ISCTE IUL

Instituto Universitário de Lisboa

Innovation, Agile Project Management and Firm Performance: Empirical Evidence from High-Tech Small and Medium-Sized Enterprises in China

Xiangui Ju

Thesis submitted as partial requirement for the conferral of the degree of

Doctor of Management

Supervisor:

Prof. Fernando Alberto Freitas Ferreira, Associate Professor, ISCTE University Institute of Lisbon

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Abstract

While agile project management has become increasingly important for high-tech small and medium-sized enterprises (SMEs), each firm's performance varies greatly, due to different degrees of innovation capability and to the dynamics of the internal and external environments. Drawing on theories of resource-based view, innovation capability and agile project management, and equipped with a comparative analysis of two high-tech SMEs, we developed a theoretical model with six hypotheses. We then carried out empirical research, including the measurement of key variables, data collection and analysis, validity and reliability tests, regression analysis, and structural equation modeling, confirming five of the six hypotheses initially presented. The model developed in this study includes the different roles of innovation capability, considers project agility in promoting firm performance, and takes into account interactions with the innovation atmosphere and environmental dynamics. The results contribute to the development and refinement of the theory of project agility by presenting new findings in the field of innovation and environmental dynamics. The results also provide guidance to project agility practices of high-tech SMEs in China, improving those firms' performance. The implications and limitations of this study are also discussed.

Keywords: China, Innovation Capability, Project Agility, Small and Medium-sized Enterprises (SMEs).

JEL Classification: M10; 031.

Resumo

Embora a gestão ágil de projetos esteja a ganhar importância para as pequenas e médias empresas (PMEs) de tecnologia de ponta, o desempenho de diferentes empresas varia consoante a sua capacidade de inovação e depende da dinâmica dos ambientes interno e externo em que elas se inserem. Recorrendo a teorias relacionadas com a visão baseada nos recursos, capacidades de inovação e gestão ágil de projetos, assim como com recurso à análise comparativa de duas PMEs de tecnologia de ponta, desenvolvemos um modelo teórico com seis hipóteses. Posteriormente, levámos a cabo investigação empírica, incluindo a medição de variáveis-chave, recolha e análise de dados e testes de validação e fiabilidade. Procedemos, ainda, a análises de regressão e à modelação de equações estruturais, confirmando cinco das seis hipóteses inicialmente estabelecidas. O modelo desenvolvido inclui diferentes funções da capacidade de inovação, considera a contribuição da agilidade de projeto para a melhoria do desempenho da empresa e tem em conta as interações com a envolvente de inovação e com as dinâmicas do ambiente. Os resultados alcançados permitem desenvolver a teoria da agilidade de projeto, apresentando contributos valiosos no campo da inovação e das dinâmicas do ambiente empresarial. Esta contribuição pode servir de guia às práticas de gestão ágil de projetos de PMEs de tecnologia de ponta na China, melhorando o seu desempenho organizacional. As implicações e limitações deste estudo são também apresentadas.

Palavras-chave: Capacidade de Inovação, China, Gestão Ágil de Projetos, Pequenas e Médias Empresas (PMEs)

Classificação JEL: M10; 031.

摘要

尽管敏捷项目管理对高科技中小企业（SME）越来越重要，但由于创新能力的不同程度以及内外部环境的动态性，每家公司的绩效差异很大。借鉴资源观、创新能力和敏捷项目管理理论，对两个高新技术中小企业进行了比较分析，建立了六个假设的理论模型。然后，我们进行了实证研究，包括关键变量的测量、数据收集和分析、有效性和可靠性测试、回归分析和结构方程建模，确认了最初提出的六个假设中的五个。本研究所建立的模型包括创新能力的不同角色，考虑项目在提升企业绩效中的敏捷性，并考虑与创新氛围和环境动态性的相互作用。这些结果通过在创新和环境动态性领域提出新的发现，有助于项目敏捷性理论的发展和完善。研究结果也为我国高技术中小企业项目敏捷性实践提供了指导，提高了高技术中小企业的绩效。本文还讨论了本研究的意义和局限性。

关键词：中国，创新能力，项目敏捷性，中小型企业

JEL 分类： M10；031

Executive Summary

The 40 years of reform and increasing openness since 1978 have led to rapid development in China's industry and information technology (IT) fields. There was an increase in the number of companies – especially of high-tech small and medium-sized enterprises (SMEs) – resulting in a diversified competitive landscape. In recent years, the Chinese national science and technology department and local government have supported a diverse range of high-tech companies, promoting high levels of competition from pure product price to internal factors such as innovation capability or management methods.

In light of this multiplicity of competitors, high-tech SMEs are faced with the need to make full use of technology and best management practices to their advantage. Different methods of developing innovation capability have been widely applied in high-tech firms, and agile management has become increasingly prominent in software enterprises. These two management processes can be combined to fruition, especially in certain innovative enterprises. Indeed, this combination has had an effect on enterprises' efforts to improve their innovation performance. Nevertheless, practically speaking, these two processes have not been sufficiently combined on the one hand and, on the other hand, high or low project agility can result in varying degrees of innovation performance in high-tech SMEs.

Based on a survey of domestic high-tech SMEs, the present study explores how firms' innovation capability and project agility influence their performance. The effects of the atmosphere of innovation and environmental dynamics between innovation capability, project agility and firm performance are also considered. Based on an extensive literature review, a comprehensive theoretical framework is developed, under which an exploratory comparative case study is conducted. We then put forward a number of hypotheses, testing them through empirical research to reveal the relationship between innovation capability, project agility and firm performance. We also consider the internal and external moderating effects of innovation atmosphere and environmental dynamics. Through a survey of more than 600 domestic high-tech SMEs, we employ structural equation modeling to test these hypotheses, analyzing the data with tools such as SPSS, STATA, and AMOS. Based on the results of the empirical research, practical suggestions are presented on improving efficiency for domestic high-tech SMEs.

In terms of structure, this study is organized as follows. In the first three chapters, the study provides some background and describes the structure, methodology, problematic and objectives, and expected results. Subsequently, the study presents a theoretical perspective on Resource-Based View (RBV), dynamic capability, project agility and innovation capability through a comprehensive literature review. Two case studies are compared and a conceptual framework is put forward, exploring the mechanisms whereby innovation capability and project agility affect firm performance. Further, the moderating role of innovation atmosphere and environmental dynamics – internal as well as external – is studied and the research hypotheses are proposed. The fourth chapter explains the research design and the means through which primary data were gathered – questionnaires, interviews, fieldwork, and the Internet. A total of 242 valid questionnaires were collected. Using statistical analysis software, the thesis carried out empirical research of the theoretical model on the mechanisms relating innovation capability, project agility, and firm performance, interacting with innovation atmosphere and environmental dynamics, respectively. Reliability and validity tests were then carried out for key variables, as well as regression analysis and summarized structural equation verifications. The verification of the research hypotheses indicated that the application of appropriate project agility and stronger innovation capability each have a positive effect on firms' performance and that the innovation atmosphere and environmental dynamics are key variables affecting innovation capability. Finally, the study summarizes the main research outcomes, offers a number of contributions and practical guidelines, and points to some of its limitations, recommending areas of future research.

Overall, this study employed a literature review, an exploratory case study, questionnaires, empirical research and statistical analysis of results, going on to propose and construct a new model for the mechanisms through which innovation capability, project agility, and firm performance interact not only with one another but also with the innovation atmosphere and environmental dynamics, thus contributing to the development and refinement of the theory of project agility. As for the field of research of innovation atmosphere and environmental dynamics, the study's contributions assist in guiding the practice of project agility to the improvement of firm performance.

Keywords: China, Innovation Capability, Project Agility, Small and Medium-sized Enterprises (SMEs).
JEL Classification: M10; 031.

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The well-known saying that “knowledge is power and learning is a tool” tells me that this doctoral thesis is a milestone in my learning process; the starting point of a new stage in the endless journey of learning. The past four years of dedication to academic research have assisted me in developing a humbler attitude, in being steadfast in the learning process, and in strengthening certain qualities I have found in other researchers.

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Thank you!

致谢

“知识就是力量，学习就是工具”这句名言告诉我，这篇博士论文是我学习过程中的一个里程碑，是学习无穷无尽新阶段的起点。在过去的四年里，致力于学术研究，使我在学习过程中养成了谦逊的态度和持之以恒，也使我从其他研究者身上学习到更多的优秀品质。

仅仅表达对我的导师费尔南多·阿尔贝托·弗雷塔斯·费雷拉教授（里斯本大学本院，葡萄牙以及孟菲斯大学，美国）和王敏教授（中国电子科技大学，中国）的谢意，是远远不够的。他们的大力支持，特别是广博的知识、科学的指导、务实合理的建议、深刻的评论和积极的心态对我影响很大。我也衷心感谢肖文教授、弗吉尼娅·特里戈教授和其他老师的无私和耐心帮助。中国有句老话，名师出学徒。我很幸运能够遇到这么多杰出的教授，并从他们的卓越中得到学习。

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List of Acronyms

AMOS – Analysis of Moment Structure

ASD – Adaptive Software Development

BSC – Balanced Scorecard

CASTED – China Academy of Science and Technology for Development

CFI – Comparative Fit Index

CNY – Chinese Yuan

CR – Coefficient of Regression

CRM – Customer Relationship Management

CTO – Chief Technology Officer

DF – Degrees of Freedom

DW – Durbin-Watson

ED – Environmental Dynamics

EP – Extreme Programming

ERP – Enterprise Resource Planning

EU – European Union

FDD – Feature Driven Development

FP – Firm Performance

IA – Innovation Atmosphere

IC – Innovation Capability

IEEE – Institute of Electrical and Electronic Engineers

IFIP – International Federation of Information Processing

IS – Information System

IT – Information Technology

JIT – Just-In-Time

KMO – Kaiser-Meyer-Olkin

MIS – Management Information System

MIIT – Ministry of Industry and Information Technology

NEBIC – Network Enabled Business Innovation Circle

NEO – Network Enabling Organization

OECD – Organization for Economic Cooperation and Development

P – Probability

PA – Project Agility

PAR – Parameter

QFD – Quality Function Deployment

RBV – Resource-Based View

R&D – Research & Development

RM – Relationship Marketing

RMSEA – Root Mean Square Error of Approximation

ROA – Return on Assets

ROI – Return on Investment

ROS – Return on Sales

RVIN – Rare, Value, Inimitable, Non-substitutable

SaaS – Software-as-a-Service

SCP – Structure Conduct Performance

SD – Standard Deviation

SE – Standard Error

SIG – Significant

SME – Small and Medium-sized Enterprise

SPSS – Statistical Product and Service Solutions

STATA – Software for Statistics and Data Science

SWOT – Strengths, Weaknesses, Opportunities and Threats

TCI – Team Climate Inventory

TLI – Tucker-Lewis Index

VIF – Variance Inflation Factor

Chapter 1: Introduction

This chapter presents the study's background and significance, research problematic and objectives, structure, methodology and expected results. The background and practical significance of this study demonstrate the importance of the research developed and the need for high-tech small and medium-sized enterprises (SMEs) in China to be proactive in improving their competitiveness. The research problematic and objectives constitute the main content of this chapter. Concluding the chapter, we describe the structure, planned methods, and expected results. These are the research outcomes that may contribute as guidelines for high-tech SMEs in China.

1.1. Background and Significance

In recent years, under the top-level design of national policies, before comprehensively promoting the building of innovation-originated nation and the implementation of innovation-driven development strategy, China has given continuous attention to the process of innovation capability-building. However, the process is hindered due to some phenomena, such as unclear objectives of innovation, lack of sustained investment in innovative resources, insufficient follow-up support of innovative achievements, lack of innovative talents, less experience in innovation management, and inadequate innovation system and support. These phenomena block the development of China's independent innovation undertakings. Under this background, enterprises need to actively face the difficulties and opportunities of innovation under the national background and the problems of innovation development at the enterprise level.

First, at the national level, China's competitiveness does not match the international standards of the national innovation capability. The driving role of innovation in China's economic development is gradually improving, but there is still enough room for innovation promotion at the national level. According to the report from China Academy of Science and Technology for Development (CASTED), *National Innovation Index Report of China in 2018* (CASTED, 2018), we can find that the national innovation index is a comprehensive index reflecting the competitiveness of a country's science, technology and innovation. It includes

five major factors: (1) innovation resources; (2) knowledge creation; (3) enterprise innovation; (4) innovation performance; and (5) innovation environment. After comparing and analyzing the evaluation results of national innovation index over the years, it is found that 40 countries can be divided into three groups. The top-15 countries in the first group are mainly developed economies in Europe and the United States, which are recognized as innovative countries. The countries ranked from 16th to 30th include a small number of emerging economies, belonging to the second group, facing the most intense competition. China has reached the 17th position in 2016. From other specific situations, the most outstanding performance is knowledge creation, which jumped from the 37th position in 2005 to the 7th position in 2016, ranking up 30 positions and showing that China has become an influential country in scientific research in the world. As for innovation performance, China has increased 11 positions since 2005, and reached the 18th place in 2016. This is due to the dramatic increase in intellectual property achievements and the rapid development of knowledge-intensive industries in China in recent years. In terms of enterprise innovation, the country ranked 11th in 2016 and increased 6 positions since 2005, reflecting the continuous improvement of international competitiveness of Chinese enterprises in recent years. The overall ranking of innovation environment has increased, rising from 27th in 2005 to 16th in 2016. The ranking of innovation resources is the slowest, moving from the lowest position to 33 from 2007 to 2008, and rising to 25th in 2016, which shows that China still needs to make long-term efforts to increase the intensity of investment in innovation resources. It can be seen that the improvement of innovation at the national level is also reflected in various specific indicators, and some aspects need to be improved.

Second, the investment of innovation resources has reached the international level and, at the same time, the business income of high-tech enterprises and the Research and Development (R&D) funds have increased. These growth indicators reflect the tremendous changes in the innovation environment, which brings new opportunities and pressures to Chinese high-tech enterprises. Meanwhile, it also brings challenges to innovative enterprises, especially those that are exploring innovative capabilities. From 2000 to 2016, China's investment in science and technology innovation resources showed a strong growth trend with the average growth rate of innovation resources index reaching 10.0% (CASTED, 2018). Over the past 16 years, China's R&D expenditure has increased 17 times, from 1.7% in 2000 to 16.1% in 2016 for the proportion of global total. The ratio of R&D expenditure to Gross Domestic Product (GDP) has risen from 0.9% to 2.11%, which exceeds the average level of

15 European Union (EU) countries. Since 2015, the average annual growth rate of business income of high-tech enterprises has remained around 20%. In recent years, China has paid more attention to economic restructuring and economic transformation, and to the improvement of economic development quality. More and more attention has been paid to scientific and technological innovation by the government and enterprises. The role of enterprises as the main body of innovation is becoming more and more obvious, evidenced by the growth rate of R&D expenditure of enterprises has increased from 8.2% in 2015 to 11.6% in 2016 and 12.5% in 2017 (CASTED, 2018).

In the context of the continuous increase of investment in innovation resources, patent and other explicit innovative achievements have been greatly improved, but they have not played a full supporting role in the competitive advantage of enterprises. One reason is that they are constrained by unreasonable innovative methods and inefficient innovative management system, and there is still a lot of room to improve the innovation efficiency of enterprises. Therefore, for enterprises as the main body of national innovation system, how to promote the quantity of innovation while ensuring the quality of innovation, and transform innovation into sustainable competitive advantage, plays an important role in the building of China as an innovation-originated nation.

Furthermore, in the era of economic globalization, business competition has increasingly intensified. Enterprises can no longer compete exclusively on their prices to maintain sustainability in their respective industries (Zeng, Zheng, & Li, 2018). Only those enterprises that rely on several aspects (*e.g.*, products, technologies and services, R&D, and continuous innovation) can keep their competitive advantage. Facing with the complex and fast changing environment, the survival and development of small and medium-sized enterprises (SMEs) depend on their ability to adapt to change quickly. However, *agility* is the core embodiment of this capability. As an innovative idea, agility has been selected as an operating model by numerous firms around the world, since the announcement of the Agile Manifesto in 2001.

In view of the domestic landscape in China, *agile management* has also experienced initial penetration and diffusion. Many high-tech SMEs have deployed agile management and performance management, with varying results due to resource and capability constraints. For example, some software companies do not implement agile management throughout products' or projects' life cycles.

ThoughtWorks (2017), as the main advocate of agile thinking and an important

promoter of agile management, conducted an agile implementation survey for Chinese enterprises from June to July 2017. The results show that most of the agile teams in China are less than 100 people. The industries are mainly distributed in high-tech industries with fierce market competition and rapid technological change, such as the Internet (26%), information technology (21%), communications (16%), finance (17%), and others (20%). For the firms, agile management is implemented mainly at the project level. To shorten the project development cycle, improve the quality of project research and development and enhance customer satisfaction are the main objectives of enterprises to implement agile management. However, the survey results also show that the role of implementing agile management in enterprise product innovation and employee capability enhancement is very limited, which makes the conclusion of the impact of agile project management on enterprise performance is complex. In the interviews with relevant personnel of Huawei Chengdu Research Institute, Keruyun Technology Co., Ltd. (Author's interview, 2018) and ThoughtWorks (2017) in implementing agile management and promoting the application of agile ideas, it was also found that the interviewees agreed that project agile management would promote project and process-level performance, including shortening the R&D cycle, improving customer satisfaction, and improving project quality. But when asked about the impact of agile management on innovation-related performance, respondents failed to provide clear conclusions. ThoughtWorks agile implementation survey (ThoughtWorks, 2017) found that enterprise implementation of agility is challenged by three factors. The first factor is the poor demand and unreasonable structure mainly manifesting in inadequate demand definition ability, weak team capacity, systematic innovation ability and talent shortage. The second factor is cumbersome process governance mainly manifesting in the collaboration between teams and traditional project management methods such as strength and performance appraisal cannot meet the needs of agility. The third factor is the corporate culture, which specifically manifests that team culture does not encourage learning and innovation, and team members lack the willingness to learn. Therefore, we believe that, as an innovation tool, the direct effect of agile management on enterprise performance depends on the enterprise's innovation ability, meaning that innovation ability is a decisive factor of agile management. The implementation effect of agile management at the enterprise level is also influenced by corporate culture.

These mixed results have led high-tech SMEs to put thought into the best methods of strengthening their innovation capabilities and agile management practices, with the aim of

improving their innovation performance. From among the different types of project management, agile management is key for enterprises to improve their R&D capabilities. Moreover, if improvements to innovation capability and agility increase performance, it is reasonable to expect competitive advantage to grow as well. For these reasons, the matter of strengthening innovation capabilities and agile management practices gains significant importance.

With the acceleration in global industrial change brought about by the emergence of new technologies, enterprises operate in increasingly complex and uncertain business environment. Innovation is the inevitable choice for enterprises to succeed under such circumstances (Chen & Zheng, 2016; Dess & Beard, 1984; Humble, Molesky, & O'Reilly, 2015; Tushman & O'Reilly III, 1996).

The survival and sustainable development of enterprises depend on their ability to identify new business opportunities and create value for customers. To this end, innovation activities are required. Theoretical and practical research alike have confirmed that the innovation capability of enterprises is becoming the most important determinant of firm performance (Ashrafi, Ravasan, Trkman, & Afshari, 2019; Mone, McKinley, & Barker III, 1998; Stieglitz, Knudsen, & Becker, 2016). However, the relationship between innovation and performance is unclear given the non-linear and high risk nature of innovation, which leads to the adage that enterprises that do not innovate die, even though innovating can also lead them to die. Clarifying the relationship between innovation and firm performance has always been an important research topic in the field of innovation research. Unfortunately, given that existing findings are fragmented and there is a lack of interdisciplinary studies, it is difficult to accurately explain this relationship. Studies often regard innovation from three isolated perspectives (*i.e.*, leadership, management, and business process), falling short of offering full explanations (Crossan & Apaydin, 2010; Humble *et al.*, 2015).

Process management methods such as lean manufacturing and agile development itself, with their “trial and error” approaches, have led practitioners to implement “fast iterative” methodologies, with the purpose of conducting innovation activities progressively and with reduced risk. Accelerated innovation is the underlying goal, taking advantage of accelerating technological developments and resulting in enhanced competitive advantage. This goal has three main drivers. First, the Internet and social media provide powerful tools for consumers to express choices and many new channels for organizations to discover users and customers. Second, advances in technology and processes have made it possible to rapidly create and

evolve disruptive products and services with smaller inputs. Finally, more advanced software has been supporting increasingly rapid innovation.

The perspective of innovation speed as resulting in competitive advantage mainly focuses on rapid responses to customer demands, which amounts to passive innovation, emphasizing innovation efficiency. It ignores active innovation and innovative effectiveness, especially breakthrough or disruptive innovations that create new businesses or new business models. The increasingly ubiquitous deployment of information technology (IT) has enabled many enterprises to pay more and more attention to lean agile methods (Zeng *et al.*, 2018). Nevertheless, existing methods and practices are often scattered, and bring only partial and unsystematic improvements for enterprises. The lean agile practices of many enterprises are limited to their R&D departments, especially in the development of IT projects. In addition, the degree of overall performance improvement for the organization is very small (Humble *et al.*, 2015). When enterprises try to manage innovation activities through process optimization, they are faced with a paradox: while uncertainty is at the heart of innovation, the core concept of lean agile is to carry out continuous and repeated experiments to reduce waste and minimize the number of project cycles, while maximizing creativity and value. Relying as they do on standardized working methods to form the innovation hypothesis, lean agile methods represent gradual improvements through incremental learning. Some studies have shown that incremental learning based on process optimization could lead to "myopic" organizational learning, pointing out that organizational learning promotes exploratory technological innovations (Stieglitz *et al.*, 2016; Zeng *et al.*, 2018). If these are sacrificed, enterprises may face obstacles in gaining a sustainable competitive advantage.

Most project managers we interviewed think that the relationship between agility and project performance is affected by various factors such as team size, task characteristics and type of industry, further considering that agile management applies only to the IT software domain. However, senior managers – especially agile experts in higher management – insist that agile management thinking can be applied to different levels of enterprise management. They further consider that enterprises' innovation capability relate to the ability to synthesize knowledge and technology, integrating all aspects of organizational capability (*e.g.*, employees, technology, information, and management systems). This study, then, considers innovation capability as a proactive factor that influences enterprise agility. The combination of innovation research at the organizational management level and at the business process level not only enriches theoretical research but can also guide enterprises to implement agile

management.

There is an inconsistency pertaining to the relationship between agility and performance in the academic field as well. While a large number of findings suggest that enterprise agility positively correlates to firm performance, recent research (Ashrafi *et al.*, 2019; Chen & Zheng, 2016; Stieglitz *et al.*, 2016) proposes that, in a dynamic environment, the best performers are not the most agile enterprises. As such, it is of great theoretical and practical importance to analyze factors affecting agility and firm performance.

Innovation is a core strategic activity of science and technology enterprises as well. One of their key challenges is to break through resource constraints and improve the efficiency of resource utilization, which they can do by combining different types of innovation or lean agile management. Compared to large enterprises, high-tech SMEs are faced with more resource constraints and the efficiency and effectiveness of their innovation have a greater impact on their survival and growth. Nevertheless, SMEs are more flexible than large enterprises and are thus better able to employ agile management.

The research object of this study, then, is high-tech SMEs in China. We will conduct a systematic empirical analysis at the enterprise level to describe the relationship between enterprises' innovation capability, agility and performance. This research is significant not only in combining the theory and practice of innovation but also in its value to SMEs as a guide for the implementation of their innovation strategies.

As for the theoretical significance of this study, our review of the literature found that most scholars give no consideration to examining the effect of the innovation atmosphere and environmental dynamics on enterprises' innovation capability, agility, and performance. This study examines the relationship between agility and innovation and adds a number of other variables to address gaps in the existing research. It takes the innovation atmosphere and environmental dynamics into account and considers innovation capability and agility from the perspective of the organization as the main beneficiary. The research carried out in this thesis is exploratory and innovative, enabling the discovery of new models in this field of knowledge.

With regard to the practical significance of this study, we note that most analyses of enterprises consider innovation and agility in isolation – not considering their interactions or their practical impact in the enterprise. This leads practitioners to separate enterprise innovation from enterprise agility and, beyond that, from the organization as a whole. The joint application of these concepts, then, is not only necessary but also of great value to SMEs

– especially high-tech SMEs. This research also provides enterprises with scientific approaches for improving their performance through developing their innovation capability and their project agility, in view of interactions with innovation atmosphere and environmental dynamics. It thus has a broad scope of application and is of significant importance for enterprises facing high competition with regard to the speed of product/service development, such as high-tech SMEs.

1.2. Research Questions and Objectives

Drucker (1984) states that innovation is a special tool for entrepreneurs to acquire sustainable competitive advantage. Through innovation, entrepreneurs can transform changes into opportunities for different businesses and services. Innovation is twofold: push and pull. The challenge for enterprises seeking proactive change is to create new business spaces for emerging technologies and to control strategic resources in new business areas to gain competitive advantage in the future. Enterprises must cope with environmental change by correctly recognizing opportunities and making quick and accurate decisions to gain first-mover advantage or to destroy and suppress their competitors' competitive advantage (D'aveni & Ravenscraft, 1994). Based on the Resource-Based View (RBV) and on dynamic capability theory, combined with literature on organizational learning and agile management, this study analyzes the impact of SMEs' innovation capability on project agility and firm performance, especially the mediating mechanism of project agility between innovation capability and firm performance. In addition, the moderating effects of innovation atmosphere and environmental dynamics are also studied. We believe that innovation capability, as an important transversal capability, affects the deployment of project agility and further affects the performance of enterprises by improving the resource and capability base of enterprises in response to environmental changes. Following this, the main questions the study aims to address are:

1. What impact does the introduction of project agility bring to enterprises?
2. How does innovation capability affect enterprises' project agility?
3. How does project agility affect enterprises' performance?
4. What is the mechanism through which innovation capability can enhance enterprises' project agility and further enhance their performance?
5. How does the innovation atmosphere affect the relationship between innovation

capability and project agility, as well as the relationship between innovation capability and firm performance?

6. How do environmental dynamics affect the relationship between project agility and firm performance?

To answer these questions and achieve our research objectives, we will introduce the main topics and conduct a detailed literature review on the themes of innovation capability, project agility, firm performance, innovation atmosphere, and environmental dynamics. We then analyze the relationships between those elements, forming a theoretical framework focusing on the problematic of this study. We will moreover explore a comparative study for typical high-tech SMEs, obtaining a comparative analysis, and will collect data through a survey. Having conducted the reliability and validity tests for several variables, we will empirically research the system mechanism of how project agility and innovation capability affect firm performance, also taking into account the impact of the innovation atmosphere and environmental dynamics.

In the end, we indicate the results, draw the main conclusions, and point to limitations and areas of future research. The main conclusions confirm that valid hypotheses were produced and that valuable advice is offered to the management of high-tech SMEs in China.

1.3. Structure

This study aims to build a mechanism describing how innovation capability and project agility affect innovation performance in high-tech SMEs in China, selecting two typical companies as the research object. It is organized as follows.

Chapter 1 identifies a number of questions to be addressed. These include the reasoning for the selection of the subject of the thesis. Once introduced the background, significance and problematic of the thesis, this chapter presents the research objectives, structure, methodology, and expected results. *Chapter 2* reviews and summarizes existing literature on innovation capability, RBV, project agility, firm performance, and dynamic capability theories. *Chapter 3* builds an exploratory case study for two typical technical companies, going on to construct a theoretical model for the mechanism whereby innovation capability and project agility affect performance, taking into account the role of the innovation atmosphere and environmental dynamics. This chapter also proposes six hypotheses. *Chapter 4* outlines the research design and data collection, develops the empirical

research for structural equation modeling, and verifies the validity and reliability of several variables. The chapter also carries out a regression analysis and verifies the six hypotheses, confirming five of them. *Chapter 5* includes the main conclusions, outcomes, and limitations of the research. It also suggests future areas of research and makes a number of contributions to management guidelines. *Figure 1-1* presents the overall structure of the thesis.

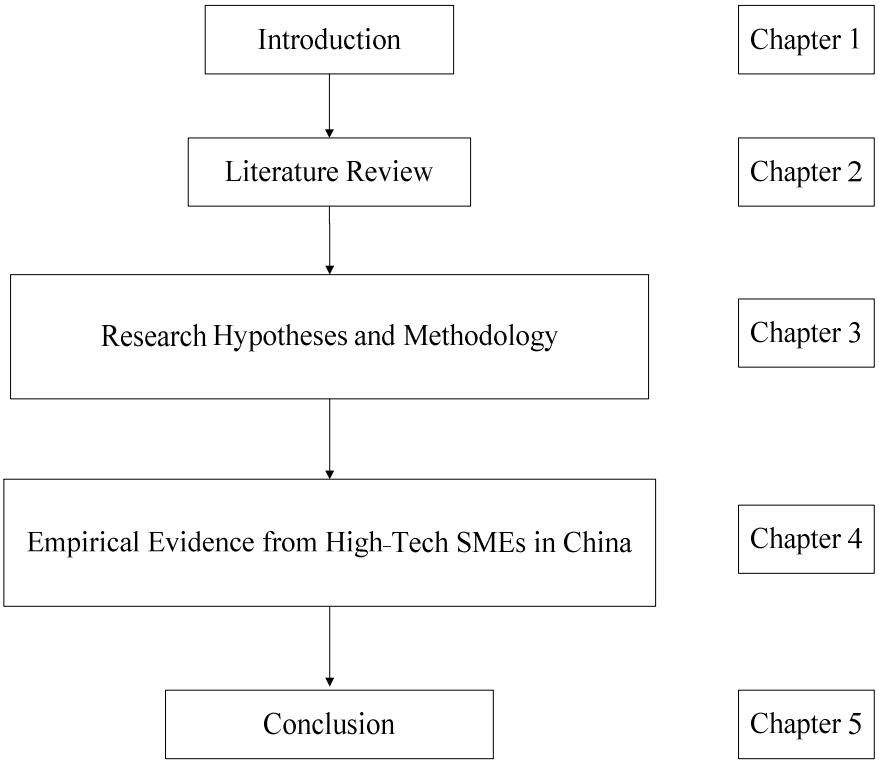


Figure 1-1. Thesis Structure.
Source: Author's Elaboration.

1.4. Methodology

In this thesis, the analysis of the literature, expert interviews and empirical research methods are combined to analyze, model, and verify research questions. The study not only enriches the theory of innovation and dynamic capabilities relating to the promotion of agility but also provides a guiding scheme for enterprises to respond to economic transformation and improve the overall agility of the organization.

Literature and case studies on agility, innovation capability, RBV and dynamic capabilities were examined and systematically analyzed to identify any gaps in existing research and formulate new questions of interest. This effort resulted in clarifying the logical relationships between each theoretical construct, thus laying a good foundation for the empirical research that would follow.

Relevant experts (*i.e.*, scholars and enterprise managers) were interviewed and offered their comments on the theoretical and scientific logic of the initial model developed in this study. The initial model was then modified according to their suggestions. Managers came from enterprises of different types, sizes, and industries, offering their opinions on methods and approaches to improve the agility of enterprises. These comments contributed to further refining preliminary research assumptions and models.

Empirical research methods were also employed, namely a number of targeted practical case studies were collected, allowing to investigate and summarize the characteristics of relationships between constructs in this study, aided by the vast amount of literature reviewed. The preliminary research allowed us to further modify the initial questionnaire.

1.5. Expected Results

As already pointed out, this study aims to build a mechanism describing how innovation capability and project agility affect innovation performance in high-tech SMEs in China, selecting two typical companies as the research object. In broad terms, this means that the following points are expected to be addressed: (1) analysis of the correlation between project agility, innovation capability and firm performance; (2) comprehension of the adjusting role of innovation atmosphere and environmental dynamics; (3) development of a theoretical model of the system mechanism; and (4) structural equation modeling and hypotheses. In this sense, we expect to propose and construct a new model for the mechanisms through which innovation capability, project agility, and firm performance interact not only with one another but also with the innovation atmosphere and environmental dynamics, thus contributing to the development and refinement of the theory of project agility and firm performance.

Additionally, after the conclusion of the study, it is expected that the insights obtained can support high-tech SMEs' managers by providing guidance to project agility practices and improving their firms' performance. Considering the research context of this study, it is expected that the results obtained can help Chinese managers to understand patterns of firm development, enabling them to formulate well-adjusted development strategies to achieve growth. The publication of the results obtained in this study in a prestigious academic journal is also an expected outcome.

Synopsis of Chapter 1

This chapter describes the introduction of the study, the topic's selection and background, and the theoretical and practical significance, problematic, objectives, structure, methodology, and expected results of the research. The main purpose of the chapter is to propose research problems and set research objectives, to outline the research framework, and to clarify the research methods used. The study employs exploratory research, based on the literature, of high-tech SMEs that apply agile project management practices. The research model relating innovation capability, project agility and firm performance is constructed and the external adjustment role of innovation atmosphere and environmental dynamics are considered. The chapter builds the overall research framework and technical direction of the study, introducing the research method and the overall structure of the thesis, emphasizing the in-depth and detailed analysis of the research problematic by combining literature analysis and empirical research. Finally, this chapter presents the expected research results of the study, describing four issues and proposing a number of hypotheses. The four issues are the correlation between project agility, innovation capability and firm performance, the adjusting role of innovation atmosphere and environmental dynamics, the theoretical model of the system mechanism, and the structural equation modeling and hypotheses.

Chapter 2: Literature Review

This second chapter focuses on the literature review. A number of relevant references are presented and summarized, allowing the theoretical background of the study to be presented. Specifically, it analyzes the principles of the Resource-Based View (RBV) and the baseline concepts of innovation, agile project management and firm performance, which are key to contextualizing the research carried out. The chapter also describes the concept of SME, and the importance of SMEs to the Chinese economic landscape.

2.1. Resource-Based View and Innovation Capability

The proposition of the theory of enterprise capability comes from the explanation on the source of enterprise competitive advantage in the fields of economics and strategic management. There are two main perspectives on the explanation of the source of competitive advantage, namely: (1) market structure theory; and (2) strategic resources theory.

First, the theory of market structure can be divided into early stage and modern stage. The early stage representatives of the market structure theory are Mason (1939) and Bain (1959). They put forward the Structure-Conduct-Performance (SCP) paradigm, and believe that the industry structure determines enterprises' conducts and behaviors, and then the behavior of R&D pricing and marketing determines the organization's performance. By the 1980s, scholars represented by Porter (1985) had developed this idea. They believe that the industry in which the enterprise is located and the position of the enterprise in the industry become key-factors to determine whether the enterprise could gain competitive advantage. The core idea of this academic theory is that the characteristics of industry structure are the source of competitive advantage of enterprises. However, due to the overemphasis on external factors, such as the decisive role of the industry in which enterprises are located, it pays less attention to the heterogeneity among different enterprises and the relationship between the heterogeneity and competitive advantage.

Second, for the theory of strategic resources, the main representative is Penrose (1959). In Penrose's (1959) book, *The Theory of the Growth of the Firm*, the author elaborates on the process of enterprise growth and its constraints and tries to open up the black box of

enterprise. Penrose (1959) holds that: (1) the enterprise is a management structure that uses the resources it owns and controls to obtain profits; and (2) the growth of the enterprise is mainly limited by the production resources and regulatory agencies coordinate the use of production resources. Penrose (1959) believes that, because the production resources controlled by enterprises may have significant differences among enterprises, there is heterogeneity among enterprises.

Since the 1990s (*i.e.*, Sutton, 1999), the general hypothesis of the market structure theory is that enterprises in the same industry have homogeneity, so it is impossible to answer the question, why are there significant performance differences among enterprises with the same industry, similar scale and similar strategy in the real world? So the answer can only be sought from within the enterprise. Based on the theory of Penrose (1959), the research on enterprise competence in modern times has gradually evolved into four theoretical branches, namely: (1) resource-based view; (2) core capability view; (3) dynamic capability view; and (4) tacit knowledge view. First, the resource-based view is based on the internal resource endowment of enterprises to study the heterogeneity of enterprises, and the scarce strategic resources are the main source of competitive advantages of enterprises. Compared with the SCP analysis paradigm, it has taken a substantial step in opening the enterprise black box. However, there are limitations in this theory, which are mainly reflected in two aspects: (1) the heterogeneity of enterprises is simply attributed to the heterogeneity of initial resources, ignoring the creation of new resources in the process of enterprise growth; and (2) the analysis unit is confined to the enterprise itself, ignoring the importance of the external environment. Second, the main point of view of core capability is that resources themselves have no productivity, and the competitive advantage of enterprises depends on how enterprises use existing core resources to enter different product markets. Compared with previous studies, this theory puts forward a path for enterprises to develop and grow based on existing resources and capabilities. However, the theory also has obvious theoretical defects, mainly reflected in three aspects: (1) still focusing on improving the static efficiency of existing resources, only studying the allocation method of internal existing resources between different uses; (2) the analysis unit is still confined to the enterprise; and (3) accompanied by the market characteristics change from stable, linear predictable to dynamic and complex direction, the rigidity limitation of core capability becomes more and more prominent. Third, the main point of dynamic capability view is that in the rapid environmental change, the ability to perceive the market and restructure the enterprise's asset structure needs, and to

complete internal and external transformation is the source of enterprise's competitive advantage. In this theory, capability is placed in a dynamic environment, and the resource diachronic leapfrogging allocation with the change of environment is studied, which is no longer confined to the enterprise itself, and the resource interaction and transformation inside and outside the enterprise are also studied. Similarly, the theory also has some shortcomings, which are mainly reflected in the emphasis on short-term competitive advantage, negating the path dependence and non-imitation of a sustainable competitive advantage of an enterprise. Finally, for the tacit knowledge theory, the main point of this theory is that knowledge is difficult to copy or imitate by individuals or teams, which makes enterprises heterogeneous and gains competitive advantage. Compared with dynamic capability, the tacit knowledge theory explains the possibility and rationality of the existence of sustainable competitive advantage. At the same time, this theory also has some limitations, mainly reflected in the abstract study of concepts and theories, lack of concrete research with corporate background (Leonard & Sensiper, 1998).

Different from the theory of market structure, the theory of enterprise capability derived from the strategic resource theory and first recognizes the existence of heterogeneity among enterprises from the point of analysis logic. It no longer regards enterprises as an inseparable atom in the environment. It mainly turns the search for the source of enterprise competitive advantage from the outside to the inside of enterprises. According to the theory of enterprise capability, the special resources with the RVIN attributes of rareness (R), value (V), imperfect imitability (I), and non-substitutability (N), and the related organizational capabilities are the key to identify and utilize the external favorable opportunities, determine the strategic positioning and gain competitive advantage. But at the same time, the four branches of the theory have both breakthroughs and limitations on how to gain and maintain competitive advantage. Among them, the concept of dynamic capability breaks through the limitations of the previous industrial and market structure theory and the static analysis of resource view, opens up the black box of the process of resource creating competitive advantage, makes up for the limitations of resource view and core capability theory to a certain extent, and explains the source of enterprise's sustainable competitive advantage. It has received extensive attention and in-depth research in the field of academia and enterprise management practice. Generally speaking, there are still some deficiencies in the research of dynamic capability theory in the theoretical circles, which are mainly manifested in the following aspects: (1) too much attention is paid to the research of dynamic capability

formation mechanism, thus ignoring the construction of conceptual framework to a certain extent; and (2) dynamic capability dimension is divided into multiple and divergent dimensions, which leads to the construction of dynamic capability possesses concepts and cannot be measured, so the empirical study of dynamic capabilities is relatively inadequate.

Resource-Based View (RBV) refers to the transformation of general enterprise resources into specific resources and, subsequently, into valuable products (Peteraf, 1993). The subtle transformation process within the enterprise constitutes the unique competitiveness of the enterprise (Barney, 1991).

One of the pioneering scholars who recognized the importance of resources to the competitive position of the enterprise was Penrose (1959), who suggested that enterprise is the combination of a series of productive resources, and that the impact of resources on the competitive position of enterprises depends on both the type and the extent of resource use (Penrose, 1959). Rubin (1978) argues that the nature of an enterprise is that of a resource bundle. Based on Penrose and Rubin's knowledge of resources, Wernerfelt (1984) attempted to develop a resource-based perspective into a formal theory. A few years later, Barney (1991) published a study in the *Journal of Management*, which led RBV to becoming one of the most widely accepted theories in strategic management (Powell, 2001; Priem & Butler, 2001). An integrative theoretical framework to establish a link between enterprise resources and sustainable competitive advantage is presented in *Figure 2-1*.

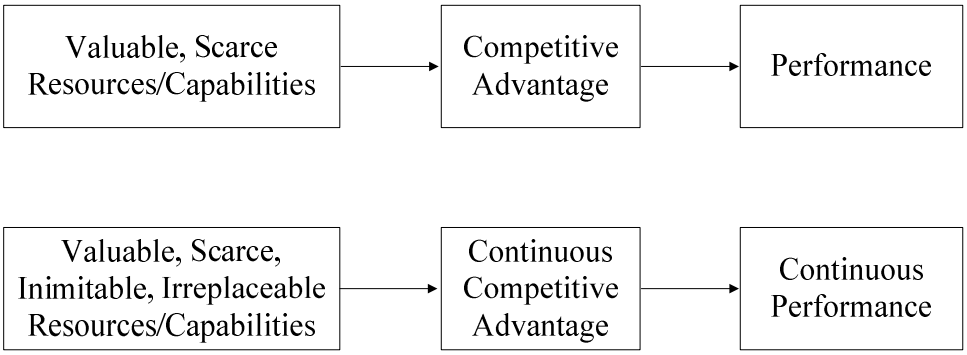


Figure 2-1. Resource-Based View Thinking.
Source: Author's Elaboration.

Compared with the traditional five-force model and the Strengths, Weaknesses, Opportunities, and Threats (SWOT) analysis, RBV has two distinct assumptions. First, the enterprises within the same industry are heterogeneous and can control different strategic resources. Second, the heterogeneous strategic resources of the enterprise are not easy to flow, for which reason they are durable. The sustainable competitive advantage of enterprise

resources has four major characteristics, namely: value, rareness, imperfect imitability, and non-substitutability (Barney, 1991). Value means that the resource is valuable for the firm and it is the foundation for the firm to conceive and execute enterprise strategy. Rareness means resources are possessed by few, bringing them competitive advantage. Imperfect imitability means resources are formed by a number of conditions such as historical uniqueness, vague causes, and social complexity, which generally cannot be copied by others. Non-substitutability means resources can hardly be replaced, constituting the core competitiveness of the firm.

Dynamic capability theory is a new and extended branch of strategic theory based on RBV. Given that the initial RBV analysis framework was static (Priem & Butler, 2001), it did not open the black box of how resources generate competitive advantage (Barney, 2001). In order to make up for the missing link between resource possession and resource utilization, scholars had turned their focus toward the heterogeneous capabilities of enterprises that can leverage resources (Ashrafi *et al.*, 2019; Henderson & Cockburn, 1994; Mahoney & Pandian, 1992; Peteraf, 1993). Subsequently, a significant amount of research was conducted, which relate to how firms use and leverage resources to gain competitive advantage from various perspectives. From a knowledge perspective, Leonard‐Barton (1992) proposes the construct of core competence, defined as the knowledge set (*i.e.*, including firm's knowledge embodied and embedded in the technical systems, managerial systems, and the process of knowledge creation), that distinguishes and provides a competitive advantage. From a combinative perspective, Kogut and Zander (1992) propose the construct of combinative capabilities, which was defined as the intersection of the capability of the firm to exploit its knowledge and the unexplored potential of the technology, or the degree of technological opportunity. From the organization theory perspective, Russo and Fouts (1997) propose organizational capabilities, including culture, commitment, and capabilities for integration and communication.

Based on the integration of previous capability constructs, Teece and Pisano (1994) pioneered the theory of dynamic capabilities. The authors define dynamic capabilities as *"the ability to integrate, construct and reconstruct internal and external capabilities that firms possess to cope with rapid changes of external environment"* (Teece & Pisano, 1994). The term "dynamic" refers to the mobility of the environment, which requires firms to adopt a specific strategy to respond to the changes of the market, to accelerate innovation speed, and to compete in emerging markets. "Ability" refers to the correct adjustment, integration and

restructuring of the organization's internal and external skills, resources and functions to meet the needs of the changing environment (Teece & Pisano, 1994). Sometime later, Teece, Pisano, and Shuen (1997) further improved the theory of dynamic capability, proposing that the competitive advantage of enterprises comes from the integration of assets, processes and evolutionary paths. Other scholars have also conducted in-depth studies from different perspectives, as shown in *Table 2-1*.

Dynamic capabilities emphasize management capabilities and inimitable combinations of resources that cut across all functions, including R&D, product and process development, manufacturing, human resources, and organizational learning. An explicit examination of innovation is usually omitted in the discussion of dynamic capabilities. However, as a key mechanism for organizational growth and renewal, innovation is implicitly central to the theory. As McGrath, Tsai, Venkataraman, and MacMillan (1996) notice, since innovation is at the heart of firms' processes to use resources to form a competitive advantage, innovation is indispensable. Innovation is the key source for enterprises to gain competitive advantage in a fast-changing environment (Ashrafi *et al.*, 2019; Dess & Picken, 2000; Malagueño, Lopez-Valeiras, & Gomez-Conde, 2018; Tushman & O'Reilly III, 1996).

The most widely accepted definition relates to five innovative forms presented by Schumpeter (1934): (1) new products or quality of products; (2) new production methods or new processes; (3) opening up new markets; (4) new sources of raw materials; and (5) new organizational structure. Existing research (*e.g.*, Drucker, 1984) regards innovation as a special tool for entrepreneurs to discover new opportunities through change. Although Schumpeter's (1934) innovation research scope clearly defines it at the enterprise level, and locates the focus of innovation in new products, processes, and business model, several innovation definitions extend its connotation to include the conditions of successfully implementing process, diffusion, and profitability. On the basis of reviewing the literature of innovation research, Crossan and Apaydin (2010) define innovation as: (1) the creation or adoption, digestion and utilization of novel things that can add value to the economic and social scope; (2) updating and expanding products, services and markets; (3) developing new production methods; and (4) implementing a new management system.

Table 2-1 *Definitions of Dynamic Capability*

References	Definition
Teece and Pisano (1994)	A set of competencies and capabilities that enable an enterprise to create new products, processes, and respond to changes in the market environment.
Teece *et al.* (1997)	The ability of enterprises to integrate, build and reconstruct internal and external capabilities in order to cope with the rapidly changing environment.
Eisenhardt and Martin (2000)	To respond to or even create market changes, companies use resources, especially those processes which include integration, restructure, increase, and transfer resources. Therefore, dynamic capability is the organization and strategic path of the acquisition of new assets following with the emergence, conflict, division, evolution, and demise of the market.
Winter (2003)	The ability to extend, adjust, or create conventional capabilities is the ability of an enterprise to build, integrate, and reorganize resources and capabilities to adapt to a rapidly changing environment.
Teece (2007)	The ability to perceive and seize opportunities quickly and skillfully. It can be divided into three categories, namely: (1) perception and shaping opportunities and threats; (2) seizing the opportunity; and (3) maintaining competitive advantage by strengthening, combining, maintaining, and reconstructing the tangible and intangible assets of the enterprise when necessary.
Wang and Ahmed (2007)	To obtain and maintain competitive advantage, enterprises continue to integrate, reorganize, update, reengineer its resources and capabilities, the most important thing is to upgrade and transform its core capabilities in response to the behavior of the changing environment.
Pavlou and El Sawy (2011)	Expand, adjust, and channel new configurations of existing operational capabilities to cope with changing environments.

Source: Author's Elaboration.

Innovation not only emphasizes the innovation subject, such as developing novel things, updating novel things, new production methods, and novel management system, but also emphasizes the acquisition of Schumpeter's (1934) rental right, especially the dominant right of value acquisition which depends fundamentally on the "deep-seated ability of enterprises" (Francis & Bessant, 2005) (*i.e.*, the firm's innovation capability/ability). Research has found that innovation ability is among the most important determinants of firm performance (Mone *et al.*, 1998). But what is innovation capability?

Firms' innovation capability/ability can be interpreted in a generalized sense and in a narrow sense. The former refers to the sum of internal factors of different innovation abilities of the same system, which includes the enterprise's management innovation, system innovation, technological innovation, and organizational innovation. In the narrow sense, innovation ability generally refers to the technological innovation ability of enterprises. Based on the concept of technological innovation proposed by Mansfield (1968), innovation ability was originally defined as *"the enterprise produces new products, new technology and the ability to improve existing products and process"* (Mansfield, 1968).

For the understanding of innovation ability, starting from different theoretical perspectives, opinions vary. From the technology innovation perspective, Mansfield (1968) defines innovation ability as the ability of enterprises to produce new products and new processes and improve existing products and processes. From the perspective of strategic management, Burgelman and Maidique (1996) argue that innovation ability refers to a series of comprehensive abilities of the organization in support of the innovation strategy: product and process innovation capabilities which, combined with financial capability, could achieve the technological innovation strategy of a certain firm (Wei & Xu, 1996). For the knowledge-based theory, Kogut and Zander (1992) argue that innovation ability refers to the ability to mobilize the internal knowledge within the organization (including employees) and combine it to create new knowledge leading to generate product or process innovation. Together with other organizational abilities, innovation ability allows firms to absorb, control, and improve existing technologies effectively and to create new technologies.

Existing definitions of innovation ability can be divided into three categories. The first category recognizes innovation ability from the perspective of ability itself (*i.e.*, this perspective holds that innovation ability refers to the ability of individual or organizations of generating a large number of ideas) (Calantone, Cavusgil, & Zhao, 2002; Mansfield, 1968). The second one regards innovation ability from the perspective of behavior or process. This

view holds that innovation ability is a process to produce a novel and useful object (Burgelman & Maidique, 1996; Lawson & Samson, 2001). The third one recognizes innovation ability from a view of results, clarifying that innovation ability is to produce a novel and meaningful object (Ashrafi *et al.*, 2019; Crossan & Apaydin, 2010; Kogut & Zander, 1992).

Based on the comprehensive analysis literature on the definition of innovation ability, we proposed that innovation ability is the ability to continuously transform knowledge and creativity into new products, new processes, and new systems. In the process of transformation, firms cannot only meet the requirements of different customers on technical ability. More importantly, they should coordinate all aspects of resources to accomplish reasonable support for the innovation of the enterprise. The nature of innovation ability is the sum of organizations' knowledge and technology, reflected in the organizations' human resources, technology system, information system and organization and management system (Chen & Zheng, 2016). The essence of innovation ability is knowledge. According to RBV, the innovation ability of different enterprises is heterogeneous, creating differences in their innovation performance.

Innovation ability is among the most important determinants of firm performance (Mone *et al.*, 1998). However, because of the multi-dimensional nature of innovation ability and different theoretical perspectives of innovation process view and innovation result view, the black box of innovation ability and firm performance relationship is not completely opened. The research of Calantone *et al.* (2002) founds that the innovation ability of enterprises is to seek change and adopt innovation, and is positively correlated with the profitability of enterprises. In their study, firm performance was evaluated using the metrics of Return on Investment (ROI), Return on Assets (ROA), and Return on Sales (ROS). The product research of Cooper (1985) focuses on the relationship between product development strategy and product performance of the enterprise. The study of Klomp and Van Leeuwen (2001) constructs a feedback model which verified the positive correlation between firm performance and innovation process. In these studies, firm performance is measured by three indicators which include sales revenue, growth rate of sales revenue and employees. Li and Calantone (1998) develop a positive relationship between product advantage and market performance (pre-tax profit, market share and ROI). Noticeably, the above studies regard innovation as a process or ability, and not as a result.

Scholars who favor the results of innovation, such as Zaheer and Zaheer (1997), see

innovation as a dependent variable rather than a moderating variable for performance. Understanding innovation ability to produce innovative results and ultimately affect the performance of enterprises is the key content of innovation management. But the existing research on innovation does not answer the question very well. One possible way to advance this research is to test the link between innovative determinants, innovation results and firm performance.

In practical terms, a firm's innovation capability is always related to or embodied by the firm's flexibility, which was defined as agility. The essence of agility is the flexibility of the firm when facing the environment and customer needs. This flexibility not only refers to the "adaptability" of the enterprise, but also to the ability of the enterprise to cope with the changes of the environment. In the following section, we will introduce the concept of agility, and its applications mainly at the project level.

With the popularization and deepening application of IT in enterprises, IT capability is an important part of enterprise innovation capability, and it should be matched with other resources and capability to gain competitive advantage through innovation (Stoel & Muhanna, 2009). The relationship between IT and enterprise competitive advantage or organizational performance has been widely concerned and followed up by continuous research in academia, which has resulted in different research paths. The understanding of the innovation effect of enterprise information technology or business value of information technology can be summarized into three types: (1) asset view; (2) resource view; (3) capability view.

Asset view regards IT as an ordinary member of the enterprise's production factor portfolio. Enterprises can adjust the investment scale of IT at any time according to the price changes to achieve the goal of maximizing profits. From this point of view, the concepts of IT can be roughly divided into five categories: (1) instrumentalism; (2) agency theory; (3) set theory; (4) computing theory; and (5) nominalism. The instrumentalism regards technology as a well-designed artifact, such as an alternative to manual tools, tools to improve production capacity, tools to process information and tools to change social relations. The logic behind instrumentalism is that information technology is a relatively problem-free computing resource. In other words, instrumentalism focuses on the technical performance of information technology. Agency theory is similar to metonymy rhetoric, referring to information technology with one or several key features of IT. The common three kinds of metonymy relate to using technology application, diffusion rate and technology investment to refer to IT. The logic behind the agency theory is that the key features of IT can be described

by some representations or measures, so this view simplifies information technology into a specific attribute. Set theory regards IT as a core element in the social and economic background, rather than merely emphasizing its technical performance. This view focuses on human-computer interaction, and there are four main variants: development project tools, production network tools, embedded system tools and structural tools. Set theory focuses on how IT is developed and applied in specific social environments. Computing theory directly focuses on the computing power of IT, including the research and development of algebra, data model, data simulation and so forth. Nominalism refers to IT as an occasional term or background information without any technical background.

In the field of business value research of information technology, many researchers have been adopted and used the above five viewpoints, except computing theory (Mukhopadhyay, Kekre, & Kalathur, 1995; Melville, Kraemer, & Gurbaxani, 2004). Among these four viewpoints, nominalism simply borrows the name of IT without the reality of IT; set theory uses a large number of qualitative research methods to study the value of IT in the social context of living reality; while instrumentalism and agency theory derive some formal concepts of IT, and mainly use definite methods to make the study of quantitative research. It is worth mentioning that instrumentalism researchers' focus on a specific system and its application in a specific business context, assuming that IT is a tool for the purpose of generating value. For example, in the study of Clemons and Row (1991), IT is regarded as a commodity, and it is demonstrated that IT is a strategic necessity, and it transmits advantages by utilizing complementary organizational resources already existing in the organization. The implicit assumption of this study is that IT provides value by increasing internal and external coordination effects, but in competitive factor markets, because IT can be acquired by all participating enterprises, this advantage is not sustainable. In the theory of agency, IT is the most widely used agent logic for investment in the view of assets. Researchers refer to IT by the amount of capital investment. Supporters of this view believe that economic investment in IT is a useful indicator of its value to enterprises or economies. In fact, a large number of studies on business value follow the logic of this view, and there are so-called investment paradox and a series of studies on the relationship between investment and organizational performance (Melville, Kraemer, & Gurbaxani, 2004; Zhu & Kraemer, 2005).

From the above outlook of review of asset view, we can see that under this view, IT resources can be obtained equally for all members of the market, and it is a homogeneous financial capital, which is in line with the assumption of homogeneity of enterprises by the

industry or market structure theory. Under this view, IT cannot become the source of industry competitive advantage of an enterprise.

Under the view of asset, there is no difference in the content of enterprise IT, only in the amount of investment. Under this logic, IT investment and income should show a linear correlation. However, the emergence of investment paradox makes the theoretical and practical circles begin to rethink the connotation of IT.

Mahoney and Pandian (1992) put forward the resource-based view of innovation capability, which has a far-reaching impact on the field of strategic management. Since then, the applicability and limitations of RBV have been widely concerned and discussed in strategic management and other fields (Barney, 2001). The resource view attributes the organization's good performance to the RVIN characteristics of resources (Barney, 1991). From this point of view, the implicit premise of the RBV theory is that because organizations have heterogeneous and fixed (*i.e.*, difficult to move, sustainable) resources and capabilities, enterprises can maintain performance advantages by increasing resource to imitate barriers and transfer costs (Wernerfelt, 1984). RBV theory has contributed a lot in explaining the role of innovation capability on organizational performance (Melville, Kraemer, & Gurbaxani, 2004; Wade & Hulland, 2004). Unlike goodwill or other enterprise assets that are not imitated by other enterprises, the contribution of innovation resources to organizational advantages is through its combination with organizational culture, organizational structure, organizational capability and other complementary resources. Wade and Hulland (2004) argue that information technology can help enterprises acquire customer data resources with strong specificity and characteristics of value, rareness, imperfect imitability, and non-substitutability, thus contributing to the achievement of performance advantages. Santhanam and Hartono (2003) advance the research samples of Bharadwaj (2000). Through adjusting and optimizing for these samples and reaching the same conclusion, its research also shows that the performance advantage generated by innovation capability has a certain sustainability and persistence. Radhakrishnan, Zu and Grover (2008) make research from the perspective of enterprise operation studies, and the results show that information technology can create managerial and operational efficiency which is unique, difficult to imitate and Irreplaceable and difficult to transfer, and it helps enterprises to form long-term competitive advantage. Wade and Hulland (2004) argue that innovative assets may have little direct impact on sustained competitive advantage, and that there may be a complex value transformation and transmission chain between resources, assets and sustained competitive

advantage. Clemons and Row (1991) believe that information technology assets are only necessary conditions for enterprises to obtain sustainable competitive advantage, not sufficient conditions.

In conclusion, the RBV provides a framework for researchers to analyze and validate the relationship between information technology and organizational strategy and organizational performance. At the same time, the theory helps to distinguish different types of information systems and the impact of different types of information systems on organizational performance (Santhanam & Hartono, 2003). Wade and Hulland (2004) point out that the concept of resource-based view is indeed very helpful to make the research of science and technology enterprises. The theory of RBV has three main contributions to the research of science and technology enterprises: (1) by defining the attributes of different resources, distinguishing science and technology resources from non-science and technology resources, and further analyzing their differences and links; (2) by defining the different attributes of scientific and technological resources, it helps to distinguish different types of scientific and technological resources and capabilities, as well as their different ways of acting on performance; and (3) it provides an effective way to evaluate the commercial value of resources, thus laying a theoretical foundation for the study of the relationship between information technology and organizational performance. Compared with the view of asset, the view of resource-based holds that the information technology assets invested by enterprises need to be combined with other resources and capabilities of enterprises to form resources with VRIN attributes so as to become the source of competitive advantages of enterprises. This kind of viewpoint acknowledges the heterogeneity of resources among different enterprises, which is in line with the branch of enterprise capability theory, namely enterprise resource-based view. From the division of the dimensions of scientific and technological assets by scholars at home and abroad, we can see that resources are more concerned with the complementary resources of human capital than assets. That is, scientific and technological resources are optimized allocation of existing assets among different enterprises through the interaction of human and material resources and the application of human capital. On the other hand, the concept of resource-based has a close relationship with the branch of enterprise theory, namely the concept of core capability of enterprises, through the introduction of human capital dimension.

The validity of RBV theory has been questioned more and more in the competitive environment, which has led to the dynamic capability theory. The difference between

organizational resources and organizational capabilities has been extensively studied in RBV literature. Amit and Zott (2001) hold that resources are all the tangible and intangible, human and non-human input elements that are controlled or owned by enterprises and can participate in the production of products and services to meet human needs. In contrast, capability refers to the ability to build, integrate and reconstruct value-based resources. Ability is often referred to as convention and invisible assets. However, whether it is called combined capability, structured competitiveness or dynamic capability, the focus of capability view is the ability to build, integrate and reconstruct established or existing resources. Eisenhardt and Martin (2000) point out that dynamic capability is the process of enterprise using resources, especially the process of enterprise integrating, reconstructing, acquiring and releasing resources to face market changes and even create market changes. Although organizational capabilities are heterogeneous, they have common characteristics.

With the increasing market changes and competition, some strategic researchers point out that performance advantage based on market position and heterogeneous resources is unsustainable (Eisenhardt & Martin, 2000; Teece, 2000; Teece & Pisano, 1994). The new dynamic competitive environment driven by economic globalization and offshore economy has eroded the long-term competitive advantage of enterprises. Therefore, the advocates of dynamic capability theory point out that only continuous innovation is the only way to gain sustainable competitive advantage. That is to say, by improving their ability to integrate tangible resources, intangible resources and skills, enterprises can improve their efficiency and effectiveness in coping with competition and market changes, and then produce performance advantages (Penrose, 1959). Efficient product development, business alliance and strategic decision-making are all realistic representations of dynamic capabilities (Eisenhardt & Martin, 2000). In the field of information systems, Sambamurthy, Bharadwaj and Grover (2003) believe that information technology affects enterprise performance through organizational capabilities such as agility, electronic options and entrepreneur alertness, and strategic processes such as capacity building, organizational activities and co-evolutionary adaptation. The authors argue that these dynamic capabilities and strategic processes affect competitive behavior and thus organizational performance.

Researchers have also proposed the concept of Network Enabling Organization (NEO) and argued that NEO is easier to survive and develop in a competitive environment (Straub & Watson, 2001). Consistent with this view, Zhu, Kraemer and Xu (2006) show that financial performance indicators, such as e-commerce capability and inventory turnover, are positively

correlated. Based on dynamic capability theory, Wheeler (2002) created a new idea and constructed a Network Enabled Business Innovation Cycle (NEBIC) model. NEBIC describes how information technology affects the growth ability of enterprises and thus creates and maintains competitive advantages. NEBIC consists of four orderly components: (1) selecting new information technology; (2) matching business opportunities with information technology; (3) business innovation based on growth purposes; and (4) evaluating customer value. NEBIC believes that the continuous innovation capability of enterprises is an essential factor in participating in the increasingly fierce market competition and a useful weapon to seize the fleeting market opportunities (Wheeler, 2002). Zahra and George (2002) extends the research of Wheeler (2002) by introducing the perspective of strategic entrepreneur function: The authors point out that although NEBIC creates new market opportunities for enterprises, enterprises are unable to identify new technologies and perceive their potential impact on performance in time because of lack of knowledge and experience. Therefore, they argue that NEBIC should introduce a strategic entrepreneurship function, so as to avoid the search perspective of enterprises confined to relatively familiar areas.

Comparing with RBV, the core capability view holds that the initial endowment formed by the combination of assets and other complementary resources of an enterprise cannot maintain its sustainable competitive advantage because the environment in which the enterprise is located is dynamic and complex rather than stable or linear predictable. The initial endowment formed by the combination of assets and other complementary resources of enterprises cannot maintain the sustainable competitive advantage of enterprises. Only the dynamic capability of continuous innovation can be called the source of competitive advantage of enterprises. That is to say, compared with RBV, the dynamic capability view focuses more on the cross-temporal allocation of assets and resources. That is, after introducing the dimension of spatial utilization of resources, the dimension of sequential utilization of capabilities is introduced also. This is in line with the dynamic capability view of branch of enterprise capability theory.

At first, the academia mainly focused on the economic method of enterprise level research, regarding enterprise as a black box, and analyzed the direct relationship between IT input and performance output. Behind this analysis is actually the logic of asset view, which holds that the resource attribute of information technology can achieve the competitive advantage of enterprises. In the absence of analysis of the process and mechanism of information technology input to performance output or the formation of differentiated

advantages of enterprises, the understanding of the strategic value of information technology is inadequate. Subsequently, after Ross, Beath and Goodhue (1996) put forward the concept of enterprise information technology capability, the research on the relationship between enterprise capability and competitive advantage has become a hot topic in academic circles. In the field of information system, more and more people are expanding the concept of information technology from simple investment (agency theory) or specific application tools (tool theory) to conceptualize information technology as resources and capabilities. It is worth mentioning that both RBV and the capability view describing resource characteristics aim at answering the basic questions why enterprises are different and how do they acquire and maintain competitive advantage. For this reason, the two views have a considerable degree of consistency in the relevant assumptions and analysis methods, which is inherent basis of the connection between them (Mallin & Susan, 2008). However, there are obvious differences between the two perspectives. The resource-based view describing the characteristics of resources adopts a balanced analysis, with static tangible or intangible assets as the research object, while the capability view mainly studies the dynamic process or behavior within the enterprise. However, the situation in reality is the alternation of equilibrium and non-equilibrium, and more of them are non-equilibrium. In the fierce market competition, the value of superior resources will be eroded constantly. This requires enterprises to strengthen their original competitive advantages, while noting the erosion of enterprise resource advantages by environmental changes and at the same time actively innovate and develop new superior resources to ensure the sustainable competitive advantage of enterprises.

From the literature review of the above-mentioned capability and competitive advantage of enterprises, the answer to the focus question of IT and performance advantage has both merits and inherent limitations. From the perspective of information system investment, IT is a financial capital. However, because it is easy to be acquired or imitated by peers, it is impossible to form an asset barrier for a long time. From the perspective of information system usage, whether information system can affect performance depends to a large extent on the matching or matching degree between IT and other tangible and intangible resources of enterprises, that is, the view of resource-based. At this time, IT is more like a human capital competition, but because of the unstable and linear environment of enterprises, accompanied by environmental changes, the matching resources between IT and organizations may lose their advantages because of their rigidity. From the perspective of sustainable operation of enterprises, whether resources can sustainably generate competitive

advantages depends on whether they can sustainably and dynamically provide resources barriers.

Because the research environment of this study is uncertain environment, the initial endowment of resources will change with the change of environment, and it does not have persistence. Only the ability to move according to the environment can guarantee the long-term competitive advantage. In view of this, under uncertain environment, IT should no longer be regarded as capital, resources or capability simply and separated, but should be based on dynamic integration of three points of view through the way of accumulation of capabilities, such as input, use and continuous use.

2.2. Agile Project Management

The world is entering an era of comprehensive information and digitalization, and the enterprises are facing the market changing rapidly. The business model and business environment of enterprises are undergoing – and will continue to undergo – tremendous changes. Successful enterprises no longer repeat the production-sales route of giants in the industrial age. They need to concentrate on responding to rapidly changing consumer needs and innovating in time to survive and develop in fierce competition (Tallon & Pinsonneault, 2011; Goodhue & Chen, 2009; Zhou & Li, 2007). In today's market, flexibility and rapid response are dominant. Organizational agility is the ability of enterprises to perceive market changes and act quickly. It has become the latest choice for organizations to cope with uncertain environments. This study will sort out the definition, characteristics and dimensions of organizational agility in the existing literature.

Agility is derived from the conceptualization of "flexibility" in the economics literature, referring to the ability to deal with (internal and external) inaccuracies and to modify the operating process and patterns. Since the appearance of the concept of agile manufacturing in 1991, scholars in different fields have produced different definitions of agility, including agile manufacturing (Iacocca Institute, 1991), agile supply chain (Reich *et al.*, 1999), agile enterprise (Sambamurthy, Bharadwaj, & Grover, 2003), and other concepts. These concepts highlight the different application scopes of agility. Agile manufacturing is the earliest theme in agility, being first proposed in the report on the 21st century manufacturing enterprise strategy by the General Motors Corporation and Iacocca Research Institute (Iacocca Institute, 1991). The core idea is an integration which emphasizes

high-quality staff, flexible production technology, flexible organization structure and flexible relationship between enterprise internal and external parts, quickly adjusting production in response to the market's unpredictable and continuous changes in demand.

The concept of agile supply chain was raised by Reich *et al.* (1999), stating that, in a competitive, cooperative and dynamic environment, the dynamic network of supply and demand can provide a rapid response to environmental changes in suppliers, manufacturers and distributors. It emphasizes managing the scheduling process of logistics, information flow and cash flow in right amount and at the right time and place. In other words, it enables the correct quantity of an object to be transacted at the right time and place. Agile enterprise refers to the enterprise actively responding to changes in market demand, achieving long-term economic benefits by quickly and continuously making sensitive and effective self-adjustments in an increasingly changing environment (D'aveni & Ravenscraft, 1994; Goldman, Nagel, & Preiss, 1995). Enterprise agility was comprehensively discussed by Sambamurthy *et al.* (2003), who point out that agility is an ability to find opportunities of innovation, to grasp opportunities in the competitive market, and to combine the necessary assets, knowledge and speed. Enterprise agility includes three competencies, namely: (1) customer agility; (2) cooperative agility; and (3) operational agility. According to Sambamurthy *et al.* (2003), lean manufacturing can be applied to the level of the enterprise's strategy, promoting an abstract concept to a higher level. Enterprise agility is no longer restricted to manufacturing enterprises, having been expanded as a requirement of service type enterprises as well (Chakravarty, Grewal, & Sambamurthy, 2013; Lee, Sambamurthy, Lim, & Wei, 2015; Roberts & Grover, 2012). Different definitions are shown in *Table 2-2*.

From the summary presented in *Table 2-2*, agility can be characterized from two main dimensions, namely: (1) variability of demand or environment; and (2) quick response to change. The agile manufacturing, agile supply chains and agile enterprises mentioned above represent specific applications of agile thinking to different levels and problem scenarios.

Table 2-2 *Different Definitions of Agility*

References	Definitions
Goldman *et al.* (1995)	The ability to thrive in a continuous, unpredictable environment, and to respond quickly to change.
Dove (1999)	The ability to manage and apply knowledge effectively.
Gunasekaran (1999)	The ability to survive and develop in a sustained and unpredictable competitive environment and adapt through rapid and selective response to changes in the market for customized products and services market.
Sharifi and Zhang (1999)	To cope with unexpected changes causing a sudden crisis in the business environment, the ability to survive and seize opportunities consists of two elements, namely: (1) respond to changes (expected or unexpected) at the appropriate time with the appropriate means; and (2) develop and utilize opportunities presented by change.
Yusuf, Sarhadi, and Gunasekaran (1999)	The ability to successfully develop and utilize a series of factors (*i.e.*, speed, flexibility, initiative, quality, and profitability), through the integration of reconfigurable resources and knowledge to improve customer-oriented products and services.
Sambamurthy *et al.* (2003)	The ability to capture opportunities by rapidly acquiring, centralizing, and reconstructing necessary assets such as knowledge and relationships to create new opportunities.
Lyytinen and Rose (2006)	This ability can be acquired by means of exploratory learning and development learning through rapid perception and response to changes in technology and business opportunities.
Neumann and Fink (2007)	The ability to respond to changes in the external environment and respond through both strategy and operations.
Bottani (2009)	The ability to respond quickly and effectively to changes in the unanticipated market demand is to meet the different needs of the customer in terms of price, specification, quality, quantity, and delivery conditions.

Source: Author's Elaboration.

Goldman *et al*. (1995) propose four dimensions of agility acquisition: (1) customer enrichment; (2) collaboration; (3) organizational change; and (4) information utilization. Sharifi and Zhang (2001) divided agility into four aspects: (1) agile driving force; (2) strategic capability; (3) agile supply source; and (4) agile capability. Tsourveloudis and Valavanis (2002) consider organizational agility is mainly embodied in four aspects: (1) production base; (2) market base; (3) personnel base; and (4) information base. Jackson and Johansson (2003) divide organizational agility into four aspects as well, namely: (1) the ability of product innovation; (2) the ability of operation change; (3) the ability of internal and external cooperation; and (4) the ability of personnel, knowledge and creativity. Overby, Bharadwaj and Sambamurthy (2005) analyze the basic ability to support organizational agility, and provided a framework to study organizational agility from the two dimensions of organizational perception and response to change. Lin, Chiu and Chu (2006) propose, from the perspective of organizational product delivery to customers, that there are three categories such as product design agility, product manufacturing agility and organizational management agility.

At present, the organization agility classification of Sambamurthy *et al*. (2003) is generally accepted by academia. The classification is mainly based on the dynamic capability view. It holds that the organization agility should have the ability of good communication with customers, cooperation with external cooperative enterprises, scientific and rational deployment of internal operations. Especially while the environment changes, new opportunities can be perceived and utilized in time. Under this definition of agility, as mentioned earlier, the authors divide organizational agility into three dimensions, such as the agility of operation, customer and collaboration. Operational agility means that in the process of perceiving innovation opportunities and taking competitive actions, enterprises' business processes are fast, accurate and economically responsive (Sambamurthy *et al*., 2003). Enterprises with better operational agility usually have modular processes, which can be effectively re-engineered and opened up new markets in the face of dynamic markets (Agarwal & Selen, 2009). Operational agility emphasizes the fast and flexible operation process of enterprises in response to change, which represents the comprehensive ability of enterprise process reengineering and coping with external changes (Lu & Ramamurthy, 2011). Customer agility describes an enterprise's ability to perceive changes in customer needs in a timely manner, and then to understand market opportunities and take timely competitive action based on customer orientation (Kohli & Jaworski, 1990; Sambamurthy *et al*., 2003).

Nambisan (2002) believes that customers can play three roles in order to facilitate enterprises to participate in market competition. First, it can become the source of enterprise's innovative ideas. Second, it is to participate in the design and development of new products and services together with enterprises. Third, it is that enterprises themselves are important testers of new products and services. Therefore, organizations with customer agility can naturally better respond to customers' demands and requirements in a timely and appropriate manner, then win and occupy in the market (Roberts & Grover, 2012). Collaborative agility refers to the ability of enterprises to utilize assets, knowledge and competitiveness of suppliers, distributors, contracting manufacturers and logistics providers through strategic alliances, partnerships and joint ventures (Sambamurthy *et al*., 2003). Enterprises can build strategic, extensible or virtual partnership networks, then it can explore the ability of innovation and utilize the opportunities for competitive action. Also, enterprises can modify and adapt to the new enterprise relationship network , then achieve the goal according to the needs they do not have on their own network, such as assets, and capabilities (Agarwal & Selen, 2009). Therefore, collaborative agility can help enterprises get better reaction capability and market performance in the fierce market environment. From the above definition of collaborative agility and its path of action, it is more appropriate to consider the content of collaborative agility as a process for organization to accomplish customer agility or operational agility.

From the definition of organizational agility in previous studies, we can feel strongly the importance of organizational agility for organizational response to uncertainty again, and all definitions refer to environmental uncertainty in different degrees. At the same time, the classification of organizational agility can be roughly divided into customer agility and operational agility, respectively, their main role is perception of changes in the external environment and taking appropriate actions, perception of changes in the internal environment and taking appropriate actions. As for cooperative agility, it is overlapping customer agility and operational agility. At the same time, we can find that although the theoretical and practical circles pay more and more attention to organizational agility, they still lack the knowledge of how to achieve organizational agility. This also explains the necessity and innovation of constructing the value creation mechanism between IT capability, organizational agility and organizational performance. Furthermore, organizational agility allows enterprises to reconstruct existing processes and generate new ones to adapt to the uncertainty of the market environment. This process of restructuring or rebirth is rooted in the internal conventions of the organization, which makes competitors unable to know exactly

where the specific valuable links of the process are. Therefore, to a certain extent, it is not imitable in the market, so it has the attributes of organizational strategic resources, which can help enterprises better obtain and integrate other resources to match the needs of enterprise with their environment (Sambamurthy *et al*., 2003). From the literature review on the definition and classification of organizational agility, we can see that the research of organizational agility cannot be separated from customer orientation and operational agility. Faced with uncertain environment, in order to survive or develop, on the one hand, enterprises need to quickly perceive and respond to the changes of customers' needs at the strategic level of customer orientation. On the other hand, they need to support and cooperate with these strategic requirements at the internal operation level of enterprises in order to achieve organizational agility accomplishment of the whole organization and sustain the achievement through holding continuous competition advantage of enterprises.

Following this, agile development refers to the use of agile thinking to address major challenges facing traditional software development such as time, cost, and lack of responsiveness to changing requirements. Agile development is defined as an iterative, step-by-step approach to software development with the evolution of user requirements at the core. In agile development, software projects are divided into several sub-projects at the early stage of construction, and the results of each sub-project are tested, with visual, integrated, and operational features. The idea of agile development is that the software development process is dynamic and organic, rather than static, predefined, or mechanical.

Agile project management is a management method to deal with changing and uncertain software projects. Agility is an attitude rather than a process; an atmosphere rather than a set of practices. The most important term in agile project management is innovation. In the process of implementing agile project management, project managers should pay attention to: (1) adjusting the team itself to adapt to changes; (2) focusing on products, coordinating with customers, and (3) paying attention to communication. Common agile software development methods include: Crystal, ASD (Adaptive Software Development), Scrum, FDD (Feature Driven Development), EP (Extreme Programming), and others. They all have the characteristics of emphasizing flexibility, iterations in stages, feedback, and gradual convergence towards goals.

From the vertical perspective, Sull (2010) divides enterprise agility into three levels: (1) strategic agility; (2) business portfolio agility; and (3) operational agility. Strategic agility includes the ability to discover and grasp opportunities to change the “rules of the game”.

Business portfolio agility refers to the ability to move resources (including cash, talent, and the attention of management) quickly and efficiently to a more attractive area from a less promising business domain. Finally, operational agility refers to the ability to take advantage of opportunities in a business model that highlights focus. In project-based IT firms, business portfolio agility mainly refers to project agility, which involves two aspects: (1) quick deployment of project resources according to the importance of the project, or resource agility; and (2) adjustment of the project content and schedule according to changes in needs and in the environment, or process agility. For high-tech SMEs, the literature has emphasized the latter notion of project agility, which mainly constitutes a set of practices for software development as created by experienced practitioners and that scholars have generally agreed on as constituting agile project management (Cobb, 2011; Holmström, Fitzgerald, Ågerfalk, & Conchúir, 2006). These methods can be seen as a reaction to plan-based or traditional methods, which emphasize *"a rationalized, engineering-based approach"* (Dyba, Kitchenham, & Jorgensen, 2005) in which it is claimed that problems are fully specifiable and that optimal and predictable solutions exist for every problem. The "traditionalists" are said to advocate extensive planning, codified processes, and rigorous reuse to make development an efficient and predictable activity (Boehm, 2002). Williams and Cockburn (2003) state that agile project management is *"about feedback and change"* and that agile methodologies are developed to *"embrace, rather than reject, higher rates of change"* (Williams & Cockburn, 2003).

According to data from the China Enterprise Agile Survey (ThoughtWorks, 2017), most organizations implementing agile project management in China employ fewer than 100 people (79%). The main goals of agile project management are to shorten the developing cycle (69%), improve project quality (60%) and customer satisfaction (49%). The survey suggests that the main problems to be solved in agile project management are:

- Poor demand structure: demand changes, work overload, insufficient detail, unreasonable and excessive demands;
- Cumbersome process management: non-agile governance, teamwork that is not smooth, and cumbersome processes;
- Corporate culture: unwillingness to learn new knowledge, low collaboration in testing, operation and maintenance.

2.3. Firm Performance

Performance uncertainty exists in many organizations (Neely, Adams, & Kennerley, 2002). Scholars' observations on firm performance vary, there being no single unified understanding in the existing literature. For the definition of performance, Kotler (1984) proposes that firm performance can be observed by the marketing perspective, meaning that organizations achieve their goals by satisfying their customers with greater efficiency and effectiveness than their competitors. No guidelines were provided, however, on how to measure such indicators of firm performance. Neely, Gregory, and Platts (1995) propose a measurement system to measure firm performance mainly with a set of metrics quantifying the efficiency and effectiveness of action. Specifically, they suggest that firm performance can be examined at three levels, namely: (1) individual performance measures; (2) the set of performance measures; and (3) the relationship between the performance measurement systems and the environment within which the firm operates. The work of Neely *et al.* (1995) also lays the foundations for measuring firm performance, though no consensus was reached about how to define firm performance.

Most of the literature is still limited to measuring firms' economic efficiency, there being little research into how enterprise innovation affects the market, society, and the environment (Grant, 2005; Malagueño *et al.*, 2018). For our research context, we modified the definitions by Guo (2003) and Kang and Zhou (2008), stating that firm performance refers to operating efficiency and managing performance during a certain period of operation. The level of enterprise operating efficiency is mainly manifested in profitability, level of operation of assets, solvency, and the enterprise's ability to carry out follow-up developments. The management of performance is mainly reflected by managers' achievements and contributions to the operation, growth, and development of enterprises in the process of management. The performance evaluation of enterprises includes two aspects: business efficiency and performance.

Performance evaluation is of significant importance for manufacturing firms, particularly manufacturing SMEs (Singh, Olugu, Musa, & Mahat, 2018). However, sales data throughout products' life cycle is difficult to collect, with the indicators used in measuring innovation performance usually being partial, such as supply chain performance (Beamon, 1999; Maestrini, Luzzini, Maccarrone, & Caniato, 2017) or innovative performance (Hagedoorn & Cloodt, 2003). One of the most well-known performance measurement tools is the Balanced Scorecard (BSC) (Kaplan & Norton, 1995). It balances the performance of both financial and non-financial aspects, which is an effective way to evaluate performance based

on enterprise goals. This method includes four dimensions, namely: (1) financial performance; (2) customer satisfaction; (3) internal process; and (4) learning and growth.

In an increasingly dynamic environment, innovation performance has increasingly become an important part of firm performance. Cooper (1985) puts forward eight measures for enterprise innovation, namely: (1) the proportion of sales resulting from products developed in the past five years; (2) the proportion of new product development initiatives that were successful in the past five years; (3) probability of failure or interruption of new product development in the past five years; (4) the proportion of new product development plans achieved in the past five years; (5) the innovation plan's importance for the company's increase in sales and profit; (6) whether the benefits of new product revenue exceed the costs; (7) the degree of success of the innovation process relative to the competition; and (8) the level of success of the overall plan. Hagedoorn and Cloodt (2003) divide innovation performance into narrow innovation performance and broad innovation performance. The former refers to the effective introduction of the innovation in the market. From this perspective, the number of new products issued can be used as an indicator of innovation performance. In turn, broad innovation performance includes all activities of the inputs and outcomes, from R&D inputs to producing new patents, new products, and eventually reaching the market. These can also be measured, through indicators such as research and design production, new patents and new products. As to the scale of innovation performance, scholars have referred to technology innovation performance, market performance and environmental performance (Baker, Grinstein, & Harmancioglu, 2016; Chen & Chen, 2006; Daft, 1978; Damanpour & Evan, 1984; Gao, Wang, & Wei, 2004).

Because we live in an dynamic world, innovation, agile management and firm performance depend strongly on innovation environmental dynamics. Indeed, uncertainty has become one of the basic assumptions in the field of economics. Knight (1921) points out that uncertainty should be the most common phenomenon in the process of various types of economic activities, and at the same time, point out that profit is the kind of corresponding compensation for the risk that entrepreneurs cannot eliminate, and this risk could be called uncertainty. In reality, the essence of all kinds of things is often concealed by bizarre phenomena, and the asymmetry of information has become the consensus of everyone. In the practice of economic activities, due to the lack of sufficient information, experience and knowledge accumulation, it is often impossible to estimate the only result completely and wholly in the required time. Objectively speaking, economic behavior itself carries different

expectations, which is also uncertain and uncertainty has become an unavoidable topic in academia and practice circle. At the enterprise level, the revolutionary development of knowledge, information and technology has led to a new type of customer demand and business model. The internal and external environment that enterprises are facing is becoming more and more dynamic and complex. Environmental uncertainty also has a profound impact on the change of organizational behavior and has attracted extensive attention of relevant researchers. For the description of uncertain environment, Milliken (1987) has a definition with high citation rate, due to lack of information or the ability to distinguish between relevant and unrelated information, individuals feel unable to predict accurately. The author further classifies uncertainty into three categories: (1) state uncertainty; (2) effect uncertainty or perceived environmental uncertainty; and (3) response uncertainty. Daft, Sormunen and Parks (2010) further emphasize the uncertainty of environmental perception and argue that managers should only respond to the external environment that they can perceive as having an impact on the organization. In other words, due to individual differences, in the face of the same objective environmental events, the environmental uncertainty perceived by individuals will still vary greatly, and the competitive behavior taken by individuals will vary greatly also. In this sense, the perceived environment uncertainty has a more direct and important impact on organizational behavior. Therefore, scholars generally agree that the measurement of environmental uncertainty should be based on the subjective feelings of managers.

When it comes to the measurement of uncertain environment, two problems must be involved. One is how to clearly define the source of uncertain environment, and the other is how to scientifically divide the research dimension of uncertain environment. Firstly, Duncan (1972) divides uncertain environmental sources into internal sources and external sources from the perspective of organizational boundaries. Internal sources include relevant elements and structures of organizational scope, such as organizational structure, corporate culture, human resource allocation, and so forth. External sources include direct peripheral correlative entities such as customers, competitors, upstream and downstream relationships, as well as macro-external social factors such as policy and technology (Li, Xiang, & Chen, 2009). Daft *et al*. (2010), based on the perspective of specific corporate behavior, according to the direct or indirect impact of environment on corporate behavior, divides environmental sources into two types of remote and task-oriented. And the indirect impact of politics, economy, social culture and technology on corporate specific behavior is considered as remote environment. And the factors, such as upstream and downstream, competitors and other groups, closely

related to weaving behavior are categorized as task-based environment (Jiang, 2007). Similar to the above classification of environmental sources are as follow. Tan and Litsschert (1994) think environment is divided into task environment and institutional environment. Hodge and Johnson (1970) divide environment into macro-environment, meso-environment and micro-environment. Meyer (1982) divides environment into technical environment and institutional environment. Furthermore, as for the specific dimension of uncertain environment, this problem is deepened with the continuous detailed study of environmental factors. Early researchers usually regarded the uncertain environment as a single-dimensional concept, and the representatives were March and Simon (1958). They mainly used the abundance of resources to describe the uncertainty of the environment. In the latter stage, two-dimensional and three-dimensional analysis of uncertain environment gradually appeared.

For the dimension division of environmental uncertainty, Duncan (1972) divided it into complexity and dynamics, Child (1972) divided it into variability, complexity and scarcity with the detailed interpretation: (1) variability refers to the degree of change of environmental characteristics, which is a function of the frequency of environmental change, the degree of difference in the process of change and the degree of irregularity of the overall change pattern; (2) complexity refers to the heterogeneity and range of environmental characteristics; and (3) scarcity refers to the degree of threat to target or neutrality from external competition faced by decision makers in the process of achieving organizational goals. Aldrich (1979) and Dess and Beard (1984) divided it into abundance, complexity and dynamics. Miller and Friesen (1982) divided it into dynamics, hostility and heterogeneity with the detailed interpretation: (1) dynamics refers to the rate of industrial change and innovation, as well as the uncertainty and unpredictability of competitors' and customers' behavior; (2) hostility refers to the multidimensional competition, competitive vitality and competitive intensity of the leading industries in which the enterprises are located, as well as the decline and prosperity of the industries; and (3) heterogeneity refers to the diversity in the market, which requires the diversity of products and marketing positioning. Sharfman and Dean (1991) divided it into complexity, instability and resource availability with the detailed interpretation: (1) complexity refers to the degree of demand for complex knowledge and the diversity of environmental factors; (2) instability refers to the unpredictability of the future development trend of a given environment; and (3) resource availability refers to the level of resource availability in the environment. Rosenbusch, Brinckmann and Bausch (2011) divided it into

abundance, hostility, dynamics and complexity with the detailed interpretation: (1) abundance refers to the availability of resources in the environment; (2) hostility shows that industrial enterprises are facing a series of constraints in their strategic choices when they compete for scarce resources and opportunities; (3) dynamics is an uncertainty of future development, such as changes in customer demand, technological discontinuity or changes in the behavior of competitors and suppliers; and (4) complexity refers to the amount of knowledge, resources and capabilities that an enterprise needs to operate successfully in a turbulent environment.

Following these authors' contributions, it can be seen that, due to the different research issues, the environmental scope and division mode of the organization are also quite different. In view of the research field of this study is the research on the value generation mechanism of the specific organization, we will explain the sources of uncertainty from the internal and external environment of the organization, and also take into account both integrity of environmental sources and clarity of research purposes.

Based on the overview of the uncertainty dimension, we can see that factors such as complexity, dynamism, hostility, abundance and heterogeneity are recognized by the academic community as part of this dimension. However, after studying the definition of related concepts, it is not difficult to find that there are some fuzziness and overlap in the concept definition of uncertainty dimension, so it is not appropriate to study as an independent variable. At the same time, we find that environmental dynamics and environmental complexity are two relatively independent and more important key research concepts in the dimension division and concept definition of scholars. Recent studies on super-competition, competitive dynamics and institutionalism also show two dimensions: (1) environmental dynamics; and (2) complexity (Vasconcelos & Ramirez, 2011). Based on the above analysis, this study also analyses the external environment faced by enterprises from the dynamic and complex dimensions. Dynamics refers to the change speed and magnitude of environmental factors (Dess & Beard, 1984) and complexity refers to the scale, difference and correlation of environmental factors (Duncan, 1972). If there are many, large differences and strong correlation of environmental factors, it will increase the complexity of the environment.

In the research of enterprise behavior under uncertain environment in the field of organization, the academic theory of strategic formation regards environment as an important carrier for the survival and development of an organization. The implicit premise is that the process of strategy formulation and implementation should be matched with the dynamic

environment in which the enterprise is located. And the uncertainty of environment becomes the biggest challenge for enterprise to achieve successful strategy formulation and implementation, and this has become a major consensus in corporate strategy research (Milliken, 1987). In this logical framework, Porter (1985) points out that the process of strategy formulation is based on the use of diagnostic tools to comprehensively analyze the competitive advantages and disadvantages within the enterprise, the opportunities and challenges outside the enterprise, and, on the basis of which, coordinate the allocation of organizational resources and establish a suitable competitive strategy. Then, the author lists the main environmental entities or elements that affect the competitive position of enterprises in the market, that is, the five forces model we are now familiar with, such as substitute threat, newcomer threat, supplier bargaining power, customer bargaining power and existing competitors. Thompson (1967) points out that eliminating or avoiding the potential or actual negative impact of uncertain environment on the organization is the key problem for top managers to solve, because improper handling of this problem may lead to unexpected losses and even threaten the survival of enterprises. Under the same framework logic, Ansoff (1991) and Armstrong (1982) also link the formulation of strategy with uncertain environment, and clearly put forward that effective strategy formulation and implementation are of great significance for enterprises to deal with uncertainty, reduce uncertainty and eliminate uncertainty. In summary, as a core concept in the field of organization, uncertainty has been widely used by scholars to analyze the interaction mechanism between organization and environment (Duncan, 1972; Lawrence & Lorsch, 1967; Thompson, 1967).

The above research on the characteristics of environmental uncertainty can be divided into three categories. The first type of uncertain environment is the control variable, which needs to be properly dealt with in the research process to eliminate the impact of environmental factors on the research process and conclusions. The second type of uncertain environment is the adjustment variable, and the contingent logical analysis environment is the main line of research. The third kind of uncertain environment is the antecedent variable, which emphasizes the decisive role of environment in organizational behavior. Among the three kinds of research on uncertainty, the second type of research is the majority, that is, the most studies of organizational behavior from the perspective of uncertainty, use contingency analysis method and take environmental uncertainty as an important regulatory variable into the analysis category. Therefore, from the literature review of the origin and connotation of uncertainty, although there are some fuzziness and overlap in the division of uncertainty

dimensions, more scholars agree that environmental uncertainty should be measured from two aspects of stability and complexity. According to the trend of mainstream research, this study will research the external environment of enterprise management from two dimensions (*i.e.*, environmental dynamics and environment complexity), where external environmental dynamics refers to the relative frequency and unpredictability of environmental changes, and external environment complexity refers to the homogeneity and heterogeneity of the environment, and the number of environmental factors and the degree of intersection between environmental requirements. At the same time, this study introduces the internal uncertainty of the organization and innovation into the research. From the literature review of organizational behavior in uncertain environment, as a core concept in the field of organization, uncertainty has been widely used by scholars to analyze the interaction mechanism between organization and environment, and most of them use contingency logic to study environmental uncertainty as a moderating variable.

Following this reasoning, it is also important to analyze the conceptualization of innovation atmosphere. Under the prevailing market environment of globalization, if an organization wishes to gain advantages in competition, it needs to constantly strengthen its own transformation and improve its innovation capability. According to the relevant research of domestic and foreign scholars, organizational atmosphere can have an important impact on the stimulation of employees' innovative consciousness and the exertion of creativity (Tsai, Horng, Liu, & Hu, 2015). Therefore, it is of great practical significance for the practice of organizational behavior management and human resource management to conduct in-depth research on the related content of organizational innovation atmosphere.

Before studying the organizational innovation atmosphere, we should clarify the meaning of the atmosphere and organizational atmosphere. The so-called atmosphere is the result or state under the interaction of multiple psychosocial factors. Its effect on the creation and subject of innovation is continuous, and there is a correlation between them (Liu, 2012). Later, scholars conducted research on innovation subject and found that talent does not necessarily lead to highly creative achievements, but organizational environment is the decisive factor to achieve innovation (Liu, Shi, & Zhang, 2009). In the early 1940s, the research on organizational atmosphere developed rapidly. Up to now, academic circles believe that there are two kinds of organizational atmosphere. The first one is psychological atmosphere from personal perspective, that is, the individual's perception of organizational environment (Halpin & Croft, 1963). The second one, organizational context from

organizational level, is the sum of relatively stable characteristics within the organization (Chen & Li, 2005), and it plays an important role in individual, team and organizational innovation. Litwin and Stringer (1968) believe that if an organization wishes to create innovation, it should first create an organizational atmosphere that can influence employees' motivation and behavior, and then provide innovative products or services to enhance its competitiveness (Zhu, 2014). Later, the focus of some studies began to shift to an innovation atmosphere. The so-called innovation atmosphere refers to employees' perceptual description of their working environment, which is more inclined to the innovation support environment provided by the organization. Scholars divide innovation atmosphere into psychological innovation atmosphere, team innovation atmosphere and organizational innovation atmosphere from the perspective of individual, team and organization (Zhang & You, 2014).

Therefore, the concept of organizational innovation atmosphere includes the following two viewpoints: (1) organizational innovation atmosphere is an objective factor independent of employees' perception and understanding; and (2) organizational innovation atmosphere is a shared perception formed by employees' innovative support to the organization. Although some scholars have different research orientations and have not yet formed a unified definition, they have reached some consensus on the concept of organizational innovation atmosphere, namely organizational innovation atmosphere is the product of the interaction between employees and organizational environment. Among the existing studies, Amabile, Conti, Coon, Lazenby and Herron (1996), the most influential foreign scholars believe that organizational innovation atmosphere is the perceptual description of the working environment with innovation support by the members of the organization. Therefore, this study considers that organizational innovation atmosphere is the perceptual description of the working environment that influences the individual's innovative behavior. At present, the relevant research on organizational innovation atmosphere has analyzed the mechanism of innovation atmosphere from different aspects, which include individual factors, team factors and work-related factors. Then, as the related research of different roles in the organizational process, this kind of research examines the causes and consequences of the organizational process, as well as the role of organizational innovation atmosphere in the process of mediation and regulation.

First, the influencing factors are introduced. The study of Isaksen, Lauer, Ekvall and Britz (2001) found that the more outstanding personal skills and the heavier work tasks, the more innovative potential employees can be stimulated, and employees' work attitudes and

behavior are vulnerable to fluctuations in demand, that is to say, employees' innovative behavior will be affected by personal motivation. When employees are driven by internal or external motivation, at the same time, they will actively use relevant knowledge to promote the emergence of innovative behavior. Liu, Wang and Li (2010) explore the impact of innovation atmosphere on employee creativity from the individual level, and found that the interaction between the two factors is significant. Scott and Bruce (1994) explain the impact on organizational innovation atmosphere from the perspective of team member relationship, and the results showed that the higher the quality of team member relationship, the more obvious the sense of individual innovation support of employees, and the more conducive to the development of innovation consciousness. Chen, Zhao and Jiang (2008), from the team level, found that psychological security atmosphere plays an important role between team learning capability and team performance. Sui, Yang and Wang (2012) believe that team leadership behavior can lead innovation through its own behavior, thus affecting the amount of innovation input of team members. Amabile *et al*. (1996) found that excessive work stress will hinder the development of employees' innovative potential, while moderate sense of responsibility, autonomy and challenge will also arouse employees' interest in work, which will have a positive impact on the organizational innovation atmosphere.

Second, some related studies of different roles in organizational processes are introduced. Sundgren, Dimenas, Gustafsson and Selart (2005) point out that the learning organization established by an enterprise can help employees learn more professional knowledge, and the cultural atmosphere formed by the learning organization is of great significance to the formation of the organizational innovation atmosphere. Liu, Hu and Liu (2009) argue that employee innovation autonomy and flexibility are obviously affected by organizational structure. The more flat and boundless the organizational structure, the more autonomous and flexible the employees' innovation is. Burke and Litwin (1992) believe that organizational strategy is directly related to organizational culture and organizational structure, which indirectly proves the relationship between organizational strategy and organizational innovation atmosphere. Isaksen *et al*. (2001) argue that managers' behavior influences organizational innovation atmosphere and organizational change through organizational members. Liu, Shi and Zhang (2009) found that the supply of organizational resources will affect the formation of organizational innovation atmosphere. Scott and Bruce (1994) state that there is a significant positive correlation between organizational innovation support and individual innovation behavior. Xue (2007) points out that supervisor support and team

support are very important for employees' innovative behavior. Gu and Peng (2010) believe that employees' innovative self-efficacy could enhance their self-confidence and be more conducive to the emergence of innovative behavior. Zhang (2009), in turn, found that the stronger the motivation of employees, the more obvious the innovative consciousness of employees. The research of Li (2012) proves that the result expectation partially mediates the relationship between organizational innovation atmosphere and employee innovation behavior. Xie, Guan and Catherine (2015) point out that under the guidance of market orientation, employees' self-efficacy and organizational learning atmosphere act together on their innovative behavior. Sun, Shi and Zhang (2009), Song, Yuan and Zhang (2011) also found that positive organizational innovation atmosphere not only plays a full intermediary role in the relationship between team member exchange and employee innovation behavior, but also plays a part of intermediary role between strategic human resources and employee innovation behavior. In this regard, Yin (2012) states that the impact of performance appraisal goal orientation on employee innovation behavior is regulated by organizational innovation atmosphere. Both Zheng, Jin and Ma (2009) and Liu (2012) believe that organizational innovation atmosphere can significantly regulate the relationship between employee innovation ability and innovation performance. Finally, Ding and Li (2016) propose that organizational innovation atmosphere significantly regulates the relationship between job characteristics and employee innovation behavior.

In summary, with the rapid development of knowledge economy, organizational innovation atmosphere plays an important role in organizational development and change. Although the research on organizational innovation atmosphere has a history of more than two decades, it still needs further study.

2.4. High-Tech SMEs in China

With the acceleration of scientific and technological progress in China, small and medium-sized enterprises, especially high-tech small and medium-sized enterprises, driven by innovation and competition, will gradually increase. China's high-tech industry shows the coexistence of three kinds of competition situation, such as following, running side-by-side and leading. For example, China has become a leader in the field of communication equipment, digital security, civil unmanned aerial vehicle and other multi-national competition. Particularly in the field of Internet and artificial intelligence, China and the United States have formed a double-headed pattern, which is far ahead of other countries. In

the field of mobile phones and intelligent manufacturing equipment, China is turning from following to running side-by-side, but in the field of nuclear high-base industries such as chips, operating systems, new materials, China is still in a backward state of following. High-tech industry is the core of the national industrial system. The key to the international competition of high-tech industry is the competition of high-tech and its industrialization speed and degree. The main way of high-tech industrialization is enterprise innovation and entrepreneurial activities. With the continuous promotion of mass innovation and the innovation of millions of people, a large number of small and medium-sized SMEs have emerged in China, which has become an important new force to promote the innovation-driven development strategy. According to the definition of Baidu Encyclopedia (2019), small and medium-sized high-tech enterprises refer to those established by scientific and technological personnel, mainly engaged in scientific research, development, production and marketing of high-tech products, with the commercialization of scientific and technological achievements, as well as technological development, technical services, technical consultation and high-tech products as the main content. It is market-oriented, meaning knowledge-intensive economic entities that implement self-financing, voluntary portfolio, self-management, self-responsible for profits and losses, self-development and self-restraint. In short, high-tech SMEs are enterprises with innovation as their mission and means of survival.

The definition of high-tech SMEs contains both “high-tech enterprises” and “SMEs”. As for high-tech enterprises, Abbott (1991) proposes two criteria to identify them: (1) engineering researchers account for 40-60% of the total number of staff; and (2) R&D investment costs of high-tech enterprises account for 5% to 15% of sales revenue. Xing and Zhou (2000) define high-tech enterprises as being high growth, high research investment, high value-added, high-skilled production technology companies.

With regard to SMEs, the Organization for Economic Co-operation and Development (OECD) (OECD, 1997) defines them based on employee size and annual sales. According to this definition, a firm is considered as small or medium if it employs not more than 300 employees and has annual sales of up to US$15 million. In China, on 19 February 2003, several official entities (the State Economic and Trade Commission, the Ministry of Finance, the State Statistical Bureau, and the State Planning Commission) jointly promulgated the Interim Provisions on the Standards for Small and Medium-sized Enterprises (No. 143, 2003). The conditions of industrial SMEs are: either the number of employees is fewer than 300, or

sales are of less than 300 million yuan, or the total assets are of less than 400 million yuan (Ministry of Finance of China, Ministry of State Planning Commission of China, Ministry of State Economic of China, & Ministry of Trade Commission of China, 2003).

While high-tech SMEs are thus defined as a combination of the two above concepts (Wang, 2007), there is no generally agreed upon definition for them. In the context of China, in 2007, the Ministry of Science and Technology and the Ministry of Finance stipulated in the *"Provisional Decision of the Ministry of Finance on the Fund for Technological Innovation of Small and Medium-sized Enterprises of Science and Technology"* that all high-tech SMEs registered in China should meet a number of requirements. First, they should have the legal status of independent enterprise. Second, 30% of the total number of staff and workers should be scientific and technological personnel with college or higher education, and more than 10% of the total number of staff and workers are directly engaged in R&D. Third, the firm should be mainly engaged in the research, development, production, or service of high-tech products and its projects must lie in the scope of operation stipulated in its business license. Fourth, the firm should have a good business performance, the ratio of assets and liabilities should be no greater than 70%, and the annual expenditure for R&D of high-tech products is of no less than 5% of sales. Fifth, the firm should have sound financial management institutions, strict financial management systems, and qualified financial management personnel. Finally, the firm's leadership should have a strong market development ability and a consciousness of continuous innovation.

From these six requirements, we can see that the standard of high-tech SMEs is unclear and dynamic. In 2011, the Ministry of Industry and Information Technology, jointly with the Ministry of Finance, the Development and Reform Commission and the State Statistical Bureau, promulgated new regulations on standards for high-tech SMEs, which offer a clearer definition of high-tech SMEs. In this definition, high-tech SMEs are divided into three specific categories that include small, medium, and micro enterprises, with their standards being based on several fixed criteria such as number of employees, enterprise income, total assets (both fixed and non-fixed assets) and the characteristics of the industry. The regulations state that *"small and mid-sized high-tech enterprise refers to the enterprises which meet the standards of SMEs in China, for example, possessing certain science and technology personnel, mastering the independent intellectual property rights and proprietary technology or advanced knowledge. Through the investment in science and technology innovation activities, these SMEs can provide products or services"* (China, 2011). The

criteria defining a high-tech SME in different industries in China are shown in *Table 2-3*.

Although differences exist in terms of industry, we note that high-tech SMEs have several characteristics in common (Su, 2014), namely:

- High-tech SMEs possess a higher proportion of scientific personnel than the generality of SMEs, with advanced training of staff being an important feature. Most of the leaders of such firms come from scientific research institutes or institutions of higher learning. They have rich experience in basic research and applied research and are at the forefront of scientific research. Those individuals who start their own businesses have a pioneering and innovative spirit or the courage to take risks, showing a strong sense of innovation and innovation ability (Huang & Guo, 2003);
- The products of high-tech SMEs have higher technology content than general SMEs. Because high-tech SMEs are mainly engaged in the research and development of high-tech products, their products condense several intellectual inputs, such as patents and proprietary technology. As such, their added value is usually higher than that of most products. Moreover, such products rely on knowledge-intensive development by scientific researchers, unlike most products, that come mainly from labor-intensive, low value-added enterprises (Su, 2014);
- The coexistence of high return and high risk in high-tech SMEs. Because high-tech SMEs invest significantly in R&D, they can obtain high added value. Nevertheless, they face much uncertainty, such as whether the research and development of new products will be successful, whether the marketing of new products can be accepted by consumers, and whether the capacity of the market can make up for the previous investment and result in profits (Xu, 2009).

Table 2-3 *Criteria Defining High-Tech SMEs in Different Industries in China*

Industry	Criteria	Medium-sized Enterprise	Small Enterprise	Micro Enterprise
Environment and Resources	Number of people employed	[100-300]	[10-100[	< 10
	Proportion of employees with college degree	> 20%	> 20%	> 20%
	Proportion of R&D personnel	> 10%	> 10%	> 5%
	Proportion of high-tech and product R&D funds	> 3%	> 3%	
	Proportion of technical income, sales revenue of high-tech products	> 50%	> 50%	
Biological Pharmaceutical	Number of people employed	[100-300]	[10-100[	< 10
	Proportion of employees with college degree	> 20%	> 20%	> 20%
	Proportion of R&D personnel	> 10%	> 10%	> 5%
	Proportion of high-tech and product R&D funds	> 3%	> 3%	
	Proportion of technical income, sales revenue of high-tech products	> 50%	> 50%	
Information Technology	Number of people employed	[100-300]	[10-100[	< 10
	Operating income (10.000 CNY)	[1.000-10.000]	[50-1.000[	< 50
	Proportion of employees with college degree	> 20%	> 20%	> 20%
	Proportion of R&D personnel	> 10%	> 10%	> 5%
	Proportion of high-tech and product R&D funds	> 3%	> 3%	
	Proportion of technical income, sales revenue of high-tech products	> 50%	> 50%	
Mechanical and Electronic Integration	Number of people employed	[300-1.000]	[20-300[	< 20
	Operating income (10.000 CNY)	[2.000-30.000]	[300-2.000[	< 300
	Proportion of employees with college degree	> 20%	> 20%	> 20%
	Proportion of R&D personnel	> 10%	> 10%	> 5%
	Proportion of high-tech and product R&D funds	> 3%	> 3%	
	Proportion of technical income, sales revenue of high-tech products	> 50%	> 50%	
New Material	Number of people employed	[300-1.000]	[20-300[	< 20
	Operating income (10.000 CNY)	[2.000-30.000]	[300-2.000[	< 300
	Proportion of employees with college degree	> 20%	> 20%	> 20%
	Proportion of R&D personnel	> 10%	> 10%	> 5%
	Proportion of high-tech and product R&D funds	> 3%	> 3%	
	Proportion of technical income, sales revenue of high-tech products	> 50%	> 50%	

Source: Ministry of Industry and Information Technology of China (2011).

High-tech SMEs, then, are the foundation of the high-tech industry, and the main driving force behind countries' technological progress that are the engine of development of national economies. Therefore, it is of great significant to study how high-tech SMEs grow and thrive, especially at the operational level. In order to grow and thrive, high-tech SMEs must possess core competitiveness, maintaining a momentum of technological innovation and constantly striving to increase the market share and value of their products. From the theoretical perspective of RBV, this study will explore how innovation capabilities and project agility lead high-tech SMEs to grow and thrive. In this manner, this study can help managers of high-tech SMEs to understand patterns of enterprise development, therefore enabling them to formulate well-adjusted development strategies to achieve growth.

Synopsis of Chapter 2

This chapter focused on the literature review. Relevant references were presented and summarized. From the concepts and definitions of innovation, project agility and performance, we propose that innovation capability and agility are two important factors for firms' dynamic capability. Innovation capability is a type of organizational resource which constitutes the foundation for firms to construct dynamic capability. Agility lies in the process through which firm dynamic capabilities are constructed. Thus, innovation capability and agility, affecting dynamic capabilities, constitute the basic logic of our research model. Specifically, dynamic capabilities consist of firms' resources, processes, locations, paths and conventions, that can be realized by perceiving market changes, enhancing absorptive capacity, integrating enterprise resources, and innovative knowledge (Pavlou & El Sawy, 2011). Moreover, dynamic capabilities cannot be obtained through external factors such as market transactions, which were built only by firms' internal learning mechanisms (Teece *et al.*, 1997). From this point of view, Zollo and Winter (2002) point out the role of learning mechanisms in the construction and development of dynamic capabilities, which were grouped into three types of learning mechanisms. First, the semi-automatic accumulation of knowledge, especially for the tacit knowledge acquired by repeated tasks and behaviors. Second, the convergence of knowledge. For example, members of the organization can exchange practical experience with each other through collective discussion or a performance evaluation process. Finally, the encoding of knowledge, such as using tools (*e.g.*, workbooks, blueprints, and management software) to record the relationship between organizational processes and business performance. The latter two learning mechanisms are more effective than the first one as the number of practice repetitions is fewer, the heterogeneity of tasks is higher, and the relationship between job performance and tasks is fuzzy. In addition, Zahra, Sapienza, and Davidsson (2006) propose four learning mechanisms for the building of dynamic capabilities: (1) improvisation; (2) trial-and-error learning; (3) experimental learning; and (4) imitative learning. Thus, we conclude that innovation capabilities, which affect agility, are the foundation for firms to acquire dynamic capabilities. While the relationship between innovation capabilities and dynamic capabilities is non-linear, it seems important to determine the best matches for innovation capabilities and agility and how to build significant dynamic capabilities for firms. This is precisely what we aim to do, focusing on high-tech SMEs in China. The next chapter introduces the research hypotheses and methodology.

Chapter 3: Research Hypotheses and Methodology

This chapter presents the research questions, methodology, comparative analyses, hypotheses, and the conceptual framework of the thesis. We begin with research questions and methods, including a discussion of existing literature. A comparative analysis is then carried out through companies A and H. Based on the discussion, six hypotheses are formulated and a model is produced relating innovation capability, project agility, firm performance, innovation atmosphere and environmental dynamics.

3.1. Research Questions and Epistemological Stance

This chapter furthers the discussion on the relationship between innovation capability, project agility and firm performance and other theoretical concepts, based on the theoretical concepts presented in *Chapter 2*. Innovation capability is generally considered to be the ability to carry out R&D, manufacturing, and innovation at the level of project and enterprise as well. Project agility is generally considered to be the degree to which enterprises can quickly and easily change their business processes to cope with changes in the market environment. Firm performance usually reflects the economic efficiency and innovation performance of enterprises.

In theory, from the perspective of RBV, enterprise innovation capability is widely regarded as a low-level capability that can improve many high-level capabilities such as agility, management processes, new product development, and so forth. (Sambamurthy *et al.*, 2003). In the turbulent and changing market environment, agility is regarded as the high-level capability of enterprises to change and respond to market changes (Zeng *et al.*, 2018). This ability promotes the integration and allocation of enterprise resources and can continuously improve firm performance by effectively responding to the needs of consumers over a long time. It is worth noting, however, that firm performance improvement is still not well explained in theory. From the perspective of practice, innovation capability, as a low-level ability of an enterprise, is not easily captured. In general, high-tech SMEs will modify their performance level by introducing agile development management, but it is not clearly known how exactly their performance is changed. Therefore, it seems important to study the

performance of high-tech SMEs after the introduction of agile development by reviewing actual cases. Theoretical hypotheses should then be formulated relating innovation capability, agility, and firm performance.

An important step in carrying out scientific research is that of selecting appropriate research methods. In recent years, case studies have drawn more and more attention from researchers (Eisenhardt & Graebner, 2007; Yin, 2003). Case studies are a special type of research method, differing from historical analysis, economic analysis, and epidemiological analysis. It is a research approach best applied to answering the questions of "How?" and "Why?" and suitable for studying objects and events beyond the researcher's control. It is helpful to explain or provide in-depth analysis for current phenomena and is conducive to comprehensively understanding complex social phenomena or processes (Eisenhardt, 1989). Case studies can also capture the essential problems of enterprises through in-depth interviews and field observation, thus providing strong support for the exploration of theoretical context (Yin, 2003).

There are relatively few studies – empirical or otherwise – analyzing how enterprise innovation capability and project agility affect firm performance. This study aims to fill this gap through case studies. These can give rise to theoretical views through a process that should be vertical and comparative. In this context, we have also opted for a longitudinal comparison case study method (Eisenhardt, 1989). This methodological option is based on a number of reasons. First, the implementation of agile development is a series of extremely complex and dynamic processes in the R&D department of an enterprise, and using a longitudinal case study is conducive to understanding internal mechanisms of action and their impact on firm performance. Second, longitudinal case design can confirm the order of critical occurrences and identify cause-and-effect relationships, improving internal validity. Third, the design of comparative cases allows us to design a research framework based on quasi-experimental logic from the perspective of different types of combinations, which is conducive to the identification of causality and the improvement of external validity (Wei, Ying, & Liu, 2014). *Figure 3-1* presents the sequence of methodological processes followed in this study.

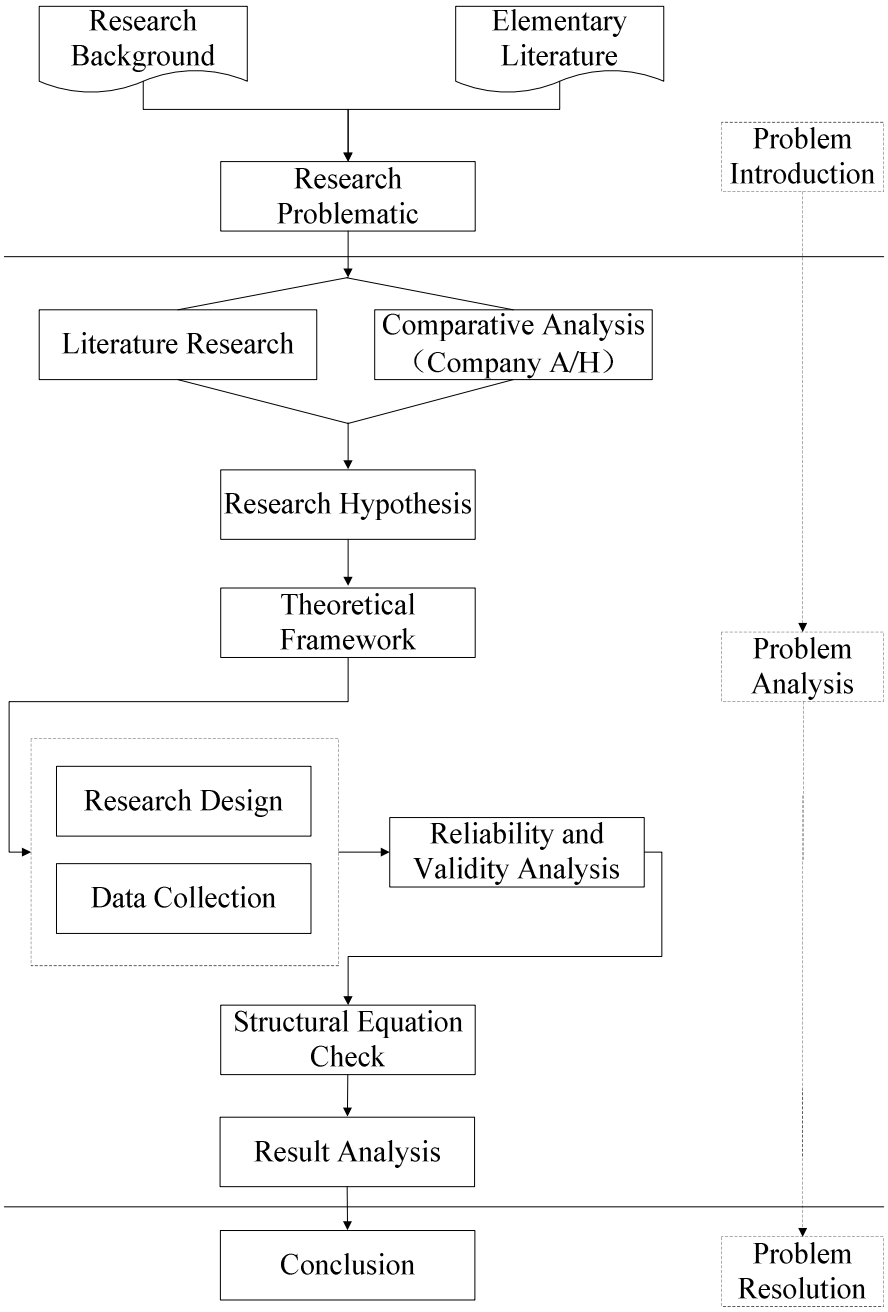


Figure 3-1. The Methodological Procedure.
Source: Author's Elaboration.

The few studies on the mechanism through which agile management improves performance in high-tech SMEs depend on the induction, discovery, and construction of theories from complex phenomena. "Theory construction" is an important research objective of this study, which aims to carry out a comparative analysis to capture the source factors driving firm performance of high-tech SMEs through the implementation of agile management. We therefore think it is necessary to use qualitative and inductive methods to discuss the problems at hand. In case studies, each case will give rise to its own theoretical point of view, and the comparative case study method can better discover characteristics,

internal links, and rules common to both cases. Generally, comparative case studies have higher reliability and validity than single case studies. Therefore, we develop a comparative case analysis to deal with our research questions.

There are many ways to collect data, including interviews, field observations, questionnaires, online media reports and other documentation. Usually, researchers use these sources to collect data and achieve comprehensive effects. Qualitative research also emphasizes the view of multi-researchers and multi-sources. Many researchers can strengthen the innovation of research. Because researchers have their own strengths, they can gather ideas and form a wider view of research. At the same time, they can also give full play to their own subjective thinking and gain new experience and understanding. Moreover, once several researchers agree on a certain point of view, the results of the study are easy to converge, which can enhance researchers' confidence on the study results. Multi-data sources can verify each other and make it easy for researchers to expand their own opinions on the collected data.

Interviews in this research include structured interviews and unstructured interviews. Interviews are one of the most commonly used methods to obtain rich data in qualitative and semi-qualitative research. Through in-depth interviews with target cases, research data can be obtained from in-depth exchanges with research subjects. In order to ensure the reliability and validity of data analysis, this study uses a variety of sources to collect data, including field-first-hand semi-structured interview data and second-hand text data, which can carry out triangular validation of data.

According to the needs of research, the present study is divided into two stages compared with the case study and data collection process. The first stage is divergent research and open data collection. On the basis of the previous theoretical research, we have initially formed a competitive conceptual framework to study the relationship between enterprise innovation capability, agile project management and enterprise performance. In order to further define the theoretical framework of this research to guide empirical research, we interviewed managers, R&D personnel and agile management consultants of high-tech SMEs in Beijing and Chengdu, respectively. At this stage of the research process, unstructured interviews were mainly conducted. The interviewees included senior R&D staff of Huawei Chengdu Research Institute, agile consultants of ThoughtWorks, and the leaders of Keruyun Technology Co., Ltd. for 1 or 1.5 hours each time. Under the guidance of theoretical literature, we collected and summarized the interview data, and through repeated discussions and

comparative analysis, put forward two competitive theoretical frameworks.

The second stage is typical enterprise research and targeted receipt collection. The main purpose of this research is to test the conceptual framework proposed in the first stage, and finally determine the basic hypothesis of the empirical research in this study. Based on the above considerations, the second stage of data collection is for two high-tech SMEs, company A and company H, mainly through semi-structured interviews to collect first-hand data, and through direct observation and documentation to collect second-hand data.

Company A is the company in which the author works as Chief Technology Officer (CTO). Based on the needs of the work, the author tracked and investigated the whole process of implementing agile project management in company A from 2011 to 2014, and interviewed the relevant personnel according to the research needs. The follow-up survey started in May 2013 and was completed in May 2015. After contacting with the management mainly, R&D personnel and general staff of company A, we get in-depth understanding of the operation and development process of company A, and collect the relevant data and information of company A from 2009 to 2014, then collate the data progress of tracking research. As for the content of the interview, the author interviewed the management, technical director and R&D personnel of Company A from January 2014 to May 2015. The main content of the interview involves the basic information of company A, the information of entrepreneurial team, and the implementation details of agile management, the development of technology, market feedback and so forth. Each interview group has more than 2 participants, and each participant recorded and made sound recording for the interview separately. After finishing the interview, content was sorted out. After that, cross-examination was conducted to discuss and confirm the unclear or controversial records. Finally, about 40.000 words of interview records were formed.

For company H, a follow-up survey and interviews were conducted from 2015 to 2018. The follow-up survey started in March 2015 and was completed in March 2018. As for the content of the interview, the research began by interviewing Company H in March 2016. Several board members were interviewed, including CTO and related R&D personnel of Company H. The main content of the interview is to design the basic information of the enterprise, the implementation of agile project management, the current situation of the enterprise development and business operation. At the same time, the related concepts of this research are divided, and the relevant indicators of the enterprise are inquired from different dimensions. At the same time, one member of our research project team joined Company H

from June 2016 to December 2016 to participate in the agile project management of company H. In addition, other company H's stakeholders were interviewed, such as suppliers and customers, aiming at understanding the possible impact of agile management in company H from the side. For company H's interview, our research team involved more than 2 participants in each interview, recording and making sound recording for the interview content separately. After finishing the interview, the content was sorted out, and then the cross-examination was conducted to discuss and determine the places where the record was unclear or might be controversial, resulting in about 50.000 words of interview records. In order to ensure the reliability and validity of the interview data, a research project team member working at company H was invited to participate in the process, making the collected data as closest to the reality as possible.

We regard interview data as the principle of core data, and constantly track and supplement the new information appearing in case data in the process of data collation. There are several ways to collect second-hand information, namely: (1) collate the information of internal and external journals, publications, company archives, meeting records, agile management process files, leaders' speeches, and refer to the information of news reports and industry reports on enterprise agile management and sort out; and (2) refer to the relevant government science and technology policies, visit the Ministry of Science and Technology Torch Program and other websites to provide the basis for the relevant macro data and standards of the two high-tech SMEs in this study. In the process of data collection, our interview team members ensure the quality of relevant information by repeatedly discussing and verifying the information.

3.2. Comparative Analysis

For the purposes of our comparative case study, two companies were selected – referred to as company A and company H, in order to address confidentiality requirements.

Founded in 2009, company A is a high-tech company in the IT industry, and is mainly engaged in the design and development of video products, industrial control products, and medical products. By the end of 2014, the company had approximately 200 employees, including more than 60 R&D personnel. Company A introduced agile management in 2011, and its R&D projects, benefits and profit margins have undergone non-linear changes. By 2014, the turnover rate of employees was maintained within 10% and the salary, development

space and freedom of R&D personnel far exceeded the standards of the industry.

Company A's products are mainly divided into three categories, such as video products, industrial control products and medical equipment. Video products and industrial control products mainly include terminal, mobile, remote control, data storage and business interaction, and more than a dozen product development types. Medical equipment products mainly include electrosurgical and organizational analysis products.

Company A's organizational structure adopts the balanced matrix structure of cross-coexistence of project department and R&D functional department, which combines the dual advantages of horizontal management and vertical management of function department. The purpose of such structure is to form a special project team to take charge of all tasks in the whole life cycle development of new products. At different stages of project management, such as technical pre-research, product design, integrated testing, assembly production and system trial, the relevant functional departments allocate special designers to participate for different responsibility. The goal is to achieve combination of strips and blocks and responsibilities' clearness. Then, different project managers are responsible for coordinating and promoting different tasks of relevant personnel in various functional departments for the project accomplishment, and ultimately ensuring the realization of project objectives. On the top of all the projects, there are project director, product director, marketing director and technical director. Project director and product director are mainly responsible for the promotion and implementation of project and product completion, while market director and technical director are mainly responsible for the planning and design of product market and technology.

For the market position of company A, it is the provider of equipment products for the market, especially in the market with high threshold and technical requirements, such as video surveillance, industrial control and medical treatment. In these above industries, market entrants are required to have certain technology and industry accumulation, and the product quality guarantee period is required for a long time and strict for after-sales service. As a result of the requirement, company A has a great advantage in these fields. At the same time, because of its good product quality and technological advantages, company A has gained a greater reputation in the market.

Company A was founded by several engineers with more than ten years of experience in system design. In the early stage of the company's development, due to the lack of funds and for the purpose of survival, based on the video and industrial control field, the

replacement and imitation of middle and low-end products, as well as the development of high-end new products are carried out simultaneously. With the success of research and development of high-end new products and the increase of market share of middle and low-end products, the company also carries out market development in different segments of high-end products. In the early stage of the company, from 2009 to 2010, after the attempt of the company's management, the company gradually implemented the management mode of combining project management with performance management. The application of these management methods greatly enhanced the company's early competitive advantage. However, with the increase of competitors and the development of new market segments, as well as the increase of new product development projects, the company has sought to improve effectiveness and efficiency without increasing company's resources in the case of limited funds and personnel. Through the attempt of multiple management methods and in this end, agile management was introduced in 2011. Since then, with the combination of project management, agile management and performance management, the company has achieved the improvement of effectiveness and efficiency in the case of limited resources, thereby enhancing the company's competitive advantage in related fields.

Founded in 2012, company H is a technology enterprise providing intelligent solutions for the local service industry, focusing mainly on the catering industry. Its main product is a Software-as-a-Service (SaaS) solution based on cloud technology. By the end of 2017, the company had approximately 500 employees, including around 200 R&D personnel. Company H established the software R&D center and introduced agile management in April 2015. Company H's vision is to connect people and services intelligently, efficiently, and simply. Its products' appearance and unique functions and its high-quality services lead the industry. By the end of 2017, it had served over 60.000 merchants. Company H pays close attention to market and technical trends, and actively responds to market changes. Its products are best-in-class in the food and beverage management industry.

Company H's products are divided into three product groups, namely SaaS product group, open platform product group and technology architecture group. Under SaaS product group and open platform product group, there are 10 kinds of product R&D lines, including terminal service, mobile service, cloud platform service, cross-platform data interaction, and each product line is responsible for product R&D of a certain kind of equipment or a subdivision area. The technology architecture group mainly focuses on platform technology architecture design, module sharing and business sharing based on different operating

systems.

Each product line is basically in accordance with the way of project management. Its members are composed of 5 to 10 members. The product line team is composed of project leader, product personnel, development engineer, system engineer, test engineer, and so forth. User interface designers are responsible for the design and production of functional interaction diagrams of other product lines, as well as the functional interaction mode and operation interface display of the final product. On all product lines, there are product director, marketing director, technical director and multiple technical architecture designers. The task of market requirement analysis falls on the market directors and product directors. The technical directors, product directors and system architecture engineers complete the system design and task decomposition. The R&D engineer completes the development and design work, which is strictly checked by the technical director and the system architecture engineer, and then tested by the tester. After checking and accepting the interaction diagram by the engineer, the product is handed over to the final merchant.

For the market position of company H, it is mainly in the local catering service and management industry, especially for lengthwise supports perspective, include multi-business management of different catering formats, such as reservation, payment, analysis and post-tracking services for dinner, fast food, group meals, fresh shops and convenience stores. From the horizontal connection perspective, it mainly faces the supply chain and cross-industry background based on data services and cross-industry linkages. At the same time, it also provides all-weather one-stop fast service based on cloud platform service, which can provide remote data sharing, mobile management, network booking and takeout services. It has gained a good reputation among many customers. Its products have been purchased and used by well-known merchants in many industries. At present, it has directly served 50 major cities and there are more than 160 cities with indirect services in domestic market.

Like most startups, company H was founded by several engineers with years of experience in software design. The product concept comes from an accidental customer requirement analysis when working with customers on other projects. Through detailed market analysis and product analysis on the catering field, the founders of the company H, found that there are huge business opportunities in this market. In the early stage of the company’s development, due to the lack of funds and the survival of the company, the founders of the company directly developed a powerful, reliable and stable product for the market, thus gaining the competitive opportunities in this field. In the early stage of the

company, from 2012 to 2014, due to the company's main product advantages, only some simple requirements from customer needs are optimized and adjusted on the human-machine interface. Similarly, due to resource constraints and through the attempt of the company's management, the company has gradually implemented a combination of project management and performance management. The application of these methods improve the early competitive advantage of the company under circumstance of market share of the company's core products is large. With the increase of competitors, the overall technological upgrading of the software industry, the development of new business markets, and the increase of new product development projects, in order to improve the effectiveness and efficiency of the company without increasing resources, the company management team seeks and implements the application of a variety of management methods, and introduces agile management in 2015. Since then, with the combination of project management, agile management and performance management, the company's effectiveness and efficiency have been greatly improved, and then the company's competitiveness in different fields has been enhanced.

These two companies were selected for a number of reasons. First, following the principle of research focus, both companies are IT enterprises and are in the stage of rapid development, having the same industry characteristics and development rules. Second, their internal processes are similar to one another, as are their sizes and development stages. Third, the two companies are located in cities which are innovation centers in China, and their development represents the typical firm in the industry. Finally, following the principle of polarization type, agile management practices were carried out in both cases within three years after their establishment, though their specific applications were quite different. The exploration of these two cases thus helped to more clearly show the relationship between constructs (Eisenhardt, 1989).

For the case analysis, data were collected from multiple sources (Glaser, Strauss, & Strutzel, 1968). The data include different openly published data about company A and company H such as those found in journals, newspaper articles, web articles, research books, research project reports, articles, books, and comments made by senior management. In addition, these data also include internal publications, annual meeting minutes and other sources such as annual reports, market analyses, market development plans, technology research and investments, project development and progress reports, and so forth. The use of these data amounts to the "triangle verification", guaranteeing reliability and validity (Eisenhardt, 1989).

The investigation examines each company for more than two years (*i.e.*, company A from 2013 to 2015, and company H from 2015 to 2018). The different time intervals are justified by two main reasons. First, long-term samples projecting results of agile management are extremely difficult to obtain, and company A has collaborated in previous projects. Second, for the period of 2013-2018, both companies operated in similar environments, and no significant changes to internal policies or to other macro environmental factors took place.

Each company granted at least two interviews per year, and the total interview time of each company exceeds 10 hours. The interviewees include the general manager of the firm, directors of various business and R&D departments. Through the collection and verification of both archival data and real-time data, factors affecting the reliability of case studies, such as retrospective interpretation and impression management, were effectively avoided. Data analysis adopted the paradigm of intra-case and inter-case analysis (Eisenhardt, 1989; Eisenhardt & Graebner, 2007).

The analysis began by reviewing the history of each case enterprise. Then, data from different sources were integrated and verified crossways, and a single case analysis was carried out to depict the internal and external changes of each case enterprise before and after the introduction of agile management. Finally, the two cases were compared and analyzed to determine the reasons behind the changes and the influencing factors. In order to make the comparison more meaningful and more likely to produce conclusions, the enterprise history was divided into important time nodes in accordance with the general vertical comparison of case studies. Both company A and company H have introduced agile management methods and thinking into their R&D departments. We defined companies' R&D stages according to the time node of introduction of agile management. The stage before the introduction of agile management was defined as the first stage, and the stage after the introduction of agile management was defined as the second stage.

Company A began to implement agile management early 2011. Therefore, we defined the first stage of company A as being from 2009 to 2010. Since the establishment of the company in 2009, the management methods adopted by company A for its R&D team are a combination of traditional project management and performance management. It also adopted a combination of matrix structure of projects and functional departments, shaping their performance evaluations accordingly. When compared to most technology SMEs, company A staff responsibilities are relatively clear, project management is well specified and functional

departments have a good division of labor. Company A regularly allocates resources to all projects in proportion to their priorities. Nevertheless, its R&D department had a 41% deferral rate in 2009 and a 44% deferral rate in 2010. Interviews with project members identified the following causes for project delays: (1) imbalance of resources; (2) poor communication; (3) lack of cooperation between different departments; (4) poor R&D capabilities; (5) lack of resource-sharing; (6) product defects; (7) poor testing capabilities; (8) poor product specifications and test standards; (9) inadequate sharing of modular products; (10) instability of technology systems; and (11) unreasonable assessment mechanisms. Further analysis shows that these causes are a reflection of lack of different aspects of project agility. The first is lack of resource agility, which is reflected in the imbalance of project resources, the lack of resource sharing, and poor R&D capabilities. The second one is insufficient process agility, resulting in poor communication, lack of cooperation between different departments, long test cycles, insufficient modularity of technology and products, and unreasonable assessment mechanisms. Lack of agility in these two aspects eventually leads to technical and product quality defects and project delays.

Delays in R&D projects lead to a number of problems. In terms of financial performance, and according to the data provided by the company, company A's annual performance growth is basically maintained at about 15%. Interviews with senior managers suggest that the heads of all departments and the general manager are not very satisfied with the growth rate. As the general manager of the company said, *"in a rapidly growing industry, it is difficult for shareholders to be satisfied with this growth rate"*. The company also receives feedback from customers each year. According to the data provided by the company, customer satisfaction was 67% in 2009 and 64% in 2010. Customer satisfaction has generally been low and shows a downward trend. As such, the company needs to actively seek management methods and solutions to reverse the situation. In terms of team management, interviews with R&D department staff found that they are not satisfied with the current situation, with some developers feeling stagnated. Indeed, the data provided by the company indicates an employee turnover rate of 40% in 2009 and of 30% in 2010.

As factors affecting performance are both internal and external to the company, after reviewing some direct investigative data, we collected the correlative data for performance, which contains information on project delays, financial performance, customer satisfaction, and employee turnover. We then calculated the annual rate for these four factors and carry out a comparative analysis according to average annual rate of different stages. These four factors

are always used in the comparative analysis of the two companies, being included in the survey. A summary of these data is shown in *Appendix 1* (see *Table A1-1* and *Table A1-2*). From it, we can know that the rate of projects delayed is 41% and 44% respectively in 2009 and 2010, and the rate of projects delayed is 42.8% from 2009 to 2010 and the average rate of projects delayed is 42.5% from 2009 to 2010. Also, we can know that the average rate of customer satisfaction is 65.5% from 2009 to 2010, the average rate of employee turnover is 35% from 2009 to 2010 and the average rate of growth is 15% from 2009 to 2010.

Having concluded the description of the first stage of company A, we now introduce the first stage of company H, which spans from 2012 to 2014, as the company introduced agile management at the beginning of 2015. The founding technical team of company H has many years of experience in technology development, using traditional development approaches combining waterfall development and incremental development since the company's foundation. Their product's simple appearance has been attractive to the market, and the resulting expansion has led merchants to become more cautious as to the functionalities and stability of the product. The company has accordingly needed to recruit large numbers of employees, with some issues arising from their integration, namely at the levels of communication, cooperation, and coordination. A number of telling comments were made by R&D staff in their interviews, such as: *"due to various historical problems, this function cannot be changed"*; *"if product features are added, at least two people are required to develop the product for at least one month for various reasons"*, *"this month's new version may not be released on time because there are several important functions that have not been developed"*, and so forth. These challenges, arising from the company's rapid growth, have proved significant to both R&D staff and project managers. According to the data provided by the company for the period from 2012 to 2014, the total number of planned development projects was 786, with only 440 (or 55.98%) of those being completed on time.

Similarly to the case of company A, project delays have resulted in a series of challenges – both internal and external – to company H. In terms of financial performance, and according to the data provided by the company, its growth rate is greater than 20%. As for customer satisfaction, the company's product was novel at the time of its launch, with pain points now beginning to emerge in customer's experience of the product. Customers are making an increasing number of customized demands, leading to a sharp rise in R&D costs and to delays in product delivery dates. As for software quality, customers express difficulty in the software operation and maintenance and indicate that the final product functions do not

match their demands. As a result of these factors, customer satisfaction of company H is also decreasing each year. According to company's marketing manager, customer satisfaction is below 80%, with a downwards trend. With regard to the management of the R&D department, the traditional waterfall and incremental R&D management method adopted by company H makes the internal development process rigid. Specifically, in traditional software development, the product line leader is very clear about the goal of product development, but the members of the team are not very clear. Some members with strong ability would do more things for some customers who do not pay attention to function, resulting in more unnecessary waste.

The project manager's insufficient emphasis on the team's development process and team culture leads project team members to get lost in the details of the work, pay no attention to the fluidity of the overall development process, neglect team cooperation and coordination, and not appreciating the team culture. In addition, poor communication in the team leads to a deterioration of the work atmosphere and a lack of a shared understanding of the objectives. Furthermore, communication between people is conducted through documents and written comments, with few opportunities for discussing matters in person. Some developers complain that other teams do not carry out testing on time. The above leads to a high turnover rate in company H's technical department. According to interview data, the average turnover rate of company H is of 30%. A summary of these data is shown in *Appendix 1* (see *Table A1-3*). From it, we can know that the average rate of projects delayed is 44.02% from 2012 to 2014. Also, we can know that the average rate of customer satisfaction is 80% from 2012 to 2014, and the average rate of growth is 20% from 2012 to 2014.

To summarize both companies' first stage, there is rapid development of the industry and rapid growth, as well as high project delay rate, low customer satisfaction, low growth of financial performance and low employee satisfaction. Although the two companies have different financial performances, they are faced with the same challenge: high delay rates of R&D projects leading to mediocre performance. It was found that a major cause of project delays is that there is insufficient coordination and collaboration between departments and slow responses to environmental changes. In-depth research and analysis of customer requirements, feasibility, potential risks, testing standards, product standards and of technical modular and serial products is insufficient at the beginning of the project. Managers of both enterprises believe that the high delay rate of R&D projects is mainly due to the low agile development ability of the enterprise. In the face of difficulties, the two companies introduced

agile management aimed at improving the speed of R&D and levels of customer satisfaction.

Having described the first stage of both companies, we now introduce the second stage of company A, ranging from 2011 to 2014. Two years after its establishment, company A's indicators related to R&D projects, which include project delay rate and turnover rate of R&D personnel, were both relatively high, while customer satisfaction and growth rate were relatively low. This situation placed company A in a passive position in the competition of the industry. Therefore, since the beginning of 2011, company A has implemented agile development in the R&D department. In the following four years, company A's relevant performance indicators have been improved to some extent. According to the data provided by the company, after the implementation of agile development from 2011 to 2014, the project delay rate, customer satisfaction, growth rate, employee turnover rate and other indicators significantly improved. The project delay rate decreased from 44% before the implementation of agile development to 27.6% in 2014. Customer satisfaction increased from 64% before agile development to 82% in 2014. Employee turnover rate was significantly reduced, from 30% before the implementation of agile development to 18% in 2014. The growth rate increased from 15% before the implementation of agile development to 27.2% in 2014. After the implementation of agile development, the management indicators of company A generally improved, as summarized in *Appendix 1* (see *Table A1-4* and *Table A1-5*). From it, we can know that the average rate of projects delayed is 28.38% from 2011 to 2014. Also, we can know that the average rate of customer satisfaction is 78.5% from 2011 to 2014, the average rate of employee turnover is 23.5% from 2011 to 2014 and the average rate of growth is 24.85% from 2011 to 2014.

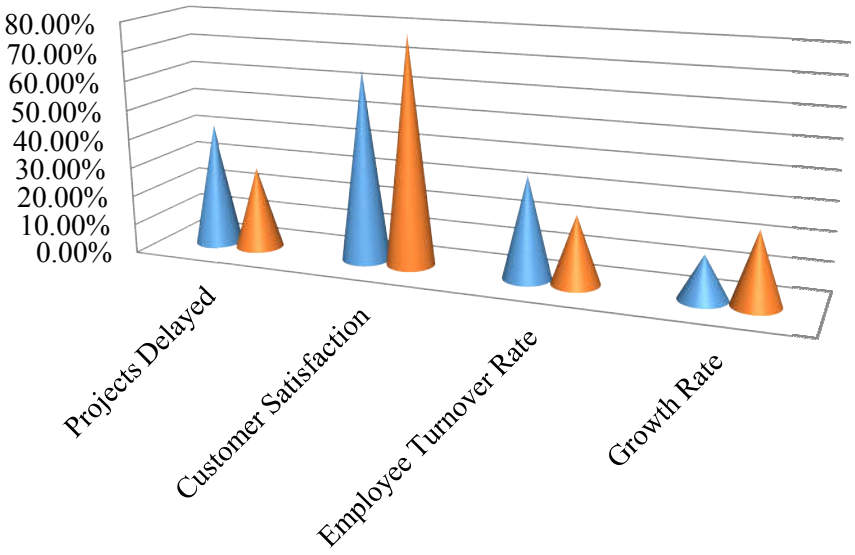
Having concluded the description of the second stage of company A, we now describe the second stage of company H, which spans from 2015 to 2017. The company introduced agile development since the beginning of 2015, gradually replacing the traditional practice of development. The internal implementation of the "controlled self-organization" mode within the R&D team has significantly improved the communication degree and mutual assistance degree of R&D team members, improved the efficiency of product development, and significantly reduced the proportion of delayed projects. After the implementation of agile development, the proportion of delayed projects, turnover rate of R&D staff, customer satisfaction, growth rate and other key indicators also changed significantly.

In terms of project development, product managers described the requirements of customers through "user stories" to help developers understand development tasks. By

reserving a portion of each iteration's development time for changes in customer requirements, it becomes possible to remove or add tasks according to specific circumstances in the development process. With the help of tools such as agile Kanban, burn-down charts and follow-up tables, developers can know their own and their teams' progress at a stand-up meeting each day, as well as the status of the story cards. Because each story card represents a separate test case developers can adjust task priorities as necessary. In this way, excessive deviations are avoided. Project completion rates were increased from 55.98% before the introduction of agile development to 88.89% after introduction, as shown in *Appendix 1* (see *Table A1-6*).

Company H's product quality also improved through agile activities such as pair programming, test-driven development, code review, daily integration, agile review meetings, and so forth. These activities run through the whole cycle of iterative development work. Teams realized that code is no longer only seen by themselves, needing to be shared in order to form a unified code and technology and achieve progress. Furthermore, these activities keep track of the situation of the code, so that its overall quality is constantly optimized. These activities encourage testers to use a combination of black and white box testing in product development to implement automated testing, unit testing, integration testing, system testing, and acceptance testing. Agile review meetings demonstrate each functional point of the iteration and document problems. The improvement of the company's product quality is reflected in its financial performance indicators. According to interview data, the company's growth rate exceeded 40%. Better products also affect customer satisfaction: according to the interview data of the heads of the marketing department, customer satisfaction reached more than 95% after the implementation of agile development.

As for the satisfaction of R&D team members, agile development increases the frequency of communication. Employees of different functions are able to work closely, and team members grow from the exchange of ideas and the sharing of knowledge. In addition, the cooperation and technical ability of team members is enhanced, as is development efficiency. According to interview data, the annual turnover rate of company H's R&D department was 10%, as shown in *Appendix 1* (see *Table A1-7*). From it, we can know that the average rate of projects delayed is 11.11% from 2015 to 2017. Also, we can know that the average rate of customer satisfaction is 95% from 2015 to 2017, and the average rate of growth is 40% from 2015 to 2017.

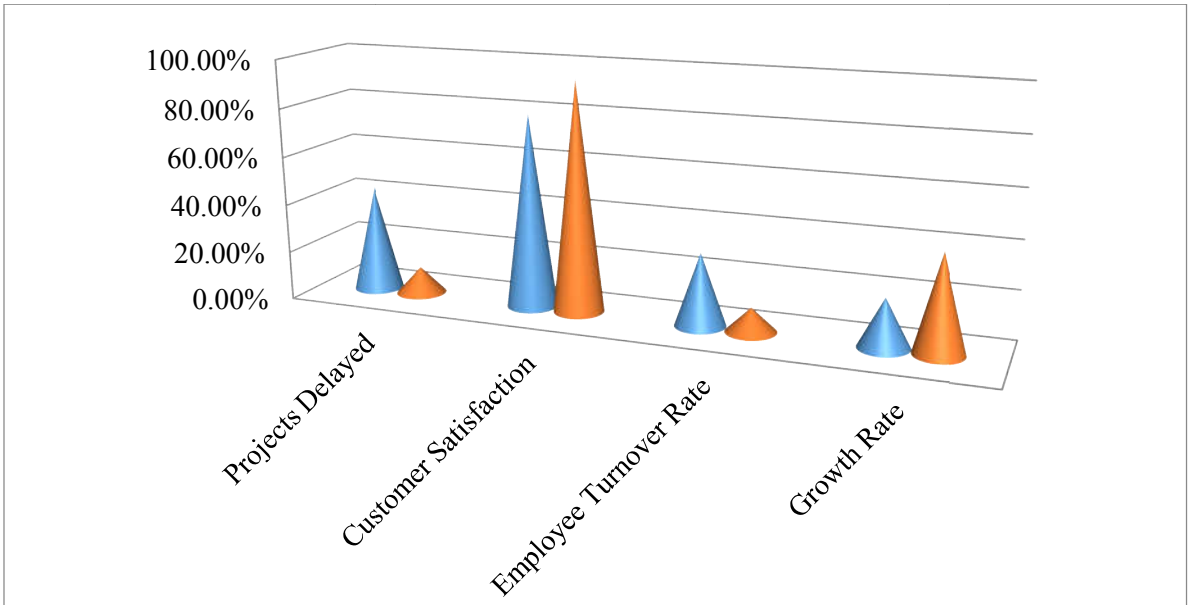


	Projects Delayed	Customer Satisfaction	Employee Turnover Rate	Growth Rate
2009-2010 Annual Average	42.50%	65.50%	35.00%	15.00%
2011-2014 Annual Average	28.38%	78.50%	23.50%	24.85%

Figure 3-2. Comparative Curves of Company A.
Source: Author's Elaboration.

With the data of company A's annual averages for the periods of 2009-2010 and 2011-2014, we can draw a comparison. *Figure 3-2* highlights the differences between the first stage and the second stage of company A, pointing to the role of agile management in the company's development.

With the data of company H's annual averages for the periods of 2012-2014 and 2015-2017, we can also draw a comparison. *Figure 3-3* highlights the differences between the first stage and the second stage of company H, pointing to the role of agile management in the company's development.



	Projects Delayed	Customer Satisfaction	Employee Turnover Rate	Growth Rate
2012-2014 Annual Average	44.02%	80.00%	30.00%	20.00%
2015-2017 Annual Average	11.11%	95.00%	10.00%	40.00%

Figure 3-3. Comparative Curves of Company H.
Source: Author's Elaboration.

The key performance indicators of company A and company H significantly improved with the implementation and application of agile management ideas. However, there are differences in these improvements between the two companies. The proportion of delayed projects in company H decreased from 44.02% in the first stage to 11.11% in the second stage. In company A, the same proportion decreased from 42.50% in the first stage to 28.38% in the second stage, representing a difference of 14.12%. This suggests that the effects of agile management were greater in company H than in company A.

Through the interviews that were carried out, this study inquired about the agility ability of the enterprise from different dimensions, such as whether the R&D personnel can effectively implement different types and scopes of business and whether the enterprise can adequately coordinate changes to products or services. The answers given differed from one company to the other. We believe that the differences in firm performance are mainly reflected in differences in project agility. Detailed descriptions are shown in *Appendix 2* (see *Table A2-1*). From it, under the perspective of project delay rate, we can know that the degree of improvement of company H (32.91%) is greater than that of company A (14.12%), then we can get conclusion that the effect of agile management as implemented by company H is

obviously better than that of company A. Also, we can know that different answers were given to the following questions: *"Can R&D personnel effectively implement different types and scopes of business?"*; and *"Can the firm adequately coordinate changes to products of services?"*, allowing for the conclusion that the differences in firm performance are mainly reflected in differences in project agility.

At the project level, the effective implementation of agile development is affected and restricted by many factors related to the project team. Kasarda and Rondinelli (1998) state that the innovation capability of the R&D department has a crucial impact on the effect of the implementation of agile development. Smith and Saint-Onge (1996) note that the successful implementation of agile development requires not only top-down transformation, but also collaboration and communication among team members, which are of vital importance to the improvement of enterprises' innovation capability.

Comparing the composition of teams in the agile projects undertaken by company A and company H, it was found that the average education level of employees in company H is higher than that of employees in company A. The employees are encouraged to apply new technology and new knowledge to solve problems. Furthermore, company H is more encouraging of collaboration and communication within teams (*i.e.*, its R&D department's innovation capability is higher than is the case for company A). Therefore, this study considers that the innovation capability of enterprises' R&D departments' is a key factor affecting firm agility, as presented in *Appendix 2* (see *Table A2-2*).

In addition, other attributes are different. From the internal perspective, the two companies have different sizes. The total number of employees of company A was about 200 by the end of 2014, and the total number of employees of company H was about 500 by the end of 2017. The operating income of the two enterprises is also significantly different. The operating income of company H is one order of magnitude greater than that of company A. In addition, the proportion of R&D personnel is also different between the two companies. The proportion of R&D personnel of company A is about 30%, while that of company H is over 40%. Lastly, the two enterprises offer different training and learning opportunities to employees, with company H tending to provide more such opportunities.

From the external point of view, the two enterprises are in different industries, facing different task environments. In addition, they face different market environments. Company A is in an industry with greater market competition pressure and numerous competitors, while company H has opened up new market segments, thus facing less competition. These factors

may have an impact on the implementation of enterprise agile development, and may have different degrees of impact on firm performance, as presented in *Appendix 2* (see *Table A2-3*).

We will carry out empirical research of China's high-tech SMEs, based on the theoretical basis of existing research.

3.3. Conceptual Framework

In order to build the conceptual framework of this study, we need to further examine the relationship between innovation capability and firm performance. Chen, Tan and Yu (2012) state that the innovation capability of high-tech SMEs includes both the existing innovation capability and the potential for future improvements to innovation capability. Existing innovation capability mainly refers to the enterprise's R&D and manufacturing capabilities (Duan, 2008). The potential for improvements to innovation capability mainly refers to the enterprise's innovation project management and innovation transformation ability (Chen *et al.*, 2012). The concept of innovation capability includes not only the above two factors, but also the organic combination of factors, an important assessment index for this capability, which can allow enterprises to secure competitive advantage (Wade & Hulland, 2004). From the perspective of RBV, the source of enterprises' competitive advantage mainly lies in unique resources (*i.e.*, those that are scarce, valuable, and difficult to imitate and replace – and in the ability to utilize and configure such resources) (Amit & Schoemaker, 1993).

Innovation capability can improve many high-level abilities of enterprises such as management processes, organizational learning, new product development, among others (Zeng *et al.*, 2018). In other words, innovation capability is the basis for higher-level abilities of enterprises, being able to promote the integration and allocation of enterprise resources and to continuously improve its performance by effectively responding to the needs of consumers (Sambamurthy *et al.*, 2003). Robert, Modesto and Steven (2001) also hold that an enterprise's innovation capability is a series of comprehensive characteristics in support of innovation strategy, such as availability and distribution of resources, understanding of industry development, understanding of technology development, and strategic management ability. As such, Leonard‐Barton (1992) notes that the core of an enterprise's innovation capability lies in mastering professional knowledge, technical systems, and the management systems and enterprise values. Therefore, the ability to innovate is conducive to using of enterprise resources more efficiently and effectively and to contributing to employee growth, profit

increase, and others, thus affecting firm performance in key ways (Mone *et al.*, 1998).

Empirical research shows that the innovation capability of enterprises is not only positively correlated with their profitability (Calantone *et al.*, 2002), but also with their ability to learn and grow. Klomp and Van Leeuwen (2001) establish a feedback model to verify the positive correlation between innovation capability and firm performance. For high-tech SMEs, the impact of innovation capability on firm performance needs to be verified by empirical results. As such, this study proposes the following hypothesis:

H1: The innovation capability of an enterprise has a positive impact on its performance.

Having described the relationship between innovation capability and firm performance, we will need to examine the impact of project agility on firm performance. Agility is widely recognized as a high-level ability of enterprises (Zeng *et al.*, 2018), promoting the integration and allocation of enterprise resources and continuously improving firm performance by effectively responding to the needs of consumers over long periods of time (Sambamurthy *et al.*, 2003). Agility is an enterprise's ability to maintain and continuously enhance its competitive advantage in turbulent market environments. It is a strategic goal that an enterprise must pursue to achieve sustainability in its performance (Wang, 2007). Chen *et al.* (2014) indicate that agility helps enterprises to make full use of market opportunities and promote their competitiveness. As for the relationship between agility and firm performance, early empirical studies confirmed the positive correlation between the two, especially the positive impact of agile manufacturing and agile supply chains (Han, Kim, & Srivastava, 1998; Yusuf, Gunasekaran, Adeleye, & Sivayoganathan, 2004). More recent studies such as that of Inman, Sale, Green Jr, and Whitten (2011) verify through empirical analysis that enterprise agility has a significant positive impact on its financial performance, market performance and operational performance. Tallon and Pinsonneault (2011) have also analyzed survey data of 241 enterprises and found a positive correlation between enterprise agility and financial performance. Lee and Yang (2014) empirically analyzed data from the flat glass industry in Taiwan and China, finding that enterprise agility had a positive effect on its financial performance.

Unlike previous studies, this study examines the effect of project agility on firm performance, based on the characteristics of high-tech SMEs. Project agility is the internal mechanism for enterprises to respond to changes in the internal and external environments (Weiss & Swan, 2018). When faced with environmental changes, enterprises need to develop

new strategies. Their interests should not be defined on the basis of departmental jurisdiction disputes, but from the starting point of team discussions on how to apply their collective wisdom to cope with crises and focus on stakeholders' common interests (Zeng *et al.*, 2018). From this perspective, enterprises with a good degree of project agility can better select partners (Narayanan, Narasimhan, & Schoenherr, 2015), respond to changes in consumer demand (Zhu, Billeter, & Inman, 2012), and improve operational processes and consumer retention, thereby improving earnings and reduce costs (Tallon, 2008). Therefore, project agility is a valuable characteristic (Swafford, Ghosh, & Murthy, 2008) that can contribute to the economic performance of an enterprise (He & Zhang, 2017). However, whether project agility can directly improve firm performance in high-tech SMEs remains to be verified by data. Accordingly, this study proposes the following hypothesis:

H2: An enterprise's project agility has a positive impact on its performance.

Given that project agility is located somewhere between innovation capability and firm performance, it is necessary to elaborate on its moderating role. Existing theoretical research suggests that an enterprise's innovation capability is a type of low-level ability that can improve a number of high-level abilities – such as management processes, organizational learning, and new product development. Agility is widely considered to be a high-level ability, and one that can promote resource integration and configuration, efficiently coping with consumer demands, and the improvement of performance over a very long time (Sambamurthy *et al.*, 2003). As mentioned in the literature review of *Chapter 2*, agility refers to the extent to which enterprises can adjust their business processes to quickly and easily respond to changes in the market environment. In turbulent and changing market environments, agility is regarded as a high-level ability for enterprises to change themselves to respond to market changes (Wang, 2007). By effectively responding to environmental threats and changing requirements, agile enterprises can better acquire and maintain sustainable competitive advantages. The ability of enterprises to use and allocate resources effectively can improve their agility. Agile enterprises are better able to respond to market changes and achieve good performance in the long term.

Innovation capability alone cannot bring about sustainable performance. Only when it is combined with other resources and abilities of the enterprise can it become a higher-level ability and contribute to the sustainable development of the enterprise. Therefore, agility transmission is important in the process of influencing firm performance through innovation capability. From the perspective of enterprise projects, many studies have shown that internal

business processes are the key factors connecting innovation capability and firm performance (Jiang & Zhao, 2015; Melville, Kraemer, & Gurbaxani, 2004).

For high-tech SMEs, identifying external market changes and quickly making business decisions is an important expression of project agility. Strong innovation capability can help projects rapidly access external markets obtain data relevant for making decisions (Ashrafi *et al.*, 2019). Through the effective management and use of this information, strong innovation capability can accelerate the decision-making process, reduce transaction costs, shorten the enterprise's reaction time in the face of external environment changes, accelerate business processes, and enhance project agility (Li & Holsapple, 2018).

In conclusion, while innovation capability is considered to be a low-level ability, it can affect firm performance mainly through project agility as a high-level ability. In other words, in order to improve their performance, enterprises need not only to have a good capability to innovate, but also to be agile: more agile business processes can improve enterprise profitability, as well as its ability to learn. As such, this study proposes the following hypotheses:

H3: Innovation capability has a positive impact on project agility.

H4: Project agility plays a mediating role between innovation capability and firm performance.

For proper research of the theoretical framework, it is necessary to also analyze the moderating effect of innovation atmosphere. In a real-work scenario, innovative and practical ideas generated by employees related to enterprise products, services and processes are defined as employees' creativity. Woodman, Sawyer and Griffin (1993) propose the interactive model of innovation ability, which considers that the creativity of employees is influenced by the interaction between individual and environment, and is the result of the comprehensive output of various complex factors. According to social learning theory, individual innovation level is not only affected by individual factors such as cognition, but also closely related to the environment in which the individual lives. The occurrence of behavior is the result of interaction between individual and environment. In this study, the impact of individual factors on employee creativity is not within the scope of this study. Innovation atmosphere, as one of the important environmental variables, is the focus of this study.

The definition of organizational innovation atmosphere proposed by Amabile *et al*. (1996) regards organizational support, and team support as the core positive environmental

incentives. Liu and Shi (2009) studied the relationship between organizational innovation atmosphere and employee innovation behavior from two sub-dimensions of organizational innovation atmosphere, such as organizational support and colleague support. In the existing research results, whether at the organizational level, or at the level of colleagues or teams, they all reflect the direct or indirect impact on employee creativity. First, Shalley, Gilson and Blum (2000) propose that the supportive attitude, fair evaluation and encouragement of employees' creative activities would significantly affect their creativity. That is to say, when employees perceive that the organization pays great attention to the creative activities of employees, and gives fair evaluation and reward to innovative achievements, they will receive the signal that employees can boldly try some new ideas and initiatives, which will help to improve their work motivation and further promote the creativity of employees. Second, the support of colleagues or the mutual help of team members can often build a high-quality interpersonal relationship and team communication atmosphere between colleagues. Tse and Dasborough (2008) believe that high-quality team member exchange includes not only the communication of work ideas and problem solving, knowledge or information sharing, task-oriented exchange, but also the relationship, support and encouragement of team members based on emotional connection. Compared with individual hard work, more interaction with colleagues is more likely to collide with the spark of thinking and generate more innovative ideas. Employees are more likely to adopt these new ideas to solve practical problems in their work.

In the comparative case analysis presented before, an apparently obvious aspect is that enterprises with a better innovation atmosphere experience greater effects of their agile implementation on their performance. As Smith and Saint-Onge (1996) indicate, successful implementation of agile development requires not only top-down transformation but also collaboration and communication among team members, which are of vital importance to the improvement of enterprises' innovation capability.

In the foregoing discussion, we find that innovation capability has a positive impact on project agility, and project agility also has a positive impact on enterprise performance. So under different levels of innovation climate, will the impact of these two types change? Existing studies suggest that, on the one hand, innovation atmosphere plays a role in the influence that innovation capability has on firm performance. According to the interaction theory of creativity, the innovation effect of an enterprise is a function of the degree to which internal environmental factors have a positive effect on innovation behavior (Woodman *et al*.,

1993). Internal environmental factors of the organization have a significant impact on the innovation performance of employees (Shalley, Zhou, & Oldham, 2004). As an important internal environment factor of an enterprise, the innovation atmosphere can exert an influence on individuals' psychological processes and influence their innovation performance (Isaksen & Tidd, 2007). The innovation atmosphere plays a strong role in promoting innovation performance (Mumford & Gustafson, 1988). On the other hand, innovation capability influences enterprise agility. A large number of studies confirm the significant influence of the innovation atmosphere on the improvement of innovation capability (Agrell & Gustafson, 1994; Amabile, Conti, Coon, Lazenby, & Herron, 1996; Anderson & West, 1998). Moreover, the organizational atmosphere that encourages innovation can stimulate the creativity of the organization's members, thus improving the role of innovation capability. As a high-level ability of enterprises, agility can be improved through innovation capability, while its effect depends on the internal processes and environment (Zeng *et al.*, 2018). A good atmosphere of innovation can make project processes run more smoothly, accelerate business processes, improve communication and coordination, develop the self-renewal and self-improvement characteristics of business processes, and promote the organization's project agility. Based on the above, this study proposes the following hypotheses:

H5a: The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on firm performance. In other words, the better the innovation atmosphere, the stronger the effect of innovation capability on firm performance.

H5b: The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on project agility. In other words, the better the innovation atmosphere, the stronger the effect of innovation capability on project agility.

The moderating effect of environmental dynamics also needs to be analyzed. Organizational environment refers to the collection of all elements that exist outside the boundaries of an organization and have an impact on part, or all, of the organization. In practice, although the development of information technology has greatly facilitated decision-making for enterprises, environmental uncertainty has not been reduced. Therefore, the environment is a contingency variable that must be considered by organizations. It is an important moderator of strategic management and innovation management, especially in the matching process between the enterprise's internal resource capacity and the external environment (Ge & Xiao, 2008). Scholars generally divide environmental uncertainty into multiple dimensions for research. Dess and Beard (1984) classify environmental characteristics into three dimensions: (1) dynamics; (2) complexity, and (3) munificence. The

latter is also known as environmental capacity and refers to the degree to which the environment can support the survival and development of the organization. From the perspective of the current organizational environment, fast change and instability are its typical characteristics (Tallon & Pinsonneault, 2011). Therefore, this study examines the moderating effect of environmental dynamics.

Environmental dynamics reflect the degree to which environmental factors remain static or dynamic. Studies have shown that environmental dynamics have a significant impact on the long-term value creation of enterprises (Azadegan, Patel, Zangoueinezhad, & Linderman, 2013), but scholars have very different views on this effect. The "threat theory" holds that environmental dynamics will bring challenges, adversely affect the production and operation of enterprises, and further erode their competitiveness. The "opportunity theory", on the other hand, holds that environmental dynamics create many opportunities, and that enterprises that can continuously perceive and seize these opportunities can achieve success. Thus, opportunities and challenges coexist in environmental dynamics. Agility, on the other hand, helps to identify and meet changing market demands, to develop dynamic capability to cope with external environments, and to turn challenges into opportunities. However, there is little research on the moderating mechanism of environmental dynamics on the relationship between agility and firm performance.

According to contingency theory, organizational behavior needs to match its environment (Miller & Shamsie, 1996). In a less dynamic environment, market demands and technological changes are relatively stable or predictable, most problems are structural in nature, and competitive advantage can last for a long time. Therefore, enterprises are not faced with stringent requirements for agility. In addition, agile activities often require investment costs, which mean that agility is more likely to yield return on investment in less dynamic environments. However, with the improvement of environmental dynamics, the acceleration of market demands, and technological changes, many aspects are challenged (*e.g.*, added value, heterogeneity, and inimitability of the enterprise's knowledge, its decision-making process, and the duration of its competitive advantage). In order to adapt to the rapidly changing external environment, enterprises must be able to respond quickly (Blome, Schoenherr, & Rexhausen, 2013). Indeed, the rapidly changing environment provides a meaningful window of opportunity for competitive enterprises. Continuous innovation and rapid and accurate reactions can enable enterprises to achieve excellent performance in dynamic environments (Swafford, Ghosh, & Murthy, 2006). It can be seen that, in highly

dynamic environments, firms' own conventional knowledge and ability often have difficulty meeting requirements. Acquiring knowledge from the outside and improving agility has become an important way for enterprises to improve their ability to survive and maintain their competitive advantage (Ackert, Church, & Zhang, 2018). Therefore, when compared to an environment that is not very dynamic, agility plays a more significant role in firm performance than in an environment that is very dynamic. As such, this study proposes the following hypothesis:

H6: Environmental dynamics play a positive role in moderating the relationship between agility and firm performance. That is, the higher the degree of environmental dynamics, the stronger the positive relationship between project agility and firm performance.

It is worth noting that innovation is at the core of project agility, based on the innovation capability of enterprise's project teams. Therefore, we propose that the innovation capability of a firm is the basis for resources to realize project agility, and project agility is the reflection of an enterprise's innovation capability on the efficiency of its innovation. Thus, we propose the basic conceptual framework shown in *Figure 3-4*.

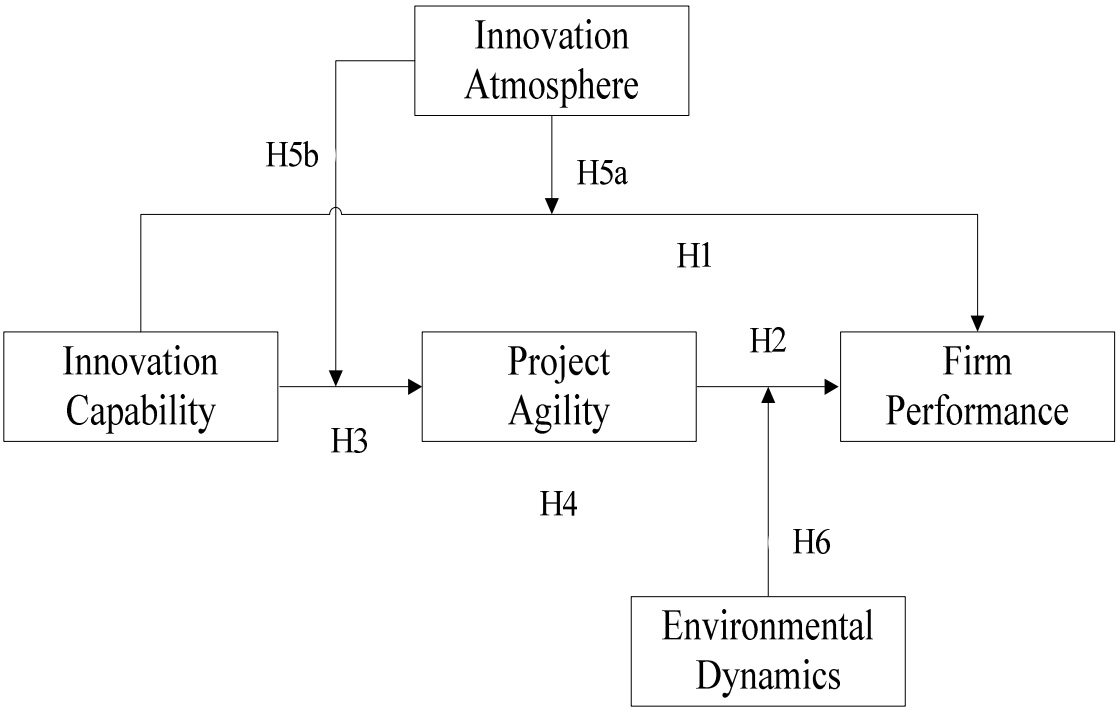


Figure 3-4. Conceptual Framework of the Study.
Source: Author's Elaboration.

Also, *Table 3-1* summarizes the research hypotheses outlined. In the next chapter, we will test these hypotheses.

Table 3-1 *Summary Table of Hypotheses*

Items	Research Hypotheses
H1	The innovation capability of an enterprise has a positive impact on its performance.
H2	An enterprise's project agility has a positive impact on its performance.
H3	Innovation capability has a positive effect on project agility.
H4	Project agility plays a mediating role between innovation capability and firm performance.
H5a	The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on firm performance.
H5b	The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on project agility.
H6	Environmental dynamics play a positive role in moderating the relationship between project agility and firm performance.

Source: Author's Elaboration.

Synopsis of Chapter 3

This third chapter begins by introducing the research problematic. Two enterprises implementing information technology were selected for comparative analysis, and the basic relationships between innovation capability, project agility and firm performance were analyzed, resulting in a conceptual model. For a detailed analysis, we selected two high-tech SMEs, company A and company H, that have implemented project agility. We observed changes in the two enterprises' performance in different stages and compared them to one another. The comparative cases illustrated that the performance of both companies significantly improved after the implementation of project agility. However, the effects of the implementation of agile management are different, with the improvements to the performance of company H being apparently better than those of company A. In terms of the enterprises' innovation capability, company H's staff have a higher level of education than company A's employees. Company H further encourages its staff to apply new technologies and knowledge to solve problems. It also promotes collaboration and communication within teams. From the perspective of agile project management, this study preliminarily concluded that enterprises with strong innovation capability and agile project management could improve their performance. We developed research hypotheses around three main variables: innovation capability, project agility, and firm performance. We then explored the theoretical relationships between the variables, suggesting that: enterprise innovation capability has a positive effect on innovation performance, project agility has a positive effect on firm performance, enterprise innovation ability has a positive effect on project agility, and that project agility has a mediating role in the effect that innovation ability has on firm performance. Furthermore, we put forward the moderating effect for the main variables and proposed several hypotheses, as follows: the innovation atmosphere has a positive moderating effect on the effect that innovation capability has on firm performance; the innovation atmosphere has a positive moderating effect on the effect that innovation capability has on project agility; environmental dynamics have a positive moderating effect on the relationship between project agility and firm performance. The next chapter presents the empirical results that were obtained.

Chapter 4: Empirical Evidence from High-Tech SMEs in China

Based on the comparative case analysis and the theoretical reasoning presented in the previous chapter, the main purpose of this chapter is to empirically test the proposed model. Following the principles of questionnaire design, we developed a set of items by selecting the proper measurement indicators of relevant variables that constitute the questionnaire. We carried out a questionnaire survey on high-tech SMEs in China and, based on the obtained results, we verified the hypotheses proposed earlier.

4.1. Research Design

We first introduce the measurement of each variable. For project agility, Cao and Dowlatshahi (2005) define six aspects of manufacturing enterprise agility, namely: (1) resource sharing; (2) core competencies; (3) time reduction; (4) capacity increase; (5) quality improvement; and (6) market share enhancement.

Tseng and Lin (2011) and Aburub (2015) divide agility into four dimensions, namely: (1) competency; (2) flexibility; (3) quickness; and (4) responsiveness. According to the specific situation of this study, and referring to Song and Lu's (2013) measurement tools of complex projects, scale prediction test, reliability test, and validity test, this study defined seven factors to measure project agility, as shown in *Appendix 3* (see *Table A3-1*). The items are as follows: (1) employees of the company can effectively carry out different types and scope of business; (2) the enterprise has the ability to operate effectively at different output levels while ensuring the quality of output; (3) the company has the ability to respond effectively to changes in planned delivery time; (4) the company can quickly detect changes in customer preferences; (5) the company can make prompt decisions in response to price changes; (6) the company can react quickly to competitors' competitive strategies; and (7) The relevant departments of the enterprise can properly coordinate service and/or product changes.

As indicated in *Chapter 2*, there is no unified understanding on the measurement of firm performance. Most scholars do not have a consistent understanding of firm performance, and most literature is limited to measuring the economic benefits of enterprises, seldom

involving the contributions of enterprise innovation to market, society, and environment. Since it is difficult to collect the data of sales revenue from high-tech SMEs, most studies use the proportion of the company's products that are innovative as an indicator of its innovation performance.

In order to reflect firm performance more comprehensively, this study adopts the Balanced scorecard (BSC) method (Kaplan & Norton, 1992) to measure firm performance. The BSC is an effective method of performance evaluation based on corporate goals, which takes into account both the financial and non-financial performance of an enterprise. Specifically, it includes four dimensions: (1) financial performance; (2) customer satisfaction; (3) internal process, and (4) learning and growth. According to this study's research goal, referring to the scale of Wu and Lu (2012) after discussion by experts, we developed six questions to measure enterprises' financial and innovation performance in *Appendix 3* (see *Table A3-1*). The items are as follows: (1) after the implementation of agile development, the turnover and profit of the company increased; (2) after the implementation of agile development, there has been an increase in customer satisfaction with the company's products or services; (3) after the implementation of agile development, the company's products or services have enhanced customers' willingness to consume; (4) after the implementation of agile development, the company's decision-making is faster and more accurate; (5) after the implementation of agile development, employees' problem-solving abilities improved; and (6) After the implementation of agile development, employees' learning and innovation abilities have improved.

As for the measurement of innovation ability, this study is based on the work of Luo and Liu (2009). To fully consider the situation at the project level (Cui, 2012), and following expert discussion, innovation ability was extracted, and six questions were defined as measurement items of innovation ability from the aspects of employees' learning ability, resource integration ability and organizational decision-making ability. Detailed descriptions are shown in *Appendix 3* (see *Table A3-2*). The items are as follows: (1) the company encourages employees to apply new technologies and knowledge; (2) the company can effectively promote the promotion and application of new technologies; (3) the R&D personnel of the company have strong abilities in technology development; (4) It is easy for the enterprise to obtain the resources needed for innovation (such as funds, talents, and so forth.) from outside; (5) schemes implemented by the enterprise are based on the viewpoints of many members, and each scheme is globally inspected before final decisions are made; and

(6) the company has a good innovation culture and environment.

For the measurement of innovation atmosphere, this study refers to the scale of Anderson and West (1998) to measure the atmosphere supporting team innovation. When applied to the research in this study, five items are defined to measure innovation atmosphere, as shown in *Appendix 3* (see *Table A3-2*). The items are as follows: (1) my job is very challenging; (2) at work, my colleagues support and assist each other; (3) my supervisor is a good example of innovation. He/she encourages his/her subordinates to come up with solutions to improve production or services; (4) our company appreciates and recognizes innovative employees; and (5) I have sufficient resources and time to realize my new ideas.

For the measurement of environmental dynamics, and based on the scale of Jaworski and Kohli (1993), this study investigated both technical dynamics and market dynamics. Considering this study's research objectives, four items were defined to measure environmental dynamics, as shown in *Appendix 3* (see *Table A3-2*). The items are as follows: (1) technological changes are very rapid in the company's industry; (2) industrial technology change provides several opportunities for the development of the whole industry; (3) in the company's market, customers are willing to accept new product ideas; and (4) in the company's market, customers' product preference changes very quickly.

Having described the measurement of variables, we elaborate on the questionnaire design. Using the survey method we can improve the efficiency of research, given that surveys can collect a large amount of structured data in a short time for quantitative analysis. The crux of questionnaire design is to have a solid foundation for data validity, and this chapter defines the questions of the survey to measure relevant variables accordingly. The questionnaire design has four main steps, namely: (1) initial questionnaire design; (2) expert discussion and improvement; (3) pre-survey and re-improvement; and (4) formal questionnaire.

In order to design a more scientific questionnaire, this study started by carrying out an extensive review of existing research, finding that the literature focused on empirical research on innovation capability, project agility, firm performance, innovation atmosphere and environmental dynamics. Following this stage, experts were consulted. After repeated consultations and feedback, the questionnaire was modified to adopt their constructive opinions. Based on these two initial steps, this study formed an initial research questionnaire, selecting dozens of enterprises in a high-tech industrial park in the Chengdu area of Sichuan, China, for a pre-survey. An exploratory factor analysis was then carried out on the valid

questionnaires received from this pre-survey, and individual items affecting the reliability of the scale were removed (items with low factor load). Taking into account comments by experts, the scale was once again revised to form a formal questionnaire. The final version of the questionnaire is presented in Appendix 4.

Since this research examines the level of the firm but questionnaires are filled out by individuals, we need to gather basic information both on the individual level and firm level – separating one from the other. According to the principles of questionnaire design (Willis, 2004), the questionnaire should include three parts. The first part surveys basic information about the respondents, such as gender, years of employment, educational background, current position, and other basic information. The second part surveys the basic situation of the enterprise (*e.g.*, years since foundation, industry, annual operating income, proportion of staff with bachelor's degrees, proportion of R&D personnel, and training and learning opportunities for employees). The third part measures the main variables (*i.e.*, innovation ability, project agility, firm performance, innovation atmosphere and environmental dynamics).

The questionnaire was designed by combining quantitative and qualitative methods, using a five-point Likert scale to assign 1 to 5 points to questions through the following answers: "strongly disagree"; "disagree"; "neither agree nor disagree"; "agree"; and "strongly agree". Respondents were asked to strive to answer all questions objectively.

Having introduced the content of the questionnaire, we will now describe the small sample survey, commonly called as "pilot study". It yields small samples of data on which exploratory factor analysis is conducted in order to modify relevant indicators of the initial questionnaire, thus improving it.

Although the above scales are selected through continuous comparison and empirical research by domestic and foreign scholars (Cao & Dowlatshahi, 2005; Tseng & Lin, 2011; Aburub, 2015; Song & Lu, 2013; Kaplan & Norton, 1992; Wu & Lu, 2012; Luo & Liu, 2009; Cui, 2012; Anderson & West, 1998; Jaworski & Kohli, 1993), it shows that the reliability and validity of the scales are relatively well-adjusted. However, because most of the scales are from foreign research, the situation applicable to foreign countries does not mean that there will be no difference in Chinese situation. Therefore, in order to ensure the reliability and validity of each variable measurement scale in this study context, it is necessary to conduct a pre-survey before conducting a formal questionnaire survey. According to the data obtained from the preliminary survey, we analyzed and judged whether it was necessary to optimize

the questionnaire on the basis of the data analysis results, and then completed the design of the formal questionnaire.

In the process of research, it is usually hoped that as much data as possible can be collected through the established questionnaire scale, so as to increase the understanding and grasp of the problem. However, some variables in the questionnaire did not achieve the expected effect when establishing the data model and analyzing the actual problems. In addition, the more data are collected, the heavier the computation and processing work in the analysis process. When there are a large number of variables, the information contained therein is likely to overlap, and the correlation between variables will bring difficulties to statistical analysis. In this sense, this study conducted exploratory factor analysis on the pilot study, adjusted relevant indicators of the scale, designed fewer questionnaire questions without affecting the information content and, ultimately, used the modified questionnaire scale.

Before data analysis and scale revision, it is important to provide a brief introduction to the principles and judgment methods of data processing. The exploratory factor analysis and reliability analysis were carried out by using SPSS 22.0 in the process of data analysis. First, exploratory factor analysis is a commonly used method of validity analysis, which mainly judges whether the scale's structural validity is ideal by identifying factor loads and explanatory power. In this study, KMO and Bartlett sphericity test are done first. If the data test results show that the KMO value is greater than 0.8 and the Bartlett sphericity test value is significant enough, the factor analysis can be carried out next step, and otherwise it does not meet the requirements. Then, according to the extraction method of principal component analysis, factor rotation is carried out to obtain the rotation component matrix. If the factor load is less than 0.5, it means that the explanatory power is insufficient, the measurement item should be deleted, otherwise the item should be retained. Another indicator that needs to be observed is the cumulative variance explanatory value, more than 60% of which indicates that the measurement items of the scale meet the requirements and can be further studied and processed. Then, for reliability analysis, the main concerns are corrected item-total correlation coefficient and Cronbach’s Alpha coefficient. When the corrected item-total correlation coefficient is less than 0.5, it indicates that the measurement item should be deleted. In general, the Cronbach's Alpha coefficient is greater than 0.7 and the coefficient value does not increase after deleting the item, which means that the item should be retained.

In the pilot study, 68 questionnaires were received from 68 companies that are

undergoing or have completed the implementation of agile development. These companies were found through resources in academia and the high-tech industry, and are all located in an industrial park in the city of Chengdu, in Sichuan, China. Through recycling, removing invalid questionnaires, we collected 59 valid questionnaires in total, amounting to an effective recovery rate of 86.76%. These effective responses were sorted and counted, and exploratory factor analysis was carried out on the questionnaires. In order to reduce the dimension and difficulty of analysis of scale factors, the data were extracted and rotated to obtain index results of relevant variables. Statistical tools used were SPSS 22.0 and STATA 12.1. In the process of testing the reliability of the tested items, the adopted method was the commonly used Cronbach's α reliability coefficient method, which generally takes values of α greater than 0.7 as being acceptable. The pilot study data with α value lower than 0.7 were adjusted and modified in order to make the questionnaire items more accurate and clearer.

Lastly, we describe the reliability statement of the questionnaire. In the process of adopting the research method of questionnaire, reliability is mainly guaranteed by the following four aspects. First, by examining the research framework of logical science and rational reasoning from the body of literature, as well as by inviting experts and scholars in the field of agile management along with executives and managers of enterprises with agile project management to give feedback on the research framework from the dual dimensions of theory and practice. Second, by resorting to the renowned and widely used Likert scale as described in the literature, and then designing the items of the questionnaire. The Likert scale has been repeatedly validated and has sufficient reliability to measure the variables involved in this study. Third, by ensuring the reliability of the text of the questionnaire. This was revised into a form that is familiar to the respondents through predictive testing, so as to avoid ambiguity in the responses. Efforts were also made to ensure that the questionnaire explained the logic of the study, and that it did not have any unclear content: inductive expressions were revised to avoid possible causal implications for respondents. Lastly, by guaranteeing the reliability of sample collection. Because the data samples in this study needed to be collected by inviting respondents to fill in questionnaires, they should be collected scientifically and reasonably according to the process of sample object definition, collection channel selection, selection of the tested objects, sample data screening, and so forth.

4.2. Data collection

Data collection is an important process to improve the scientific nature and validity of

questionnaire research methods. In order to acquire data, a number of arrangements were made on the working nodes of questionnaire acquisition objects, questionnaire respondents, acquisition channels, data screening, and so forth. The purpose of this study is to explore the impact of innovation capability and project agility of high-tech SMEs in China on their performance. Considering that samples should fit the research problem, this study followed a strict selection of samples. First, the enterprises surveyed were limited to high-tech SMEs in China. Second, the sample was further narrowed to enterprises that are implementing or have implemented agile development or agile management. Finally, the respondents were limited to individuals responsible for selected R&D departments, such as general manager, technical director, CTO, and deputy general manager.

As for the data collection process, and in order to collect accurate data, respondents were carefully selected so as to ensure that they are very familiar with the situation of the R&D department of the enterprise. In processing the responses, any responses that were incomplete or revealed a lack of understanding of the questions were discarded. Responses were collected through two main channels: online and on-site. The former was mainly for senior managers of enterprises familiar with agile management projects of the enterprise. Over 300 online questionnaire links and nearly 100 e-mail messages were sent out. On-site distribution was mainly for high-tech industrial parks, science and technology industrial parks, and incubators in Beijing, Shenzhen, Hangzhou, Shanghai, Chengdu, and other areas. The process was defined through consultation with these entities' managing departments, resulting in over 200 questionnaires distributed. The questionnaire included questions on basic information about respondents, through which we verified their credibility to participate in the survey. In addition, a number of trap questions were included to detect cases of respondents filling the surveys carelessly.

From January 2018 to August 2018, through these two methods of questionnaire collection (*i.e.*, online and on-site), 659 questionnaires were distributed and 376 questionnaires were recovered, corresponding to a response rate of 57.06%. Out of these 376 questionnaires, 242 were valid and 134 were invalid, corresponding to an effective rate of valid questionnaires of 64.36%. Responses were invalidated for a number of reasons, such as obviously incorrect answers, missing values, and so forth. Among the valid questionnaires, 74 were collected on-site and 168 were collected online. Details of the collection process are shown in *Appendix 5* (see *Table A5-1*).

Having described the process of sample selection and data collection, and given that

two channels (*i.e.*, online and on-site) were used to collect responses, we will now discuss the effectiveness of data merging. Before merging and analyzing the collected data, it was necessary to verify whether there were any significant differences between the two different groups. The responses received online and on-site were compared to identify any differences, as shown in *Appendix 5* (see *Table A5-2*). From it, we can know that 168 valid samples have been obtained from online and 74 valid samples have been collected from on-site. Thus, the total number of valid questionnaires is 242.

SPSS software was used to analyze the variance of the two groups of data for the measurement of firm performance. The Levene test yielded a value of *p* greater than 0.05, indicating that the sample data from different sources had homogeneity of variance in each index dimension of firm performance, as shown in *Table 4-1*. We thus considered that the data from the two channels could be merged.

Table 4-1 *Homogeneity of Variance Test for Samples from Different Sources*

Firm Performance Indicators	p-value (Levene)	Df1	Df2	Sig.
FP1 After the implementation of agile development, the turnover and profit of the company increased.	1.869	1	240	0.122
FP2 After the implementation of agile development, there has been an increase in customer satisfaction with the company's products or services.	0.561	1	240	0.515
FP3 After the implementation of agile development, the company's products or services have enhanced customers' willingness to consume.	1.043	1	240	0.253
FP4 After the implementation of agile development, the company's decision-making is faster and more accurate.	0.150	1	240	0.189
FP5 After the implementation of agile development, employees' problem-solving abilities improved.	1.082	1	240	0.255
FP6 After the implementation of agile development, employees' learning and innovation abilities have improved.	0.477	1	240	0.628

FP=Firm Performance, Df=Degrees of freedom, Sig.=Significance.

Source: Author's Elaboration.

Table 4-2 lists the results of the analysis of variance of the firm performance indicators from the two groups of data. As the P-value (Sig.) is greater than 0.05, we conclude that there was no significant difference between the two groups of data in the measurement of firm performance indicators and the two groups of data could be combined for analysis.

Table 4-2 *Analysis of Variance for Samples from Different Sources*

Firm Performance	Group Type	Sum of Squares	Df	Mean Square Deviation	F value	Sig.
FP1	Between groups	0.066	1	0.066	0.065	0.799
	In group	245.145	240	1.021		
FP2	Between groups	1.460	1	1.460	1.432	0.233
	In group	244.660	240	1.019		
FP3	Between groups	1.565	1	1.565	1.522	0.218
	In group	246.749	240	1.028		
FP4	Between groups	0.916	1	0.916	0.905	0.324
	In group	225.382	240	0.939		
FP5	Between groups	0.726	1	0.726	0.706	0.402
	In group	246.716	240	1.028		
FP6	Between groups	0.004	1	0.004	0.004	0.948
	In group	213.257	240	0.889		

FP=Firm Performance. Df=Degrees of freedom. Sig.=Significance.

Source: Author's Elaboration.

Once addressed the effectiveness of data merging, we elaborated on the descriptive statistics. The basic personal information in this survey includes gender, years of employment, educational background, main responsible department, among other data. The proportion of genders of the respondents of the 242 valid responses is of 80.2% males and 19.8% females, respectively. In terms of the number of working years of respondents, the proportion of individuals with fewer than 3 years of work experience is 18.2%, that of individuals with three to five years of experience is 20.7%, that of individuals with five to 10 years of experience is 29.3%, and that of individuals with more than 10 years of experience is 31.8%. The proportion of individuals with a relatively high number of years of work experience can be explained by the fact that respondents middle and senior managers of enterprises. As for educational background, the proportion of employees without a bachelor's degree is of 3.3%, that of individuals with only a bachelor's degree is of 47.5%, and that of individuals with education higher than a bachelor's degree is of 49.2%, indicating that managers of R&D generally possess a high degree of education. From the perspective of main responsible department, marketing or sales accounted for 14.1%, technology R&D accounted for 64.9%, production or manufacturing accounted for 3.3%, the financial sector accounted for 1.2%, administration accounted for 6.6%, and 9.9% were in other departments. In other words, most respondents work in technical or R&D departments, which fits the research purpose of this

article. This information is summarized in *Table 4-3*.

Table 4-3 *Descriptive Statistical Analysis of Individual Respondents (N=242)*

Information of Respondents		Frequency	Percentage
Gender	Female	48	19.8
	Male	194	80.2
Years of Work Experience	Less than 3 years	44	18.2
	[3-5] years	50	20.7
	]5-10] years	71	29.3
	More than 10 Years	77	31.8
Level of Education	Below Undergraduate	8	3.3
	Undergraduate	115	47.5
	Postgraduate and Above	119	49.2
Main Responsible Department	Marketing or Sales	34	14.1
	Technology or R&D	157	64.9
	Production or Manufacturing	8	3.3
	Finance	3	1.2
	Administration	16	6.6
	Others	24	9.9

Source: Author's Elaboration.

The information on the sampled enterprises is presented in *Table 4-4*. In order to validate the data, basic information on enterprises included the number of years since their foundation, or establishment time, their industries, the type of ownership, annual operating income, proportion of staff with bachelor's degrees, and the proportion of R&D personnel. Enterprises established for less than one year account for 1.2% of the total, enterprises with one to three years of establishment account for 27.7%, enterprises with three to five years of establishment account for 41.8%, enterprises with five to 10 years of establishment account for 25.6%, and enterprises established for over 10 years account for 3.7%. As for industry distribution, the proportion of firms in the Internet industry is 30.2%, firms in the communications and electronic information industries account for 36.8%, firms in financial industries account for 10.3%, and firms in other industries are 22.7% of the total. Most companies, therefore, were in the Internet and communications industries.

In terms of ownership, enterprises owned by the state or by state holdings account for 18.6%, private enterprises account for 71.5%, foreign-funded enterprises account for 7.4%, enterprises controlled by Hong Kong, Macao or Taiwan account for 0.8%, and enterprises with other types of ownership account for 1.7%. In terms of their annual income, enterprises with income under 5 million CNY account for 9.9%, enterprises with income between 5 and 10 million CNY account for 8.7%, enterprises with income between 10 and 50 million CNY account for 25.2%, enterprises with income between 50 and 100 million CNY account for 18.2%, and enterprises with income greater than 100 million CNY account for 38.0 percent.

Regarding the proportion of staff with bachelor's degrees, enterprises with fewer than 20% of undergraduates in their staff account for 5.8% of the total, enterprises with [20%–40%] of undergraduates in their staff account for 9.9%, enterprises with]40%–60%] of undergraduates in their staff account for 18.6%, enterprises with]60%–80%] of undergraduates in their staff account for 28.1%, and enterprises with over 80% of undergraduates in their staff account for 37.6%. As for the proportion of R&D personnel in enterprises, enterprises with fewer than 10% R&D personnel account for 14.0% of the total, enterprises with [10%–20%] R&D personnel account for 15.3%, enterprises with]20%–30%] R&D personnel account for 15.3%, enterprises with]30%–50%] R&D personnel account for 22.3%, and enterprises with over 50% R&D personnel account for 33.1%.

Following this, a number of observations can be made. Most enterprises are privately owned (173 enterprises, corresponding to over 70% of the total). This may be related to the high degree of development of the locations in which questionnaires were distributed (*i.e.*, Beijing, Shanghai, Shenzhen, Hangzhou, and Chengdu). We also notice a prevalence of enterprises that have been established for a relatively long time – presumably because they will have more mature practices with regard to the implementation of innovation and agile management. *Table 4-4* and *Figure 4-1* show that over 95% of the enterprises were established between one and 10 years earlier, and fewer than 5% were established either more than 10 years earlier or within the previous year.

Table 4-4 *Description of Respondents at Firm Level (N=242)*

	Information of Surveyed Enterprises	Frequency	Percentage
Established Time	Within 1 year	3	1.2
	[1–3] years	67	27.7
	]3–5] years	101	41.8
	]5–10] years	62	25.6
	More than 10 years	9	3.7
Industry	Internet	73	30.2
	Communication and electronic information	89	36.8
	Finance	25	10.3
	Others	55	22.7
Ownership	State-owned or state-controlled	45	18.6
	Private or private-controlled	173	71.5
	Foreign-owned	18	7.4
	Owned or controlled by Hong Kong, Macao or Taiwan	2	0.8
	Others	4	1.7
Percentage of Annual Operating Income	Under 5 million CNY	24	9.9
	[5–10] million CNY	21	8.7
	]10–50] million CNY	61	25.2
	]50–100] million CNY	44	18.2
	Over 100 million CNY	92	38.0
Percentage of Bachelor's Degrees Among the Staff	Under 20%	14	5.8
	[20%–40%]	24	9.9
	]40%–60%]	45	18.6
	]60%–80%]	68	28.1
	Over 80%	91	37.6
Percentage of R&D Personnel	Under 10%	34	14.0
	[10%–20%]	37	15.3
	]20%–30%]	37	15.3
	]30%–50%]	54	22.3
	Over 50%	80	33.1

Source: Author's Elaboration.

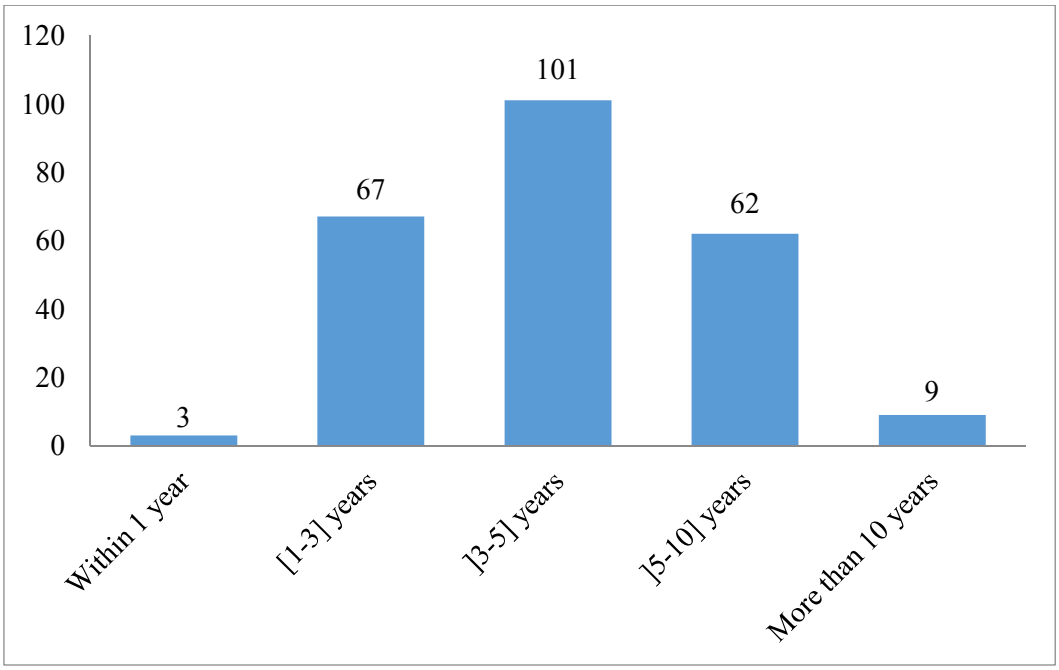


Figure 4-1. Description of the Sample for Established Time.
Source: Author's Elaboration.

In the case of high-tech enterprises, especially those enterprises in the network, communication, electronic information and finance industries, their external competitive pressure is greater and their innovation ability is stronger. The distribution of enterprise industry is relatively balanced, as shown in *Figure 4-2*.

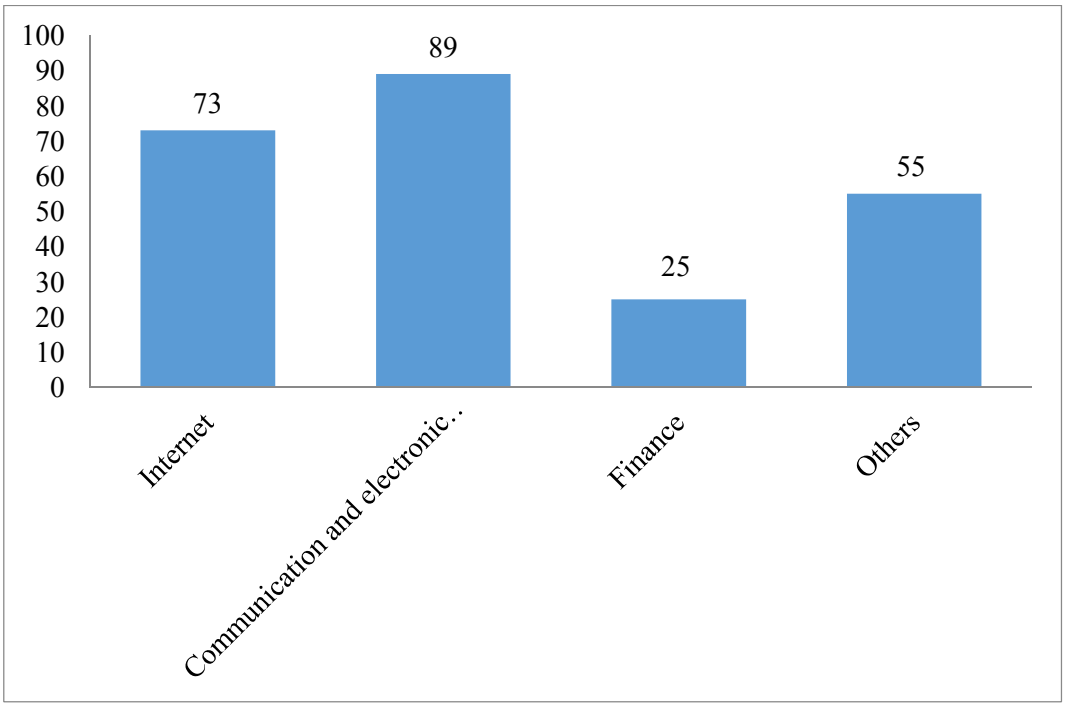


Figure 4-2. Description of the Sample for Distribution of Industry.
Source: Author's Elaboration.

With regard to enterprises' annual operating income, shown in *Figure 4-3*, the two lower brackets account for fewer than 10% of enterprises, the two following brackets account for about 20% of enterprises, and the highest bracket accounts for about 40% of the total. In other words, we consider the distribution to be balanced.

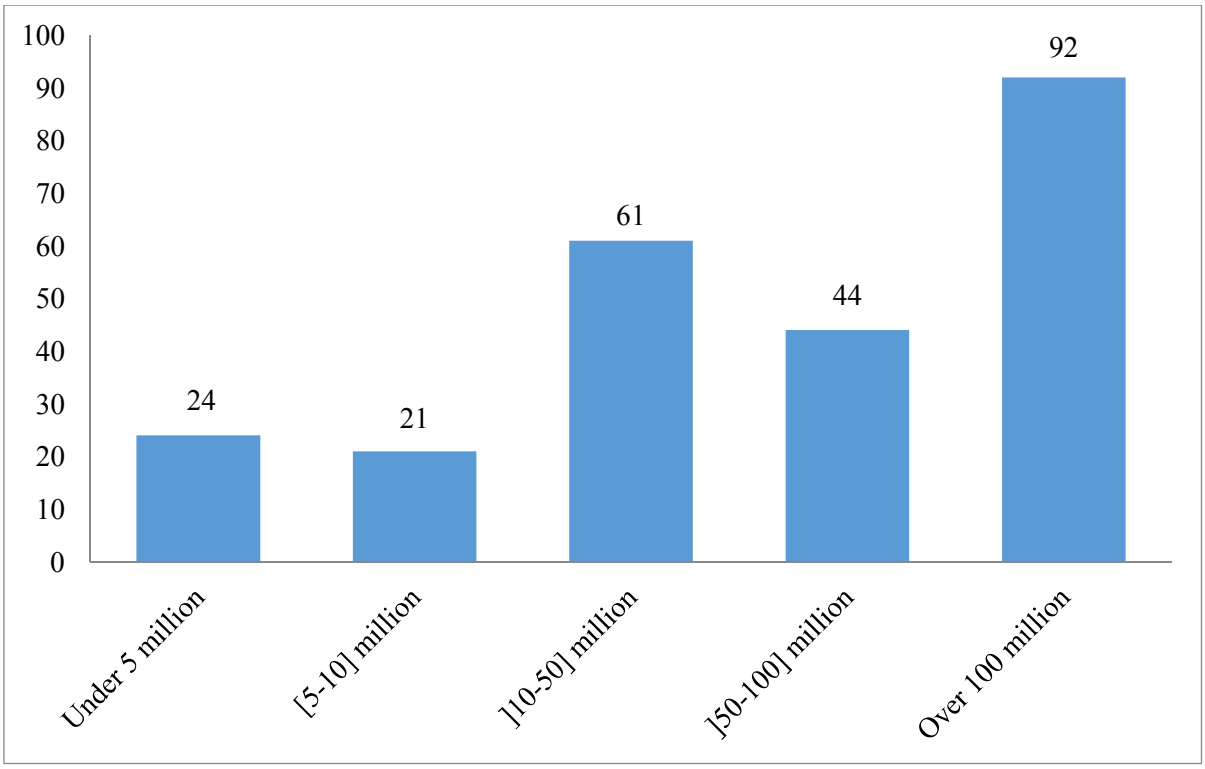


Figure 4-3. Description of the Sample for Distribution of Annual Operating Income.
Source: Author's Elaboration.

In conclusion, we find from *Figures 4-1* to *4-3*, as well as from *Table 4-4*, that the sample of enterprises has a wide coverage, reasonable structure, and good representativeness, laying a good foundation for empirical analysis to follow.

The first part of the questionnaire relates to basic information about the individual respondent, and the second part relates to basic information about the firm of the respondent. In the third part, the main variables of the study were measured using a five-level Likert scale: "Strongly disagree" scored 1 point; "disagree" scored 2 points; "neither agree nor disagree" scored 3 points; "agree" scored 4 points; and "strongly agree" scored 5 points. Variables measured included firm performance, project agility, innovation capability, innovation atmosphere, environmental dynamics, employee training and learning. The data for key variables is outlined in *Appendix 5* (see *Table A5-3*).

As shown in *Appendix 5* (see *Table A5-3*), the average performance of the enterprise is 3.41 with a standard deviation of 0.88. The mean and standard deviation for project agility

were 3.57 and 0.82, respectively. The mean and standard deviation for innovation ability are 3.61 and 0.85, respectively. The mean of innovation atmosphere is 3.72, with a standard deviation of 0.82. The mean of environmental dynamics is 3.48, with a standard deviation of 0.90. The mean of employee training and learning is 3.30, with a standard deviation of 1.14. We thus consider that the data collected in this study comprehensively reflect the current situation of high-tech SMEs in China, and that their representativeness meets the analysis requirements of the research.

4.3. Validity and Reliability

Validity refers to any influence of the method or tool used in the measurement process on the measurement results (Rubin & Babbie, 2000). It can be divided into content validity and structure validity, and we tested the validity of the scale and data from both these perspectives. By resorting to the Likert scale, a mature and established scale, we consider that the validity of the scale data is theoretically guaranteed.

We employed the Kaiser-Meyer-Olkin (KMO) test for sampling adequacy and Bartlett test of sphericity. After confirming that the data met the detection conditions of the exploratory factor analysis method, exploratory factor analysis was conducted on all variables in the scale. According to Kaiser's division standard from Kaiser (1974), when the KMO value is greater than or equal to 0.9, the data is very suitable for exploratory factor analysis. When the KMO value is between 0.8 and 0.9, the data is suitable for exploratory factor analysis. When the KMO value is between 0.7 and 0.8, the data is suitable for exploratory factor analysis and the effect of data is normal. When the KMO value is less than 0.6, the data is not suitable for factor analysis. According to the Bartlett sphericity test, when the significance level of chi-square less than 0.01, it means that the test of the scale is in good condition.

Having carried out the KMO test and the Bartlett sphericity test, using SPSS 22.0, we extracted the factors common to each variable through factor analysis, reducing the number of variables, so as to improve the scientific nature and rationality of the design of the measurement index system, and to increase the reliability and persuasion of the measurement results.

First, we carry out exploratory factor analysis on six items of firm performance. As shown in *Appendix 6* (see *Table A6-1*), the results of the KMO test and of the Bartlett test are

significant, indicating that factor analysis is suitable. In *Appendix 7* (see *Table A7-1*), we also indicate that, according to the expected six items, the cumulative explanation of the factor varies considerably. The loads of all factors are greater than 0.7. Therefore, the six items reflect the performance of enterprises, which can be called the "firm performance" factor.

We then carried out exploratory factor analysis on six items of innovation capability. As shown in *Appendix 6* (see *Table A6-1*), the results of the KMO test and the Bartlett sphericity test are significant, indicating that factor analysis is suitable. The results of the factor analysis are shown in *Appendix 7* (see *Table A7-1*). According to the expected six items, the cumulative explanation of the factor varies to 66.549%. The load of all factors is greater than 0.7. Therefore, these six items reflect the situation of innovation capability significantly, and can be referred to as the "innovation capability" factor.

Exploratory factor analysis was then carried out on seven items of project agility. As shown in *Appendix 6* (see *Table A6-1*), the results of the KMO test and of the Bartlett test are significant, indicating that factor analysis was suitable. Its results are shown in *Appendix 7* (see *Table A7-2*). According to the expected seven items, the cumulative explanation of the factor varies to 66.178%, and the load of all factors is greater than 0.7. Therefore, these seven items reflect the situation of project agility significantly, and can be referred to as the "project agility" factor.

We then carried out exploratory factor analysis on five items of innovation atmosphere. As shown in *Appendix 6* (see *Table A6-1*), the results of the KMO test and of the Bartlett test are also significant, indicating suitability for factor analysis. The results of the factor analysis are shown in *Appendix 7* (see *Table A7-2*). According to the expected five items, the cumulative explanation of the factor varies to 67.279%. The loads of all factors are greater than 0.7. Therefore, these five items reflect the situation of the innovation atmosphere, and can be referred to as the "innovation atmosphere" factor.

Lastly, exploratory factor analysis was carried out for four items of environmental dynamics. As shown in *Appendix 6* (see *Table A6-1*), the results of the KMO test and of the Bartlett test are significant, indicating that factor analysis was suitable. Its results are shown in *Appendix 7* (see *Table A7-2*). According to the expected four items, the cumulative interpretation of the factor varies to 74.539%, and the loads of all factors are greater than 0.7. Therefore, the four items reflect the situation of environmental dynamics, which can be referred to as the "environmental dynamics" factor.

The above tests showed that the items used in this study have good validity and can

effectively measure the five key variables in this study, which provides a good data support for statistical analysis and theoretical verification.

In addition to the analysis of validity, we also conducted a reliability analysis. Reliability refers to the ability of reaching the same conclusions when testing the respondents more than once (Hunter, Gerbing, & Boster, 1982). While validity refers to the influence of the method used in the measurement process on the effectiveness of the measurement results, reliability refers to whether the results of each measurement are the same. To ensure the reliability and validity of this survey, SPSS 22.0 was used to analyze the sample data, and Cronbach's alpha was used to test the reliability of each variable. According to the criteria of Cronbach's alpha value, when it is above 0.6, the reliability of the corresponding scale is relatively high. For benchmark studies, the reliability of Cronbach's alpha scale is higher when Cronbach's alpha is greater than 0.8, though the value of 0.6 is normally used, as it is sufficient for most purposes (Nunnally, 1978).

We first analyzed the reliability of firm performance. As shown in *Appendix 8* (see *Table A8-1*), Cronbach's alpha for firm performance is greater than 0.7, the item-total correlation coefficient is much greater than 0.35, and Cronbach's alpha values after the deletion of the items are less than 0.945, which means that the data passed the reliability test.

Next, we analyzed the reliability of innovation capability. As shown in *Appendix 8* (see *Table A8-1*), Cronbach's alpha coefficient of innovation capability variable is greater than 0.7, the item-total correlation coefficient is much greater than 0.35, and Cronbach's alpha values after the deletion of the items are less than 0.899, which means that the data passed the reliability test.

The next step was to analyze the reliability of project agility. As shown in *Appendix 8* (see *Table A8-2*), Cronbach's alpha coefficient of the project agility variable is greater than 0.7, the item-total correlation coefficient is much greater than 0.35, and Cronbach's alpha values after the deletion of the items are less than 0.915, which means that the data passed the reliability test.

We then analyzed the reliability of innovation atmosphere. As shown in *Appendix 8* (see *Table A8-2*), Cronbach's alpha of the innovation atmosphere variable is greater than 0.7, the item-total correlation coefficient is much greater than 0.35, and Cronbach's alpha after the deletion of each item are less than 0.877. Therefore, the data passed the reliability test.

Lastly, we analyzed the reliability of environmental dynamics. As shown in *Appendix 8* (see *Table A8-2*), Cronbach's alpha of the environmental dynamic variable is greater than

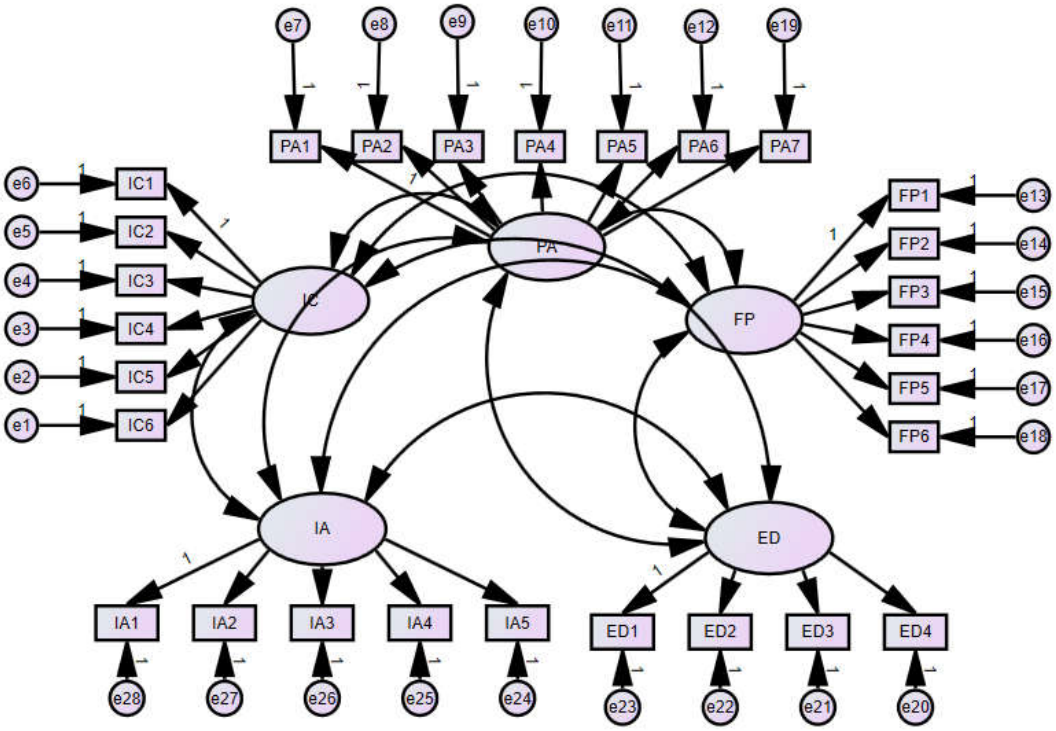
0.7, the item-total correlation coefficient is much greater than 0.35, and Cronbach's alpha of the deleted items are less than 0.886, respectively. Therefore, the data passed the reliability test.

Having analyzed all key variables, we summarize the results in *Appendix 8* (see *Table A8-1 and Table A8-2*). From it, we can observe that Cronbach's alpha of firm performance is 0.945, Cronbach's alpha of project agility is 0.915, Cronbach's alpha of innovation capability is 0.899, Cronbach's alpha of innovation atmosphere is 0.877 and Cronbach's alpha of environmental dynamics is 0.886.

By referring to these widely used tests, this study objectively evaluates firm performance through six items. It then measures the innovation capability of the enterprises, investigating their actual innovation capability through six questions and investigating project agility through seven questions. Five questions are used to measure the innovation atmosphere of enterprises, an aspect which is comprehensively evaluated. In addition, four questions are used to measure environmental dynamics, with managers providing responses according to the situation of their enterprises. Cronbach's alpha was used to test the reliability of relevant variables. Cronbach's alpha value of all main variables in this study is greater than 0.8, indicating that the reliability of the five main variables is reasonable. Therefore, in general, the reliability of the scale and related data used in this study is very good.

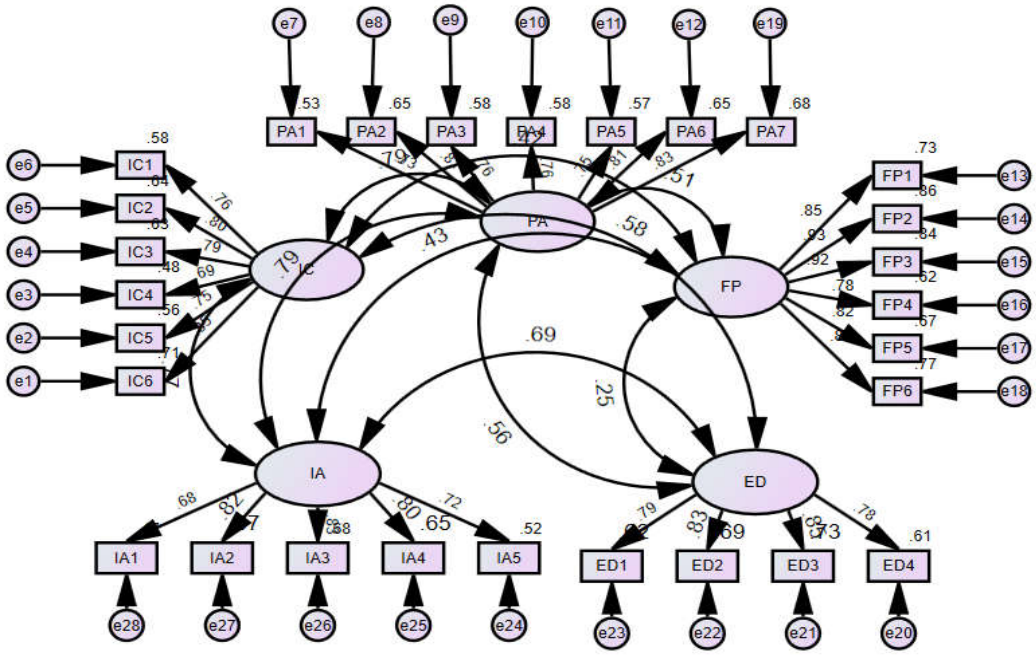
4.4. Results and Analysis

Before conducting a correlation analysis, we analyzed the structural equation model using the AMOS software to fit the correlation of the five main variables in the model (*Figure 4-4*). *Table 4-5* presents the results of this analysis, which show that the values of Chi-squared are 826.328 and the degrees of freedom (df) are 340, resulting in a value of Chi-squared/df of 2.43, which is less than 5. The values of the Comparative Fit Index (CFI) and the Tucker-Lewis Index (TLI) are 0.927 and 0.907, respectively, which are more than 0.9, close to 1. The value of the Root Mean Square Error of Approximation (RMSEA) is 0.077, or less than 0.1, and the path coefficients are statistically significant at the level of $P < 0.001$. The fit of the overall model is very good and has passed the validity test, which shows that the model measurement in this study is effective. These results are shown in *Figure 4-5*.



ED=Environmental Dynamics; FP=Firm Performance; IA=Innovation Atmosphere; IC=Innovation Capability; PA=Project Agility.

Figure 4-4. Measurement Model of the Main Variables Studied.
Source: Author's Elaboration.



ED=Environmental Dynamics; FP=Firm Performance; IA=Innovation Atmosphere; IC=Innovation Capability; PA=Project Agility.

Figure 4-5. Fitting Result Diagram of Directional Relations of Main Variables.
Source: Author's Elaboration.

Table 4-5 *Model Fitting Results*

Path	Path Coefficient (estimate)	SE	CR	P	Label
IC6 ← IC	1.107	0.081	13.721	*	Par_1
IC5 ← IC	1.040	0.089	11.699	*	Par_2
IC4 ← IC	0.928	0.085	10.925	*	Par_3
IC3 ← IC	1.050	0.083	12.698	*	Par_4
IC2 ← IC	0.993	0.076	13.113	*	Par_5
IC1 ← IC	1.000	-	-	-	-
PA1 ← PA	1.000	-	-	-	-
PA2 ← PA	1.077	0.087	12.399	*	Par_6
PA3 ← PA	1.021	0.088	11.551	*	Par_7
PA4 ← PA	1.001	0.085	11.828	*	Par_8
PA5 ← PA	1.108	0.098	11.351	*	Par_9
PA6 ← PA	1.188	0.096	12.419	*	Par_10
PA7 ← PA	1.156	0.092	12.532	*	Par_11
FP1 ← FP	1.000	-	-	-	-
FP2 ← FP	1.085	0.054	20.299	*	Par_12
FP3 ← FP	1.079	0.054	19.883	*	Par_13
FP4 ← FP	0.883	0.058	15.199	*	Par_14
FP5 ← FP	0.965	0.060	15.999	*	Par_15
FP6 ← FP	0.960	0.052	18.517	*	Par_16
ED4 ← ED	1.011	0.079	12.853	*	Par_17
ED3 ← ED	1.121	0.078	14.363	*	Par_18
ED2 ← ED	1.024	0.075	13.586	*	Par_19
ED1 ← ED	1.000	-	-	-	-
IA5 ← IA	1.207	0.122	9.913	*	Par_20
IA4 ← IA	1.304	0.115	11.316	*	Par_21
IA3 ← IA	1.268	0.110	11.576	*	Par_22
IA2 ← IA	1.123	0.098	11.438	*	Par_23
IA1 ← IA	1.000	-	-	-	-
Chi-squared = 826.328 Df = 340 Chi-squared/Df = 2.43		CFI 0.927 TLI 0.907 RMSEA 0.077			

* Level of significance P < 0.001. CFI=Comparative Fit Index; Df=Degrees of Freedom; ED=Environmental dynamics; FP=Firm Performance; IA=Innovation Atmosphere; IC=Innovation Capability; PA=Project Agility; RMSEA=Root Mean Square Error of Approximation; TLI=Tucker-Lewis Index.

Source: Author's Elaboration.

Having discussed the structural equation for the major variables, we elaborated on the correlation analysis. Correlation analysis is a statistical method to study the linearity between variables – whether there is a correlation between variables and the degree of correlation. The Pearson correlation analysis is commonly used for this purpose. The absolute value of the correlation coefficient of two variables reflects the degree of correlation. The larger the absolute value is, the stronger the correlation between the two variables will be. Generally speaking, if the correlation coefficient of two variables is less than 0.4, it means that the degree of correlation between them variables is low. If the correlation coefficient is between 0.4 and 0.7, the two variables are moderately correlated. If the correlation coefficient is above 0.7, it indicates a high degree of correlation between the two variables (Wu, 2013).

To study how enterprises' innovation ability can improve their implementation of agile development and, by extension, their performance, this study used SPSS 22.0. A correlation analysis was conducted between control variables such as the annual operating income of the enterprise, the proportion of bachelor's degrees among the staff, the proportion of R&D personnel, staff training and learning opportunities, and the five main variables. The results of this analysis are shown in *Table 4-6*.

A number of relationships can be derived from *Table 4-6*. There is a significant positive correlation between firm performance and project agility (0.488), as well as between firm performance and innovation capability (0.401) and between project agility and innovation capability (0.616). The correlation coefficients of the main variables are in the appropriate range. Following this, we introduced the regression analysis that tests the hypotheses of the theoretical model. According to the results of the correlation analysis and to the theoretical basis of *Chapter 2*, the relationship between variables in this study can be preliminarily obtained. There is a significant positive correlation between project agility and firm performance and between innovation capability, project agility, and firm performance.

In order to further verify the relationship between innovation capability, project agility, and firm performance, and the moderating role of innovation atmosphere and environmental dynamics, subsequently clarifying the mechanism of action between them, this study uses the multiple linear regression analysis method. According to this method, the heteroscedasticity and sequence correlation of the model should be tested first, so as to ensure the authenticity and effectiveness of the results.

Table 4-6 *Correlation Coefficient Matrix of Each Research Variable (N=242)*

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
1. Firm Performance	3.41	0.880	1.000								
2. Project Agility	3.57	0.815	0.488**	1.000							
3. Innovation Capability	3.61	0.854	0.401**	0.616**	1.000						
4. Innovation Atmosphere	3.72	0.821	0.417**	0.615**	0.686**	1.000					
5. Environmental Dynamics	3.48	0.901	0.241**	0.503**	0.533**	0.616**	1.000				
6. Percentage of Annual Operating Income	3.66	1.327	0.024	0.082	0.028	0.057	0.025	1.000			
7. Percentage of Bachelor's Degrees Among the Staff	3.82	1.205	0.242**	0.338**	0.325**	0.332**	0.221**	0.111	1.000		
8. Proportion of R&D Personnel	3.45	1.437	0.104	0.242**	0.220**	0.284**	0.177**	-0.108	0.483**	1.000	
9. Employee Training and Learning	3.30	1.135	0.202**	0.495**	0.461**	0.483**	0.346**	0.217**	0.395**	0.289**	1.000

* Significant correlation at the level of significance of 0.05.
** Significant correlation at the level of significance of 0.01. SD=Standard Deviation.

Source: Author's Elaboration.

From the regression residual diagram of this study, we know that the model in this study does not have heteroscedasticity. Also, the Durbin-Watson (DW) value can be used to verify the sequence correlation problem. If the DW value is approximately equal to 2, the model is valid. To test multicollinearity, the variance inflation factor (VIF) can be used. A value of VIF between 0 and 10 indicates that there is no problem of multicollinearity in the model. If the VIF value is greater than 10 and less than 100, there is a problem of multicollinearity in the model. As the VIF values of all variables in this study are less than 10, there is no multicollinearity in the models of this study.

Since innovation capability, project agility, firm performance, innovation atmosphere and environmental dynamics are continuous variables, this study adopts the method of multiple linear regression analysis to test the data. This study establishes several regression models to test the hypotheses proposed in this study, including: (1) the impact of innovation capability on project agility; (2) the moderating effect of innovation atmosphere on the influence of innovation capability on project agility, and the moderating effect of innovation atmosphere on the influence of innovation capability on firm performance; (3) the influence of innovation capability on firm performance; (4) the mediating role of project agility in the influence of innovation ability on firm performance; (5) the influence of project agility on firm performance; and (6) the moderating effect of environmental dynamics on the influence of agility on firm performance. The specific steps taken are as follows: step-by-step, control variables, independent variables, moderating variables, addition of moderators to conduct the model regression analysis, and judging the hypothesis by comparing the size and significance of regression coefficient changes in the model.

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Table 4-7 shows the results of the regression analysis of the control variables of this study. The independent variables are annual business income, the proportion of bachelor's degree among the staff, the proportion of R&D personnel, and staff training and learning; the dependent variable is firm performance. It can be seen that the DW value of the model is 2.099, and there is no heteroscedasticity. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the results of regression analysis show that, except for the proportion of bachelor's degree among the staff, the other three variables have no significant impact on the standardized coefficient of firm performance (beta value, $p > 0.05$), meaning that the other three control variables in this study have no significant impact on firm performance.

Table 4-7 *Regression Result of Control Variables on Firm Performance*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	2.637	0.062		0.000	1.000	
Annual Operating Income	-0.022	0.066	-0.034	-0.518	0.605	1.101
Percentage of Bachelor's Degrees Among the Staff	0.155	0.075	0.212	2.805	0.005	1.458
Percentage of R&D Personnel	-0.025	0.074	-0.041	-0.562	0.575	1.389
Employee Training and Learning	-0.107	0.070	0.138	1.963	0.051	1.262
R^2 change			0.074			
F change			4.738			

DW = 2.099, F value is significant at the level of significance of 0.05.

Source: Author's Elaboration.

Table 4-8 presents the results of the regression analysis of project agility for the control variables in this study. The four control variables are annual income, the proportion of bachelor's degrees among the staff, the proportion of R&D personnel, and staff training and learning; project agility is the dependent variable. It can be seen that the DW value of the model is 1.825, and that the model in this study does not have heteroscedasticity. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the results of regression analysis show that, except for the proportion of bachelor's degree among the staff and employee training and learning, the standardized coefficient of project agility (Beta value) of the other two variables has not reached a significant level ($p > 0.05$). This

shows that the higher the proportion of bachelor's degree among the staff or employee training and learning, the higher the level of project agility implementation.

Table 4-8 *Regression Result of Control Variables on Project Agility*

Variables	Project Agility					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	2.138	0.204		10.494	0.000	
Annual Operating Income	-0.015	0.036	-0.025	-0.428	0.669	1.101
Percentage of Bachelor's Degrees Among the Staff	0.103	0.045	0.152	2.265	0.024	1.458
Percentage of R&D Personnel	0.025	0.037	0.043	0.664	0.507	1.389
Employee Training and Learning	0.307	0.045	0.428	6.867	0.000	1.262
R^2 change			0.272			
F change			22.089			

DW = 1.825, F value is significant at the level of significance of 0.001.

Source: Author's Elaboration.

Table 4-9 presents the results of the regression analysis of innovation capability on firm performance, to validate hypothesis H1 of this study. The model takes four variables as control variables, namely: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. Innovation ability is the independent variable and firm performance is the dependent variable. It can be seen that the DW value of the model is 2.204 and there is no heteroscedasticity in the model. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the change in R^2 is 0.103 and the change in F value is 29.440, which show that the addition of innovation capability increases the explanatory power of the model.

From the results of regression analysis, we can see that the standardization coefficient (Beta value) of the regression results of innovation ability on firm performance is 0.368, reaching a significant level ($p < 0.001$). Therefore, innovation ability has a significant positive impact on firm performance, and H1 is considered to be confirmed.

Table 4-9 *Regression Result of Innovation Capability on Firm Performance*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	1.763	0.059		0.000	1.000	
Annual Operating Income	-0.004	0.062	-0.006	-0.089	0.929	1.109
Percentage of Bachelor's Degrees Among the Staff	0.110	0.072	0.151	2.089	0.038	1.495
Percentage of R&D Personnel	-0.028	0.070	-0.046	-0.668	0.505	1.389
Employee Training and Learning	-0.010	0.072	-0.012	-0.173	0.863	1.482
Innovation Capability	0.380	0.068	0.368	5.426	0.000	1.320
R^2 change			0.103			
F change			29.440			

DW = 2.204, F value is significant at the level of significance of 0.001.

Source: Author's Elaboration.

Table 4-10 presents the results of regression analysis of project agility to firm performance, to validate hypothesis H2 of this study. The model takes four variables as control variables, namely: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It takes project agility as the independent variable, and firm performance as the dependent variable. It can be seen that the DW value of the model is 2.204, and the model in this study does not have heteroscedasticity. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the change of R^2 is 0.179 and the change of F value is 56.491, which show that the addition of innovation ability increases the explanatory power of the model.

From the results of regression analysis, we can see that the standardization coefficient (Beta value) of the regression results of project agility to firm performance is 0.495, reaching a significant level ($p < 0.001$). Therefore, project agility has a significant positive impact on firm performance, and H2 is considered to be confirmed.

Table 4-10 *Regression Result of Project Agility on Firm Performance*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	1.487	0.056		0.000	1.000	
Annual Operating Income	-0.014	0.059	-0.023	-0.382	0.703	1.101
Percentage of Bachelor's Degrees Among the Staff	0.099	0.069	0.137	1.997	0.047	1.490
Percentage of R&D Personnel	-0.038	0.066	-0.063	-0.946	0.345	1.391
Employee Training and Learning	-0.058	0.069	-0.074	-1.074	0.284	1.514
Project Agility	0.538	0.066	0.495	7.516	0.000	1.373
R^2 change			0.179			
F change			56.491			

DW = 2.204, F value is significant at the level of significance of 0.001.

Source: Author's Elaboration.

Table 4-11 presents the results of regression analysis result of innovation capability to project agility, in order to validate hypothesis H3 of this study. The model takes four variables as control variables, namely: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It takes innovation ability as the independent variable and project agility as the dependent variable. It can be seen that the DW value of the model is 1.936, and the model in this study does not have heteroscedasticity. The VIF values are all less than 10, which guarantees no multicollinearity in the model. The change of R^2 is 0.280, and the change of F value is 147.358, which reveal that the addition of innovation ability increases the explanatory power of the model.

From the results of regression analysis, we can see that the standardization coefficient (Beta value) of the regression results of innovation ability to firm performance is 0.610, reaching a significant level ($p < 0.001$). Therefore, innovation capability has a significant positive impact on project agility, and H3 is considered to be confirmed.

Table 4-11 *Regression Result of Innovation Capability on Project Agility*

Variables	Project Agility					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	0.798	0.194		4.117	0.000	
Annual Operating Income	0.013	0.028	-0.021	0.463	0.644	1.108
Percentage of Bachelor's Degrees Among the Staff	0.034	0.036	0.051	0.956	0.340	1.494
Percentage of R&D Personnel	0.021	0.029	-0.036	0.712	0.477	1.389
Employee Training and Learning	0.128	0.038	-0.178	3.371	0.001	1.482
Innovation Capability	0.583	0.048	0.610	12.230	0.000	1.319
R^2 change			0.280			
F change			147.358			

DW = 1.936, F value is significant at the level of significance of 0.001.

Source: Author's Elaboration.

Table 4-12 takes project agility as a mediating variable, innovation capability as an independent variable and firm performance as the dependent variable in order to verify the mediating effect of project agility on firm performance (H4). The model takes four variables as control variables, specifically: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It also takes innovation ability as an independent variable, project agility as a mediating variable, and firm performance as the dependent variable. It can be seen that the DW value of the model is 2.245, and there is no heteroscedasticity in this model. The VIF values are all less than 10, and there is no multicollinearity in the model. The change of R^2 is 0.082, and the change of F value is 25.845, which show that the mediating variable increases the explanatory power of the model.

When the effect of project agility on firm performance is joined to that of innovation capability, the Beta value decreases significantly, from 0.368 ($p < 0.01$) to 0.109 ($p > 0.05$), while the Beta value of project agility was 0.427 ($p < 0.001$), or very strong significance. In other words, with the addition of project agility, the regression coefficient of innovation ability to firm performance is no longer significant, indicating that project agility plays a complete mediating role between innovation ability and firm performance, and H4 is confirmed.

Table 4-12 *Regression Result of Project Agility as Mediating Variable*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	1.392	0.056		0.000	1.000	
Annual Operating Income	-0.010	0.059	-0.016	-0.266	0.790	1.110
Percentage of Bachelor's Degrees Among the Staff	0.094	0.069	0.129	1.882	0.061	1.500
Percentage of R&D Personnel	-0.037	0.066	-0.061	-0.925	0.356	1.391
Employee Training and Learning	-0.069	0.070	-0.089	-1.275	0.204	1.554
Innovation Capability	0.109	0.082	0.109	1.322	0.187	2.145
Project Agility	0.465	0.084	0.427	5.087	0.000	2.230
R^2 change			0.082			
F change			25.845			

DW = 2.245, F value is significant at the level of significance of 0.001.

Source: Author's Elaboration.

As detailed in *Appendix 9* (see *Table A9-1*), innovation atmosphere was considered as a moderating variable, innovation capability as an independent variable and firm performance as the dependent variable, in order to verify the moderating effect of innovation atmosphere on firm performance (H5a). The model takes four variables as control variables, specifically: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It also takes innovation ability as an in dependent variable, innovation atmosphere a moderating variable, and firm performance as the dependent variable. It can be seen that the DW value of the model is 2.115, and there is no heteroscedasticity in the model. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the change of R^2 is 0.012, and the change of F value is 3.593, revealing that the introduction of innovation atmosphere increases the explanatory power of the model. From the results of regression analysis, we can see that the standardization coefficient (Beta value) of the regression results between innovation capability and innovation atmosphere is 0.123, reaching a significant level ($p < 0.05$). Therefore, innovation atmosphere has a positive moderating role in the process of the effect of innovation ability on firm performance, and H5a is confirmed.

The information presented in *Appendix 9* (see *Table A9-2*) validates the moderating

effect of innovation atmosphere on project agility (H5b) by taking innovation atmosphere as a moderating variable, innovation capability as an independent variable and project agility as the dependent variable. The model takes four variables as control variables, namely: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It takes innovation capability as a dependent variable, innovation atmosphere as a moderating variable and project agility as the dependent variable. It can be seen that the DW value of the model is 1.824, and there is no heteroscedasticity in the model. The VIF values are all less than 10, and there is no multicollinearity. In addition, the change of R^2 is 0.000, and the change of F value is 0.279, which show that the interaction between innovation atmosphere and innovation capability does not increase the explanatory power of the model. As such, the moderating effect of innovation atmosphere on the process and the effect of innovation ability on project agility are not significant, and H5b is not confirmed.

The calculi presented in *Appendix 9* (see *Table A9-3*) verifies the moderating effect of environmental dynamics in the process of project agility affecting firm performance (H6) by taking environmental dynamics as a moderating variable, project agility as an independent variable and firm performance as the dependent variable. The model takes four variables as control variables, namely: (1) annual business income; (2) the proportion of bachelor's degrees among the staff; (3) the proportion of R&D personnel; and (4) staff training and learning. It takes project agility as an independent variable, environmental dynamics as a moderating variable, and firm performance as the dependent variable. It can be seen that the DW value of the model is 2.230, and the model in this study does not have heteroscedasticity. The VIF values are all less than 10, and there is no multicollinearity in the model. Furthermore, the change of R^2 is 0.020, and the change of F value is 6.374, which show that the addition of environmental dynamics increases the explanatory power of the model. From the results of regression analysis, we can see that the standardization coefficient (Beta value) of the regression results between project agility and environmental dynamics is 0.147, which reaches a significant level ($p < 0.05$). Therefore, innovation atmosphere has a positive moderating role in the process of innovation ability affecting firm performance, and it is considered that H6 is confirmed.

Table 4-13 summarizes the results and steps of the multiple linear regression analysis with firm performance as dependent variable. The first step is to add the control variable to the multiple linear regression analysis, and then add the independent variable innovation

capability to the linear regression analysis to obtain the results of model 1. The second step is to add innovation atmosphere and the interaction items of innovation atmosphere and innovation capability to verify the moderating effect of innovation atmosphere, as shown in the results of model 2. The third step is to add project agility to verify its impact on firm performance (*i.e.*, model 3). The fourth step is to verify the mediating effect of project agility in the process of innovation capability affecting firm performance (*i.e.*, model 4). The fifth step is to add environmental dynamics and the intersection of environmental dynamics and project agility to verify the moderating effect of environmental dynamics (*i.e.*, model 5).

Table 4-14 summarizes the results and steps of the multiple regression analysis with project agility as the dependent variable. The first step is to add the control variable to the linear regression analysis, and then add the independent variable innovation capability to the multiple linear regression analysis of project agility, and obtain the results of model 6. The second step is to add the innovation atmosphere and the interaction items of innovation atmosphere and innovation capability to verify project agility. The moderating effect of innovation atmosphere is shown in the results of model 7.

Table 4-13 *Summary Table of Regression Result of Firm Performance as Dependent Variable*

Step	Variables	Firm Performance							
		Model 1		Model 2		Model3	Model 4	Model 5	
Step1:	Control Variables								
	Annual Operating Income	-.034	-.006	-.008	.005	-.023	-.016	-.023	-.003
	Percentage of Bachelor's Degrees Among the Staff	.212*	.151*	.143	.125	.137*	.129	.137*	.122*
	Proportion of R&D Personnel	-.041	-.046	-.072	-.063	-.063	-.061	-.063	-.052
	Employee Training and Learning	.138	-.012	-.062	-.068	-.074	-.089	-.074	-.069
Step2-1:	The Main Effect								
	Innovation Capability		.368***	.209**	.228**		.109		
Step2-2:	The Adjusted Effect 1								
	Innovation Atmosphere			.277**	.318***				
	Innovation Atmosphere | Innovation Capability				.123*				
Step3:	The Moderating Effect								
	Project Agility					.495***	.427***	.495***	.524***
Step4:	The Adjusted Effect 2								
	Environmental Dynamics							-.002	.009
	Environmental Dynamics | Project Agility								.147**
	Changed value of R^2	.074	.103	.037	.012	.179	.082	.271	.020
	Changed value of F	4.738*	29.440***	11.077**	3.593*	56.491***	25.845***	22.078***	6.374*

*$p < 0.05$, **$p < 0.01$, ***$p < 0.001$. The coefficient is a standardized Beta value.

Source: Author's Elaboration.

Table 4-14 *Summary Table of Multivariate Regression Results with Project Agility as Dependent Variable*

Step	Variables	Project Agility			
		Model 6		Model 7	
Step1:	Control Variables				
	Annual Operating Income	-.025	-.021	.020	.019
	Percentage of Bachelor's Degrees Among the Staff	.152	.051	.039	.042
	Proportion of R&D Personnel	.043	-.036	.000	-.002
	Employee Training and Learning	.428**	-.178*	.113*	.112*
Step2:	The Main Effect				
	Innovation Capability		.610***	.391***	.389***
Step3:	The Adjusted Effect				
	Innovation Atmosphere			.378***	.371***
	Innovation Atmosphere | Innovation Capability				-.023
	Changed value of R^2	.272	.280	.069	.000
	Changed value of F	22.089***	147.358***	42.867***	.279

*p < 0.05, **p < 0.01, ***p < 0.001; The coefficient is a standardized Beta value.

Source: Author's Elaboration.

Through the analysis carried out, H1 has been verified, confirming a positive impact of innovation capability on firm performance. H2 has been verified, confirming a positive impact of project agility on firm performance. H3 has been verified, confirming a positive impact of innovation capability on project agility. H4 has been verified, confirming a positive mediating effect of project agility in the process of innovation capability influencing firm performance. H5a has been verified, confirming a positive moderating effect of innovation atmosphere on the effect of innovation capability on firm performance. H6 has also been verified, confirming that that environmental dynamics have a positive moderating effect on the relationship between project agility and firm performance. H5b was verified but indicated that the innovation atmosphere does not have a positive moderating effect on the effect of innovation capability on project agility. The results of the tests of all hypotheses are shown in *Table 4-15*.

Table 4-15 *Summary Table of Hypothesis Test Results*

Item	Research hypothesis	Empirical results
H1	The innovation capability of an enterprise has a positive impact on its performance.	Confirmed
H2	An enterprise's project agility has a positive impact on its performance.	Confirmed
H3	Innovation capability has a positive effect on project agility.	Confirmed
H4	Project agility plays a mediating role between innovation capability and firm performance.	Confirmed
H5a	The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on firm performance.	Confirmed
H5b	The innovation atmosphere plays a positive moderating role in the effect that innovation capability has on project agility.	Not confirmed
H6	Environmental dynamics play a positive role in moderating the relationship between project agility and firm performance.	Confirmed

Source: Author's Elaboration.

From the above summary we can clearly see that all hypotheses except H5b were confirmed by the empirical research. Although hypothesis H5b has not been verified, the basic model of this research has passed the test. The basic model of this research has two paths. Path 1 is the relationship between enterprise innovation capability and firm performance level without considering project agility before implementing agile management. The results of regression analysis show that the stronger the innovation capability of enterprises, the higher their performance level will be; that is, as an important type of

enterprise capability, innovation capability can promote the performance level of enterprises in high-tech SMEs. This relationship is affected by innovation atmosphere and environmental dynamics, respectively. In this research, the moderating effects of innovation atmosphere and environmental dynamics are analyzed. Through regression analysis of the interaction between innovation atmosphere, innovation capability and firm performance, the results show that the stronger the innovation atmosphere, the stronger the promotion effect of innovation capability on enterprise performance; through regression analysis of the interaction between environmental dynamics, project agility and firm performance, the results show that the higher the environmental dynamics, the more the project agility promotes firm performance.

Path 2 is the key content of this research, which considers the impact of project-level agility on enterprises after implementing agile project management. Through theoretical analysis, this research argues that project agility can be stimulated by innovation capability, and then affect the performance level of enterprises. However, through the analysis of comparative cases, this research finds that the impact of implementing agile project management on enterprises varies in different high-tech SMEs. Therefore, it is further put forward theoretically and logically that innovation capability is the basic ability of an enterprise and the pre-factor of the realization of enterprise agility. Agility is an obvious ability of an enterprise, which has a strong explanatory degree to the performance level of an enterprise, so the project agility of an enterprise is the deep-seated innovation capability of an enterprise. Therefore, the enterprise's ability of project agility plays an intermediary role in the relationship between the enterprise's deep innovation capability and its performance level. The results of regression analysis show that, first, project agility can positively promote enterprise performance. This means that the better the implementation of agile project management, the higher the performance level of enterprises. Second, project agility plays an intermediary role in the path that innovation capability affects enterprise performance. That is, after enterprises start the agile project management, the path that innovation capability affects enterprise performance has changed. Innovation capability first influences project agility, and then promotes enterprise performance through project agility. Similarly, the explanatory variables and the explained variables of path 2 also need to consider the different situations that may occur when the innovation atmosphere and environmental dynamics are different. Through the analysis of regulatory effect, this research analyzed the regulatory effect of environmental dynamics and innovation atmosphere respectively. Indeed, for the role of environmental dynamic regulation of project agility in enterprise performance level, the

higher the environmental dynamic, the more project agility can promote enterprise performance level. In addition, for the effect of innovation atmosphere on project agility, the results of this research show that the positive effect of innovation capability on project agility is unchanged in both high and low innovation atmosphere. Therefore, the hypothesis that innovation capability positively regulates project agility in H5b with high innovation atmosphere has not been verified. Through interviews with enterprises and theoretical analysis in the latter part, this research argues that the reasons why this hypothesis has not been supported are mainly explained as follows. The premise of implementing agile management at project level is that project team members have high execution ability. Therefore, the tasks assigned to each individual are highly clear. The tasks and progress of implementing agile management by project team members need to be carried out in strict accordance with the process. This highly demarcated work arrangement has a clear process arrangement for each person's task in the project. Therefore, after the implementation of agile management, enterprise R&D process has a clear workflow, and the process of shaping project team agility with different endowments of innovation capability does not change with the different innovation atmosphere. Therefore, the innovation atmosphere has no obvious influence in this process.

Synopsis of Chapter 4

This chapter describes the research design, data collection, validity and reliability testing, and analysis and results. For the research design, we conducted a survey of a series of measurement indicators for relevant variables. The data was collected through two channels, network completion and on-site distribution. After obtaining sufficient data from this survey of high-tech SMEs in China, we merged it to carry out an effectiveness analysis for a number of items. We verified the samples through homogeneity of variance from different sources and through analysis of variance for samples from different sources between groups and within groups as well. We found that 242 samples were valid and we carried out a descriptive statistical analysis of respondents at the individual level and at the firm level, going on to conclude with a descriptive statistical analysis of key variables. Through the KMO test and Bartlett sphericity test, we verified the structural validity of our study through five items, namely, firm performance, innovation capability, project agility, innovation atmosphere, and environmental dynamics. We verified the reliability of these five items through Cronbach's alpha value. For the section of results and analysis, we produced the structural equation model before the correlation analysis and regression analysis, as well as a number of multivariate regressions. Furthermore, we verified these hypotheses and obtained the respective results. A number of summaries were obtained based on the research design, data collection and the many tests and analyses. This chapter validates the relationship between innovation capability, project agility and firm performance through a series of research analyses on the mechanism of innovation capability improving project agility and promoting firm performance, on the moderating role of innovation atmosphere and of environmental dynamics, and testing the hypotheses put forward in *Chapter 3*. All the hypotheses of the thesis fully or partially passed the empirical tests, except for H5b. This indicates a good fit between the theoretical model and the results obtained in the sample. The empirical analysis supports the theoretical model of innovation ability and project agility promoting firm performance proposed by literature research and comparative case analysis. In the next chapter, according to the empirical analysis results obtained, we will provide policy suggestions on promoting firm performance by project-level agile management, in order to formulate valuable theoretical guidance for enterprise agile management practice.

Chapter 5: Conclusion

Building on RBV's theoretical perspective and on the management practice of introducing agile management at the project level, this study puts forward a theoretical model for innovation capability to continuously improve firm performance. Through the data collected in a survey of high-tech SMEs in China, the hypotheses proposed by the comparative and theoretical analyses were verified. In this chapter, we outline the conclusions arrived at and discuss limitations of the study, addressing them from three perspectives. We also indicate managerial implications and guidelines resulting from our research. Lastly, based on the contributions made and limitations identified, we offer suggestions on future research.

5.1. Research Outcomes

The research carried out in this study allows the relationship among innovation capability, project agility and enterprise performance to be systematically studied, and expands the research on the direct relationship between existing innovation capability and enterprise performance, project agility and enterprise performance. Based on case studies and theoretical deduction, this study proposes that project agility is an innovation at the organizational process level, and plays an intermediary role in the relationship between innovation capability at the organizational level and enterprise performance. Based on this core hypothesis, this study puts forward six related research questions as following. The first research question was related to the impact that the introduction of project agility has on enterprises. The second question was regarding how innovation capability affects enterprises' project agility. The third question was on how project agility affects firm performance. The fourth question concerned the "path mechanism" for innovation capability to enhance project agility and further enhance firm performance. The fifth question pertained to how the innovation atmosphere adjusts the relationship between innovation capability and project agility, as well as the relationship between innovation capability and firm performance. The sixth question was related to how environmental dynamics adjust the relationship between project agility and firm performance. This study draws the following conclusions regarding these research questions.

First, the implementation of project agility has a positive impact on the performance on enterprises. In other words, the innovation capability of an enterprise has a positive impact on its performance (*i.e.*, the stronger its innovation capability is, the better its performance will be). While this conclusion is aligned with existing research, this study focuses on high-tech SMEs in China, expanding the application scope of the positive influence of innovation capability on firm performance.

Second, for the question of how innovation capability affects enterprises' project agility, our findings suggest that innovation capability has a positive impact on project agility. Specifically, the stronger innovation capability is, the greater the effect on agile management will be. The relevant findings and implications will be explained in detail below, in discussing the "path mechanism".

Third, for the question of how project agility affects firm performance, our study finds that project agility plays a mediating role in the influence that enterprise innovation capability has on firm performance. In other words, the theoretical model that innovation capability can improve project agility and further influence the sustainable performance of the enterprise is confirmed. Combined with the question of how innovation capability affects enterprises' project agility, these two questions constitute the "mechanism" through which innovation capability enhances project agility and further enhances firm performance.

Fourth, with regard to the "path mechanism" through which innovation capability enhances project agility and further enhances firm performance, we found that, among high-tech SMEs, the innovation capability of enterprises is generally considered to be a low-level capability, rarely affecting in a direct manner enterprises' continuous competitive advantage. Although this capability can improve the performance of enterprises to a certain extent, it cannot bring about sustained development. Only when the innovation capability of an enterprise is combined with other resources and capabilities, and a high-level capability is formed through reconstruction, can it contribute to the continuous improvement of the performance of the enterprise. For high-tech SMEs, project-level agility is a high-level capability.

We also answered the question of how the innovation atmosphere adjusts the relationship between innovation capability and project agility, and on the relationship between innovation capability and firm performance. On the one hand, in the course of influencing the path through which innovation capability influences project agility, the innovation atmosphere has no obvious moderating effect. This empirical result does not support our

hypothesis, perhaps because enterprises implementing project-level agile management require project team members to possess high capabilities for that implementation. In high-tech SMEs, the influence of innovation capability on firm performance needs to be stimulated by certain external factors, and the innovation atmosphere is a favorable factor to stimulate the effect of innovation capability on firm performance.

Next, we answered the question on how environmental dynamics adjust the relationship between project agility and firm performance, finding that the more dynamic the environment is, the stronger the positive effect of project agility on firm performance will be. Therefore, the introduction of agile management practices at the project level can improve the performance of high-tech SMEs, as they experience high environmental dynamics.

In addition, there are two competitive theoretical explanations for the relationship between project agility and firm performance in the extant literature. One stream of thought thinks that the agility of the project is the embodiment of the ability of the enterprise to cope with the change of external environment at the process level. The higher the project agility, the quicker the R&D team responds to the change of demand and the shorter the R&D cycle will be. In this sense, the organization can continuously improve product quality and customer satisfaction with gradual, iterative and low-risk methods. The final result is the improvement of enterprise performance. This theoretical logic is highly consistent with the current management practice of "speed is advantage", which include accelerating innovation iteration, and making software and technology-driven faster and faster, then make innovation cycle become a competitive advantage of enterprises.

Another stream of thought believes that the innovation process that regards the speed of innovation as a competitive advantage is problematic. As such, it focuses on responding quickly to customers' needs as a passive innovation. The conclusion of this study shows that project agility has a positive role in promoting corporate performance, that is, in the Chinese context, the first logic of interpretation is the dominant theoretical logic. This is because China is an emerging economy in the "catch-up mode". The business model of most high-tech SMEs is mainly based on demand-oriented incremental innovation rather than breakthrough innovation in creating new business. Therefore, the "rapid iteration" strategy based on project agility is a reasonable management strategy. However, as China's economy gradually transforms into an "innovation-driven" economy, these strategies may face new challenges.

From the level of organizational innovation, agile management is process level innovation, and its implementation effect (*i.e.*, agility) is affected by organizational level

innovation capability. On the one hand, agile management as a tool only provides a mechanism for rapid product validation, and can not specify the product direction. Therefore, agility will also depend on the product manager with innovative consciousness and knowledge, which is the micro-foundation of organizational innovation capability. On the other hand, the implementation of high efficiency of agility depends on the technology and organizational structure of the enterprise, which is based on the innovation capability of the organizational system.

A large number of studies have considered that innovation capability is an important determinant of enterprise performance (Mone *et al.*, 1998), and has a positive research on enterprise performance. The results of this study also confirm this conclusion. However, the black box of the relationship between innovation capability and firm performance has not been completely opened due to the multi-dimensionality of the composition of innovation capability and the different theoretical perspectives of innovation process view and innovation result view.

5.2. Limitations of the Study

This study explores the mechanism through which project agility impacts firm performance from the perspective of resource-based view theory, synthesizing innovation ability, agile project management, firm performance and other theoretical constructs into a useful theoretical framework. This results in novel research content for both the Chinese and the global settings. However, due to the newness of research topics, to the specified research background, and to the relatively concentrated questions, there are a number of limitations in this research. Below, we list the limitations identified and offer a few comments.

First, while this study highlights the importance of agile management in high-tech SMEs in China, it is limited by the lack of prior research in the field. Naturally, future research can explore such topic from other theoretical perspectives.

Second, the relationship between innovation capability, project agility and firm performance is affected by internal and external factors of enterprise. With the continuous development and evolution of enterprises and changes in external policies, environment, and other elements, the factors affecting the theoretical model in this study will also develop and change. Although this study proposes that the internal innovation atmosphere and external environmental dynamics of the enterprise are the moderating variables that affect the main

model, the role of innovation atmosphere is not verified in the process of moderating the effect of innovation capability on project agility.

Finally, the relationship between innovation capability, corporate project agility and firm performance may vary significantly across industries. This study only verified the correctness of the theoretical model in high-tech SMEs in China and did not consider whether the theoretical model is still applicable to other types of enterprises, or in other regions and countries. Future research can verify the correctness of the theoretical model beyond the category of high-tech SMEs and beyond the geographical location of this study.

5.3. Managerial Implications and Guidelines

This study makes several contributions not only to the existing theories of agile management, but also to managerial practice. First, it extends the extant research on the agile management topic. Through literature analysis and a comparative case study, it identifies the key variables that promote the implementation of agile management, and analyzes the influence mechanism of the relationship between innovation capability, project agility and firm performance. It also enriches the theoretical research results of project agility. Second, this study expands the practical significance of introducing agile project management. On the one hand, for the internal management of high-tech SMEs, the analysis and solution of various problems are closely related to innovation capability or project agility. If considering the internal factors of innovation management or agile management separately, while disregarding the collaboration between innovation capability and project agility from the internal perspective, it is difficult to optimize and integrate internal efficiency, which will also result in waste of resources. The results of this study show that the combination of innovation and agile project management methods in enterprise management will greatly improve the performance of enterprises. On the other hand, the external impact of innovation atmosphere and environmental dynamics have a moderating effect on innovation capability and project agility, improving firm performance. Combining these internal and external factors, methods and management systems are provided to promote performance, based on the limited available resources, maximizing the practical significance of project agility to management. Finally, this study expands the significance to management of a structural model based on innovation ability, project agility and company performance. Under the influence of external factors, innovation atmosphere and environmental dynamics, the overall management of high-tech SMEs can be improved, resulting in greater competitive advantage. Through empirical analysis, we see that

we can further improve the design of company systems, especially for the optimization of factors such as the assessment method of relevant items and the level of education of personnel, which improve management ability and the overall performance of enterprises.

As mentioned above, the mediating role of project agility proposed in this research for enterprise innovation capability and firm performance is applicable to the management situation of "innovation speed is competitive advantage". In this management situation, the innovation activities of enterprises are the process of seeking the best solution locally, that is, the search learning in the process of innovation is the local search, so it is a gradual innovation activity. This type of management situation mainly exists in the growing or mature industries, with relatively low uncertainty. Its main characteristics are: (1) clear boundaries of business areas; (2) clear basic functions of products; and (3) locked-in of major customers. Enterprise performance level is highly correlated with market growth rate. In the field of exploring commercialization with new technologies such as artificial intelligence, block chain and quantum communication, the industry is still in the early incubation stage. There are high uncertainties in market, technology and supporting environment. Enterprises are facing the management situation of integration of innovation and entrepreneurship, and innovation activities have higher openness and overall characteristics. They are breakthrough or destructive innovation activities with cross-border search and learning as the core. In this innovative situation, it is worth discussing whether the mediating mechanism of project-level agility for enterprise innovation capability and performance still exists, and it is also a main direction of future research.

5.4. Future Research

We consider that future research can focus on the following aspects. First, combined with the research in this study, future research can further extend the concepts of enterprises' innovation capability, project agility and firm performance, enriching the applicable scope of relevant research. The relationship between the three factors can be further explored and other possible systematic mechanisms of action can be found. Second, this study analyzes the influence of innovation atmosphere and environmental dynamics as moderating variables, leaving out the total internal and external influencing factors of the theoretical model. Furthermore, the hypothesis on the moderating role of innovation atmosphere on the relationship between innovation capability and project agility was not confirmed. Future research can look for more and possibly more relevant factors moderating the relationship

between innovation capability, project agility and firm performance. Finally, this study surveys data only from high-tech SMEs in China. As stated above, the introduction of agile project management in different industries and countries may lead to different outcomes. Future research, then, can examine this aspect.

Questions related to actual management practice are the ones that managers and researchers face. These still represent a field full of vitality and with great social and economic value. Analyzing the problem of enterprises implementing agile management by combining RBV and other theories of strategic management, of enterprise growth, and of the theoretical framework of economics, could improve the achievements in relevant fields.

Synopsis of Chapter 5

This chapter begins by summarizing the four main research conclusions of this study. It not only answers the six research questions outlined in the first chapter, but also verifies the impact of the introduction of agile management on high-tech SMEs. Next, the three main limitation of this study are explained. The first is the limitation of focus and depth, the analysis of the concept and interaction mechanism of project agility. The second pertains to the relationship between innovation capability, project agility and firm performance, and how it is affected by internal and external factors of enterprise. With the continuous evolution of enterprises and changes in external policies, environment and other factors, the factors affecting the theoretical model in this study will also develop and change. The third aspect is that the relationship between innovation capability, enterprise project agility and firm performance may vary significantly across industries and countries. This study examined only the model in high-tech SMEs in China. The chapter then summarizes the research contribution of this study, mainly divided into three aspects that include the development and improvement of the current project agility related research theory system, the enrichment of the theoretical research results on project agility, and the clarification on divergence in the research regarding the influence of project agility on firm performance. Four lines of future research are then proposed. The first is further research into the concepts of enterprises' innovation capability, project agility and firm performance. The second is the analysis of the effect of the total internal and external affecting factors of the theoretical model. The third is the expansion of the research into other industries and countries. The fourth is the combination of RBV and other theories of strategic management, of enterprise growth, and even of economics, improving the theoretical achievements in relevant fields.

Bibliography

Abbott III, T. (1991). Measuring high technology trade: Contrasting international trade administration and bureau of census methodologies and results. *Journal of Economic and Social Measurement*, *17*(1), 17-44.

Aburub, F. (2015). Impact of ERP systems usage on organizational agility: An empirical investigation in the banking sector. *Information Technology & People*, *28*(3), 570-588.

Ackert, L., Church, B., & Zhang, P. (2018). Informed traders' performance and the information environment: Evidence from experimental asset markets. *Accounting, Organizations and Society*, *70*, 1-15.

Agarwal, R., & Selen, W. (2009). Dynamic capabillity building in service value network for achieving service innovation. *Decision Sciences*, *40*(3), 431-475.

Agrell, A., & Gustafson, R. (1994). The Team Climate Inventory (TCI) and group innovation: A psychometric test on a Swedish sample of work groups. *Journal of Occupational and Organizational Psychology*, *67*(2), 143-151.

Aldrich, H. (1979). *Organizations and Environments*, Englewood Cliffs, NJ: Prentice-Hall.

Amabile, T., Conti, R., Coon, H., Lazenby, J., & Herron, M. (1996). Assessing the work environment for creativity. *Academy of Management Journal*, *39*(5), 1154-1184.

Amit, R., & Schoemaker, P. (1993). Strategic assets and organizational rent. *Strategic Management Journal*, *14*(1), 33-46.

Amit, R., & Zott, C. (2001). Value creation in e-business. *Strategic Management Journal*, *22*(6/7), 493-520.

Anderson, N., & West, M. (1998). Measuring climate for work group innovation: Development and validation of the team climate inventory. *Journal of Organizational Behavior: The International Journal of Industrial, Occupational and Organizational Psychology and Behavior*, *19*(3), 235-258.

Ansoff, H. (1991). Critique of Henry Mintzberg's "the design school: reconsidering the basic premises of strategic management". *Strategic Management Journal*, *12*(6), 449-461.

Armstrong, J. (1982). The value of formal planning for strategic decisions: Review of empirical research. *Strategic Management Journal*, *3*(3), 197-211.

Ashrafi, A., Ravasan, A., Trkman, P., & Afshari, S. (2019). The role of business analytics

capabilities in bolstering firms' agility and performance. *International Journal of Information Management*, *47*, 1-15.

Azadegan, A., Patel, P., Zangoueinezhad, A., & Linderman, K. (2013). The effect of environmental complexity and environmental dynamism on lean practices. *Journal of Operations Management*, *31*(4), 193-212.

Baidu Encyclopedia, *High-tech SMEs*, Retrieved from https://baike.baidu.com/item/%E7%A7%91%E6%8A%80%E5%9E%8B%E4%B8%AD%E5%B0%8F%E4%BC%81%E4%B8%9A/8072660?fr=aladdin [June 2019].

Bain, J. (1959). *Industrial Organization: A Treatise*, London: John Wiley.

Baker, W., Grinstein, A., & Harmancioglu, N. (2016). Whose innovation performance benefits more from external networks: entrepreneurial or conservative firms? *Journal of Product Innovation Management*, *33*(1), 104-120.

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

Barney, J. (2001). Is the resource-based "view" a useful perspective for strategic management research? Yes. *Academy of Management Review*, *26*(1), 41-56.

Beamon, B. (1999). Measuring supply chain performance. *International Journal of Operations & Production Management*, *19*(3), 275-292.

Bharadwaj, A. (2000). A resource-based perspective on information technology capability and firm performance: An empirical investigation. *MIS Quarterly*, *24*(1), 169-196.

Blome, C., Schoenherr, T., & Rexhausen, D. (2013). Antecedents and enablers of supply chain agility and its effect on performance: A dynamic capabilities perspective. *International Journal of Production Research*, *51*(4), 1295-1318.

Boehm, B. (2002). Get ready for agile methods, with care. *Computer, 35*(1), 64-69.

Bottani, E. (2009). A fuzzy QFD approach to achieve agility. *International Journal of Production Economics*, *119*(2), 380-391.

Burgelman, R., & Maidique, M. (1996). *Strategic Management of Technology and Innovation*, Chicago: Irwin.

Burke, W., & Litwin, G. (1992). A causal model of organizational performance and change. *Journal of Management*, *18*(3), 523- 545.

Calantone, R., Cavusgil, S., & Zhao, Y. (2002). Learning orientation, firm innovation capability, and firm performance. *Industrial Marketing Management*, *31*(6), 515-524.

Cao, Q., & Dowlatshahi, S. (2005). The impact of alignment between virtual enterprise and information technology on business performance in an agile manufacturing

environment. *Journal of Operations Management*, *23*(5), 531-550.

CASTED (2018). *National Innovation Index of China in 2018*, Beijing: Scientific and Technical Documentation Press.

Chakravarty, A., Grewal, R., & Sambamurthy, V. (2013). Information technology competencies, organizational agility, and firm performance: Enabling and facilitating roles. *Information Systems Research*, *24*(4), 976-997.

Chen, G., Zhao, H., & Jiang, L. (2008). Empirical study on the relationship between team psychological safety, team learning ability and team performance. *Scientific Research*, *26*(6), 1283-1292.

Chen, J., & Chen, Y. (2006). Research on performance evaluation index system of enterprise technology innovation. *Science and Technology Management*, *27*(3), 86-91.

Chen, J., & Zheng, G. (2016). *Innovation Management: To Win Continuous Competitive Advantages*, Beijing: Peking University Press.

Chen, Z., & Li, J. (2005). Review and prospect of organizational climate research. *Foreign Economy and Managemen*t, *8*, 18-25.

Chen, Y., Tan, C., & Yu, L. (2012). Research on the evaluation index system of technological innovation ability of small and medium-sized technological enterprises. *Scientific and Technological Progress and Countermeasure*, *29*(2), 110-112.

Chen, Y., Wang, Y., Nevo, S., Jin, J., Wang, L., & Chow, W. (2014). IT capability and organizational performance: The roles of business process agility and environmental factors. *European Journal of Information Systems*, *23*(3), 326-342.

Child, J. (1972). Organizational structure, environment and performance: The role of strategic choice. *Sociology*, *6*(1), 1-22.

China, MIIT. (2011). *Circular on the Issue of Standards for Small and Medium-sized Enterprises*. Retrieved from http://www.miit.gov.cn/n1146285/n1146352/n3054355/n3057278/n3057286/c3592332/content.html [November 2017].

Clemons, E., & Row, M. (1991). Sustaining IT advantage: The role of structural differences. *MIS Quarterly*, *15*(3), 275-292.

Cobb, C. (2011). *Making Sense of Agile Project Management: Balancing Control and Agility*, New York: John Wiley & Sons.

Cooper, R. (1985). Industrial firms' new product strategies. *Journal of Business Research*, *13*(2), 107-121.

Crossan, M., & Apaydin, M. (2010). A multi‐dimensional framework of organizational innovation: A systematic review of the literature. *Journal of Management Studies*, *47*(6), 1154-1191.

Cui, Z. (2012). *Study on Project Technical Innovation Network Innovation Capability Based on SE.* Master Thesis, Central South University.

D'aveni, R., & Ravenscraft, D. (1994). Economies of integration versus bureaucracy costs: Does vertical integration improve performance? *Academy of Management Journal*, *37*(5), 1167-1206.

Daft, R. (1978). A dual-core model of organizational innovation. *Academy of Management Journal*, *21*(2), 193-210.

Daft, R., Sormunen, J., & Parks, D. (2010). Chief executive scanning, environmental charateristics, and company performance: An empirical study. *Strategic Management Journal*, *9*(2), 123-139.

Damanpour, F., & Evan, W. (1984). Organizational innovation and performance: The problem of "organizational lag". *Administrative Science Quarterly*, 29(3), 392-409.

Dess, G., & Beard, D. (1984). Dimensions of organizational task environments. *Administrative Science Quarterly*, *29*(1), 52-73.

Dess, G., & Picken, J. (2000). Changing roles: Leadership in the 21st century. *Organizational Dynamics*, *28*(3), 18-34.

Ding, G., & Li, H. (2016). How job characteristics influence employees' creative behavior: A mediated moderating model. *Human Resource Development of China*, *22*, 19-27.

Dove, R. (1999). Knowledge management, response ability, and the agile enterprise. *Journal of Knowledge Management*, *3*(1), 18-35.

Drucker, P. (1984). Converting social problems into business opportunities: The new meaning of corporate social responsibility. *California Management Review*, *26*(2), 53-63.

Duncan, R. (1972). Characteristics of organizational environments and perceived environmental uncertainty. *Administrative Science Quarterly*, *17*(3), 313-327.

Duan, S. (2008). Construction of evaluation index system for technological innovation ability of small and medium-sized technological enterprises. *Market Modernization*, *2*, 89.

Dyba, T., Kitchenham, B., & Jorgensen, M. (2005). Evidence-based software engineering for practitioners. *IEEE software*, *22*(1), 58-65.

Eisenhardt, K. (1989). Agency theory: An assessment and review. *Academy of Management Review*, *14*(1), 57-74.

Eisenhardt, K., & Graebner, M. (2007). Theory building from cases: Opportunities and challenges. *The Academy of Management Journal*, *50*(1), 25-32.

Eisenhardt, K., & Martin, J. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, *21*(10/11), 1105-1121.

Francis, D., & Bessant, J. (2005). Targeting innovation and implications for capability development. *Technovation*, *25*(3), 171-183.

Gao, J., Wang, J., & Wei, P. (2004). Enterprise technology innovation performance indicators: Status quo, problem and new concept model. *Scientific Research Management*, *25*(S1), 14-22.

Ge, Q., & Xiao, H. (2008). Research and evaluation of competitive strategy theory based on environment. *Management Review*, *20*(7), 42-49.

Glaser, B., Strauss, A., & Strutzel, E. (1968). The discovery of grounded theory: Strategies for qualitative research. *Nursing Research*, *17*(4), 364.

Goldman, S., Nagel, R., & Preiss, K. (1995). *Agile Competitors and Virtual Organizations: Strategies for Enriching the Customer*, New York: Van Nostrand Reinhold.

Goodhue, D., & Chen, D. (2009). Addressing business agility challenges with enterprise systems. *MIS Quarterly Executive*, *8*(2), 73-87.

Grant, R. (2005). *Contemporary Strategy Analysis: Text and Cases Edition, 5th Ed.*, Oxford: Blackwell Ltd.

Gu, Y., & Peng, J. (2010). The Impact of organizational innovation climate on employee innovation behavior: The mediating role of innovation self-efficacy. *Nankai Management Review*, *1*, 30-41.

Gunasekaran, A. (1999). Agile manufacturing: A framework for research and development. *International Journal of Production Economics*, *62*(1/2), 87-105.

Guo, W. (2003). Performance evaluation index system and methods for science and technology SMEs. *Journal of Zhengzhou Institute of Aeronautical Industry Management*, *21*(3), 43-44.

Hagedoorn, J., & Cloodt, M. (2003). Measuring innovative performance: Is there an advantage in using multiple indicators? *Research Policy*, *32*(8), 1365-1379.

Halpin, A., & Croft, D. (1963). *The Organizational Climate of Schools,* Chicago: Midwest Administration Center of the University of Chicago.

Han, J., Kim, N., & Srivastava, R. (1998). Market orientation and organizational performance: Is innovation a missing link? *The Journal of Marketing*, 62(4), 30-45.

He, Y., & Zhang, S. (2017). Research on the impact of technological innovation sustainability on enterprise performance. *Scientific Research Management*, 9, 1-11.

Henderson, R., & Cockburn, I. (1994). Measuring competence? Exploring firm effects in pharmaceutical research. *Strategic Management Journal*, *15*(S1), 63-84.

Hodge, B., & Johnson, H. (1970). *Management and Organizational Behavior: A Multidimensional Approach*, New York: Wiley.

Holmström, H., Fitzgerald, B., Ågerfalk, P., & Conchúir, E. (2006). Agile practices reduce distance in global software development. *Information Systems Management*, *23*(3), 7-18.

Huang, Z., & Guo, H. (2003). Research on technological innovation of small and medium-sized technological enterprises in China. *Research on Productivity*, 5, 217-220.

Humble, J., Molesky, J., & O'Reilly, B. (2015). Lean enterprise. *Springer Texts in Business & Economics*, *17*(4), 15-22.

Hunter, J., Gerbing, D., & Boster, F. (1982). Machiavellian beliefs and personality: Construct invalidity of the Machiavellianism dimension. *Journal of Personality and Social Psychology*, *43*(6), 1293.

Iacocca Institute (1991). *21st Century Manufacturing Enterprise Strategy: An Industry-Led View*, Iacocca Institute: Lehigh University.

Inman, R., Sale, R., Green Jr, K., & Whitten, D. (2011). Agile manufacturing: Relation to JIT, operational performance and firm performance. *Journal of Operations Management*, *29*(4), 343-355.

Isaksen, S., Lauer, K., Ekvall, G., & Britz, A. (2001). Perceptions of the best and worst climates for creativity: Preliminary validation evidence for the situational outlook questionnaire. *Creativity Research Journal*, *13*(1), 171-184.

Isaksen, S., & Tidd, J. (2007). *Meeting the Innovation Challenge: Leadership for Transformation and Growth*, Chichester: John Wiley & Sons Ltd.

Jackson, M., & Johansson, C. (2003). An agility analysis from a production system perspective. *Integrated Manufacturing Systems*, *14*(6), 482-488.

Jaworski, B., & Kohli, A. (1993). Market orientation: Antecedents and consequences. *Journal of Marketing*, *57*(3), 53-70.

Jiang, L. (2007). *Scanning Behavior of Technological Environment, External Linkage Characteristics and the Relation between Continuous Innovations: An Empirical Research Based on Manufacturing Enterprises*. Doctoral Dissertation, Xi'an Jiaotong

University.

Jiang, Y., & Zhao, J. (2015). The creative process of business value of IT in dynamic environment: The mediating effect of firm agility. *International Journal of Networking and Virtual Organisations*, *15*(2/3), 200-214.

Kaiser, H. (1974). An index of factorial simplicity. *Psychometrika*, *39*(1), 31-36.

Kang, G., & Zhou, Q. (2008). Research on the construction and application of financial evaluation index system of technology-based small and medium-sized enterprises. *Journal of Nanchang University (Humanities and Social Sciences Edition)*, *39*(1), 87-91.

Kaplan, R., & Norton, D. (1992). The balanced scorecard: Measures that drive performance. *Harvard Business Review*, *70*(1), 71-79.

Kaplan, R., & Norton, D. (1995). Putting the balanced scorecard to work: Performance measurement. *Management, and Appraisal Sourcebook*, *66*, 17511.

Kasarda, J., & Rondinelli, D. (1998). Innovative infrastructure for agile manufacturers. *Sloan Management Review*, *39*(2), 73-83.

Klomp, L., & Van Leeuwen, G. (2001). Linking innovation and firm performance: A new approach. *International Journal of the Economics of Business*, *8*(3), 343-364.

Knight, F. (1921). Risk, uncertainty and profit. *Social Science Electronic Publishing*, *4*, 682-690.

Kogut, B., & Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. *Organization Science*, *3*(3), 383-397.

Kohli, A., & Jaworski, B. (1990). Market orientation: the construct, research propositions, and managerial implications. *Journal of Marketing*, *54*(2), 1-18.

Kotler, P. (1984). *Marketing essentials*, New Jersey: Prentice Hall.

Lawrence, P. & Lorsch, J. (1967). *Organization and Environment: Managing Differentiation and Integration*, Boston, MA: Harvard University, Graduate School of Business Administration.

Lawson, B., & Samson, D. (2001). Developing innovation capability in organisations: A dynamic capabilities approach. *International Journal of Innovation Management*, *5*(3), 377-400.

Lee, Sambamurthy, V., Lim, K., & Wei, K. (2015). How does IT ambidexterity impact organizational agility? *Information Systems Research*, *26*(2), 398-417.

Lee, Y., & Yang, C. (2014). The relationships among network ties, organizational agility, and organizational performance: A study of the flat glass industry in Taiwan. *Journal of*

Management & Organization, *20*(2), 206-226.

Leonard‐Barton, D. (1992). Core capabilities and core rigidities: A paradox in managing new product development. *Strategic Management Journal*, *13*(S1), 111-125.

Leonard, D., & Sensiper, S. (1998). The role of tacit knowledge in group innovation. *California Management Review*, *40*(3), 112-132.

Li, D., Xiang, B., & Chen, Y. (2009). Enterprise dynamic capability and its efficiency: Impact of environmental uncertainty. *Nankai Management Review*, *12*(6), 60-68.

Li, J. (2012). *Research on the relationship between organizational innovation climate and employee innovation behavior*. Master Thesis, Southwest University of Finance and Economics.

Li, T., & Calantone, R. (1998). The impact of market knowledge competence on new product advantage: Conceptualization and empirical examination. *The Journal of Marketing*, *62*(4), 13-29.

Li, X., & Holsapple, C. (2018). Entrepreneurial work design for organization agility. *Journal of Management Policy and Practice*, *19*(3), 35-49.

Lin, T., Chiu, H., & Chu, P. (2006). Agility index in the supply chain. *International Journal of Production Economics*, *100*(2), 285-299.

Litwin, G., & Stringer, R. (1968). *Motivation and Organization Climate*, Boston: Graduate School of Business Administration, Harvard University.

Liu, Q., Hu, B., & Liu, E. (2009). Empirical study on the relationship between organizational structure, innovation climate and time-based performance. *Research and Development Management*, *5*, 46-55.

Liu, X., Wang, Y., & Li, Q. (2010). Multilevel analysis of the impact of innovative climate on employee creativity. *Management Review, 8*, 84-89.

Liu, Y., & Shi, J. (2009). A study on the relationship between the effects of the organizational innovative climate and those of motivational preference, on employees' innovative behavior. *Management World*, *1*(10), 88-101.

Liu, Y., Shi, J., & Zhang, W. (2009). A research of innovation climate: Definition, classification and scale development. *Studies in Science of Science*, *27(*2), 289-294.

Liu, Z. (2012). *The Influence of Organizational Justice on Employee Innovation - Mediate Effect of Organizational Innovation Climate*. Master Thesis, Shanghai Jiaotong University.

Lu, Y., & Ramamurthy, K. (2011). Understanding the link between information technology capability and organizational agility: An empirical examination. *MIS Quarterly*, *35*(4),

931-954.

Luo, M., & Liu, Y. (2009). Theoretical framework and constituent elements of dynamic capabilities of enterprise. *China Industrial Economics*, *1*, 75-86.

Lyytinen, K., & Rose, G. (2006). Information system development agility as organizational learning. *European Journal of Information Systems*, *15*(2), 183-199.

Maestrini, V., Luzzini, D., Maccarrone, P., & Caniato, F. (2017). Supply chain performance measurement systems: A systematic review and research agenda. *International Journal of Production Economics*, *183*(1), 299-315.

Mahoney, J., & Pandian, J. (1992). The resource‐based view within the conversation of strategic management. *Strategic Management Journal*, *13*(5), 363-380.

Malagueño, R., Lopez-Valeiras, E., & Gomez-Conde, J. (2018). Balanced scorecard in SMEs: Effects on innovation and financial performance. *Small Business Economics*, *51*(1), 221-244.

Mallin, M., & Susan, K. (2008). Salesforce automation tool selectivity: An agency theory perspective. *Journal of Business & Industrial Marketing*, *23*(7), 486-496.

Mansfield, E. (1968). *The Economics of Technological Change*, New York: Edward Elgar Publishing.

March, J., & Simon, H. (1958). *Organizations*, New York: McGraw-Hill.

Mason, E. (1939). Price and production policies of large-scale enterprise. *The American Economic Review*, *29*(1), 61-74.

McGrath, R., Tsai, M., Venkataraman, S., & MacMillan, I. (1996). Innovation, competitive advantage and rent: A model and test. *Management Science*, *42*(3), 389-403.

Melville, N., Kraemer, K., & Gurbaxani, V. (2004). Information technology and organizational performance: An integrative model of IT business value. *MIS Quarterly, 28*(2), 283-322.

Meyer, A. (1982). Adapting to environmental jolts. *Administrative Science Quarterly*, *27*(4), 515-537.

Miller, D., & Friesen, P. (1982). Innovation in conservative and entrepreneurial firms: Two models of strategic momentum. *Strategic Management Journal*, *3*(1), 1-25.

Miller, D., & Shamsie, J. (1996). The resource-based view of the firm in two environments: The Hollywood film studios from 1936 to 1965. *Academy of Management Journal, 39*(3), 519-543.

Milliken, F. (1987). Three types of perceived uncertainty about the environment: State, effect, and response uncertainty. *Academy of Management Review*, *12*(1), 133-143.

Ministry of Finance of China, Ministry of State Planning Commission of China, Ministry of State Economic of China, & Ministry of Trade Commission of China. (2003). *Notice on the Issue of Interim Provisions on Standards for Small and Medium-sized Enterprises*. Retrieved from http://www.miit.gov.cn/newweb/n973401/n973642/n973645/c3795013/content.html [November 2017].

Mone, M., McKinley, W., & Barker III, V. (1998). Organizational decline and innovation: A contingency framework. *Academy of Management Review*, *23*(1), 115-132.

Mukhopadhyay, T., Kekre, S., & Kalathur, S. (1995). Business value of information technology: A study of electronic data interchange. *MIS quarterly*, *19*(2), 137-156.

Mumford, M., & Gustafson, S. (1988). Creativity syndrome: Integration, application, and innovation. *Psychological Bulletin*, *103*(1), 27.

Nambisan, S. (2002). Designing virtual customer environments for new product development: Toward a theory. *Academy of Management Review*, *27*(3), 392-413.

Narayanan, S., Narasimhan, R., & Schoenherr, T. (2015). Assessing the contingent effects of collaboration on agility performance in buyer-supplier relationships. *Journal of Operations Management*, *33*, 140-154.

Neely, A., Adams, C., & Kennerley, M. (2002). *The Performance Prism: The Scorecard for Measuring and Managing Business Success*, London: Prentice Hall Financial Times.

Neely, A., Gregory, M., & Platts, K. (1995). Performance measurement system design: A literature review and research agenda. *International Journal of Operations & Production Management*, *15*(4), 80-116.

Neumann, S., & Fink, L. (2007). Gaining agility through IT personnel capabilities: The mediating role of IT infrastructure capabilities. *Journal of the Association for Information Systems*, *8*(8), 25.

Nunnally, J. (1978). *Psychometric Methods*, New York: McGraw-Hill.

OECD (1997). *Education at a Glance: OECD Indicators 1997*, Paris.

Overby, E., Bharadwaj, A., & Sambamurthy, V. (2005). A framework for enterprise agility and the enabling role of digital options. In *Proceedings of the IFIP International Working Conference on Business Agility and Information Technology Diffusion*. Springer, Boston, MA, 295-312.

Pavlou, P., & El Sawy, O. (2011). Understanding the elusive black box of dynamic capabilities. *Decision Sciences*, *42*(1), 239-273.

Penrose, E. (1959). *The Theory of the Growth of the Firm*, Oxford: Oxford University Press.

Peteraf, M. (1993). The cornerstones of competitive advantage: A resource‐based view. *Strategic Management Journal*, *14*(3), 179-191.

Porter, M. (1985). *Competitive Advantage: Creating and Sustaining Superior Performance*, New York: Free Press.

Powell, T. (2001). Competitive advantage: logical and philosophical considerations. *Strategic Management Journal*, *22*(9), 875-888.

Priem, R., & Butler, J. (2001). Is the resource-based "view" a useful perspective for strategic management research? *Academy of Management Review*, *26*(1), 22-40.

Radhakrishnan, A., Zu, X., & Grover, V. (2008). A process-oriented perspective on differential business value creation by information technology: An empirical investigation. *Omega - The International Journal of Management Science*, *36*(6), 1105-1125.

Reich, Y., Konda, S., Subrahmanian, E., Cunningham, D., Dutoit, A., Patrick, R., Westerberg, A. (1999). Building agility for developing agile design information systems. *Research in Engineering Design*, *11*(2), 67-83.

Robert, B., Modesto, M., & Steven, W. (2001). *Strategic Management of Technology and Innovation and Analysis*, Boston: McGraw-Hill/lrwin.

Roberts, N., & Grover, V. (2012). Leveraging information technology infrastructure to facilitate a firm's customer agility and competitive activity: An empirical investigation. *Journal of Management Information Systems*, *28*(4), 231-270.

Rosenbusch, N., Brinckmann, J., & Bausch, A. (2011). Is innovation always beneficial? A meta-analysis of the relationship between innovation and performance in SMEs. *Journal of Business Venturing*, *26*(4), 441-457.

Ross, J., Beath, C., & Goodhue, D. (1996). Develop long-term competitiveness through IT assets. *Sloan Management Review*, *38*(1), 31-42.

Rubin, A., & Babbie, E. (2000). *Research Methods for Social Work, 4th Ed.*, Pacific Grove, CA: Brooks/Cole.

Rubin, P. (1978). The economics of crime. *Atlanta Economic Review*, *28*(4), 38-43.

Russo, M., & Fouts, P. (1997). A resource-based perspective on corporate environmental performance and profitability. *Academy of Management Journal*, *40*(3), 534-559.

Sambamurthy, V., Bharadwaj, A., & Grover, V. (2003). Shaping agility through digital options: Reconceptualizing the role of information technology in contemporary firms. *MIS Quarterly*, *27*(2), 237-263.

Santhanam, R., & Hartono, E. (2003). Issues in linking information technology capability to firm performance. *MIS Quarterly*, *27*(1), 125-153.

Schumpeter, J. (1934). *The Theory of Economic Development*, Cambridge, MA: Harvard University Press.

Scott, S., & Bruce, R. (1994). Determinants of innovative behavior: A path model of individual innovation in the workplace. *Academy of Management Journal*, *37*(3), 580-607.

Shalley, C., Gilson, L., & Blum, T. (2000). Matching creativity requirements and the work environment: Effects on satisfaction and intentions to leave. *Academy of Management Journal*, *43*(2), 215-223.

Shalley, C., Zhou, J., & Oldham, G. (2004). The effects of personal and contextual characteristics on creativity: Where should we go from here? *Journal of Management, 30*(6), 933-958.

Sharfman, M., & Dean, J. (1991). Conceptualizing and measuring the organizational environment: A multidimensional approach. *Journal of management*, *17*(4), 681-700.

Sharifi, H., & Zhang, Z. (1999). A methodology for achieving agility in manufacturing organisations: An introduction. *International Journal of Production Economics, 62*(1/2), 7-22.

Sharifi, H., & Zhang, Z. (2001). Agile manufacturing in practice: Application of a methodology. *International Journal of Operations & Production Management*, *21*(5/6), 772-794.

Singh, S., Olugu, E., Musa, S., & Mahat, A. (2018). Fuzzy-based sustainability evaluation method for manufacturing SMEs using balanced scorecard framework. *Journal of Intelligent Manufacturing*, *29*(1), 1-18.

Smith, P., & Saint-Onge, H. (1996). The evolutionary organization: Avoiding a Titanic fate. *The Learning Organization*, *3*(4), 4-21.

Song, D., Yuan, Y., & Zhang, W. (2011). Strategic human resource management and innovation-oriented cross-level research on employees' innovative behavior. *Science and Management of Science and Technology*, *32*(1), 172-179.

Song, Y., & Lu, Z. (2013). A study of project organizational agility effect mechanism for complex product and system. *Management Review*, *25*(9), 29-39.

Stieglitz, N., Knudsen, T., & Becker, M. (2016). Adaptation and inertia in dynamic environments. *Strategic Management Journal*, *37*(9), 1854-1864.

Stoel, M., & Muhanna, W. (2009). IT capabilities and firm performance: A contingency analysis of the role of industry and IT capability type. *Information & Management*, *46*(3), 181-189.

Straub, D., & Watson, R. (2001). Research commentary: transformational issues in researching IS and net-enabled organizations. *Information Systems Research*, *12*(4), 337-345.

Su, J. (2014). *An Exploratory Research on the Driving Factors of Tech SME Technological Innovation*. Doctoral Dissertation, Nankai University.

Sui, Y., Yang, Y., & Wang, H. (2012). Innovation climate, innovation efficacy and team innovation: the moderating role of team leadership. *Journal of Psychology*, *44*(2), 237-248.

Sull, D. (2010). Competing through organizational agility. *Mckinsey Quarterly*, *1*(1), 48-56.

Sun, R., Shi, J., & Zhang, T. (2009). Empirical research on the relationship between leadership member exchange, team member exchange, organizational innovation climate and employee innovation behavior in Chinese enterprises. *Journal of Management Engineering*, *23*(4), 109-114.

Sundgren, M., Dimenas, E., Gustafsson, J., & Selart, M. (2005). Driver of organizational creativity: A path model of creative climate in pharmaceutical R&D. *R&D Management*, *35*(4), 359-374.

Sutton, J. (1999). Technology and market structure: Theory and history. *Review of Industrial Organization*, *15*(1), 89-92.

Swafford, P., Ghosh, S., & Murthy, N. (2006). The antecedents of supply chain agility of a firm: scale development and model testing. *Journal of Operations Management*, *24*(2), 170-188.

Swafford, P., Ghosh, S., & Murthy, N. (2008). Achieving supply chain agility through IT integration and flexibility. *International Journal of Production Economics*, *116*(2), 288-297.

Tallon, P. (2008). Inside the adaptive enterprise: an information technology capabilities perspective on business process agility. *Information Technology and Management*, *9*(1), 21-36.

Tallon, P., & Pinsonneault, A. (2011). Competing perspectives on the link between strategic information technology alignment and organizational agility: Insights from a mediation model. *MIS Quarterly*, *35*(2), 463-486.

Tan, J., & Litsschert, R. (1994). Environment-strategy relationship and its performance implications: An empirical study of the Chinese electronics industry. *Strategic Management Journal*, *15*(1), 1-20.

Teece, D. (2000). Strategies for managing knowledge assets: the role of firm structure and

industrial context. *Long Range Planning*, *33*(1), 35-54.

Teece, D. (2007). Explicating dynamic capabilities: the nature and micro foundations of (sustainable) enterprise performance. *Strategic Management Journal*, *28*(13), 1319-1350.

Teece, D., & Pisano, G. (1994). The dynamic capabilities of firms: An introduction. *Industrial and Corporate Change*, *3*(3), 537-556.

Teece, D., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, *18*(7), 509-533.

Thompson, J. (1967). *Organizations In Action*, New York: McGraw-Hill.

ThoughtWorks (2017). *China Enterprise Agile Implementation Survey in 2017: Summary and Reflection*. Retrieved from https://mp.weixin.qq.com/s/Ms7QXGWa5i3cnjS4ZpmmIg [November 2017].

Tsai, C., Horng, J., Liu, C., & Hu, D. (2015). Work environment and atmosphere: The role of organizational support in the creativity performance of tourism and hospitality organizations. *International Journal of Hospitality Management*, *46*, 26-35.

Tse, H., & Dasborough, M. (2008). A study of exchange and emotions in team member relationships. *Group & Organization Management*, *33*(2), 194-215.

Tseng, Y., & Lin, C. (2011). Enhancing enterprise agility by deploying agile drivers, capabilities and providers. *Information Sciences*, *181*(17), 3693-3708.

Tsourveloudis, N., & Valavanis, K. (2002). On the measurement of enterprise agility. *Journal of Intelligent and Robotic Systems*, *33*(3), 329-342.

Tushman, M., & O'Reilly III, C. (1996). Ambidextrous organizations: Managing evolutionary and revolutionary change. *California Management Review*, *38*(4), 8-29.

Vasconcelos, F., & Ramirez, R. (2011). Complexity in business environments. *Journal of Business Research*, *64*(3), 236-241.

Wade, M., & Hulland, J. (2004). The resource-based view and information systems research: Review, extension, and suggestions for future research. *MIS Quarterly*, *28*(1), 107-142.

Wang, C., & Ahmed, P. (2007). Dynamic capabilities: A review and research agenda. *International Journal of Management Reviews*, *9*(1), 31-51.

Wang, H. (2007). *Research on the Growth of Technology-based SMEs from the Perspective of Ecological Niche*. Doctoral Dissertation, University of Tianjin.

Wang, T. (2007). *Research on Organizational Change of Manufacturing Enterprises Based on Agility*. Doctoral Dissertation, Central South University.

Wei, J., & Xu, Q. (1996). Research on the relationship between enterprise technical ability and technological innovation ability. *Scientific Research Management*, *17*(1), 22-26.

Wei, J., Ying, Y., & Liu, Y. (2014). Research and development network decentralization, organizational learning order and innovation performance: A comparative case study. *Management World*, *2*, 137-151.

Weiss, J., & Swan, J. (2018). Introduction to the mini-track on IT and project management. In *Proceedings of the 51st Hawaii International Conference on System Sciences*.

Wernerfelt, B. (1984). A resource‐based view of the firm. *Strategic Management Journal*, *5*(2), 171-180.

Wheeler, B. (2002). NEBIC: A dynamic capabilities theory for assessing net-enablement. *Information Systems Research*, *13*(2), 125-146.

Williams, L., & Cockburn, A. (2003). Guest editors' introduction: Agile software development: It's about feedback and change. *Computer*, *36*(6), 39-43.

Willis, G. (2004). *Cognitive Interviewing: A Tool for Improving Questionnaire Design*, Thousand Oaks: Sage Publications.

Winter, S. (2003). Understanding dynamic capabilities. *Strategic Management Journal*, *24*(10), 991-995.

Woodman, R., Sawyer, J., & Griffin, R. (1993). Toward a theory of organizational creativity. *Academy of Management Review*, *18*(2), 293-321.

Wu, M. (2013). *Structural Equation Model: Amos Practice Advancement*, Chong Qing: Chong Qing University Press.

Wu, S., & Lu, C. (2012). The relationship between CRM, RM, and business performance: A study of the hotel industry in Taiwan. *International Journal of Hospitality Management*, *31*(1), 276-285.

Xie, L., Guan, X., & Catherine, M. (2015). The effect of individual and organizational factors on employee innovative behavior of travel service provider. *Tourism Tribune*, *2*, 79-89.

Xing, Y., & Zhou, J. (2000). On the management methods of high technology enterprises. *China's High and New Technology Enterprises*, *5*, 52-55.

Xu, M. (2009). Thoughts on the construction of policy-based financial system for Chinese SMEs. *Finance and Accounting Communications*, *11*, 29-30.

Xue, Y. (2007). *Analysis of the Influencing Factors of Individual Innovation: From the Perspective of Creative Personality, Leadership Style and Organizational Innovation Environment*. Doctoral Dissertation, Xiamen University.

Yin, R. (2003). *Case Study Research Design and Methods, 3rd Ed.,* Thousand Oaks: Sage Publications.

Yin, R. (2012). Research on the impact of performance appraisal goal orientation on employees' innovative behavior: the mediating role of innovative atmosphere. *Research on Science and Technology Management*, *32*(1), 126-130

Yusuf, Y., Gunasekaran, A., Adeleye, E., & Sivayoganathan, K. (2004). Agile supply chain capabilities: Determinants of competitive objectives. *European Journal of Operational Research*, *159*(2), 379-392.

Yusuf, Y., Sarhadi, M., & Gunasekaran, A. (1999). Agile manufacturing: The drivers, concepts and attributes. *International Journal of Production Economics*, *62*(1/2), 33-43.

Zaheer, A., & Zaheer, S. (1997). Catching the wave: Alertness, responsiveness, and market influence in global electronic networks. *Management Science*, *43*(11), 1493-1509.

Zahra, S., & George, G. (2002). Absorptive capability: A review, reconceptualization, and extension. *Academy of Management Review*, *27*(2), 185-203.

Zahra, S., Sapienza, H., & Davidsson, P. (2006). Entrepreneurship and dynamic capabilities: A review, model and research agenda. *Journal of Management Studies*, *43*(4), 917-955.

Zeng, F., Zheng, X., & Li, X. (2018). Research on the relationship between IT capability and enterprise sustainable development performance. *Scientific Research Management*, *39*(4), 92-101.

Zhang, H., & You, L. (2014). Summary of research on the influencing factors of organizational innovation climate. *Science and Technology Management Research*, *7*, 115-122.

Zhang, T. (2009). *Interaction Between Motivation Orientation and Innovation Climate on Employee Innovation Behavior*. Master Thesis, Shanghai Jiaotong University

Zheng, J., Jin, S., & Ma, G. (2009). Measurement of organizational innovation climate and its moderating effect on the relationship between employee innovation capability and innovation performance. *Journal of Psychology*, *41*(12), 1203-1214.

Zhou, H., & Li, H. (2007). The mechanism of information technology improving enterprise organizational agility. *East China Economy Management*, *17*(1), 77-79.

Zhu, K., & Kraemer, K. (2005). Post-adoption variations in usage and value of e-business by organizations: Cross-country evidence from the retail industry. *Information Systems Research*, *16*(1), 61-84.

Zhu, K., Kraemer, K., & Xu, S. (2006). The process of innovation assimilation by firms in

different countries: A technology diffusion perspective on e-business. *Management Science*, *52*(10), 1557-1576.

Zhu, Q. (2014). *Research on the Influence of Leader-member Exchange on Employees' Innovative Behavior*. Doctoral Dissertation, Southwest University of Finance and Economics.

Zhu, M., Billeter, D., & Inman, J. (2012). The double-edged sword of signaling effectiveness: When salient cues curb post purchase consumption. *Journal of Marketing Research*, *49*(1), 26-38.

Zollo, M., & Winter, S. (2002). Deliberate learning and the evolution of dynamic capabilities. *Organization Science*, *13*(3), 339-351.

Appendices

Appendix 1: Information of Company A and Company H

Section I: Progress of Projects of Company A in the First Stage

Table A1-1 *Progress of Projects of Company A in the First Stage*

Time	Total Number of Projects	Projects Completed	Projects Delayed	Projects Delayed (%)
2009	100	59	41	41.00%
2010	150	84	66	44.00%
Total	250	143	107	42.80%

Source: Author's Elaboration.

Section II: Performance Indicators of Company A in the First Stage

Table A1-2 *Performance Indicators of Company A in the First Stage*

Time	Projects Delayed (%)	Customer Satisfaction	Employee Turnover Rate	Growth Rate
2009	41.00%	67.00%	40.00%	15.00%
2010	44.00%	64.00%	30.00%	15.00%
Average	42.50%	65.50%	35.00%	15.00%

Company A chose not to provide exact numbers for customer satisfaction, employee turnover, and financial performance, providing approximate values instead.
Source: Author's Elaboration.

Section Ⅲ: Performance Indicators of Company H in the First Stage

Table A1-3 *Performance Indicators of Company H in the First Stage*

Time	Projects Delayed (%)	Customer Satisfaction	Employee Turnover Rate	Growth Rate
Annual Average (2012-2014)	44.02%	80.00%	30.00%	20.00%

Note 1: Company H chose not to provide exact numbers for customer satisfaction, employee turnover, and financial performance, providing approximate values instead.
Note 2: Since Company H did not provide specific data, the data in this table was estimated from comments made by relevant staff during interviews.
Source: Author's Elaboration.

SectionⅣ: Progress of Projects of Company A in the Second Stage

Table A1-4 *Progress of Projects of Company A in the Second Stage*

Time	Total Number of Projects	Projects Completed	Projects Delayed	Projects Delayed (%)
2011	180	120	60	33.33%
2012	200	140	60	30.00%
2013	240	186	54	22.50%
2014	250	181	69	27.60%
Total	870	627	243	27.93%

Source: Author's Elaboration.

Section Ⅴ: Performance Indicators of Company A in the Second Stage

Table A1-5 *Performance Indicators of Company A in the Second Stage*

Time	Projects Delayed (%)	Customer Satisfaction	Employee Turnover Rate	Growth Rate
2011	33.33%	70.00%	31.00%	19.80%
2012	30.10%	80.00%	26.00%	23.60%
2013	22.50%	82.00%	19.00%	28.80%
2014	27.60%	82.00%	18.00%	27.20%
Average	28.38%	78.50%	23.50%	24.85%

Source: Author's Elaboration.

Section Ⅵ: Completion of R&D Projects in Company H

Table A1-6 *Completion of R&D Projects in Company H*

Time	Planned Completion	Actual Completion	Completion Rate (%)
2012-2014	786	440	55.98%
2015-2017	954	848	88.89%

Source: Author's Elaboration.

Section Ⅶ: Performance Indicators of Company H in the Second Stage

Table A1-7 *Performance Indicators of Company H in the Second Stage*

Time	Projects Delayed (%)	Customer Satisfaction	Employee Turnover Rate	Growth Rate
Annual Average (2015-2017)	11.11%	95.00%	10.00%	40.00%

Source: Author's Elaboration.

APPENDIX 2: Comparison of Company A and Company H

Section I: Comparison of R&D Project Delay Rate for Companies A and H

Table A2-1 *Comparison of R&D Project Delay Rate for Companies A and H*

Factor	Indication	Conclusion and Prediction
Project Delay Rate	The degree of improvement of company H (32.91%) is greater than that of company A (14.12%). Different answers were given to the following questions: *"Can R&D personnel effectively implement different types and scopes of business?"* and *"Can the firm adequately coordinate changes to products of services?"*	The effect of agile management as implemented by company H is obviously better than that of company A. The differences in firm performance are mainly reflected in differences in project agility.

Source: Author's Elaboration.

Section II: Comparison of R&D Project Level for Companies A and H

Table A2-2 *Comparison of R&D Project Level for Companies A and H*

Factor	Indication	Conclusion and Prediction
Project Level	The average education level of employees in company H is higher than in company A. Employees are encouraged to apply new technology and new knowledge to solve problems. Company H is more encouraging of collaboration and communication within teams – its R&D department's innovation capability is higher than is the case for company A.	The innovation capability of enterprises' R&D departments' is the key factor affecting enterprise agility.

Source: Author's Elaboration.

Section Ⅲ: Comparison of Internal and External Factors for Companies A and H

Table A2-3 *Comparison of Internal and External Factors for Companies A and H*

Factor	Indication	Conclusion and Prediction
Internal Factors	The two companies have different sizes. The total number of employees of company A is about 200 by the end of 2014, and the total number of employees of company H is about 500 by the end of 2017. The operating income of the two enterprises is also significantly different. The operating income of company H is one order of magnitude greater than that of company A. In addition, the proportion of R&D personnel is also different between the two companies. The proportion of R&D personnel of company A is about 30%, while that of company H is over 40%. Lastly, the two enterprises offer different training and learning opportunities to employees, with company H tending to provide more such opportunities.	These factors may have an impact on the implementation of enterprise agile development, and may have different degrees of impact on firm performance.
External Factors	The two enterprises are in different industries, facing different task environments. They face different market environments. Company A is in an industry with greater market competition pressure and numerous competitors, while company H has opened up new market segments, thus facing less competition.	

Source: Author's Elaboration.

APPENDIX 3: Measurement Items of Main Variables

Section I: Measurement Items of Project Agility and Firm Performance

Table A3-1 *Measurement Items of Project Agility and Firm Performance*

Item Number	Item Content	Reference Sources
PA1	Employees of the company can effectively carry out different types and scope of business.	Cao and Dowlatshahi (2005); Tseng and Lin (2011); Aburub (2015); Song and Lu (2013).
PA2	The enterprise has the ability to operate effectively at different output levels while ensuring the quality of output.	
PA3	The company has the ability to respond effectively to changes in planned delivery time.	
PA4	The company can quickly detect changes in customer preferences.	
PA5	The company can make prompt decisions in response to price changes.	
PA6	The company can react quickly to competitors' competitive strategies.	
PA7	The relevant departments of the enterprise can properly coordinate service and/or product changes.	
FP1	After the implementation of agile development, the turnover and profit of the company increased.	Kaplan & Norton (1992); Wu and Lu (2012).
FP2	After the implementation of agile development, there has been an increase in customer satisfaction with the company's products or services.	
FP3	After the implementation of agile development, the company's products or services have enhanced customers' willingness to consume.	
FP4	After the implementation of agile development, the company's decision-making is faster and more accurate.	
FP5	After the implementation of agile development, employees' problem-solving abilities improved.	
FP6	After the implementation of agile development, employees' learning and innovation abilities have improved.	

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.

Source: Author's Elaboration.

Section II: Measurement Items of Innovation Capability, Innovation Atmosphere and Environmental Dynamics

Table A3-2 *Measurement Items of Innovation Capability, Innovation Atmosphere and Environmental Dynamics*

Item Number	Item Content	Reference Sources
IC1	The company encourages employees to apply new technologies and knowledge.	Luo & Liu, (2009); Cui, (2012).
IC2	The company can effectively promote the promotion and application of new technologies.	
IC3	The R&D personnel of the company have strong abilities in technology development.	
IC4	It is easy for the enterprise to obtain the resources needed for innovation (such as funds, talents, and so forth.) from outside.	
IC5	Schemes implemented by the enterprise are based on the viewpoints of many members, and each scheme is globally inspected before final decisions are made.	
IC6	The company has a good innovation culture and environment.	
IA1	My job is very challenging.	Anderson and West (1998).
IA2	At work, my colleagues support and assist each other.	
IA3	My supervisor is a good example of innovation. He or she encourages his or her subordinates to come up with solutions to improve production or services.	
IA4	Our company appreciates and recognizes innovative employees.	
IA5	I have sufficient resources and time to realize my new ideas.	
ED1	Technological changes are very rapid in the company's industry.	Jaworski and Kohli (1993).
ED2	Industrial technology change provides several opportunities for the development of the whole industry.	
ED3	In the company's market, customers are willing to accept new product ideas.	
ED4	In the company's market, customers' product preference changes very quickly.	

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.

Source: Author's Elaboration.

APPENDIX 4: Questionnaire on Agile Management of Small and Medium-Sized Science and Technology Enterprises

Thank you for participating in this important research. Questionnaires are anonymous and confidential. There is no right or wrong choice. The quality of research results depends on your answers. Please give your answers according to your own actual situation. This questionnaire is only for scientific research. The information and contents you fill in will be kept strictly confidential. In order to thank you for your participation, we will give you feedback on the research results as necessary.

Note 1: Please fill in your basic information on the underline and underline the appropriate options with "√".

Note 2: The related concepts of agile development (management) in this questionnaire mainly refer to the relevant programs or tools used by enterprises in the development of new products (projects). The main characteristics are fast iteration, periodicity, and timely and continuous response to frequent customer feedback.

Section I: Basic Personal Information

1. Gender: A: Male; B: Female.
2. You have the following number of years of work experience: A: Up to 1 year; B: [1-3] years; C:]3-5] years; D:]5-10] years; E: More than 10 years.
3. Your educational background: A: Postgraduate and above; B: Undergraduate; C: Higher Vocational College; D: Other (Please specify: _____).
4. Your current position is in: A: Marketing or Sales; B: Technology or R&D; C: Production or Manufacturing; D: Finance; E: Administration; F: Others (Please specify:_____).
5. Your current position is: A: Top Manager; B: Middle Manager; C: Team Manager; D: Others.

6. The extent to which agile development (management) has been implemented in the enterprises you have worked for: A: Not at all; B: Little; C: Average; D: High; E: Extensively.
7. The extent to which you are involved in agile development (management): A: Not at all; B: Little; C: Average; D: High; E: Extensively.

Section II: Basic Enterprise Information

1. Years of establishment of your company: A: Less than one year; B: [1-3] years; C:]3-5] years; D:]5-10] years; E: More than 10 years.
2. The industry of your company is: A: Information technology; B: Internet; C: Communication; D: Transportation; E: Aerospace; F: Finance; G: Energy; H: Military Industry; I: Education; J: Others (please specify: _____).
3. Ownership of your company: A: State-owned or state-controlled; B: Private or private-controlled; C: Foreign-owned; D: Owned or controlled by Hong Kong, Macao or Taiwan; E: Others (please specify: _____).
4. The proportion of employees with bachelor's degree or above in your enterprise: A: Below 20%; B: [20%–40%]; C:]40%–60%]; D:]60%–80%]; E: More than 80%.
5. The proportion of employees engaged in research and development activities in your enterprise among all employees: A: Less than 10%; B: [10%–20%]; C:]20%–30%]; D:]30%–50%]; E: More than 50%.
6. Annual business revenue of your company: A: Less than 5 million CNY; B: [5–10] million CNY; C:]10–50] million CNY; D:]50–100] million CNY; E: More than 100 million CNY.
7. Training and learning opportunities for employees provided by your company: A: Very Few; B: Few; C: Average; D: Many; E: Very Many.

Section Ⅲ: Agile Management Related Items

Explanation: Each question in this section is divided into five levels. Adhering to the principle of objectivity and impartiality, please mark it

according to your company's current situation.

Scene 1: PA (Project agility)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
PA1 Employees of the company can effectively carry out different types and scope of business.	1	2	3	4	5
PA2 The enterprise has the ability to operate effectively at different output levels while ensuring the quality of output.	1	2	3	4	5
PA3 The company has the ability to respond effectively to changes in planned delivery time.	1	2	3	4	5
PA4 The company can quickly detect changes in customer preferences.	1	2	3	4	5
PA5 The company can make prompt decisions in response to price changes.	1	2	3	4	5
PA6 The company can react quickly to competitors' competitive strategies.	1	2	3	4	5
PA7 The relevant departments of the enterprise can properly coordinate service and/or product changes.	1	2	3	4	5

Scene 2: IC (Innovation Capability)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
IC1 The company encourages employees to apply new technologies and knowledge.	1	2	3	4	5
IC2 The company can effectively promote the promotion and application of new technologies.	1	2	3	4	5
IC3 The research and development personnel of the company have strong abilities in technology development.	1	2	3	4	5
IC4 It is easy for the enterprise to obtain the resources needed for innovation (such as funds, talents, and so forth.) from outside.	1	2	3	4	5
IC5 Schemes implemented by the enterprise are based on the viewpoints of many members, and each scheme is globally inspected before final decisions are made.	1	2	3	4	5
IC6 The company has a good innovation culture and environment.	1	2	3	4	5

Scene 3: FP (Firm Performance)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
FP1 After the implementation of agile development, the turnover and profit of the company increased.	1	2	3	4	5
FP2 After the implementation of agile development, there has been an increase in customer satisfaction with the company's products or services.	1	2	3	4	5
FP3 After the implementation of agile development, the company's products or services have enhanced customers' willingness to consume.	1	2	3	4	5
FP4 After the implementation of agile development, the company's decision-making is faster and more accurate.	1	2	3	4	5
FP5 After the implementation of agile development, employees' problem-solving abilities improved.	1	2	3	4	5
FP6 After the implementation of agile development, employees' learning and innovation abilities have improved.	1	2	3	4	5

Scene 4: ED (Environmental dynamics)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
ED1 Technological changes are very rapid in the company's industry.	1	2	3	4	5
ED2 Industrial technology change provides several opportunities for the development of the whole industry.	1	2	3	4	5
ED3 In the company's market, customers are willing to accept new product ideas.	1	2	3	4	5
ED4 In the company's market, customers' product preference changes very quickly.	1	2	3	4	5

Scene 5: IA (Innovation Atmosphere)	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
IA1 My job is very challenging.	1	2	3	4	5
IA2 At work, my colleagues support and assist each other.	1	2	3	4	5
IA3 My supervisor is a good example of innovation. He or she encourages his or her subordinates to come up with solutions to improve production or services.	1	2	3	4	5
IA4 Our company appreciates and recognizes innovative employees.	1	2	3	4	5
IA5 I have sufficient resources and time to realize my new ideas.	1	2	3	4	5

APPENDIX 5: Data Information of Questionnaires

Section I: Description of the Distribution and Collection of Questionnaires

Table A5-1 *Description of the Distribution and Collection of Questionnaires*

Questionnaire Channels	Distributed Questionnaires	Responses Collected	Rate of Recovery	Valid Responses	Rate of Valid Responses
Network completion	419	194	46.30%	168	86.60%
On-site distribution	240	182	75.83%	74	40.66%
Total	659	376	57.06%	242	64.36%

Rate of Recovery = Responses Collected / Distributed Questionnaires; Effectiveness = Rate of Valid Responses = Valid Responses / Responses Collected.
Source: Author's Elaboration.

Section II: Sample Data from Different Sources

Table A5-2 *Sample Data from Different Sources*

Group	Data Sources	Source Description	Sample Size	Subtotal
First Group	Online	Recommendations by friends, acquaintances, and so forth.	168	168
Second Group	On-site	Visits to firms and depositing questionnaires with the management of science and technology parks, and so forth.	74	74
Total			242	242

Source: Author's Elaboration.

Section Ⅲ: Descriptive Statistical Analysis Table of Key Variables (N=242)

Table A5-3 *Descriptive Statistical Analysis Table of Key Variables (N=242)*

Main variables Studied	Number of Samples	Min	Max	Mean	Standard Deviation
Firm performance	242	1	5	3.41	0.88
Project Agility	242	1	5	3.57	0.82
Innovation Capability	242	1	5	3.61	0.85
Innovation Atmosphere	242	1	5	3.72	0.82
Environmental Dynamics	242	1	5	3.48	0.90
Employee Training and Learning	242	1	5	3.30	1.14

Source: Author's Elaboration.

APPENDIX 6: KMO Test and Bartlett Sphericity Test of Main Variables

Table A6-1 *KMO Test and Bartlett Sphericity Test of Main Variables*

Items	FP	IC	PA	IA	ED
Kaiser-Meyer-Olkin sampling adequacy test	0.863	0.859	0.903	0.838	0.839
Bartlett sphericity test approx. chi-square	144.597	838.711	1052.268	620.424	519.579
Degrees of freedom (df)	15	15	21	10	6
Significance (Sig)	0.000	0.000	0.000	0.000	0.000

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.
Source: Author's Elaboration.

APPENDIX 7: Exploratory Factor Analysis of Main Variables (N=242)

Section I: Exploratory Factor Analysis of Firm Performance and Innovation Capability (N=242)

Table A7-1 *Exploratory Factor Analysis of Firm Performance and Innovation Capability (N=242)*

Title Number	Item	Factor Loading
FP1	After the implementation of agile development, the turnover and profit of the company increased.	0.882
FP2	After the implementation of agile development, there has been an increase in customer satisfaction with the company's products or services.	0.930
FP3	After the implementation of agile development, the company's products or services have enhanced customers' willingness to consume.	0.992
FP4	After the implementation of agile development, the company's decision-making is faster and more accurate.	0.829
FP5	After the implementation of agile development, employees' problem-solving abilities improved.	0.842
FP6	After the implementation of agile development, employees' learning and innovation abilities have improved.	0.914
IC1	The company encourages employees to apply new technologies and knowledge.	0.814
IC2	The company can effectively promote the promotion and application of new technologies.	0.845
IC3	The R&D personnel of the company have strong abilities in technology development.	0.827
IC4	It is easy for the enterprise to obtain the resources needed for innovation (such as funds, talents, and so forth.) from outside.	0.754
IC5	Schemes implemented by the enterprise are based on the viewpoints of many members, and each scheme is globally inspected before final decisions are made.	0.775
IC6	The company has a good innovation culture and environment.	0.874

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.

Source: Author's Elaboration.

Section II: Exploratory Factor Analysis of Project Agility, Innovation Atmosphere and Environmental Dynamics (N=242)

Table A7-2 *Exploratory Factor Analysis of Project Agility, Innovation Atmosphere and Environmental Dynamics (N=242)*

Title Number	Item	Factor Loading
PA1	Employees of the company can effectively carry out different types and scope of business.	0.774
PA2	The enterprise has the ability to operate effectively at different output levels while ensuring the quality of output.	0.842
PA3	The company has the ability to respond effectively to changes in planned delivery time.	0.809
PA4	The company can quickly detect changes in customer preferences.	0.805
PA5	The company can make prompt decisions in response to price changes.	0.787
PA6	The company can react quickly to competitors' competitive strategies.	0.833
PA7	The relevant departments of the enterprise can properly coordinate service and/or product changes.	0.842
IA1	My job is very challenging.	0.756
IA2	At work, my colleagues support and assist each other.	0.859
IA3	My supervisor is a good example of innovation. He or she encourages his or her subordinates to come up with solutions to improve production or services.	0.867
IA4	Our company appreciates and recognizes innovative employees.	0.856
IA5	I have sufficient resources and time to realize my new ideas.	0.754
ED1	Technological changes are very rapid in the company's industry.	0.855
ED2	Industrial technology change provides several opportunities for the development of the whole industry.	0.863
ED3	In the company's market, customers are willing to accept new product ideas.	0.889
ED4	In the company's market, customers' product preference changes very quickly.	0.846

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.

Source: Author's Elaboration.

APPENDIX 8: Reliability Test of Main Variables (N=242)

Section I: Reliability Test of Firm Performance and Innovation Capability (N=242)

Table A8-1 *Reliability Test of Firm Performance and Innovation Capability (N=242)*

Variables	Items (Abbreviation)	Item-Total Correlation	Cronbach's α After Deleting the Item	Cronbach's α
Firm Performance	FP1	0.825	0.936	0.945
	FP2	0.895	0.927	
	FP3	0.882	0.929	
	FP4	0.757	0.944	
	FP5	0.733	0.942	
	FP6	0.872	0.931	
Innovation Capability	IC1	0.718	0.881	0.899
	IC2	0.764	0.874	
	IC3	0.741	0.877	
	IC4	0.649	0.891	
	IC5	0.672	0.888	
	IC6	0.807	0.867	

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.
Source: Author's Elaboration.

Section II: Reliability Test of Project Agility, Innovation Atmosphere and Environmental Dynamics (N=242)

Table A8-2 *Reliability Test of Project Agility, Innovation Atmosphere and Environmental Dynamics (N=242)*

Variables	Items (Abbreviation)	Item-Total Correlation	Cronbach's α After Deleting the Item	Cronbach's α
Project Agility	PA1	0.689	0.906	0.915
	PA2	0.774	0.898	
	PA3	0.732	0.902	
	PA4	0.731	0.902	
	PA5	0.705	0.905	
	PA6	0.764	0.898	
	PA7	0.775	0.897	
Innovation Atmosphere	IA1	0.619	0.867	0.877
	IA2	0.763	0.836	
	IA3	0.777	0.830	
	IA4	0.756	0.834	
	IA5	0.673	0.870	
Environmental Dynamics	ED1	0.738	0.858	0.886
	ED2	0.750	0.854	
	ED3	0.790	0.838	
	ED4	0.625	0.863	

PA=Project Agility. FP=Firm Performance. IC=Innovation Capability. IA=Innovation Atmosphere. ED=Environmental Dynamics.
Source: Author's Elaboration.

APPENDIX 9: Regression Result of Moderating Variables

Section I: Regression Result of Innovation Atmosphere as Moderating Variable 1 with Firm Performance as Dependent Variable

Table A9-1 *Regression Result of Innovation Atmosphere as Moderating Variable 1 with Firm Performance as Dependent Variable*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	-2.489	0.374		-6.651	1.000	
Annual Operating Income	0.006	0.061	0.005	0.093	0.926	1.122
Percentage of Bachelor's Degrees Among the Staff	0.126	0.071	0.125	1.775	0.077	1.520
Percentage of R&D Personnel	-0.064	0.068	-0.063	-0.932	0.352	1.415
Employee Training and Learning	-0.071	0.072	-0.068	-0.987	0.325	1.552
Innovation Capability	0.259	0.096	0.228	2.699	0.007	2.033
Innovation Atmosphere	0.402	0.104	0.318	3.855	0.000	2.224
Std. Innovation Atmosphere | Innovation Capability	0.086	0.045	0.123	1.927	0.045	1.234
R^2 change			0.012			
F change			3.593			

DW = 2.115, F value is significant at the level of significance of 0.05; FP=Firm Performance.

Source: Author's Elaboration.

Section II: Regression Result of Innovation Atmosphere as Moderating Variable 2 with Project Agility as Dependent Variable

Table A9-2 *Regression Result of Innovation Atmosphere as Moderating Variable 2 with Project Agility as Dependent Variable*

Variables	Project Agility					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	Beta	Std. Error	Beta			
Constant	0.458	0.261		-12.691	0.000	
Annual Operating Income	0.010	0.042	0.019	0.447	0.655	1.122
Percentage of Bachelor's Degrees Among the Staff	0.029	0.049	0.042	0.860	0.391	1.520
Percentage of R&D Personnel	-0.001	0.048	-0.002	-0.037	0.970	1.415
Employee Training and Learning	0.080	0.050	0.112	2.237	0.026	1.552
Innovation Capability	0.371	0.067	0.389	6.806	0.000	2.033
Innovation Atmosphere	0.369	0.073	0.371	6.211	0.000	2.224
Std. Innovation Atmosphere | Innovation Capability	-0.014	0.031	-0.023	-0.519	0.604	1.234
R^2 change			0.000			
F change			0.279			

DW = 1.824, F value is not significant; FP=Firm Performance.

Source: Author's Elaboration.

Section Ⅲ: Regression Result of Environmental Dynamics as Moderating Variable

Table A9-3 *Regression Result of Environmental Dynamics as Moderating Variable*

Variables	Firm Performance					
	Non-standardization Coefficient		Standardization Coefficient	T value	Sig.	VIF
	B	Std. Error	Beta			
Constant	1.261	0.059		-0.872	0.384	
Annual Operating Income	-0.001	0.059	-0.003	-0.052	0.959	1.123
Percentage of Bachelor's Degrees Among the Staff	0.088	0.068	0.122	1.781	0.076	1.502
Percentage of R&D Personnel	-0.031	0.066	-0.052	-0.782	0.435	1.398
Employee Training and Learning	-0.054	0.069	-0.069	-0.995	0.321	1.537
Project Agility	0.569	0.072	0.524	7.281	0.000	1.667
Environmental Dynamics	0.007	0.065	0.009	0.130	0.896	1.372
Std. Project Agility | Environmental Dynamics	0.091	0.041	0.147	2.519	0.012	1.091
R^2 change			0.020			
F change			6.374			

DW = 2.230, F value is significant at the level of significance of 0.05.

Source: Author's Elaboration.