledge that need to be integrated. It takes more time and costs, and the amount of new ideas may be too complicated to coordinate, which hurts new product development efficiency and increases potential difficulties for innovation success (Katila and Ahuja, 2002; Laursen and Salter, 2006). This implies that an excessive inbound OI adoption, focusing more on absorbing new ideas but lacking coordination and adaptation with internal knowledge, may lead to brand new product features that are incompatible with the customers' needs (Atuahene-Gima and Murray, 2007). Therefore, a firm's marginal benefits may decline because of the increase of marginal costs and risks (Wei et al., 2014). To summarise, if there is not an appropriate balance between inbound and outbound OI, innovation performance may be deferred and weakened because of potential risks. Hence, a balancing level of inbound and outbound OI can help firms effectively utilise internal and external ideas and reduce the risks of excessive conduction, leading to a better innovation performance.

Overall, by revealing the importance and benefits of balancing inbound and outbound OI, it is necessary to conduct a relative balance between inbound and outbound OI, which can lead better innovation performance. The study thus proposes a hypothesis:

H7.2: Firms with a balanced portfolio of inbound and outbound OI perform better in innovation performance than those with a less balanced of inbound and outbound OI.

7.2.3 Moderating Effect of ACAP on the Balance in OI and Innovation Performance

The study proposes that a firm's ACAP may moderate the relationship between the balance in OI and innovation performance. How well firms can achieve innovation performance by balancing inbound and outbound OI can be built on utilising internal and external ideas — a capacity that can strengthen or weaken a firm's access to internal and external knowledge also affect the extent of the relationship between OI balance and innovation performance. Thus, the moderating function of ACAP arises.

Regarding the relationship between balanced OI and innovation performance, the study argues that ACAP can enhance the strength of the relationship between the balance in OI and innovation performance. By utilising and combining the internal and external sources into a relatively balanced level, ACAP can strengthen the extent of the balance in OI and innovation performance (Tushman and Katz, 1980). On the one hand, some high-tech firms may already possess stronger internal sources or ideas for their R&D, such as having a sufficiently long time to conduct R&D, and high numbers of patents and technologies (Cohen and Levinthal 1990; Zahra and George, 2002); these ACAP indictors not only increase the firm's capacity to recognise the value of external knowledge (Vanhaverbeke et al., 2008), more importantly enhancing the firm's ability to more smoothly externalise its internal knowledge to outsiders — no matter if it gains commercial benefits or cooperates with partners to develop innovative products. In this condition, because the knowledge stock and internal sources are sufficient and well developed, ACAP thus can combine and utilise internal and external sources into a relatively balanced level, which is done by externalising some available ideas to outsiders for product upgrades and financial interests (e.g., software firms are more likely to launch open-source software or platforms and out-licensing to obtain more interests and co-developments with outsiders when they possess strong internal R&D; West, 2003). This indicates that ACAP allows the firm to apply its internal sources to gain potential benefits through outsiders, thus utilising internal and external ideas to an appropriate level. Through ACAP, firms can flexibly deal with the allocation of the two kinds of sources, attaining a balance and thus enhancing the extent of the balance in OI and innovation performance. On the other hand, broadly speaking, firms need to engage with more external sources to have a better relationship between the balance in OI and innovation performance. By allowing the firms to effectively recognise, assimilate and integrate new knowledge with their own base, that is, dealing with external sources more sufficiently to merge them into internal sources, ACAP leads to the utilisation of both kinds of sources to a relatively balanced level. In this condition, a balanced point of internal and external sources is related to how firms utilise and acquire external ideas into the firm, rather than simply equalising or outflowing internal sources to meet acquisitions. For those firms with a relative lack of internal strengths or that need external resources, effectively using external knowledge is the priority rather than emphasising the output of internal sources. For instance, the R&D intensity of ACAP, especially for the investments in accessing external valuable sources, helps firms combine and utilise significant external ideas or licences appropriately; that is, ACAP not only encompasses a firm's ability to process knowledge internally, but also focuses on the acquisition and assimilation of external knowledge (Rothaermel and Alexandre, 2009). Therefore, by absorbing sufficient external sources via ACAP into the firm to achieve a balanced level of internal and external ideas, the extent of balance in OI and innovation performance can be enhanced. The study thus indicates that by allowing firms to flexibly combine and process both internal and external sources across their boundaries (to attain a relative balance), ACAP enhances the extent of the relationship between OI balance and innovation performance.

Regarding the synergistic effect of the balance in OI that acts on innovation performance, a self-reinforcing effect between inbound and outbound OI (two kinds of OI activities that can reinforce each other) could be facilitated by ACAP. It is by enhancing a firm's mutual effect between internal and external knowledge that leads to the reinforcement between inbound and outbound OI (see Cassiman and Veugelers, 2006; Hagedoorn and Wang, 2012). Some key ACAP components such as R&D expenditure, continuous R&D and the number of R&D professionals are often noted as aspects that help firms process internal and external knowledge mutually to enable inbound and outbound OI to reinforce each other (Caloghirou et al., 2004; Higgins and Rodriguez, 2006). On the one hand, ACAP contains the firm's resources spent on intramural and external R&D investments, including purchasing and selling inside and outside licenses or ideas. By investing and utilising ideas or patents (internal ones), firms are more likely to know what technologies are supportive and essential and that can be utilised to support innovation (to the market) while being able to spot the technologies and resources that are popular and demanded by outsiders (Zahra and George, 2002). That is, the use of a firm's own products and ideas to sell or license to outsiders and subsequently getting financial benefits can promote the acquisition of significant technologies from other parties. When the relevant internal and external knowledge has been mutually affected, inbound and outbound OI thus can be reinforced by ACAP. On the other hand, ACAP also represents a function, such as R&D professionals, that can help the firm promote the mutual effect between internal and external sources, thus facilitating the reinforcement of inbound and outbound OI. Because when those R&D people have sufficient publications or research outcomes in the area, they may easier identify and absorb the existence of specialised knowledge in the market, leading to a reinforcement between inbound and outbound OI (Escribano et al., 2009; Zahra and George, 2002). In this condition, ACAP based on the firm's own technology and R&D requests can acquire target knowledge for the firm, that is, for obtaining more significant ideas from external actors; here, the engagement of external knowledge can affect the firm and help it externalise internal 'market-ready' products to gain commercial benefits (Cohen and Levinthal, 1990). Thus, by identifying and absorbing valuable knowledge flows from outside, ACAP facilitates the externalisation of internal available sources to outsiders for commercial purposes, thus enhancing internal and external knowledge processing mutually. Hence, ACAP as the internal capacity of the firm (Escribano et al., 2009) facilitates the mutual effect between internal and external sources, which drives inbound and outbound OI to reinforce each other.

Therefore, taking these two points together, by influencing the interrelated, self-reinforcing effect of inbound and outbound OI (based on internal and external knowledge processing), ACAP can moderate the relationship between the balance in OI and innovation performance; when firms have a higher level of ACAP, they may be able to leverage a stronger synergy that strengthens the extent of this relationship. A hypothesis is given:

H7.3: ACAP moderates the relationship between the balance of inbound and outbound OI and firms' innovation performance, such that the positive relationship is stronger when the firm possesses higher levels of ACAP.

7.3 Data and Methods

7.3.1 Introduction of Sample and Data Collection

This study regards China's innovation environment as a background for studying firms' OI. The participants are based on ZSP, where high-tech SMEs provide their R&D and OI conduction information for the data and research. There are 800 firms participated the research, and its response rate was recorded as 37.75%. The specific research process and data collection are derived from the same steps of the survey that indicated in chapter 3. In this chapter, it applies relevant data to test the effect between the balance in OI and innovation performance, while ACAP as a moderating role.

7.3.2 Variables

7.3.2.1 Dependent Variable

Innovation performance is the dependent variable of hypotheses, which is measured as a continuous variable of the 'new product's percentage contribution (to the firm and market) of turnover' (in the last three years). This was mainly adapted from both Lai et al. (2014) and Chang and Hughes (2012).

7.3.2.2 Independent Variable

The balance in OI is the independent variable in regression model, which is based on the same measurement in chapter 6's formula. It applies to observe the relationship the balance in OI and innovation performance.

7.3.2.3 Moderating Variable

R&D intensity is still used as the moderating variable of ACAP in all models in this chapter. The measurement and adaption has been given in chapter 6.

7.3.2.4 Control Variables

The control variables applied in this chapter are keeping the same variables tested in chapters 6. It also adds two instruments into the whole model to observing the effect on the overall relationship. Also, firm status for national and private-owned firm attributes were controlled by one dummy variable. Moreover, four founding source items, government funding, foreign investment, money from other firms or institutions, and bank loans, were controlled within the model for observing whether they affect dependent variables and have linkages among the variables in the regression.

7.3.3 Analytical Approach

To assess whether the theoretical model has been accurately developed, this study applied GLM to examine the potential hypotheses and relations between these variables. Following the reasons given in Chapter 6 (comparing to SEM), in this chapter, the model assesses innovation performance as the dependent variable, of which the 'new product sales' is a continuous variable and the interaction item (the balance in OI and ACAP) generated by multiplication is not a simple linear variable. Accordingly, the GLM is applied as an extension of the ordinary linear model that allows for the testing of other distributions other than a normal distribution (McCullagh and Nelder, 1982). Because there are also different categorical and dummy variables as the controls (e.g., funding sources and status of firms), when compared with SEM, to integrate every variable into one model, the GLM can test the dependent variable with other necessary variables in this condition.

Regarding GLM's form, it first includes multiple model that can present as $y_i \sim N(x_i^T \beta, \sigma^2)$, where x_i contains known covariates and β contains the coefficients to be estimated (McCullagh and Nelder, 1982), this provides an advantage in obtaining an overall p-value for the variable as a whole when there are many multi-category variables. Hence, based on the hypotheses and relationships as proposed, in GLM, a dependent variable (innovation performance, y_i) is independently distributed and does not need to be normally distributed, however, it typically assumes distribution from an exponential family. Therefore, it provides the reason for examining the interaction item and other variables' relationships with dependent variable in the overall model in regression.

7.4 Results

Table 7.1 reports the descriptive statistics and correlation matrix among the essential variables. In order to identify whether there is a multicollinearity issue in regression models, a VIF test was conducted. The average and independent scores of all variables were below five, suggesting that multicollinearity issue is not a major concern (see Pan and Jackson, 2008). Table 7.2 presents the results of the GLM regression of OI activity, the balance in OI, and the interaction item's effect on innovation performance (new product sales). Model 1 includes all control variables (with R&D intensity); model 2 includes both inbound and outbound OI activity as independent variables; and model 3 includes the control variables, OI activity variables, and the balance in OI. Model 4 is the full model that comprises an interaction item, all control variables, and independent variable. Model 5 is the model that not only includes all control, independent variables but with two instruments to demonstrate the robustness of the data.

Hypothesis 1 predicts that the adoptions of inbound and outbound OI are positively affecting innovation performance, and the results in model 4 show that the coefficient for outbound OI activity is positive and significant (β=0.140, $p<.001$); while the coefficient for inbound OI activity (β=-0.025) is not significant on innovation performance. Thus, H1 is partially supported, and implies that highly conduction of inbound OI may not significantly affect innovation performance, whereas outbound OI could be positively affecting innovation performance. To test H2, which predicted that the balance in OI is positively related to the innovation performance, the result indicates that the coefficient for the balance in OI (β=-3.904, p<.05) is negatively significant on innovation performance. It reveals that although ambidexterity in OI is considered a positive factor influencing innovation performance, it is still built on OI activity's balance, which means an imbalance OI conduction may be negatively affecting innovation performance. Thus, a proper the balance in OI is significant to achieve positive effect on innovation performance.

In order to examine the moderating effect of ACAP between the balance in OI and innovation performance (hypothesis 3), one interaction variable is inserted into the model, thereby linking ACAP and the balance in OI as a whole concept. It indicates that the coefficient for interaction item is positive and significant on innovation performance (β=0.051, p<.05). The positive interaction result reveals that ACAP can moderate this relationship positively, and implies that the relationship is stronger when one firm possesses higher levels of ACAP.

7.5 Robustness Check

In order to check the robustness of the results, an alternative test is conducted regarding the hypotheses by using different independent and dependent variables. As the balance in OI and the interaction item are key variables that mainly affect innovation performance, a ratio variable is utilised as the balance in OI, while interaction items are the multiplication of ACAP and the ratio variable. Therefore, a new GLM regression was conducted and showed that outbound OI activities have a positive and significant relation with innovation performance (β=0.119, p<.01); the interaction item is also positive and significant (β=0.028, p<.05). Inbound OI item is still insignificant to innovation performance (the dependent variable), therefore the model presented in the study is appropriate for examining and interpreting the data, and is consistent with the hypotheses and model testing.

Meanwhile, to check the common method bias, a Harman's single-factor test was applied (Podsakoff et al., 2003) among all the independent variables to determine whether most the variance can be accounted for by one general factor. The results show that a 42% variance in four independent variables is indicated from the loadings. Thus, due to most of variances are not represented by one factor, the common method bias is not a major concern of this study.
Further, to control the potential endogeneity, instrumental variables are used to test the

relationship between ambidexterity in OI and innovation performance. The instruments are utilised for ambidexterity in OI, which is used as the first independent variable in the full model. This uses two OI motivation factors - ‘accelerating time to complete R&D’, and ‘reducing R&D costs for projects’. The first OI motivation factor indicates the degree of ambidexterity that supports firms in accelerating R&D under efficiently applying ambidextrous OI activities; the second reveals an advantage that ambidexterity can bring to firms to lower costs when over-applying inbound or exploration activities may have led to innovation costs raising and a funding shortage. Therefore, positive balance/ambidexterity should be better for R&D to reduce innovation time and to achieve new products and inventions. Following this, it applies Durbin and Hausman’s test to examine whether there is an endogeneity issue, and the Sargan test will be applied to check instruments’ validity.

According to the results, two regression tests are conducted to examine whether they are consistent with or without instruments, and it shows that the probability value (between these tests) is 0.259, and so the two models are consistent with each other, which means there does not exist an endogeneity issue; while the score from the Hausman test is 1.280 (p=0.259). Meanwhile, the results from the Sargon test indicate that both instruments are valid for ambidexterity in OI (0.134, p=0.714).

7.6 Discussion

The study investigated the influence of the balance of inbound and outbound OI and how it affects innovation performance. It also examined ACAP moderating role in this relationship. By focusing on the balance of ambidexterity in the literature on OI, the study showed that a more balanced portfolio of inbound and outbound OI may lead to better innovation performance and that this relationship is positively moderated by a firm’s ACAP.

The findings show that a more balanced conduction in OI can lead to better innovation performance, which has implications for research on OI and balanced ambidexterity in OI. Regarding OI, the study integrated the balancing of inbound and outbound to observe the influence this would have on innovation performance. Although some of the literature shows that a balance would have to contain equal levels of both OI activities (see Gupta et al. 2006; Wei et al., 2014), the conceptual dimension of OI balance can be broadly understood as firms that apply inbound and outbound OI into an appropriate level to meet their innovation strategies and achieve innovation performance. The result on the relationship between balanced OI and innovation performance indicates that there is a need for observing the association between inbound and outbound OI with innovation performance and to do so by adopting a balanced view; this provides empirical evidence for Dahlander and Gann (2010), who suggest firms need to pursue a balance of inbound and outbound OI that can reflect the benefit of an appropriate combination. This finding is also consistent with Camerani et al. (2015) and Wei et al. (2014), who indicate that the notion of balance shows that firms should flexibly match inbound and outbound OI to an appropriate level, rather than simply equalising the two activities. Compared to Cassiman and Valentini (2015), who suggest the positive, reinforcing effect of inbound and outbound OI that may exist at the industrial level, the study further develops and demonstrates the idea that at the firm level, conducting a balance in OI can reinforce the positive effect of inbound and outbound OI, which is derived from the synergistic benefit. This extends the discussion of Cassiman and Valentini (2015) that the contemporaneous use of BUY and SELL (extended to more inbound and outbound OI practices) can be more advantageous because of the contingency of the balance in OI. That is, by applying the balance dimension of ambidexterity in OI and examining its influence on innovation performance, the findings show a theoretical development in ambidexterity — the notion of OI balance, indicating that the balance point or an optimal relative level of inbound and outbound OI is contingent, which can positively affect innovation performance. The study thus not only adopted a balanced view of ambidexterity in OI to show a positive relationship with innovation performance, but further clarified its conceptual dimension in the OI paradigm.

On the other hand, in examining the separate influences of inbound and outbound OI on innovation performance, the results indicate that compared to the positive effect of inbound OI in prior studies (e.g., Enkel et al., 2005; Van de Vrande et al., 2009; West, 2003), this study revealed an insignificant influence of the inbound OI on innovation performance. However, outbound OI was shown to have a positive significant effect. The findings show that firms may achieve positive innovation performance by applying outbound OI instead of only focusing on inbound OI. The study showed that outbound OI is not only an option, but rather a requirement in the contribution to innovation performance (Hu et al., 2015; Van de Vrande et al., 2009). On the other hand, inbound OI leads to a negative effect on innovation performance. One possible explanation for this is that when SMEs intend to apply more inbound OI activities to achieve innovation outcomes, some outbound OI practices may not properly fit the strategic focus of the innovation. For this reason, a firm with a high percentage of inbound OI may over-absorb external sources that cannot be fully or effectively utilised. Also, because inbound OI is recognised as bringing positive outcomes by gaining access to resources and knowledge of partners (Laursen and Salter, 2006; Powell et al., 1996), firms may also apply inbound OI in the hopes of accessing new knowledge that has already been developed externally. But the results are not positive if firms cannot properly apply inbound OI, such as by controlling an appropriate level with outbound OI for achieving innovation outcome. Thus, the findings imply that for SMEs, outbound OI leads to more positive effects than inbound OI.

Second, the study showed that ACAP has a positive moderating effect on the strength of the relationship between OI balance and innovation performance. The study indicates that the extent (stronger or weaker) of this relationship varies by the firm's level of ACAP. Firms rely on different levels of ACAP to achieve diverse extents for the relationship between balancing inbound and outbound OI and innovation performance. The positive moderating effects (for the balance in OI and innovation performance) have similarities to Clausen (2013), who indicated that firms with better developed ACAP are better able to apply internal and external knowledge from different types of actors and act on innovation performance. The findings also confirm that the abilities a firm possesses for integrating, combining and exploiting external knowledge together with internal knowledge become fundamental to deploying the benefits of the balance in OI and lead to innovation performance. In addition, examining the moderating effect for the relationship between the balance in OI and innovation performance in high-tech firms can also support the study's results. Due to high-tech firms being characterised by fast-changing technologies, even the largest firms cannot keep pace with all the technological developments alone (Chen et al., 2011). Because there are high levels of technological opportunities and knowledge spill-overs, high-tech SMEs conducting OI activities with adequate ACAP capacities to evaluate, assimilate and integrate valuable knowledge from external sources are more likely to benefit from the strength of the balance in OI and innovation performance (Flor et al., 2017). The results can explain a growing number of high-tech firms that are applying OI activities to achieve better innovation performance under the influence of ACAP. Therefore, a stronger extent of the balance in OI and innovation performance can be obtained when the firm has a higher level of ACAP.

Accordingly, the study makes two contributions to the literature on OI. First, the study enhances the understanding of ambidexterity in OI by bringing greater conceptual clarity to the balance in OI, which highlights the contingency of the balance in OI and how it acts on innovation performance. Even if there is broad agreement that an ambidextrous conduction of inbound and outbound OI can be associated with innovation performance, the balanced view to explain the relationship with innovation performance is still debatable. For instance, Hung and Chou (2013) indicate that the interaction between inbound and outbound OI positively influences a firm's financial performance; Cassiman and Valentini (2015) reveal that firms that engage simultaneously in buying and selling technologies can achieve greater sales of new products; Laursen and Salter (2006, 2014) indicate the advantages and disadvantages of inbound and outbound OI on innovation performance. However, these studies do not provide an explanation that could satisfy the possible balancing effect of inbound and outbound OI on innovation performance. Instead of arguing that the notion of balance presents the extent to which the inbound and outbound OI are equal, those studies neglect to clarify whether other inbound and outbound OI combinations can be regarded as balanced and if they are affecting innovation performance. This lack of understanding points to a significant gap in the OI literature. In theory, there needs to be clarification regarding the understanding of balanced OI, that is, what combinations of inbound and outbound OI also represent the balance in OI while acting on innovation performance (see Cao et al., 2009; Wei et al., 2014). The study thus explores the contingent role of the balance in OI in affecting innovation performance. Practically speaking, clarity on the idea of balance can guide firms (SMEs in this study) to more appropriately conduct inbound and outbound OI, which will depend on their own OI condition, rather than trying to keep an equalised conduction between inbound and outbound OI. Therefore, the study showed that in the context of OI, when firms are pursuing balanced inbound and outbound OI, this does not mean an equal '50–50' engagement, but rather a balancing of both kinds of OI into a relatively equal level to benefit innovation performance. An optimal balance between inbound and outbound OI can bring better innovation performance (Cao et al., 2009; Dahlander and Gann, 2010).

Second, building on the organisational learning perspective, the study contributed to the OI literature by highlighting the contingent value of ACAP on the relationship between OI balance and innovation performance. Even though prior studies look at the direct effect between ambidexterity in OI and innovation performance (e.g., Camerani et al., 2015; Mazzola et al., 2012; Michelino et al., 2014), exploring ACAP's moderating function as an indirect effect on the relationship between the balance in OI and innovation performance has been ignored. For instance, Brunswicker and Vanhaverbeke (2015), Michelino et al. (2014) mainly focused on to demonstrate the direct effect of ambidexterity (the balance) in OI and innovation performance, indicated the different influences of inbound and outbound OI practices that might act on innovation outcome. But they overlooked to explain when firms conduct similar OI activities why their strengths of ambidexterity (the balance) in OI and innovation performance were presented differently, which ACAP, as an internal factor may have an indirect effect on this relationship and able to explain the reason of extent variations. Thus, researchers have not documented the implications of ACAP as a boundary condition for the relationship between ambidexterity in OI and innovation performance. A significant gap remained and needed to be addressed. One important reason for addressing this gap is that in the context of OI, ACAP helps explain the performance variation of firms with a similar balance of inbound and outbound OI. The study thus explored the contingent role of ACAP as an internal firm's characteristics in affecting the strength of this relationship. Another important reason for addressing this gap relates to its practical implications because firms may face challenges in how to strengthen the positive impact of the balance in inbound and outbound OI on innovation performance. Identifying the capacity needed to strengthen this positive relationship is one problem that needed to be solved. Regrading and examining ACAP as an internal capacity to this relationship can help firms find how to facilitate the strength of the relationship internally and autonomously. To achieve a stronger extent of the balance in OI and innovation performance, firms need to have a higher level of ACAP, such as enhancing their continuous R&D, engaging more professionals (scientific or engineering background in the area) for new product development, and investing sufficient R&D funds to support the utilisation and acquisitions of internal and external ideas (Zahra and George, 2002). This will support firms' existing knowledge stock of ACAP and strengthen the extent of the balance in OI and innovation performance. Hence, when firms have a higher level of ACAP, they can achieve a stronger relationship between balanced OI and innovation performance.

7.7 Conclusion

In this chapter, the study investigates association between the balance in OI and innovation performance, and recognises the moderating role of ACAP in the condition for the balance in OI and innovation performance. Based on an OI paradigm and a balance view of ambidexterity in OI, the study finds that a balancing level of inbound and outbound OI has a positive effect on innovation performance. While ACAP has a positive moderating effect on the strength of the relationship between the balance in OI and innovation performance. Regarding the separate effect of how inbound and outbound OI act on innovation performance, the study finds that outbound OI positively leads to innovation performance while inbound OI negatively influences innovation performance. One possible reason is that, although the majority of firms conducted inbound OI, the ideas or technologies that they brought in were supplement for their core ideas (of in-house R&D); and the possible positive influence on innovation performance still 'in processing' that not presented in this cross-sectional study period. Overall, the finding implies that ambidexterity in OI not only means a simultaneous conduction of inbound and outbound OI, but also that firms need to ensure an appropriate adoption between inbound and outbound OI as a relative balancing level for achieving ideal innovation performance. A higher level of ACAP can help the firm to have a stronger extent of the relationship between the balance in OI and innovation performance.

Chapter 8 Mediation Effect of Ambidexterity in OI for the Relationship between Locational Factors and Innovation Performance

8.1 Introduction

As the adoption of OI becomes increasingly significant, and cluster plays a more important role in firms' innovation, there is a growing need to understand what is the role of ambidexterity in OI relates to locational factors and innovation performance. Prior studies discussed the role of ambidexterity, alongside locational factors, on closed innovation (e.g., Cao et al., 2009; Lai et al., 2014; Sack, 2015; Sikimic et al., 2016). However, there were few studies on the indirect effect of ambidexterity in OI, such as the mediation effect of ambidexterity in OI which links the cluster to innovation performance. Therefore, this aspect in OI requires further investigation.

Most of the prior studies relating to ambidexterity in OI, cluster and innovation performance have focused on the direct impact of the cluster on innovation performance and, similarly, the ambidexterity in OI on innovation performance (e.g., Jansen, et al., 2009; Hughes, et al., 2010; Li and Huang, 2012). Few studies have examined the overall relationship among these factors, especially lacking a focus on ambidexterity in OI as a mediator. For instance, Li et al. (2013) indicated that ambidexterity has a direct effect on OI and innovation performance, showing a moderating role of environmental factors (via management assessors) on this effect. Even though the authors examined the overall relationship among environmental (locational) factors, ambidexterity in OI and innovation performance, an explanation regarding whether environmental factors have an indirect, or any influence at all, on innovation performance was unexplored (instead, they showed a moderating role of locational factors). The extent to the effect of ambidexterity on OI in explaining what potential influence on the process through a cluster or a science park on innovation performance still remains under explored. Similar works such as Lai et al. (2014), Lin et al. (2017) and Ozer and Zhang (2015) only researched a partial picture of these three factors. For example, by exploring the effect of clusters' resources and benefits on innovation performance (e.g., knowledge utilisation and easy to form collaborations), Lai et al. (2014) indicated that a cluster could directly influence firms' innovation performance. Although, the study did not examine the role of ambidexterity (the balance) in OI for the relationship between cluster and innovation performance, and the adoption and process (of OI activities) that leads to innovation performance was overlooked. Although Lin et al. (2017) explored how firms achieve ambidexterity in OI in high-tech science parks (while acting on innovation performance), the authors mainly regarded the cluster as a background and did not consider the utilisation of locational factors that can lead to ambidexterity in OI. Instead, they mainly demonstrated the link between ambidexterity in OI and innovation performance by focusing on the use of internal knowledge. Testing whether there is a potential link among locational factors, ambidexterity in OI and innovation performance was not present in these studies. Also, though Ozer and Zhang (2015) demonstrated that the use of locational factors can lead to ambidexterity in OI in the cluster, they did not explain whether, and if so how, locational factors can be linked to innovation performance through the role of ambidexterity in OI. That is, they did not examine what role ambidexterity in OI may play in the middle of locational factors and innovation performance. From this, the existing literature only offered partial pictures both on locational factors and ambidexterity in OI, while ambidexterity in OI and innovation performance is mostly unexamined; the gap regarding these three factors being looked at as a whole picture needs to be filled, which can demonstrate the mediation role of ambidexterity in OI.

In order to gain an in-depth understanding of the mediation effect of the balance in OI on the relationship between locational factors and innovation performance, the study proposes that the relation between locational factors and innovation performance is mediated by the balance of inbound and outbound OI. The study states, therefore, that an understanding of the mediating effect of ambidexterity in OI is significant to reveal and enrich further observation of the entire relationship, and that investigating the interaction among such factors is also supportive to achieve ideal innovation performance. Furthermore, as ACAP is observed having moderating effects on the relationships between locational factors and the balance in OI, and the balance in OI and innovation performance, it is also applied to test a moderated mediation model in which ambidexterity in OI as a mediator between locational benefits and innovation performance and ACAP as a moderator. It indicates that ACAP affects how well firms can utilise locational benefits to lead the balance in OI, and, the balance in OI leading to innovation performance, and thus it strengthens the mediation relationship (with ambidexterity in OI) by different levels to utilise locational benefits. In practice, there is a need to guide firms to engage the indirect effect arising from the mediation effect of the balance of inbound and outbound OI — between locational benefits and innovation performance — in order to avoid adverse effect resulting from improper OI activity engagement, which can in turn be caused by ignoring the balance between internal and external capabilities. Hence, the study provides new implications by showing a mediation effect of ambidexterity in OI in the new framework.

This study makes a key contribution to the literature on OI; it extends the understanding of the balance in OI by conceptualising it as a mediator that mediates in the relationship between locational factors and innovation performance. Even though previous studies demonstrate the direct relationships between ambidexterity in OI, locational factors and innovation performance (e.g., Bocquet and Mothe, 2015; Li et al., 2013; Lin et al., 2017; Hung and Chou, 2013; Ozer and Zhang, 2015; Sack, 2015), few explanations have been provided that can be used to test the indirect effect and examine the impact of ambidexterity in OI, especially when it comes to linking locational factors to innovation performance. Thus, the existing research is limited to examine these variables comprehensively, which means that there is a gap regarding the existence of a potential mediation effect of the balance in OI. In theory, there needs an explanation of which factor may affect the process through locational factors to innovation performance. That is, to understand the overall relationship of locational factors, the balance in OI and innovation performance is an analysis to examine what potentials or contingencies of a variable that may produce a mediating effect. It needs to conceptualise, interpret the role of ambidexterity (the balance) in OI when firms locate in the cluster to achieve innovation performance. In practice, by showing this mediation effect, it guides managers to maintain the balance of inbound and outbound OI (as a middle factor) by utilising locational benefits to achieve innovation performance. This points to the importance for examining the mediation effect in practice, and the new empirical evidence also can supplement and guide firms toward a proper balance in OI that bridges the link between locational factors and innovation performance. By testing this framework, the study shows that locational factors have an indirect effect on innovation performance through the mediation effect of balance in OI while ACAP has a moderating effect on this overall relationship, which reveals a moderated mediation effect (with the balance in OI) on innovation performance. The study thus contributes to the OI literature by conceptualising the balance in OI as a mediator in the process for the relationship between locational factors and innovation performance.

The structure of this chapter is organised as follows. Section two is based on the theoretical discussion and develops relevant hypotheses associated with the research predictions. Section three describes the research method linked to the data collection and develops the variables, while section four presents the results of the study. Section five checks the study's robustness and demonstrates its correctness and validity. Section six discusses the theoretical and empirical implications of the research. Section seven is the conclusion of this chapter.

8.2 Hypothesis

8.2.1 Overall Relationship between Locational Factors, Ambidexterity in OI and Innovation Performance

Previous chapters demonstrated and supported the propositions regarding locational factors' positive effect on ambidexterity in OI and ambidexterity in OI's positive effect on innovation performance. This chapter therefore integrates these three factors to test their overall relationship, based on the framework presented in Chapter 2 — that is, to indicate the mediation effect of ambidexterity in OI. It thus seeks to propose an alternative possible channel that might facilitate the relationship demonstrated by the traditional literature propositions (e.g., Lai et al., 2014; Wei et al., 2014). Building on demonstrating the effect of locational factors on ambidexterity in OI in Chapter 6 and the effect of ambidexterity in OI on innovation performance in Chapter 7, this chapter further examines the overall relationship and a mediating model to enrich the OI literature.

8.2.2 Mediating Effect of Ambidexterity in OI on the Relationship between Locational Factors and Innovation Performance

According to the demonstrations and discussions in previous chapters, locational factors have a significant effect on the balance of inbound and outbound OI and may indirectly affect innovation performance. Regarding the previous literature, even if some studies have inferred that innovation performance could be influenced by ambidexterity (the balance) in OI (e.g. Dahlander and Gann, 2010; Chesbrough and Brunswicker, 2013; Sikimic et al., 2016), and that the cluster could affect ambidexterity (the balance) in OI (e.g., Lee et al., 2010; Bocquet and Mothe, 2015; Sack, 2015), there remains a lack of studies focusing on the OI paradigm to reveal the potential function of the balance in OI. In particular, as the balance in OI which is promoted by locational factors to affect innovation performance, it is necessary to provide a further explanation for this indirect relationship to reveal the mediation role of the balance in OI. Therefore, the study examines the relevant hypotheses as a whole and argues that locational factors may affect innovation performance through the mediating effect of the balance of inbound and outbound OI, which builds an indirect path relating locational factors to innovation performance.

In the first part of the framework developed in Chapter 2, locational factors are seen to affect firms to achieve the balance in OI by appropriately applying knowledge acquisitions and diffusions. When firms locate in science parks, they may be affected by following reasons to conduct inbound and outbound OI into a balancing level. Firstly, knowledge acquisitions facilitate the interactions among related parties to share and learn common knowledge from others (Lazzeretti and Capone, 2016; Tallman et al., 2004). Clustering firms will likely have ample opportunities to sourcing and acquiring valuable external knowledge from them (Bell and Zaheer, 2007; Ozer and Zhang, 2015). Secondly, firms are also likely to identify themselves with a joint venture with other firms, engage in and develop shared products/ideas for knowledge diffusions. It enables them to enjoy a sense of openness, to externalise knowledge, products for commercialisation to get financial or innovation interests (Dahlander and Gann, 2010; Ozer and Zhang, 2015). In particular, previous studies provide a consensus that firms may achieve the balance dimension of ambidexterity in OI in a cluster by using the benefits into a balance level, and that those locational benefits may help the firm become more ambidextrous — a balanced level by providing the missing knowledge for any imbalanced conduction (Bocquet and Mothe, 2015; Sack, 2015). It can be seen that relying on the local benefits, a cluster provides an ideal environment for firms to be more effectively acquire and diffuse necessary knowledge for conducting inbound and outbound OI in relative balancing level. As a result, a synergy based on this balance in OI also could be derived to further enhance innovation performance (Dahlander and Gann, 2010).

The second part of the framework (Chapter 2) indicates the relationship between the balance of inbound and outbound OI and innovation performance. Previous discussion has implied that the innovation performance is affected by the balance in OI (Dahlander and Gann, 2010). The study indicates that by applying inbound and outbound OI in a balanced level, a synergy may be achieved, which enables firms to have a greater effect than the sum of to conduct OI activity solely on innovation performance. Firstly, there is an interrelated effect between inbound and outbound OI, and they can reinforce each other to leverage a greater outcome than those who exclusively conducted. Secondly, compared with a firm who less balanced to apply either inbound or outbound OI, the balance in OI also offsets the disadvantages and risks on innovation performance, performing a greater effect. Thus, a synergistic advantage leveraged by the balance in OI affects innovation performance, which may derive from the utilisation of locational benefits and then contribute to the balance in OI. The balance in OI in the middle builds a link between locational factors and innovation performance, thus plays a role as an intermediate variable to mediate the relationship between locational factors and innovation performance.

Moreover, the study obtained similar qualitative results through interviews with managers, which verified the mediation effect of ambidexterity (the balance) in OI. There were some commonalities in the views expressed by seven managers regarding the mediation effect. First, these managers expressed their acknowledgments of the function and influence of locational factors in achieving the balance of inbound and outbound OI based on the utilisation of benefits. One manager from a software firm stated: "*We think and agree that locating the science park is easier and convenient to access similar firms and resources in order to have cooperation or a common R&D project. It brings our strengths together. Licences or products can be acquired from or provided to other firms so that we can innovate or re-launch new products in this way. The cluster provides these benefits to enable us to be more likely to conduct a balanced engagement of inbound and outbound OI"*. Second, those managers agreed that the balance of inbound and outbound OI can significantly affect innovation performance, which is observable in their actual experience of conducting OI. A manager at an electronics firm explained that: "*A balanced engagement of inbound and outbound OI can apply and bring both internal and external knowledge together, so buying key licences from external firms or updating/improving our own existing products for further development relies on the balancing conduction of inbound and outbound OI. That is, through a relative balance adoption of inbound and outbound OI, we can achieve a better innovation outcome".* Taken together, when asked '*do you think ambidexterity (the balance) in OI can mediate the relationship between these two factors*?' a typical answer provided by managers was: '*Yes, because ambidexterity in OI is a middle factor that builds a bridge to connect locational factors and our innovation performance. We achieve the balance of inbound and outbound OI by relying on the locational benefits, while it also affects the way to make new products. So it builds an indirect path in the middle between the utilisation of locational factors and having better innovation performance afterwards*'. Therefore, based on managers' understanding of the balance in OI, the study achieves the consistency and predicts that ambidexterity in OI — the balance of inbound and outbound OI — can be a mediator for the relationship between locational factors and innovation performance.

Regarding ACAP's moderating effects in the two parts of the framework, ACAP moderates the relationship between locational factors and the balance in OI, which affects the strength of this relationship. By identifying and acquiring the knowledge gained from the locational factors, ACAP facilitates knowledge acquisitions and diffusions in the cluster, strengthens the extent of the relationship by utilising locational factors to achieve the balance in OI. In addition, ACAP moderates the relationship between the balance of inbound and outbound OI and innovation performance. By enhancing the mutual effect and combination of internal and external sources (see Zahra and George, 2002), ACAP can enhance the extent of the balance in OI and innovation performance as well. That is, for a given quantity of internal and external knowledge, the strength by which the firm applies inbound and outbound OI in a balance level to realise new generations — the innovation performance, relying on its level of ACAP. Thus, ACAP moderates these relationships through its ability to identify, assimilate, transform and apply valuable knowledge (Cohen and Levinthal, 1990; Zahra and George, 2002). Therefore, the study implies that when suggesting that the balance of inbound and outbound OI mediates the relationship between locational factors and innovation performance, ACAP may moderate this overall relationship.

In summary, concerning the arguments above and the hypotheses that have been proven, the study suggests that the balance of inbound and outbound OI mediates the relationship between locational factors and innovation performance, while ACAP may moderate this relationship. The arguments above thus lead to a moderated mediation effect for the entire relationship as hypothesised below:

H8.1: The balance of inbound and outbound OI mediates the relationship between locational factors and firms' innovation performance, while the overall relationship is moderated by ACAP.

8.3 Data and Methods

8.3.1 Introduction to Sample and Data Collection

The study regards China's innovation environment as the background for studying firms' OI. The participants are based at ZSP, where high-tech SMEs provided their R&D and OI conduction information for the data and research. 800 firms participated in the research, and the response rate was recorded as 37.75%. The specific research process and data collection are derived from the steps in a survey that is referred to in chapters 3 and 6. In this chapter, the research applies relevant data to demonstrate the mediation effect and the relationship of the framework.

8.3.2 Variables

8.3.2.1 Dependent Variable

Innovation performance is the dependent variable used in all regression models in this chapter. The measurement is the same method that has been indicated in chapter 7.

8.3.2.2 Independent Variable

Locational factor is used as the independent variable in examining the mediation effect of ambidexterity in OI in this chapter. Its measurement has been indicated in chapter 6.

8.3.2.3 Moderating Variable

R&D intensity is used as the moderating variable of ACAP in all models in this chapter. The measurement has been indicated in chapters 6 and 7.

8.3.2.4 Mediating Variable

Ambidexterity in OI, referring to the balance of inbound and outbound OI is the mediating variable used in this chapter, which measures the mechanism between locational factors and innovation performance. Its measurement is revealed in chapter 6.

8.3.2.5 Control Variables

The control variables applied in this chapter are the same variables tested in chapters 6 and 7. Four instruments (used in chapters 6 and 7) are added to observe the overall effect.

8.3.3 Analytical Approach

The approach used in the previous chapters was conducted through the GLM to test the relationships between locational factors and the balance in OI, whilst the balance in OI and innovation performance. In this chapter, the test of the mediation effect comprises causal step methods that contain three GLMs models, which follows the approach used by Baron and Kenny (1986), where the presence of a mediation effect is indicated if the following are true: (1) the independent variable significantly predicts the mediating variable; (2) the independent variable significantly predicts the dependent variable; and (3) the mediating variable significantly predicts the dependent variable while controlling for the effect of the independent variable. Therefore, this GLM tests the relationship between the locational factors and the balance in OI and then tests the relationship between the locational factors and innovation performance; finally, it tests the mediating effect of the balance in OI on innovation performance by controlling for the locational factors to demonstrate the mediation effect that exists between cluster and innovation performance. This is why other models, such as SEM, are not preferred because here, SEM may represent one model that integrates every variable together, which would make it near impossible to observe whether a mediation effect is present (Baron and Kenny, 1986) and is influenced by diverse control variables. That is, SEM may lack the function to examine whether different control variables have a significant effect on different dependent variables (e.g., the effect of diverse control variables on dependent variables in Chapters 6 and 7; see Hox and Bechger, 1998); and because instrumental variables are included in the different steps of the mediation model (e.g., strategic focus, founders' overseas experience, etc.) and because the estimation methods that are applied by the GLM for testing instrumental variables tend to be more efficient than SEM (instruments can be inserted and tested separately rather than in an integrated model; see Kline, 2010), the study thus applies the GLM for observing the mediation effect. The form of GLM – $y_i \sim N(x_i^T \beta, \sigma^2)$ – also has an advantage in obtaining an overall p-value for the variable as a whole when there are many multi-category variables (McCullagh and Nelder, 1982). Therefore, by using Baron and Kenny's (1986) approach via the GLM, the mediation effect can be properly analysed.

8.4 Results

The descriptive statistics and correlation matrix for this chapter are shown in Table 8.1, and Table 8.2 presents regression results. In order to identify whether there is a multicollinearity issue in regression models, a VIF test was conducted. The average and independent scores of all variables were below four, suggesting that the multicollinearity issue is not a major concern (see Pan and Jackson, 2008). In Table 8.2, Model 1 is the baseline model that includes all control variables; Model 2 includes all control variables and adds locational factors as the independent variable (in predicting the balance in OI); Model 3 regards locational factors as the independent variable (in predicting innovation performance); and Model 4 includes all control variables while using the balance in OI as the independent variable to predict innovation performance. Model 5 is the full model that includes all control variables and instruments, and regards the balance in OI as the independent variable (while controlling locational factors) in predicting innovation performance. To test mediation effect in all models, Baron and Kenny's (1986) approach is applied.

The results show that the coefficient for locational factors was statistically significant (β=0.181, p<.05) in predicting the balance in OI (Model 2); and the variable showed a positive and significant result (β=4.244, p<.05) in predicting innovation performance in the second step for testing the medication effect as well (Model 3). This shows that locational factors not only significantly predict the balance in OI (as the independent variable on mediation variable), but have a significant effect on innovation performance, which may present a partial meditation effect in the full model.

When the model regressed innovation performance on locational factors and the balance in OI for the meditation effect (Model 5), the coefficient for the interaction between the balance in OI and R&D intensity indicated a positive and significant result (β=0.055, p<.05). This reveals that combined with the moderating effect of ACAP (R&D intensity), the balance in OI's interaction on innovation performance is positive and significant, which as a moderated mediating factor affects the relationship between locational factors and innovation performance. The balance in OI integrates ACAP to mediate the relationship between two variables. Also, the balance in OI (the pure item) showed a negative result (β=-4.521, p<.05) on innovation performance. This indicates that instead of purely applying two types of OI activities, the balance between each OI activity is crucial. That is, under inappropriate OI conditions (even if it is ambidextrous), the imbalance would still have a negative effect on innovation performance, which reveals the importance of balance and indicates that one OI activity's domination or inclination is not advantageous and might negatively affect the innovation outcome. Moreover, the locational factors also have a significant effect on the innovation performance (β=4.717, p<.05), as shown by the direct association between the two variables. This association of a partial mediation effect indicates that locational factors are linked to innovation performance, and here, the firms could utilise some locational benefits to achieve the innovation performance directly. The partial mediation results show that one reason why the given locational benefits (e.g., 'the firm can obtain and apply resources from external parties for innovation' or 'the firm can obtain technical/resources interaction from the employees' flow') are expected to lead to supporting firms in achieving innovation performance is because the resources or technologies that can produce the innovation outcome are 'ready-made' or already have the value to contribute to the R&D.

In sum, according to the results based on mediation effect testing, all models supported the hypothesis; there is a mediating effect for the relationship between locational factors and innovation performance, and the balance in OI (the interaction) is a mediator that mediates a positive relationship between locational factors and innovation performance in OI. The significance predictions between locational factors and the balance in OI, the balance in OI and innovation performance are verified, and the hypothesis is accepted.

8.5 Robustness Check

To check the robustness of the data, an alternative test was conducted regarding the hypothesis by using different independent variables. A ratio variable of the balance in OI was applied, while the interaction item was the multiplication of ACAP and the ratio variable. Therefore, a new GLM regression was conducted, which showed that the balance in OI has a negative and significant result on innovation performance ($\beta=-2.365$, $p<.05$); the interaction item was positive and significant ($\beta=0.029$, $p<.01$). This indicates that the alternative measurement and item used (the balance in OI and interaction) to test the mediation effect in the model were still significant and revealed similar results to the original method. That is, the data and model applied in examining the hypothesis and framework maintain robustness and coherence, and that different methods used for model testing are consistent.

To control for the potential endogeneity bias, instrumental variables were used to test the relationships among the balance in OI, locational factors and innovation performance. The instruments were applied for both the balance in OI and locational factors, and this was tested in the full model. There were four instruments: 'founder's overseas experience', 'exporting percentage of turnover', 'accelerating time to complete R&D', and 'reducing R&D costs for projects'. All four instruments were verified and tested through regression analysis to confirm their suitability for the whole model. Following this consideration, the Durbin-Hausman test was applied to examine whether there was an endogeneity issue, and the Sargan test was applied to check the validity of these instruments (whether the instruments are valid).

Two regression tests were conducted to determine whether they (independent, instruments, and dependent variables) were consistent with or without instruments, and the estimated results of the probability value are testing whether they are consistent with each other. The score of the Durbin-Hausman test shows that the model was not affected by the instruments for the relationship between the independent and dependent variables, while the result of the Sargan test indicates that these instruments are valid (1.07, $p=0.30$) for demonstrating that there was no significant endogeneity between locational factors and ambidexterity in OI in the model.

Thus, the instruments were verified to demonstrate that there was no significant endogeneity for regressions.

8.6 Discussion

The study, which is based on an understanding of the balance in OI as a mediator, indicating its influence on the relationship between locational factors and innovation performance, building an overall model to test the theoretical linkage of three factors as a whole. The research extends ambidexterity (the balance view) in OI by conceptualising and broadening its theoretical understanding as a mediator in the condition for the three factors, clarified its indirect influence in this process.

The findings extend the knowledge on ambidexterity in OI beyond the previous literature (Cao et al., 2009; Raisch et al., 2009), indicating that excepting the direct influence of ambidexterity in OI on innovation performance, the balance of inbound and outbound OI could also serve as a mediator for the relationship between locational factors and innovation performance. That is, to consider the role of environmental factors in the relationship between the balance of inbound and outbound OI and innovation performance is important for firms to achieve ideal innovation performance and optimise OI activity engagement derived from locational benefits. Also, the presence of a partial mediation effect shows that in a cluster, some locational benefits may also give the cluster a significant influence when it comes to innovation performance, and these benefits can lead to an innovation outcome because of the positive characteristics they have on innovation (Lai et al., 2014). For instance, a factor such as 'the firm can obtain technical/resources interaction from employees' flow' may contain the knowledge flows from in-house R&D and communication with outsiders, which the 'ready-made' technologies or products from inside the firm can directly contribute to in the form of innovation performance and which may not be entirely applied or combined to the balance in OI. One possible explanation is that apart from the significant influence on the balance in OI, some benefits (e.g., the licenses, products as sourced, financial interests directly achieved from the cluster, etc.; see Roper et al., 2017) can act on innovation performance straight, so these factors may not need to be fully transferred or engaged into the balance in OI, but having effects to lead the innovation outcome. Specifically, when some resources in a cluster are easy to absorb or ready-to-use (e.g., a R&D outcome shared by the parent company of a SME, large-scale procurement of new products, etc.), firms may vertically integrate those benefits inside the firm to lower costs, obtain profits, and share resources (Lai et al., 2014; Lazzeretti and Capone, 2016). Such actions enhance knowledge creation and flow, and from a financial-related aspect, they influence the innovation performance. Based on this, the partial mediation effect is further revealed in the role of locational factors, showing that the balance in OI may play a significant, partial mediating role in affecting the association between locational benefits and innovation performance. The study therefore indicates that the balance in OI has a mediation effect on the relationship between locational factors and innovation performance on the one hand, but locational factors can contribute to the innovation outcome on the other hand.

In addition, by considering the role of ACAP, the findings indicate that the interaction between the balance in OI and ACAP has an indirect effect on innovation performance when controlling for locational factors — that is, a mediation effect of the balance of inbound and outbound OI on the relationship between locational benefits and innovation performance is also moderated by ACAP. While such an integrated perspective is lacked in the existing OI literature, this has not been the case in empirical studies, which have typically focused on either one aspect of locational factors on ambidexterity in OI (e.g., Bocquet and Mothe, 2015; Sack, 2015) or ambidexterity in OI on innovation performance (e.g., Cassiman and Valentini, 2016; Sikimic et al., 2016). Meanwhile, the findings also further imply that ACAP not only has the moderation effects for the relationships between locational factors and the balance in OI and innovation performance, but also moderates the overall relationship for those three factors when examining the mediation effect of the balance in OI. Thus, the findings further explain and recognise the role of ACAP in terms of the moderating effect indicated by Rothaermel and Alexandre (2009).

The study contributes to the growing body of research in OI literature, which conceptualises the balance in OI as a mediator that mediates the relationship between locational factors and innovation performance. As prior literature partially examines the direct effect of ambidexterity in OI on innovation performance (e.g., Hung and Chou, 2013; Cassiman and Valentini, 2015; Sikimic et al., 2016) or the influence resulting from locational factors (e.g., Jansen et al., 2005; Ferrary, 2011), it still lacks an explanation on observing the influence for firms locating in the science park by applying ambidexterity in OI (the balance in OI) to achieve innovation performance. Due to previous studies are more likely to examine the direct relationships among locational factors, ambidexterity in OI and innovation performance, the lack of interpretations of whether, what potential influence may bring by ambidexterity in OI — as a middle factor in this relationship still needs to be demonstrated. As a theoretical reason, an observation to explain which factor may affect the process through locational factors to innovation performance still lacked. In the context of OI, combining with the view of cluster to understand locational factors' effect to affect innovation performance through the balance in OI needs to clarify, which is to know what contingencies of a variable that may strengthen or weaken this mediating effect. That is, regarding this specific condition, literature should provide a clearer picture to conceptualise and interpret the role of ambidexterity (the balance) in OI. As a practical reason, by showing this mediation effect, it is supportive for managers to maintain a proper balance of inbound and outbound OI (as a middle factor) from utilising locational benefits to achieve ideal innovation performance. It thus points to the importance for examining the mediation effect in practice, for firms that have located in a cluster environment to conduct OI. New empirical evidence can guide firms to have a better relationship in this context. By considering the role of the balance in OI as a mediator, a potential channel from locational factors to innovation performance is built through the balance in OI, while ACAP has a moderating effect in this overall relationship, which reveals a moderated mediation effect (with the balance in OI) on innovation performance. The findings show that a moderated mediation effect of the balance of inbound and outbound OI (with ACAP) not only produces a (direct) effect on innovation performance, but could also, when firms apply OI activity under the engagement of locational benefits, mediate this relationship. The study thus contributes to OI literature by conceptualising the balance in OI as a mediator in the process for the relationship between locational factors and innovation performance.

Empirically, as the majority of the previous OI research has focused on large or multinational firms in developed economies (Christensen et al., 2005; Chesbrough and Crowther, 2006; Laursen and Salter, 2006; Lichtenthaler, 2008; van de Vrande et al., 2009), it is important to investigate OI engagement linked to SMEs, particularly in developing economies (such as China), thus addressing the gaps in the literature. Therefore, by using data on China's high-tech SMEs to examine the actual innovation condition (from practical view), the study provides new empirical evidence that differs from the findings in relation to Western firms. The study therefore focuses on observing these effects in a transition economy, adding new data to OI research regarding this mediation effect.

8.7 Conclusion

The investigation in this chapter indicates an overall relationship between locational factors, the balance in OI, and innovation performance (with ACAP's moderating role), which indicates a mediation effect for the balance in OI. The findings indicate that the balance in OI not only directly affects innovation performance, but also acts as a mediator between locational factors and innovation performance. This suggests that, when firms are locating in the cluster, the balance in OI may indirectly lead to innovation performance by reflecting the benefits from locational factors. The hypotheses and framework are thus supported and verified, and new empirical evidence is added to the OI literature. The study therefore contributes to the OI literature by proposing a new framework and advancing a theoretical understanding of the mediating role of ambidexterity (the balance) in OI in the relationship between locational factors and innovation performance.

Chapter 9 Conclusions and Recommendations

9.1 Introduction

This chapter concludes and summarises the main findings and contributions from the theoretical framework and data analysis. It aims to interpret the reasons and linkages for theories, as well as the relationships derived from the model. Therefore, by providing an overview of the entire study and its implication on business operations, the study associates theoretical with practical aspects, and makes contributions to both literature and practice.

9.2 Overview of the Study

A key objective of the study is to examine OI adoption by connecting the theoretical model with practical operations, thus providing contributions to theory and practice. Concerning the OI paradigm and integrating with locational factors and ACAP, the study constructs a new theoretical framework to examine these factors' relationships and their effects on innovation performance. A quantitative method is applied to investigate OI conduction in Beijing's high-tech firms, thus regarding locational factors as the environmental background. By analysing the hypotheses and framework, a key finding of the study relates to the mediation effect provided by ambidexterity in OI, which affects the relationship between locational factors and innovation performance. The study thus addresses gaps in the existing literature and makes new implications by extending the present understanding of OI, locational factors, and their effects on innovation performance. Managerial implications are provided to support managers in their future OI implementation to achieve ideal R&D and innovation performance. Future recommendations and limitations are given as well that broaden the view of the study and reveal potential flaws that can be addressed in future research.

9.2.1 Main Findings

Regarding the demonstration of the framework and hypotheses, the study has identified the following significant findings through analysis and examination.

First, concerning locational factors on ambidexterity (the balance) in OI, and ACAP's moderating effect, the results indicate that, by engaging locational factors in a cluster, the balance in OI is positively affected by locational factors. It implies that locational factors lead firms to balance inbound and outbound OI, and can create a synergy by balancing inbound and outbound OI in a proper level. Meanwhile, the interaction between locational factors and ACAP showed a significant effect on the balance in OI, in that ACAP as the moderator influences the relationship in a positive way, with higher levels of ACAP leading to stronger relationships. The findings thus indicate that locational factors are significantly influencing the balance in OI, while ACAP strengthens the relationship in such a way that a stronger effect between cluster and the balance in OI is enhanced when higher ACAP is engaged in this relationship.

Second, regarding inbound and outbound OI activities, the balance in OI on innovation performance, and ACAP's moderating effect, the results indicate that outbound OI activities have a positive significant effect on innovation performance, whereas inbound OI activities are less significantly on innovation performance. The balance in OI (the item) was led to a negative impact on innovation performance due to imbalance conduction of one kind of activity (inbound in this study). The interaction between ACAP and the balance in OI showed a significant effect on innovation performance, in that ACAP as the moderator influences their relationship in a positive way, with a higher level of ACAP leading to a stronger relationship. The findings thus indicate that inbound OI activities may insignificantly affect innovation performance, but outbound OI activities can significantly influence innovation performance; while a proper combination of inbound and outbound OI can form a balance in OI thus affect innovation performance positively. ACAP strengthens the relationship in such a way that a stronger effect of balance in OI and innovation performance is enhanced when higher ACAP is engaged.

Third, regarding the mediation effect of the balance in OI, the results firstly indicate that the balance in OI has a mediating influence on the relationship between locational factors and innovation performance, and a moderated mediation effect of the balance in OI and ACAP is also demonstrated. That is, the balance in OI can mediate the relationship between locational factors and innovation performance by building an indirect path through these two factors, a synergy may be regarded as an element of the balance in OI to drive this effect. This result highlights the significance of maintaining an optimal level of the balance in OI, Secondly, the findings indicate that the interaction between ACAP and the balance in OI reveals a positive significant effect on innovation performance, which is a moderated mediation factor to affect the relationship. It thus advances a theoretical perspective in the OI literature, suggesting that the observed indirect relationship between the two factors may depend on the balance in OI (also with ACAP), which means that their relationship can be affected by the moderated mediation item of the balance in OI and ACAP. It therefore integrates the key findings in explaining the relationship among locational factors, the balance in OI, and innovation performance.

9.2.2 Main Contributions

Through its main findings, this study makes three key contributions to the literature. First, the study contributes to the literature of OI by bringing a greater conceptual clarity to the view of balance. The study shows that a proper conduction between inbound and outbound OI could be a contingent value in affecting innovation performance; while a more balanced portfolio may bring better innovation performance than those less balanced. It builds a part of new framework to conceptualise the balance in OI as an important factor that enables firms to generate ideal innovation performance (see Cao et al., 2009; Dahlander and Gann, 2010). The study thus contributes to the literature by enriching the knowledge of the balance in OI. Meanwhile, building on the organisational learning perspective, the study contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between OI balance and innovation performance. This study suggests that ACAP plays a positive moderating role in this relationship, when there is a higher level of ACAP, there is a stronger relationship between the two factors.

Second, from a firm-level view to study OI and linking to cluster perspective, the study contributes to the literature on OI by advancing the knowledge of locational benefits' influence on the balance in OI. The study shows that firms that pursue a balance of inbound and outbound OI relying on the utilisation of locational benefits. By integrating the environmental factors acting on the balance (ambidexterity) in OI, the study extends OI literature relating to cluster (e.g., Bocquet and Mothe, 2015; Sack, 2015). Meanwhile, this study also contributes to the OI literature by highlighting the contingent value of ACAP on the relationship between locational factors and the balance in OI. This study shows that ACAP as a moderator has its moderating effect for the relationship between locational factors and the balance in OI, when there is a higher level of ACAP, there is a stronger relationship between the two factors.

Third, the study advances the knowledge on the balance in OI for the relationship between locational factors and innovation performance, whereby the balance in OI is conceptualised as a mediator that mediates the relationship between the utilisation of locational benefits and innovation performance; while a moderated mediation effect of the balance in OI with ACAP has also been explored in the relationship, which extends existing OI literature. This new theoretical knowledge broadens the understanding of ambidexterity in OI beyond that displayed in prior studies (e.g., Chen et al., 2011; Li and Huang, 2012), affirming that the balance in OI not only produces a (direct) effect on innovation performance, but that, when firms apply balancing conduction in OI under the influence of locational benefits, the balance in OI could mediate this relationship. Therefore, by enriching this understanding in OI, this study building upon the existing literature shows that locational factors have an indirect effect on innovation performance through the mediation influence of the balance in OI.

Overall, this study extends and enhances existing OI research by constructing a new relationship: it demonstrates a mediation effect of ambidexterity in OI on the relationship between locational factors and innovation performance, offering new evidence to OI literature. The firm-level research provides a unique perspective by using non-Western firms from a transition economy (China), which adds new empirical evidence.

9.3 Managerial Implications

The study has identified three significant managerial implications from the research on OI, which can be used to support actual operations.

First, in practice, ambidexterity in OI can be a source of competitive advantage in achieving high innovation performance. In OI conduction, it is necessary for firms to take into consideration the appropriate combination of inbound and outbound OI in order to achieve better performance. Specifically, managers should be according to own R&D capacity and innovation demand to apply inbound and outbound OI to form a proper balance in OI. That is, as inbound OI practices may not always produce direct or positive effects on innovation performance, outbound OI should, from another aspect, be concerned with transferring internal knowledge for ‘inside-out’ practice. A significant implication of the findings of this study, as regards managers following OI practice, is that this ‘inside-out’ process can be used to create new possibilities to utilise a firm’s total resources.

Meanwhile, the study also provides some representative inbound and outbound OI practices for assessing firms’ OI and the balance of OI activity (Chesbrough and Brunswicker, 2013). It suggests that besides the OI practices applied in this study, other ‘firm-specific’ OI practices can also be applied to enhance firms’ knowledge sourcing, which may also have a positive impact on innovation performance. This OI activity's balance will encourage managers to create and maintain an 'opening' strategy that not only enables firms to effectively engage in potential activities simultaneously, but also provides and reveals additional sources for facilitating them to apply more valuable resources to develop new products (see Cai et al., 2014). Hence, the balance in OI is essential to a firm's ability to maintain proper conduction in practice, further supports firms in meeting business objectives, and leading to a well-managed OI strategy.

Second, locational factors are necessary for firms to enhance OI conduction, and can also produce positive effects on ambidexterity in OI. It can be seen that clusters provide additional opportunities for firms to engage in OI practices in this environment, whereas firms located individually lack such advantages, being unable to interact and form relationships with other parties in as effective a manner (Porter, 1990). When it comes to the function of ACAP, taking an appropriate ACAP to pursue ambidexterity in OI is significant to internal and external technology sourcing, which serves to reinforce higher levels of ACAP in the cluster. As ACAP can moderate the relationship between locational factors and ambidexterity in OI, it is evident that the positive stronger relationship (to ambidexterity in OI) can be obtained when firms properly engage ACAP in a cluster. Therefore, managers should apply, absorb positive locational factors to promote a better adoption of ambidexterity in OI, while selectively linking their knowledge with that of other firms to access more resources in the cluster so as to achieve knowledge search depth and width, leading to improved innovation performance. Overall, when firms are located in a cluster, managers should regard ambidexterity in OI, ACAP, and locational factors as an entity, while a suitable combination of ambidexterity in OI can bring improved innovation performance.

Third, the mediation effect of the balance in OI suggests that managers, firms need to find a 'self-appropriate' balance in the context of OI, as it not only has a direct effect on innovation performance, but mediates the relationship between flowing from locational benefits to innovation performance. It is critical for managers to develop this mechanism between innovation performance and locational factors in order to encourage and maintain a fitted balance strategy. For the moderated mediation effect of the interaction (with ACAP), it indicates that integrating the interaction between the balance in OI and ACAP is essential to manage specific OI conduction on an ACAP basis. The study suggests that preparing the ability to utilise the mediation effect related to both the balance in OI and ACAP (e.g., internal and external R&D expenditure, and continuous innovation investment) may support firms via this mechanism to properly pursue innovation performance.

9.4 Limitations and Recommendations of the Study

In this study, there are four limitations that may be noted for further OI study. It also provides some recommendations for future research.

First, in the design of the field work and the examination of variables, the measurements used to construct locational factors (ten items) may have captured only limited dimensions of the cluster (Lai, et al., 2014); in practice, firms may have various engagements based on specific environmental conditions. Also, the measurements used to construct OI activities and the formula of ambidexterity in OI may have only captured some dimensions of the inbound and outbound OI practices (Cassiman, et al., 2015).

Regarding this, in the first place, future research should examine the usefulness of additional measures, and may use a more comprehensive list of sources to conceptualise cluster factors — that is, to test whether firms purposively interact with external sources by applying OI in this context; other connectedness may also be tested in order to further demonstrate cluster effects. Secondly, future research needs to examine the usefulness of proposed additional measures, and use a more refined list of sources to conceptualise OI activities. This method can facilitate testing on whether SMEs purposively interact with external sources for innovation by applying new activities in the OI context, while a range of additional sources and behaviours may also affect the balance of ambidexterity in OI, which is based on the level of engagement in inbound and outbound activities (Laursen and Salter, 2006).

Second, when measuring ambidexterity in OI, the combination between inbound and outbound OI may vary according to market and technological dynamism, particularly in other areas (other science parks) in China. Due to sample limitations, the study was only able to obtain and analyse data for a particular area, rather than covering larger regions that contain aggregated industries and technology classes from other iconic science parks. Also, according to the results, the majority of valid respondents were *Manufacturing* and *Electronic* firms (29.8% and 24.5% respectively) that traditional industries still composed the main body of the data. Linking this to sample investigation and model analysis, it might be only from one respect indicated the innovation performance of high-tech industries, the sample distribution was slightly concentrated. Therefore, in order to reflect the connectedness between OI and high-tech industries (e.g., telecommunications, biological engineering, pharmaceuticals), samples should be balanced and more equally distributed.

In order to reduce the influence of these factors, when examining the correctness and representativeness of the mediation effect, future research should utilise a larger sample to provide more refined data on the market and environmental factors, in order to enable more accurate examination of the combination of inbound and outbound OI. A larger sample size and the participation of various industries should increase the representativeness of future studies, improving their ability to examine relevant relationships and hypotheses, and consequently enabling them to achieve more accurate results and to further enrich the literature. In addition, ACAP could also be examined by combining additional factors into a comprehensive simulation, that is to further examine its potential interaction.

Third, in this research, the sample and data collection was focused on high-tech SMEs in Beijing, meaning that the study may be limited to some specific parameters in other science parks in China. As SMEs can have their own business features and operation characteristics (Parida et al., 2012), the results and implications may reduce applicability to large firms or other clusters. As such, there is an issue regarding the applicability of the study to large firms or MNCs; if a more diverse sample of firms is taken, the findings on OI and other results may differ significantly.

In this respect, it suggests that, if future studies focus on large firms or MNCs in OI, they should adapt the method appropriately — that is, by guaranteeing the validity of the sample and avoiding scale differences that may affect the accuracy of results. While more clusters may also integrate for investigating, minimising one-sidedness in Beijing if the sample is not well-fitted for the research. The measurements and items construction may also vary according to the requirements of the research, based on the scale of businesses and the clustering environment, in order to ensure the robustness and validity of future studies.

Fourth, this study mainly focuses on geographical proximity as a key aspect of the science park, investigating the relationship between locational factors and the balance in OI; with this consideration, institutional factors (within the cluster) may also able to analyse the pursuit of the balance in OI because institutional factors can bring firms together through the sharing similar values and norms at the macro-level (Boschma, 2005; North, 1990). The institutional values and norms could be informal cultures and habits that foster trust and facilitate interactions (e.g., a common language) or formal laws and rules (e.g., a legal system that secures intellectual property rights) that reduce uncertainty and risks during innovation and OI adoption (Edquist and Johnson, 1997; Hong and Su, 2013). From this, examining the effect of institutional factors in the science park can be another aspect to consider when investigating how firms utilise locational factors to achieve the balance in OI, which is less concerned in this study.

Therefore, to broaden the understanding of the relationship between locational factors and the balance in OI, future research can include and use institutional factors to examine their influence on the balance in OI, because institutional factors can measure whether two firms are exposed to the same institutional context (Balland et al., 2013; Boschma, 2005), which the sharing of formal or informal rules and codes increases the likelihood of firms being able to start a partnership relating to OI activities and ambidexterity in OI (Lazzeretti and Capone, 2016). Thus, the observation on locational factors and the pursuit of the balance in OI in a cluster can be enriched by adopting the view of institutional factors.

Fifth, due to time limitations, this study could not investigate the impact of OI on long-term performance (e.g., through a five-year longitudinal study), which could be necessary if future researchers wish to examine OI in the context of science parks, that is to increase and guarantee the validity of the study.

Therefore, to address this issue, future research may assemble longitudinal data over a sufficiently long period by applying both quantitative and qualitative approaches to collect more data to support and demonstrate the correctness of the model. This approach should be better and more convincing than a specific cross-sectional study for enriching the literature.

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Appendices

Appendix 1 Survey Questionnaire

Section A - General Business Information

1. Name__________ Address___________________

Contact number__________ Position in the firm__________

2. Please indicate when this firm has been established_______

3. Please indicate whether your firm is mainly established by a university (university spin-offs)? ☐ Yes ☐ No

4. Please indicate whether your firm is state-owned firm or a part of this business group? ☐ Yes ☐ No

5. Please indicate in which geographic markets did your firm sell products?

☐ National ☐ Asia ☐ Europe ☐ North Americas Others_______

6. Please indicate the number of fulltime employees in your firm_______

6.1 How many fulltime employees have bachelor degrees in science and engineering subjects? _______

6.2 Please indicate the number of employees with postgraduate degrees or PhD degrees within the research team_______

7. Please indicate the number of patents of the firm_______

8. Please indicate the number of licenses bought from other parties during the last three years (in-licensing activities) _______

8.1 Please indicate the number of licenses sold to other parties during the last three years (out-licensing activities) _______

9. Whether the founder (e.g., CEO) has the oversea study experiences, if so, the degree is? ☐ Yes ☐ No ☐ Bachelor ☐ Master ☐ PhD

10. Please indicate whether your frim have had the specific government support, such as grant, tax reductions, and policy support during the last three years?

☐ Yes ☐ No

11. Please indicate whether the firm will continuously engage the R&D activities for innovation? ☐ Yes ☐ No

12. Please approximately estimate the fixed assets of firm_____________RMB

13. Please indicate the approximate percentage of turnover growth (average number) during the last three years_______

14. Please indicate the approximate percentage of sales from exporting__________

15. Please indicate the approximate amount spent on intramural (in-house) research and development activities of total turnover during the last three years_______

15.1 Please indicate the approximate amount spent on acquisition of external knowledge or R&D activities of total turnover during the last three years________

16. Please indicate whether your firm has received the following sources of funding (tick all that apply)?

Personal savings ☐

Money from families and friends ☐

Venture capital ☐

Government funding ☐

Foreign investment ☐

Money from other firms or institutions ☐

Bank loans ☐

Others_______

17. Please indicate the strategic focus of your firm for operating business (tick all that apply)?

Research and Development, Innovation ☐

Product Manufacturing and Processing ☐

Distribution ☐

Marketing and Sales ☐

18. Please indicate the motivation of your firm to engage in open innovation practices (tick all that apply)?

Establishing new partnerships ☐

Exploring new technological trends ☐

Identifying potential business opportunities ☐

Accelerating time to complete R&D ☐

Mitigating risks of innovation projects ☐

Reducing R&D costs for projects ☐

Other objective_______ ☐

19. Please indicate which sector/industry is your main business area?

☐ Manufacturing/Processing ☐ Electronic Engineering

☐ Telecommunications ☐ Network Engineering

☐ Software Engineering ☐ Bioengineering

☐ Pharmaceutical Engineering Others_______

Section B - Open Innovation Practices

In this section, please give the specific data of how you consider and apply the open innovation practices in actual operations.

1. Please approximately estimate the percentage of your firm for conducting both the activities (of the entire innovation activities): exploring and integrating external knowledge for technology development/exploitation, and exploiting technology capabilities by utilizing not only internal but also external paths of commercialization during the last three years.

☐ Yes _______% ☐ No

2. Please indicate whether your firm has conducted the practice of exploring and integrating external knowledge for technology development and exploitation during the last three years:

☐ Yes _______% ☐ No

Also please indicate whether or not you have carried out the following activities, if yes, please give an approximate estimation of the percentage of the following activities in your overall activities during the last three years.

a. conducting external R&D contracting for innovation activities_______%

b. buying rights to use inventions of others (in-licensing activities) for innovation activities_______%

c. engaging in external R&D consulting for innovation activities_______%

3. Please indicate whether your firm has conducted the practice of exploiting technology capabilities by utilizing not only internal but also external paths of commercialization during the last three years:

☐ Yes _______% ☐ No

Also please indicate whether or not you have carried out the following activities, if yes, please give an approximate estimation of the percentage of the following practices in your overall activities during the last three years.

a. providing R&D contracting to partners or others for innovation activities______%

b. selling rights to use internal inventions (out-licensing activities) for innovation activities_______%

c. conducting R&D consulting for others (e.g., partners, universities) for innovation activities_______%

4. Please indicate the degree of challenges, barriers that you considered for applying open innovation practices and their importance (1 = very important, 5 = not very important).

Challenges, Barriers For Conducting Open Innovation Activities	**Agreement Scale**				
	1	**2**	**3**	**4**	**5**
Managing the organizational change correctly from internal side					
Management of external relationship effectively with innovation sources					
Protecting internal critical know-how and technology					
Identifying new innovation sources					
Effectiveness of intellectual property protection					
Avoidance of external or already existing knowledge					

Section C - Locational (Cluster) Effect on Innovation Activities

In this section, please indicate the degree of agreement or disagreement (1= strongly agree, 5= strongly disagree) on locational factors effect (Science Park):

Contents	**Agreement Scale**				
	1	**2**	**3**	**4**	**5**
The firm can access high-educated, experienced people for product/processing innovation.					
The firm can obtain and apply resources from external parties for innovation.					
The firm can obtain technical/resources interaction from employees' flow.					
The firm have cooperation with upstream and downstream parties to lower costs.					
The firm can easily connect with suppliers and be devoted to innovative techniques.					
The firm can easily enhance information exchange and sharing within the cluster.					
The firm can easily develop strategic alliances within the cluster.					
The network relations can support the firm to easily meet market dynamics.					
The firm can easily obtain government grants, tax reductions, and policy support within the cluster.					
The firm can easily obtain venture capital, angel investment and private investment within the cluster.					

Section D - Innovation Performance

In this section, please give the specific data of how you consider the innovation performance based on open innovation practices in actual operations.

1. Please estimate how your total turnover in last three years was distributed between the categories below:

1.1 The average percentage of products introduced were new to the market_______

1.2 The average percentage of products introduced were new to your firm but not new to the market_______

1.3 The average percentage of products introduced were significantly improved_______

2. Please estimate how your product performance in the last three years was distributed between the categories below:

2.1 The average percentage of new product turnover growth_______

2.2 The average percentage of turnover growth from improving existing products/process_______

2.3 The average percentage of turnover growth from significantly improved processes for producing products_______

3. Please estimate the average number of new products in the market launching by your firm during the last three years_______

3.1 Please estimate the number of new products under development of your firm in this year_______

Section E - Alliance Activities

In this section, please provide the specific information about the partners your firm have cooperated, and the effects on innovation.

1. Please indicate the number of partners cooperated for R&D activities_______

The longest cooperation time with partners (based on years) _______

The shortest cooperation time with partners (based on years) _______

Average R&D cooperation time with partners (years) _______

1.1 Please indicate the type of partners you have for supporting R&D activities (tick all that apply).

Other firms within the firm group ☐

Universities ☐

Consultants ☐

Competitors ☐

Suppliers ☐

Government research institutions ☐

Commercial laboratories or R&D firms ☐

Others_______

1.2 Please indicate how you consider the quality of partners for supporting R&D activities (1= extraordinary good, 5= extraordinary poor).

Partners in cooperation	**Agreement Scale**				
	1	**2**	**3**	**4**	**5**
Other firms within the firm group					
Universities					
Consultants					
Competitors					
Suppliers					
Government research institutions					
Commercial laboratories or R&D firms					
Others					

2. Please indicate the number of partners cooperated for market based activities_______

The longest cooperation time with partners (based on years) _______

The shortest cooperation time with partners (based on years) _______

Average market based cooperation time with partners (years) _______

2.1 Please indicate the type of partners you have for supporting market based activities (tick all that apply).

Other firms within the firm group ☐

Large established firms ☐

Competitors ☐

Distributors ☐

Market Consultants ☐

State owned enterprises ☐

Others_______

2.2 Please indicate how you consider the quality of partners for supporting market based activities (1= extraordinary good, 5= extraordinary poor).

Partners in cooperation	**Agreement Scale**				
	1	**2**	**3**	**4**	**5**
Other firms within the firm group					
Large established firms					
Competitors					
Distributors					
Market Consultants					
State owned enterprises					
Others					

This is the end of questionnaire, thank you for your cooperation

Appendix 1.1 Interview Questions

Interview Questions of Open Innovation Practices and Implementation

Section I:

1. Whether the company currently has conducted open innovation practices or not?
2. What specific open innovation practices the company has applied?
3. The company expects to obtain and create what kind of value from open innovation practices?
4. What are the main obstacles to this company for conducting open innovation?
5. What are the main drivers of the company to applying open innovation?

Section II:

1. Does the company use to absorb or buy an external intellectual property or technology? If so, whether such activities are regularity?
2. How does the assimilation of external technology will help the company? Any significant impact on innovation and R&D?
3. The purchase of external technologies can support or solve what kind of problems to firm's technological innovation:

a. Improvement and enhancement on products

b. Breakthrough, new product launches and research

c. Improve core expertise

d. Technical improvements to upgrade non-core technology

4. To provide, sell internal technology of the firm can support or solve what kind of problems to firm's technological innovation:

a. Obtaining a new innovative idea or opportunity by an external platform to reveal interior technology

b. Sell internal technology to get new innovations or redevelopment opportunities through external indications

5. The firm generally cooperate with what kind of external partners to find innovative ideas and develop new technologies, e.g., : Universities, Suppliers, Competitors, and R&D firm

Appendix 2 Survey Questionnaire (Chinese)

第一部分：一般公司信息

1. 姓名：__________　　　　地址：__________

联系方式：__________　　　　公司职位：__________

2. 请指出本公司建立时间（至今年数）：__________

3. 请指出本公司是否由大学建立或为其所属企业：☐是　☐否

4. 请指出本公司是否为国有企业或其下属企业：☐是　☐否__________

5. 请指出本公司主要的产品市场为（多选）：

☐本国　☐亚洲　☐欧洲　☐北美洲　其他__________

6. 请指出本公司全职员工人数：__________

6.1 请指出员工中具有理工科大学专业背景的人数为：__________

6.2 请指出研发团队中持有硕士、博士学位的人数为：__________

7. 请指出本公司所持有的技术专利和知识产权数量：__________

8. 请指出近三年内本公司买进外部技术专利或知识产权数量：__________

8.1 请指出近三年内本公司卖出技术专利或知识产权数量：__________

9. 请指出本公司建立者是否具有海外留学或取得学位经历，如果是，则学位为：☐是　☐否　☐学士　☐硕士　☐博士

10. 请指出本公司在最近三年内是否获得过政府支持（如投资、减税、资金给予）：☐是　☐否

11. 请指出本公司是否会在当前基础上继续进行研发创新投资：☐是　☐否

12. 请大约估计本公司的固定资产为__________RMB

13. 请大约估计本公司近三年营业收入的平均增长比例为：__________%

14. 请大约估计本公司出口产品销售额所占总销售额的比例为：__________%

15. 请大约估计本公司近三年进行内部研发创新所花费的资金占营业收入的比例（平均值）为：__________%

15.1 请大约估计本公司近三年进行获取外部知识、资源所花费的资金占营业收入的比例（平均值）为：__________%

16. 请指出本公司是否获得过以下资金作为自身资本来源（选取所有适合的）

个人资金 ☐

家族或朋友资金 ☐

风险投资 ☐

政府投资 ☐

外商投资 ☐

其他公司或机构投资 ☐

银行贷款 ☐

17. 请指出以下符合公司战略目标和商业经营目的的选项 （选取所有适合的）

产品科技研发与创新 ☐

常规产品生产与制造 ☐

产品运输 ☐

市场营销与销售 ☐

18. 请指出本公司采取开放式创新模式的动机及目的（选取所有适合的）

建立新的合作伙伴 ☐

发现新技术趋势 ☐

发现潜在商业与创新机会 ☐

加速、缩短产品研发时间 ☐

降低研发项目潜在风险 ☐

降低研发项目成本 ☐

19. 请指出本公司所属高科技行业类别

☐ 制造加工业　　☐ 电子工程业
☐ 电信工程业　　☐ 网络工程业
☐ 软件工程业　　☐ 生物工程业
☐ 制药工程业　　其他__________

第二部分：开放式创新实践

本部分中，请指出本公司如何应用开放式创新行为进行实际研发创新。

1. 请指出近三年内本公司采用或买进外部知识或资源投入到自身内部研发创新，以及提供或转移内部知识资源或研究成果到外部环境寻求商业化创新的行为占公司全部创新行为的比例

（注：此创新行为包含正在或已经完成的新产品创新，新研发项目实施，新创新资源使用。且公司全部创新行为比例为 100%）

☐ 是 _______%　　☐ 否

2. 请指出本公司在近三年内采用或买进外部知识或资源投入到自身内部研发创新的比例（注：此比例为此种创新行为占第一题数值之比例）

☐ 是 _______%　　☐ 否

同时请指出本公司是否进行以下内部开放式创新行为，如果是，请估计给出它们在近三年内所占平均比例：（此比例为三种行为各占第二题数值之比例）

a. 采取建立外部研发合同进行创新行为__________%

（注：包含外部新研发项目/合作研发项目，外至内新产品研发合同建立）

b. 采取购买外部（如对手、相关机构等）技术专利用于内部创新______%

c. 采取通过担任外部研发创新顾问所产生、获得创新行为__________%

3. 请指出本公司在近三年内提供或转移内部知识资源或研究成果到外部环境寻求商业化创新的比例：（注：此比例为此种创新行为占第一题数值之比例）

☐ 是 _______%　　☐ 否

同时请指出本公司是否进行以下外部开放式创新行为，如果是，请估计给出它们在近三年中所占平均比例：（此比例为三种行为各占第三题数值之比例）

a. 向合作伙伴或其他单位提供研发创新合同（内至外）进行创新行为______%

（注：包含新研发项目/合作研发项目建立，内至外新产品研发合同外包）

b. 卖出内部技术专利（同时利用内部资源）产生、进行创新行为_______%

c. 作为其他单位研发创新顾问所产生、进行新创新行为__________%

4. 请指出以下因素是否为采取开放式创新行为的困难及其重要性

（1=非常不重要，5=非常重要）

影响采用开放式创新行为的因素（困难）	**重要程度**				
	1	**2**	**3**	**4**	**5**
如何管理并协调公司内部研发行为变化					
如何管理内部资源与外部资源协作					
如何保护公司内部重要专利技术					
如何及时发现有益的创新资源与机会					
如何运用及突出内部知识产权重要性					
如何防止重复使用外部存在知识资源					

第三部分：科技园（创新集群）对创新活动的影响

本部分中请指出对于下列陈述中的同意程度与否（1= 非常不同意，5=非常同意），表明对科技园区中区位因素对于创新研发活动的影响。

内容	**同意程度**				
	1	**2**	**3**	**4**	**5**
公司可以接触/吸纳高学历、经验丰富的专业人才对产品进行创新活动					
公司可以获得与应用外部资源进行创新、研发活动					

公司可以通过员工的技术与资源互动沟通产生新产品研发和创新机会					
公司可以通过与科技园内的上下游单位合作降低研发成本					
公司可以通过与供应商的合作配合产生新的研发创新机会					
在科技园内公司可以增强/提高信息交换与获取的能力					
在科技园内公司可以较容易的建立战略合作伙伴					
在科技园内公司关系网络可以较容易的支持自身应对市场变化					
在科技园内公司可以较容易的获得政府辅助资金，降低税金，及优惠政策支持					
在科技园内公司可以较容易的获得风险投资，天使投资，或私人（机构）投资作为创新资金支持					

第四部分：创新绩效的影响因素

本部分中，请指出开放式创新行为在商业运营中对创新绩效的影响。

1. 请大约估计近三年内本公司营业收入由以下行为所贡献的比例：

1.1 对市场及公司均为创新产品所带来的收入平均比例：__________

1.2 对公司为创新产品所带来的收入平均比例：__________

1.3 由公司显著改善产品所带来的收入平均比例：__________

2. 请大约估计近三年内本公司产品绩效由以下行为所贡献的比例：

2.1 由新研发产品所产生的营业收入增长的平均比例：__________

2.2 由显著改善当前产品所产生的营业收入增长的平均比例：__________

2.3 由显著改善制造过程所产生的营业收入增长的平均比例：__________

3. 请指出近三年内由本公司所推出的新产品数量：__________

3.1 请指出本公司目前正在研发的新产品数量（本年度）：__________

第五部分：创新合作行为

本部分中，请指出合作伙伴对于开放式创新在商业运营及创新绩效的影响。

1. 请指出与本公司进行研发创新合作的伙伴数量：__________

其中合作时间最长的伙伴为（基于年数）：__________

其中合作时间最短的伙伴为（基于年数）：__________

平均合作年份为：__________

1.1 请指出与本公司进行研发创新的合作伙伴类型：

同一母公司子企业 ☐

大学 ☐

科技顾问公司 ☐

同行业竞争公司 ☐

供应商 ☐

政府或私人研究院所 ☐

科技实验室或研发创新公司 ☐

其他__________

1.2 请指出以下合作伙伴对于研发创新的质量（1=非常低，5=非常好）：

合作伙伴类型	**质量程度**				
	1	**2**	**3**	**4**	**5**
同一母公司子企业					
大学					
科技顾问公司					

同行业竞争公司					
供应商					
政府或私人研究院所					
科技实验室或研发创新公司					
其他					

2. 请指出与本公司进行市场运营合作的伙伴数量：___________

其中合作时间最长的伙伴为（基于年数）：___________

其中合作时间最短的伙伴为（基于年数）：___________

平均合作年份为：___________

2.1 请指出与本公司进行市场运营的合作伙伴类型：

同一母公司子企业 ☐

大型企业 ☐

同行业竞争公司 ☐

分销商 ☐

市场顾问公司 ☐

国有企业 ☐

其他___________

2.2 请指出以下合作伙伴对于市场运营的质量（1=非常低，5=非常好）：

合作伙伴类型	**质量程度**				
	1	**2**	**3**	**4**	**5**
同一母公司子企业					
大型企业					
同行业竞争公司					
分销商					
市场顾问公司					
国有企业					
其他					

本问卷到此结束，谢谢合作！

Appendix 2.1 Interview Questions (Chinese)

高科技企业开放式创新面谈相关问题

第一节：

1.本公司目前是否进行了开放式创新活动？

2. 本公司目前采用了何种具体的开放式创新行为？

3. 本公司期望从开放式创新中得到，创造什么价值，并希望经历何种开放式创新活动？

4. 本公司进行开放式创新的主要障碍是什么？

5. 本公司进行开放式创新的主要驱动因素是什么？

第二节：

1.本公司是否采用吸收或买进外部知识产权或技术的行为？如果是，这种行为是否为规律性亦或为偶然性？

2. 引进外部技术将如何帮助本公司？有何重大影响（创新研发方面）？

3. 引进，买入外部技术对于本公司产品技术创新方面可解决以下哪些问题：

   a. 产品的改进与提高

   b. 突破性、全新产品推出与研制

   c. 提高核心专业技术

   d. 技术改进与非核心技术提高

4. 提供，卖出内部技术对于本公司产品技术创新方面可解决以下哪些问题：

   a. 通过外部平台展示内部技术从而获得新的创新理念或机会

   b. 卖出内部专业技术通过外部单位再发展获得新的创新可能或机会

5. 本公司通常通过哪些单位或合作伙伴寻找外部创新理念和技术： 例如： 大学、 初创企业、 竞争对手？

Appendix 3 Result Tables

Table 6.1 Descriptive Statistics Correlation Matrix

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12
1. YEAR	13.480	7.563	1											
2. Number of Employees	2484	14659	0.253	1										
3. R&D	0.874	0.332	0.076	0.014	1									
4. Product Manufacturing	0.656	0.476	0.157	0.261	0.040	1								
5. Distribution	0.248	0.433	0.056	0.060	0.010	0.223	1							
6. Marketing and Sales	0.517	0.501	0.073	0.069	0.073	0.080	0.249	1						
7. Inbound OI activities	0.505	0.272	-0.113	-0.094	0.217	0.081	0.041	-0.048	1					
8. Outbound OI activities	0.350	0.227	0.164	-0.019	-0.008	0.141	0.114	0.156	-0.038	1				
9. Locational Factor	-0.403	0.713	0.052	0.089	0.041	0.078	0.218	0.238	-0.121	0.206	1			
10. R&D Intensity	0.542	0.403	0.149	0.012	0.027	0.088	0.079	0.039	-0.015	0.138	0.193	1		
11. Interaction	0.552	0.471	0.099	0.084	0.109	0.038	0.145	0.923	0.046	0.131	0.800	0.266	1	
12. the balance in OI	1.284	0.867	0.001	-0.072	0.164	0.181	0.072	0.061	0.630	0.161	0.070	0.069	0.125	1

Note: N = 302; Correlations with absolute value greater than 0.11 are significant at 0.05, and those greater than 0.15 are significant at 0.01.

Table 6.2 Regression Relationship between Locational Factor and the Balance in OI

Variables	the balance in OI	the balance in OI	the balance in OI	the balance in OI
	Model 1 Coef. (SD)	Model 2 Coef. (SD)	Model 3 Coef. (SD)	Model 4 Coef. (SD)
YEAR	-0.008 (0.007)	-0.008 (0.005)	-0.007 (0.007)	-0.007 (0.007)
R&D	0.367* (0.156)	0.363* (0.156)	0.392* (0.156)	0.395* (0.156)
Product Manufacturing	0.249* (0.112)	0.248* (0.113)	0.240* (0.112)	0.242* (0.112)
Distribution	0.026 (0.121)	0.017 (0.123)	0.042 (0.112)	0.052 (0.123)
Marketing and Sales	0.057 (0.104)	0.048 (0.106)	0.042 (0.105)	0.059 (0.107)
Manufacturing	0.296 (0.244)	0.304 (0.244)	0.262 (0.243)	0.287 (0.247)
Electronics	0.330 (0.246)	0.337 (0.246)	0.333 (0.245)	0.388 (0.252)
Telecommunications	0.085 (0.283)	0.093 (0.284)	0.094 (0.282)	0.140 (0.287)
Network	0.130 (0.260)	0.139 (0.261)	0.134 (0.259)	0.175 (0.264)
Software	-0.024 (0.273)	-0.008 (0.275)	-0.018 (0.273)	0.032 (0.277)
Bioengineering	0.127 (0.290)	0.138 (0.291)	0.137 (0.289)	0.191 (0.293)
Pharmaceutical	0.512 (0.351)	0.525 (0.353)	0.494 (0.350)	0.475 (0.351)
R&D Intensity (RDI)	0.142 (0.126)	0.132 (0.128)	0.065 (0.131)	0.120 (0.141)
Founder's Experience				-0.175 (0.126)
Exporting Percentage				0.033 (0.247)
Locational Factors (LF) H1		0.036* (0.074)	0.055* (0.073)	0.080* (0.077)
LF X RDI H2			0.259* (0.111)	0.258* (0.111)

Constant	0.576	0.584	0.593	0.613
	(0.238)	(0.239)	(0.237)	(0.238)
R^2	0.087	0.086	0.105	0.110

Note: N = 302; Standard Errors are in parentheses; p*<.05; p**<.01; p***<.001

Table 7.1 Descriptive Statistics Correlation Matrix

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13
1. YEAR	13.480	7.563	1												
2. Number of Employees	2484	14659	0.253	1											
3. Exporting sales	0.233	0.231	0.196	0.084	1										
4. R&D	0.874	0.332	0.076	0.014	0.082	1									
5. Product Manufacturing	0.656	0.476	0.157	0.026	0.067	0.040	1								
6. Distribution	0.248	0.433	0.056	0.060	0.092	0.010	0.223	1							
7. Marketing and Sales	0.517	0.501	0.073	0.069	0.204	0.073	0.080	0.249	1						
8. Inbound OI activities	0.505	0.272	-0.113	-0.094	-0.095	0.217	0.081	0.042	-0.048	1					
9. Outbound OI activities	0.350	0.227	0.164	-0.019	0.189	-0.008	0.141	0.114	0.156	-0.038	1				
10. R&D Intensity	0.542	0.403	0.149	0.012	0.356	0.027	0.088	0.079	0.039	-0.015	0.138	1			
11. the balance in OI	1.284	0.867	0.000	-0.072	0.058	0.164	0.181	0.072	0.061	0.630	0.161	0.080	1		
12. Interaction	0.719	0.837	0.118	0.002	0.286	0.088	0.145	0.078	0.105	0.344	0.109	0.659	0.637	1	
13. Innovation Performance	0.271	0.162	0.086	-0.015	0.250	0.182	0.030	0.044	0.235	-0.049	0.234	0.259	0.024	0.220	1

Note: N = 302; Correlations with absolute value greater than 0.11 are significant at 0.05, and those greater than 0.15 are significant at 0.01.

Table 7.2 Regression Relationship between the Balance in OI and Innovation Performance

Variables	New Product Sales	New Product Sales	New Product Sales	New Product Sales	New Product Sales
	Model 1 Coef. (SD)	Model 2 Coef. (SD)	Model 3 Coef. (SD)	Model 4 Coef. (SD)	Model 5 Coef. (SD)
YEAR	0.009	-0.066	-0.065	-0.080	-0.078
	(0.130)	(0.130)	(0.130)	(0.130)	(0.131)
Status of Firms	1.318	1.388	1.478	1.179	1.110
	(2.162)	(2.137)	(2.144)	(2.135)	(2.158)
Number of Employees	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Exporting Sales	0.084	0.064	0.067	0.061	0.061
	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
Government Funding	0.095	-0.188	-0.280	0.116	0.075
	(2.034)	(2.010)	(2.018)	(2.013)	(2.033)
Foreign Investment	0.057	0.453	0.326	0.293	0.294
	(2.389)	(2.363)	(2.374)	(2.359)	(2.367)
Money from Other Firms	0.494	0.623	0.591	0.749	0.835
	(1.907)	(1.939)	(1.941)	(1.931)	(1.958)
Bank Loans	1.257	0.801	0.800	0.856	1.018
	(2.069)	(2.062)	(2.065)	(2.051)	(2.129)
R&D	6.501*	7.989**	8.035**	8.357**	8.427**
	(2.941)	(2.948)	(2.952)	(2.937)	(3.009)
Product Manufacturing	-1.270	-1.640	-1.511	-1.338	-1.376
	(2.063)	(2.049)	(2.062)	(2.050)	(2.059)
Distribution	-1.446	-1.752	-1.777	-1.564	-1.593
	(2.219)	(2.196)	(2.199)	(2.187)	(2.217)
Marketing and Sales	5.836***	5.286**	5.347**	4.936*	4.970*
	(1.922)	(1.902)	(1.906)	(1.903)	(1.919)
Manufacturing	3.066	2.555	2.599	2.617	2.563
	(4.466)	(4.417)	(4.423)	(4.394)	(4.414)
Electronics	2.007	1.181	1.207	1.641	1.682
	(4.533)	(4.496)	(4.501)	(4.476)	(4.496)
Telecommunications	-1.183	-1.771	-1.855	-1.841	-1.856
	(5.164)	(5.100)	(5.107)	(5.074)	(5.097)
Network	1.906	0.053	-0.003	0.514	0.610
	(4.788)	(4.769)	(4.775)	(4.750)	(4.771)

Software	0.484	-1.644	-1.698	-1.691	-1.773
	(5.008)	(4.981)	(4.987)	(4.954)	(4.981)
Bioengineering	0.453	0.004	0.027	0.466	0.462
	(5.295)	(5.220)	(5.226)	(5.196)	(5.227)
Pharmaceutical	-0.499	-0.513	-0.413	0.433	0.264
	(6.416)	(6.342)	(6.351)	(6.322)	(6.385)
Accelerating time to complete R&D					0.260
					(2.018)
Reducing R&D costs for projects					-0.844
					(2.039)
R&D Intensity (RDI)	0.086***	0.080***	0.081***	0.017	0.015
	(0.026)	(0.025)	(0.025)	(0.039)	(0.039)
Inbound OI activities		-0.044	-0.027	-0.025	-0.024
H1a		(0.036)	(0.045)	(0.045)	(0.045)
Outbound OI activities		0.120***	0.125***	0.140***	0.141***
H1b		(0.042)	(0.042)	(0.043)	(0.043)
the balance in OI			-0.836	-3.904*	-3.945*
H2			(1.366)	(1.963)	(1.972)
the balance in OI X RDI				0.051*	0.050*
H3				(0.023)	(0.023)
Constant	9.670	9.817	9.621	12.519	12.734
	(4.386)	(4.482)	(4.498)	(4.665)	(4.709)
R^2	0.168	0.153	0.199	0.212	0.213

Note: N = 302; Standard Errors are in parentheses; p*<.05; p**<.01; p***<.001

Table 8.1 Descriptive Statistics Correlation Matrix

Variables	Mean	SD	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1. YEAR	13.480	7.563	1													
2. Number of Employees	2484	14659	0.253	1												
3. R&D	0.874	0.332	0.076	0.014	1											
4. Product Manufacturing	0.656	0.476	0.157	0.261	0.040	1										
5. Distribution	0.248	0.433	0.056	0.060	0.010	0.223	1									
6. Marketing and Sales	0.517	0.501	0.073	0.069	0.073	0.080	0.249	1								
7. Inbound OI activities	0.505	0.272	-0.113	-0.094	0.217	0.081	0.041	-0.048	1							
8. Outbound OI activities	0.350	0.227	0.164	-0.019	-0.008	0.141	0.114	0.156	-0.038	1						
9. Locational Factor (LF)	-0.403	0.713	0.052	0.089	0.041	0.078	0.218	0.238	-0.121	0.206	1					
10. R&D Intensity (RDI)	0.542	0.403	0.149	0.012	0.027	0.088	0.079	0.039	-0.015	0.138	0.193	1				
11. LF X RDI	0.552	0.471	0.099	0.084	0.109	0.038	0.145	0.923	0.046	0.131	0.800	0.266	1			
12. the balance in OI	1.284	0.867	0.001	-0.072	0.164	0.181	0.072	0.061	0.630	0.161	0.069	0.070	0.125	1		
13. the balance in OI X RDI	0.719	0.837	0.118	0.002	0.088	0.145	0.078	0.105	0.344	0.109	0.659	0.205	0.331	0.637	1	
14. Innovation Performance	0.271	0.162	0.086	-0.015	0.182	0.030	0.044	0.235	-0.049	0.234	0.259	0.228	0.162	0.024	0.220	1

Note: N = 302; Correlations with absolute value greater than 0.11 are significant at 0.05, and those greater than 0.15 are significant at 0.01.

Table 8.2 Mediation Effect of the Balance in OI

Variables	Innovation Performance	the balance in OI	Innovation Performance	Innovation Performance	Innovation Performance
	Model 1 Coef. (SD)	Model 2 Coef. (SD)	Model 3 Coef. (SD)	Model 4 Coef. (SD)	Model 5 Coef. (SD)
YEAR	-0.040	0.003	0.006	-0.004	-0.015
	(0.127)	(0.006)	(0.127)	(0.126)	(0.128)
Number of Employees	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
R&D	8.288**	0.018	8.379***	9.008***	8.659***
	(2.960)	(0.125)	(2.828)	(2.818)	(2.955)
Product Manufacturing	-1.548	0.152*	-1.793	-1.539	-1.427
	(2.009)	(0.088)	(1.992)	(1.988)	(2.005)
Distribution	-1.855	-0.064	-2.297	-2.092	-2.144
	(2.189)	(0.095)	(2.164)	(2.152)	(2.192)
Marketing and Sales	5.311**	0.059	5.025**	4.483*	4.233*
	(1.910)	(0.083)	(1.890)	(1.894)	(1.942)
Manufacturing	2.226	0.130	4.091	4.139	3.309
	(4.392)	(0.190)	(4.318)	(4.288)	(4.387)
Electronics	1.119	0.102	3.074	3.440	2.431
	(4.510)	(0.193)	(4.373)	(4.343)	(4.507)
Telecommunications	-2.090	-0.016	-0.009	-0.046	-0.930
	(5.097)	(0.221)	(5.008)	(4.970)	(5.090)
Network	-0.172	0.021	1.721	2.118	1.377
	(4.742)	(0.206)	(4.677)	(4.644)	(4.749)
Software	-2.098	0.060	0.200	0.037	-0.677
	(4.915)	(0.216)	(4.903)	(4.867)	(4.955)
Bioengineering	0.017	0.126	1.907	2.225	1.402
	(5.209)	(0.225)	(5.116)	(5.080)	(5.204)
Pharmaceutical	-0.928	0.174	0.561	1.747	1.191
	(6.298)	(0.274)	(6.227)	(6.198)	(6.282)
Founder Experience	1.249				0.318
	(2.367)				(2.396)
Exporting of Turnover	0.062				0.043
	(0.043)				(0.044)
Accelerating time to complete R&D	0.579 (1.994)				0.636 (1.983)

Reducing R&D costs for projects	-0.502				-0.050
	(1.970)				(1.979)
Inbound OI	-0.038	0.021***	-0.030	0.001	0.004
	(0.035)	(0.002)	(0.035)	(0.044)	(0.045)
Outbound OI	0.116**	0.005***	0.112***	0.137***	0.132***
	(0.043)	(0.002)	(0.041)	(0.042)	(0.044)
R&D Intensity (RDI)	0.075**	0.001	0.089***	0.020	0.014
	(0.026)	(0.001)	(0.023)	(0.037)	(0.039)
Locational Factor		0.181*	4.244*	5.143*	4.717*
		(0.099)	(2.247)	(2.262)	(2.392)
Locational Factor X RDI		-0.001	-0.031	-0.052	-0.049
		(0.001)	(0.033)	(0.034)	(0.035)
the balance in OI				-4.534*	-4.521*
				(1.976)	(1.989)
the balance in OI X RDI				0.057*	0.055*
				(0.024)	(0.024)
Constant	10.143	-0.232	9.520	12.244	12.435
	(4.491)	(0.195)	(4.429)	(4.576)	(4.656)
R^2	0.197	0.462	0.202	0.220	0.223
Adj. R^2	0.140	0.428	0.151	0.165	0.156

Note: N = 302; Standard Errors are in parentheses; p*<.05; p**<.01; p***<.001