

**INVESTIGATING THE DRIVING FACTORS FOR
SUSTAINABLE PERFORMANCE IN CHINESE
TECHNOLOGY-BASED SMEs: THE MEDIATING
ROLE OF GREEN INNOVATION**

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by

CAO SHANSHAN

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TABLE OF CONTENTS

ACKNOWLEDGEMENT	ii
TABLE OF CONTENTS	iv
LIST OF TABLES	xiii
LIST OF FIGURES	xv
LIST OF ABBREVIATIONS	xvi
LIST OF APPENDICES	xvii
ABSTRAK	xviii
ABSTRACT	xx
CHAPTER 1 INTRODUCTION	1
1.1 Introduction	1
1.2 Background of the study	2
1.2.1 The background of Chinese SMEs	4
1.2.2 The background of Chinese technology-based SMEs	8
1.2.3 Three Spheres of Sustainability Drivers	13
1.3 Preliminary Study	15
1.3.1 Findings of Preliminary Study	16
1.3.2 Implication of Preliminary Study	18
1.4 Problem Statement	19
1.5 Research Objectives	24
1.6 Research questions	25
1.7 Significance of the Study	26
1.7.1 Practical Significance	27
1.7.2 Theoretical Significance	28
1.8 Scope of the Study	31

1.9	Definition of Key Terms	32
1.10	Organization of the Study Chapters	34
1.11	Summary	35
CHAPTER 2	LITERATURE REVIEW	36
2.1	Introduction	36
2.2	Chinese Technology-based SMEs	37
2.2.1	Definition of Chinese Technology-based SMEs	37
2.2.2	Characteristics of Chinese Technology-based SMEs	38
2.3	Sustainability	39
2.3.1	Sustainable development	39
2.3.2	Sustainability in China	43
2.4	Sustainable Performance	48
2.4.1	Economic Performance	52
2.4.2	Environmental Performance	54
2.4.3	Social Performance	56
2.5	Green Innovation Strategy	58
2.6	Green Intellectual Capital	64
2.6.1	Green human capital	70
2.6.2	Green relational capital	71
2.6.3	Green structural capital	73
2.7	Green human resource management	75
2.8	Green innovation	78
2.9	Theoretical Foundation	82
2.9.1	Natural-Resource-Based View (NRBV Theory)	82
2.9.2	Diffusion of Eco-innovations Theory (DOEI)	87
2.10	Literature gap	89
2.11	Research Framework	92

2.12	Hypothesis development	95
2.12.1	Linking Green Innovation Strategy and Green Innovation	95
2.12.2	Linking Green Human Capital and Green Innovation	98
2.12.3	Linking Green Relational Capital and Green Innovation	99
2.12.4	Linking Green Structural Capital and Green Innovation	101
2.12.5	Linking Green Human Resource Management and Green Innovation	103
2.12.6	Linking Green Innovation and Sustainable Performance	105
2.12.6(a)	Linking Green Innovation and Economic Performance	105
2.12.6(b)	Linking Green Innovation and Environmental Performance	106
2.12.6(c)	Linking Green Innovation and Social Performance	108
2.12.7	Green Innovation as Mediator between Green Innovation Strategy and Sustainable Performance	110
2.12.8	Green Innovation as Mediator between Green Intellectual Capital and Sustainable Performance	113
2.12.8(a)	Green Innovation as Mediator between Green Human Capital and Sustainable Performance	114
2.12.8(b)	Green Innovation as Mediator between Green Relational Capital and Sustainable Performance	118
2.12.8(c)	Green Innovation as Mediator between Green Structural Capital and Sustainable Performance	122
2.12.9	Green Innovation as Mediator between Green Human Resource Management and Sustainable Performance	125
2.13	Summary	129
CHAPTER 3 RESEARCH METHODOLOGY		130
3.1	Introduction	130
3.2	Research Design	130
3.2.1	Research Design	130
3.2.2	Research Philosophy	131

3.3	Population, Sampling Frame and Unit of Analysis	132
3.3.1	Population	132
3.3.2	Sampling Frame	134
3.3.3	Unit of Analysis	137
3.4	Sample Size	138
3.5	Questionnaire Development Processes	139
3.5.1	Questionnaire Translation	141
3.5.2	Adapted Measurement Items	142
3.5.2(a)	Measurement of Green Innovation Strategy	142
3.5.2(b)	Measurement of Green Intellectual Capital	143
3.5.2(c)	Measurement of Green Human Resource Management	146
3.5.2(d)	Measurement of Green Innovation	148
3.5.2(e)	Measurement of Sustainable Performance	149
3.5.2(f)	Measurement of Marker Variable	151
3.6	Pre-test	152
3.7	Pilot Test	153
3.8	Data Collection Procedures	154
3.9	Data Analysis Technique	155
3.9.1	SPSS for Data Analysis	155
3.9.2	PLS-SEM Method	156
3.9.3	Assessment for Survey Bias	158
3.9.3(a)	Common Method Variance (CMV)	158
3.9.3(b)	Response Bias	159
3.10	Measurement Model Analysis	160
3.10.1	Reliability	160
3.10.2	Validity	160

3.10.2(a)	Content Validity	161
3.10.2(b)	Construct Validity	161
3.10.2(c)	Convergent Validity	162
3.10.2(d)	Discriminant Validity	162
3.11	Assessment of Structural Model	162
3.11.1	Explained Variance (R^2)	163
3.11.2	Effect Size (f^2)	163
3.11.3	Predictive Relevance (Q^2)	164
3.11.4	PLS Predict	164
3.11.5	Bootstrapping	165
3.11.5(a)	Descriptive Statistics	166
3.11.5(b)	Assessment of Mediation Relationship	166
3.12	Summary	167
CHAPTER 4 DATA ANALYSIS		168
4.1	Introduction	168
4.2	Data Screening	168
4.2.1	Testing for Errors	169
4.2.2	Missing Values	169
4.2.3	Identifying Outliers	170
4.2.4	Normality of Data	170
4.3	Descriptive Analysis	171
4.3.1	Response Rate	172
4.3.2	Demographic Characteristics of Respondents	172
4.3.3	Mean and Standard Deviation of the Study Variables	175
4.4	Control Variables	175
4.5	The Assessment of Common Method Variance	177
4.5.1	Harmon's single factor test	177

4.5.2	Marker Variable Technique	178
4.5.3	Full Collinearity Technique	180
4.6	Assessment of Reflective Measurement Model	181
4.6.1	Assessing Indicator Reliability (Outer Loadings)	182
4.6.2	Assessing Internal Consistency	182
4.6.3	Convergent Validity	183
4.6.4	Discriminant Validity	185
4.7	Assessment of Structural Model	187
4.7.1	Path Coefficient and Hypotheses Testing	187
4.7.2	Explained Variance (R^2)	191
4.7.3	Assessment of Effect Size (f^2)	192
4.7.4	Predictive Relevance (Q^2)	193
4.7.5	PLS Predict	193
4.7.6	Assessing the Mediating Effect	195
4.7.7	The Results of Hypothesis Testing	198
4.8	Summary	204
CHAPTER 5 FINDINGS AND DISCUSSIONS		205
5.1	Introduction	205
5.2	Recapitulation of Findings	205
5.3	Findings on the Direct Relationship	210
5.3.1	The Relationship between Green Innovation Strategy and Green Innovation	211
5.3.2	The Relationship between Green Intellectual Capital and Green Innovation	212
5.3.2(a)	The Relationship between Green Human Capital and Green Innovation	213
5.3.2(b)	The Relationship between Green Relational Capital and Green Innovation	214

5.3.2(c)	The Relationship between Green structural Capital and Green Innovation	216
5.3.3	The Relationship between Green Human Resource Management and Green Innovation	217
5.3.4	The Relationship between Green Innovation and Sustainable performance	218
5.3.4(a)	The Relationship between Green Innovation and Economic Performance	219
5.3.4(b)	The Relationship between Green Innovation and Environmental Performance	220
5.3.4(c)	The Relationship between Green Innovation and Social Performance	222
5.4	Findings on the Indirect Relationship	223
5.4.1	The Mediating Role of Green Innovation between Green Innovation Strategy and Sustainable Performance	223
5.4.1(a)	The Mediating Role of Green Innovation between Green Innovation Strategy and Economic Performance	224
5.4.1(b)	The Mediating Role of Green Innovation between Green Innovation Strategy and Environmental Performance	225
5.4.1(c)	The Mediating Role of Green Innovation between Green Innovation Strategy and Social Performance	226
5.4.2	The Mediating Role of Green Innovation between Green Intellectual Capital and Sustainable Performance	227
5.4.2(a)	The Mediating Role of Green Innovation between Green Human Capital and Economic Performance	228
5.4.2(b)	The Mediating Role of Green Innovation between Green Human Capital and Environmental Performance	229
5.4.2(c)	The Mediating Role of Green Innovation between Green Human Capital and Social Performance	230
5.4.2(d)	The Mediating Role of Green Innovation between Green Relational Capital and Economic Performance	231

5.4.2(e)	The Mediating Role of Green Innovation between Green Relational Capital and Environmental Performance	233
5.4.2(f)	The Mediating Role of Green Innovation between Green Relational Capital and Social Performance	234
5.4.2(g)	The Mediating Role of Green Innovation between Green Structural Capital and Economic Performance	235
5.4.2(h)	The Mediating Role of Green Innovation between Green Structural Capital and Environmental Performance	237
5.4.2(i)	The Mediating Role of Green Innovation between Green Structural Capital and Social Performance	238
5.4.3	The Mediating Role of Green Innovation between Green Human Resource Management and Sustainable Performance	239
5.4.3(a)	The Mediating Role of Green Innovation between Green Human Resource Management and Economic Performance	240
5.4.3(b)	The Mediating Role of Green Innovation between Green Human Resource Management and Environmental Performance	241
5.4.3(c)	The Mediating Role of Green Innovation between Green Human Resource Management and Social Performance	242
5.5	The Study Contributions	244
5.5.1	Practical contributions	244
5.5.1(a)	Effect of Strategic Level Factor (Green Innovation Strategy)	244
5.5.1(b)	Effect of Resources Level Factor (Green Intellectual Capital)	245
5.5.1(c)	Effect of Management Level Factor (Green Human Resource Management)	246
5.5.1(d)	The Quest for Sustainable Performance starts with Green Innovation	248
5.5.2	Theoretical Contributions	249
5.6	Limitations of the Research	253

5.7	Suggestions for Future Research	254
5.8	Summary of the Chapter	256
REFERENCES		258
APPENDICES		
LIST OF PUBLICATIONS		

LIST OF TABLES

	Page
Table 1.1	Sector classification standards for Chinese SMEs5
Table 2.1	Definition criteria for Chinese Technology-based SMEs38
Table 2.2	The dimensions of sustainable performance51
Table 2.3	Related definitions of green innovation strategy 62
Table 2.4	The main findings of Green Intellectual Capital67
Table 3.1	Selection criteria for technology-based SMEs133
Table 3.2	Number of Chinese technology-based SMEs in Henan Province by Size (the ninth batch of list, 2023) 137
Table 3.3	Summary of Questionnaire Design 141
Table 3.4	Measurement Items for Green Innovation Strategy143
Table 3.5	Measurement Items for Green Human Capital 144
Table 3.6	Measurement Items for Green Relational Capital 145
Table 3.7	Measurement Items for Green Structural Capital 146
Table 3.8	Measurement Items for Green Human Resource Management 147
Table 3.9	Measurement Items for Green Innovation 148
Table 3.10	Measurement Items for Economic Performance150
Table 3.11	Measurement Items for Environmental performance 150
Table 3.12	Measurement Items for Social performance 151
Table 3.13	Measurement Items for cognitive rigidity151
Table 3.14	Results of Pilot Test 154
Table 3.15	Summary of Evaluation Summary for Structural Model 165
Table 4.1	Descriptive Frequency Analysis 169
Table 4.2	Normality of Data 171

Table 4.3	Response Rate	172
Table 4.4	Demographic Characteristics of Respondents	173
Table 4.5	Mean and Standard Deviation	175
Table 4.6	Control Variables and Dependent Variables	176
Table 4.7	Comparison of Path coefficient (β) between the baseline model and marker included the model	179
Table 4.8	Comparison of R^2 Value between the baseline model and marker included the model.	179
Table 4.9	Assessment of Full Collinearity	180
Table 4.10	The Results of Measurement Model	183
Table 4.11	Discriminant Validity (HTMT)	186
Table 4.12	Discriminant Validity (Fornell -Larcker)	187
Table 4.13	Path Coefficient and Hypothesis Testing of Direct Relationship	189
Table 4.14	Coefficient of Determination (R^2)	191
Table 4.15	The Effect Size of Variables	192
Table 4.16	The Predictive Relevancy of Endogenous Variables	193
Table 4.17	The Result of PLS Predict	194
Table 4.18	Assessment of Structural Model (Indirect Relationship)	197
Table 4.19	The summary of the Hypotheses Tested	203

LIST OF FIGURES

		Page
Figure 1.1	Composition of tax revenue by size	6
Figure 1.2	Number of urban employments by size	6
Figure 1.3	The number of Chinese enterprises by size	7
Figure 1.4	The number of Chinese technology-based SMEs	9
Figure 1.5	The number of Chinese technology-based SMES by province (January-June 2023)	10
Figure 1.6	The main industries of Chinese technology-based SMEs	11
Figure 2.1	Research Framework	95
Figure 3.1	The result of G-power analysis	139
Figure 4.1	The outcomes of measurement model	190
Figure 4.2	The Bootstrapping Results	198

LIST OF ABBREVIATIONS

GIS	Green Innovation Strategy
GIC	Green Intellectual Capital
GHC	Green Human Capital
GRC	Green Relational Capital
GSC	Green Structural Capital
GHRM	Green Human Resource Management
GAD	Green Analysis and Description of Job Position
GRD	Green Recruitment
GSD	Green Selection
GTD	Green Training
GPA	Green Performance Assessment
GED	Green Rewards
GI	Green Innovation
EP	Economic Performance
ENP	Environmental Performance
SP	Social Performance
GPI	Green Product Innovation
GRI	Green Process Innovation
USM	Universiti Sains Malaysia

LIST OF APPENDICES

Appendix A	Cover Letter
Appendix B	Questionnaires (English)
Appendix C	Questionnaires (Chinese)
Appendix D	The main findings of Green Human Resource Management
Appendix E	The main findings of Green Innovation
Appendix F	The result of the control variable measurement model
Appendix G	The result of collinearity diagnostics

**MENYELIDIK FAKTOR-FAKTOR PENGGERAK UNTUK PRESTASI
LESTARI DALAM PKS BERASASKAN TEKNOLOGI DI CHINA:
PERANAN PERANTARA INOVASI HIJAU**

ABSTRAK

Sebagai tindak balas kepada krisis ekonomi, alam sekitar, dan sosial global, perniagaan sedang mencari cara yang berkesan dan cekap untuk meminimumkan kesan yang ketara. Walaupun pelbagai asas teori menyerlahkan kepentingan kemampanan, prestasi mampan PKS berasaskan teknologi masih kurang diterokai. Oleh itu, penyelidikan ini bertujuan untuk mengkaji pemacu dan pemacu dan hasil daripada amalan mampan yang bertujuan mengurangkan krisis ekonomi untuk mengurangkan krisis ekonomi, kemerosotan alam sekitar dan ketidakadilan sosial. Khususnya, faktor peringkat strategik, (strategi inovasi hijau), sumber, (modal intelektual hijau), dan pengurusan (pengurusan sumber manusia hijau) didapati mampu memacu inovasi hijau dapat memacu inovasi hijau. Faktor-faktor ini seterusnya akan mempengaruhi prestasi mampan. Berdasarkan teori NRBV dan DOEI, rangka kerja teori telah dibangunkan dan dianalisis menggunakan 283 responden dalam kalangan PKS berasaskan teknologi China. Penemuan kajian mendedahkan bahawa strategi inovasi hijau, modal insan hijau, modal struktur hijau dan pengurusan sumber manusia hijau adalah pemacu utama inovasi hijau. Sementara itu, modal hubungan hijau didapati bukan faktor penting yang mempengaruhi inovasi hijau. Selain itu, inovasi hijau didapati mempunyai kesan positif terhadap prestasi ekonomi, alam sekitar dan sosial. Walau bagaimanapun, inovasi hijau tidak berfungsi sebagai pengantara antara strategi inovasi hijau dan prestasi ekonomi, dan juga tidak menjadi pengantara hubungan antara modal insan

hijau, modal struktur hijau, pengurusan sumber manusia hijau dan prestasi ekonomi. Tambahan pula, modal hubungan hijau hubungan yang tidak penting dengan prestasi ekonomi, alam sekitar dan sosial. Namun, inovasi hijau adalah pengantara dalam korelasi strategi inovasi hijau, dan prestasi alam sekitar dan sosial. Di peringkat sumber, inovasi hijau menjadi pengantara korelasi modal insan hijau dan prestasi alam sekitar dan sosial. Di samping itu, di peringkat pengurusan, inovasi hijau merupakan pengantara dalam korelasi pengurusan sumber manusia hijau dan tiga dimensi prestasi mampan. Berdasarkan penemuan utama, kekangan dan implikasi kajian ini dibentangkan. Kajian masa depan dicadangkan untuk meneroka faktor-faktor lain yang mungkin mempengaruhi inovasi hijau dalam konteks yang berbeza.

INVESTIGATING THE DRIVING FACTORS FOR SUSTAINABLE PERFORMANCE IN CHINESE TECHNOLOGY-BASED SMEs: THE MEDIATING ROLE OF GREEN INNOVATION

ABSTRACT

In response to global economic, environmental, and social catastrophes, businesses are seeking effective and efficient means to minimize their significant impacts. While various theoretical foundations highlight the importance of sustainability, the sustainable performance of technology-based SMEs remains underexplored. Therefore, this research seeks to examine the drivers and outcome of sustainable practices to mitigate economic crisis, environment degradation, and social injustice. In particular, the strategic, (green innovation strategy), resource, (green intellectual capital), and management (green human resource management) level factors are presumed to drive the green innovation. These factors will in turn influence sustainable performance. Drawing on NRBV and DOEI theory, a theoretical framework had been developed and analysed using 283 respondents among Chinese technology-based SMEs. The findings reveal that green innovation strategy, green human capital, green structural capital and green human resource management are the key drivers of green innovation. Meanwhile, green relational capital is found to be not a significant factor that influences green innovation. Additionally, green innovation is discovered to have positive effect on economic, environmental and social performance. However, green innovation does not serve as a mediator between green innovation strategy and economic performance, nor does it mediate the relationship between green human capital, green structural capital, green human resource management, and economic performance. Furthermore, green

relational capital has a non-significant relationship with economic, environmental, and social performance. Yet, green innovation is the mediator in the correlations of green innovation strategy, and environmental and social performance. At the resource level, green innovation mediates the correlation of green human capital and environmental and social performance. In addition, at management level, green innovation is the mediator in the correlation of green human resource management and the three dimensions of sustainable performance. Based on the major findings, this study's constraints and implications are presented. Also, the recommendation for future study is discussed in detail in the conclusion.

CHAPTER 1

INTRODUCTION

1.1 Introduction

The concept of dual-carbon goals motivates organizations to actively seek environmentally friendly, low-carbon, and sustainable development strategies (Sharifa K Mousa & Mohammed Othman, 2020). The immense economic, environmental, and societal pressures on the ecosystem have made sustainable development a global priority. Meanwhile, China engages in extensive collaboration with numerous nations and international organizations on environmental protection, climate change, green finance, and other facets of global sustainable development (K.-H. Wang et al., 2022).

Technology-based SMEs account for 80% of new products and 65% of the total number of patents in China (Wang & Esperança, 2023). Consequently, Chinese technology-based SMEs have emerged as a significant catalyst for both economic and social progress, which are vital for green innovation and economic progress (Peng et al., 2021a). However, the COVID-19 pandemic has challenged their survival and growth, and these SMEs also face environmental challenges related to pollution and resource use (Zou et al., 2023). As a result, understanding the driving factors that drive sustainable performance among technology-based SMEs is critical (Begum et al., 2022).

Sustainable performance has become a major concern for enterprises seeking long-term growth. For Chinese technology-based SMEs, balancing economic, environmental, and social performance remains a challenge. This study seeks to understand how key organizational factors—such as green innovation strategy, intellectual capital, and human resource management—affect sustainable

performance. Green innovation is now an essential strategy for organizations seeking to improve their market share and secure their long-term viability (Cancela et al., 2023). Furthermore, it explores the mediating role of green innovation in strengthening the link between organizational strategies and sustainability outcomes.

This chapter provides the background of the study, followed by the preliminary study, problem statement, research objectives, and research questions. Next, the chapter delves into the importance and extent of the research concerning sustainable performance in Chinese technology-based SMEs. Finally, it provides a further explanation of the definition of key terms and the organization of the study chapters.

1.2 Background of the study

Empirical researchers focused on corporate performance, including environmental performance, economic performance, and innovation performance. Javeed et al. (2022) examined the relationship between green innovation strategy and corporate financing in the Chinese manufacturing firms. Previous studies that are related to sustainable performance include the iterative actions of creating organization objectives, evaluating key performance indicators, and implementing changes to attain these aspirations in a manner that is more productive and effective (Sunarta & Astuti, 2023), which comprise economic performance, social performance, and environmental performance (Yusliza et al., 2020). Therefore, Mahmood and Nasir (2023) appropriately divide sustainable performance into three dimensions. Several scholars have highlighted that sustainable performance should be a highly valued and prioritized evaluation index in technology-based SMEs (Javed et al., 2022; Peng et al., 2021). For instance, Prasanna et al. (2019) looked at how

technology-based small businesses could improve their long-term performance, and Peng et al. (2021) looked at how to measure the efficiency of green technological innovation in technology-based small businesses using the undesirable SBM and the malmquist index. In addition, Arshad et al. (2014) examined sustainable performance in technology-based SMEs in Malaysia. Sustainable performance belongs to the growing consensus in society regarding the degradation of the environment, and their increased efficiency and deterioration encourages society to transform traditional economic growth into more sustainable social and environmental growth (Saba, 2023). However, as with sustainable development, there is a high degree of technological and market risk in technology-based SMEs, facing more severe financing difficulties (Zhou et al., 2021).

As an environmental strategy, green innovation strategy guides enterprises to reduce the environmental damage caused by their production and operation activities (Sun & Sun, 2021), which focus on the impact on corporate performance and competitive advantage (Soewarno et al., 2019). While green intellectual capital encompasses the knowledge, skills, and abilities of an organization's employees that contribute to its ability to create and manage sustainable value (Mahmood & Nasir, 2023). Previous studies have proved that the green intellectual capital emphasizes the firm's knowledge resources to solve environmental challenges as part of normal business operations (Mohua & Yusoff, 2023). This study identifies three dimensions of green intellectual capital, namely green human capital, green relational capital, and green structural capital, as independent variables to forecast the sustainable performance of technology-based SMEs in China. The purpose of identifying the three dimensions of green intellectual capital, respectively, is to understand which dimension has the most impact on green innovation, which further affects the

sustainable performance of Chinese technology-based SMEs. Moreover, green human resource management, which has been considered a new research trend in environmental management, aims at organizing HRM practices in organizations (Ansari et al., 2020). Green innovation, which is regarded as a mediator for the prediction of environmental performance in manufacturing small and medium-sized enterprises (SMEs) (Awan et al., 2022). Singh et al. (2021) identified green innovation as the mediator for studying SMEs' corporate performance in the manufacturing sector. The current study aims to gain a comprehensive picture of the factors related to the sustainable performance of Chinese technology-based SMEs at strategic, resource, and management levels. Based on the conception of sustainable performance, the current study adopted green innovation strategy, green intellectual capital, and green human resource management as independent variables and identified green innovation as the mediator that could influence sustainable performance in the Chinese technology-based SMEs.

1.2.1 The background of Chinese SMEs

According to the Chinese regulations on the classification of SMEs and measures for the classification of statistically large, medium-sized, small and micro-enterprises (National Bureau of Statistics 2017), the size of one SMEs is divided according to three indicators: the number of employees, business income, and total assets. Taking the industrial enterprises as an example, medium-sized enterprises should adhere to the following standards: the number of employees must be between 300 and 1000, and the business income should be between RMB 20 million and RMB 400 million. For small-sized enterprises, the standards are as follows: The number of employees must be between 20 and 300, and business income must be between RMB 3 million and RMB 20 million. For microenterprises, the number of

employees must be less than 20, and business income must be lower than RMB 3 million (Zhang & Merchant, 2020). The specific classification criteria are shown in Table 1.1. Thus, the scale classification of technology-based SMEs will be based on this standard.

Table 1.1 Sector classification standards for Chinese SMEs

Sector	Annual Sales Revenue (Unit: RMB 10000)			Number of employees (Unit: person)		
	Medium	Small	Micro	Medium	Small	Micro
Agriculture, forestry, animal husbandry and fishery	500-20000	50-500	<50	300-500	50-300	<50
Industry	2000-40000	300-2000	<300	300-1000	20-300	<20
Architecture	6000-80000	300-6000	<300	300-800	100-300	<100
Wholesale	5000-40000	1000-5000	<1000	20-200	5-20	<5
Retail industry	500-20000	100-500	<100	50-300	10-50	<50
Transportation	3000-30000	200-3000	<200	300-1000	20-300	<20
Warehousing	1000-30000	100-1000	<100	100-200	20-100	<20
Postal industry	2000-30000	100-2000	<100	300-1000	20-300	<20
Accommodation	2000-10000	100-2000	<100	100-300	10-100	<10

Source: National Bureau of Statistics 2017

In China, as in many other parts of the world, SMEs are an integral part of the domestic economy (Chen et al., 2006; Zhang & Merchant, 2020). In fact, (F. Lin et al., 2021) refer to them as the “backbone of China’s economic growth.” Recent reports indicate Chinese SMEs account for more than 50% of tax revenue (as shown in Figure 1.1), approximately 60% of Chinese GDP (China Daily, 2022), more than 70% of patents (China Banking News, 2022), and nearly 70% of exports (Ecovis,

2022), with an export growth rate higher than that for overall exports (Chen et al., 2017).

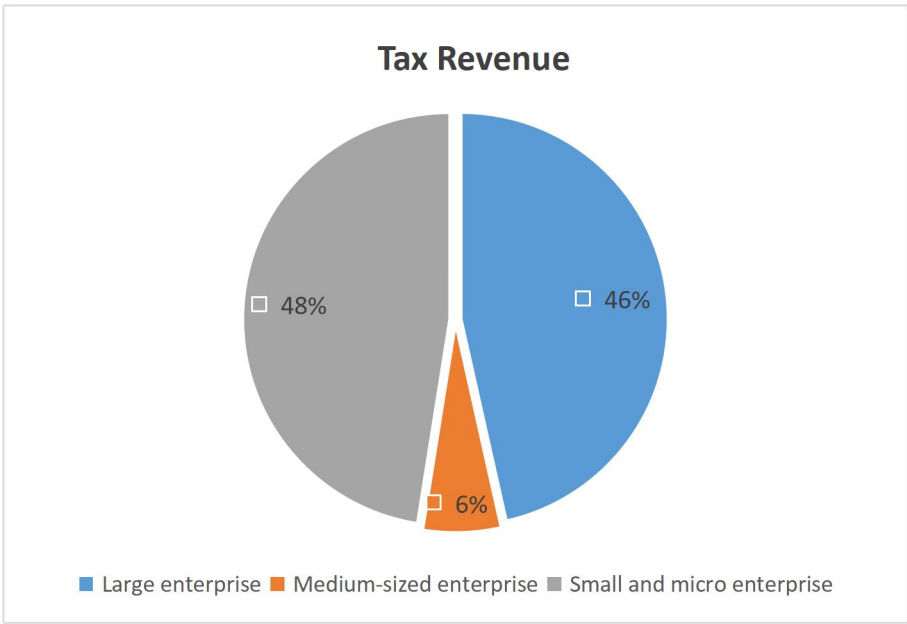


Figure 1.1 Composition of tax revenue by size

Source: China Daily, 2022

In addition, Chinese SMEs contribute more than 70% of technological innovation and more than 80% of urban employments, as shown in Figure 1.2 (unit: 10,000 people), (Song, 2023).

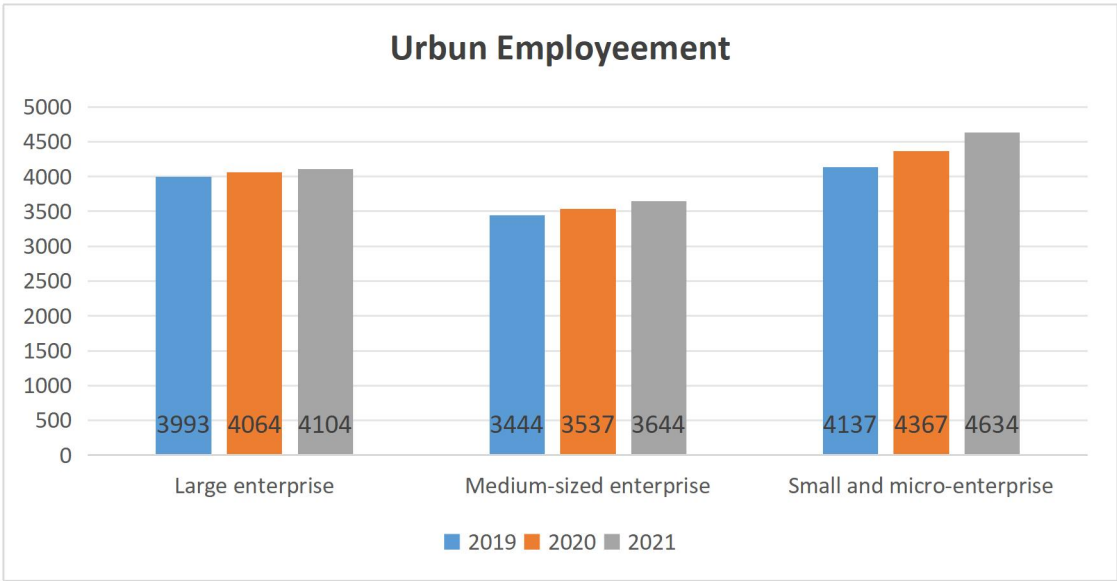


Figure 1.2 Number of urban employments by size

Source: (Song, 2023)

Furthermore, SMEs account for more than 90% of all enterprises in China, (Figure 1.3) encompassing small, medium, and micro-sized enterprises, as defined by the Ministry of Industry and Information Technology (MIIT). Among these, micro and small enterprises constitute the majority, playing a crucial role in employment generation and industrial chain stability. The resilience of Chinese SMEs is an important foundation for Chinese economic resilience, the main force in maintaining market entities and employment, a key link in improving the stability and competitiveness of the industrial chain, and a strong support for building a new development pattern (Du et al., 2023; Gong et al., 2020).

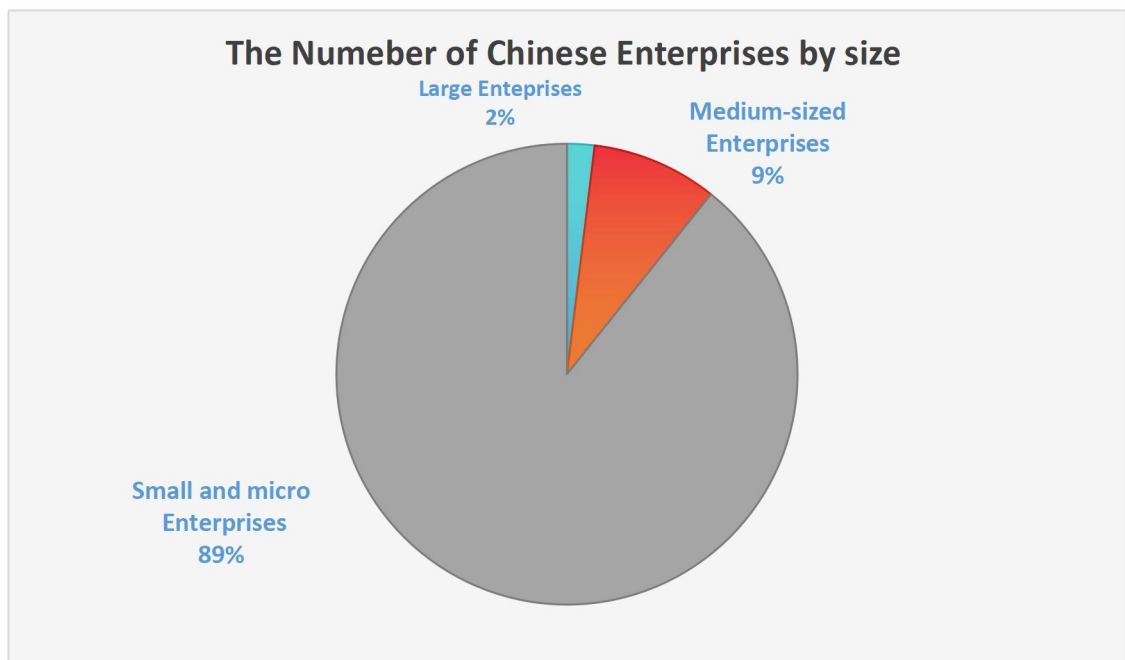


Figure 1.3 The number of Chinese enterprises by size

Source: National Bureau of Statistics of China

In summary , SMEs play a critical role in Chinese economy, contributing significantly to GDP, employment, and technological innovation (Jia et al., 2020; Song, 2023). Among them, technology-based SMEs are particularly important, driving green transformation and economic competitiveness. However, despite their

economic contributions, these firms face increasing pressure to achieve sustainable performance, has become a key concern in both academia and industry. While extensive research has been conducted on corporate sustainability, there is still a lack of understanding regarding how technology-based SMEs in China can effectively achieve sustainable performance. Given the global emphasis on sustainability, it is crucial to explore the factors influencing sustainable performance in these enterprises."

1.2.2 The background of Chinese technology-based SMEs

In the process of implementing a green innovation development strategy and economic transformation and upgrading, small- and medium-sized technology-based enterprises (technology-based SMEs) play an irreplaceable role (Feng et al., 2022; Peng et al., 2021). It has been found that 65% of the total number of patents and 80% of new products in China are created by technological-based SMEs (Wang & Esperança, 2023). As a result, the development of Chinese technology-based SMEs has become an important force in social and economic development (Peng et al., 2021). However, the early 2020 COVID-19 has significantly impacted China's and the global economy, posing serious challenges such as a scarcity of innovative talent, a relative lack of funds for R&D, the need to optimize the innovation environment, and the risk of human resource management (Zou et al., 2023). In domestic and foreign research on technology-based SMEs, scholars have generally found that the growth law of this group has certain particularities compared with mature large-scale enterprises (Ruiz-Jiménez & Fuentes-Fuentes, 2016). Therefore, exploring how to maintain the sustainable and healthy development of technology-based SMEs has become a topic of concern to scholars.

Between 2017 and 2021, the number of technology-based SMEs in China rose from less than 30,000 to 328,000 (Figure 1.4), exhibiting an average annual growth of 250%. This growth was driven by an average annual increase in R&D investment of 11%, an average annual increase in sales revenue of 9.4%, and an average annual increase in profits of 13.1%. At the end of 2022, the number of technology-based SMEs in China was 454,000, an increase of 38.4% from 2021 (Lu et al., 2024). With 1.512 million valid invention patents, accounting for 65.1% of the total number of Chinese enterprise patents, an increase of 0.5% from 2021 (Securities Daily Online, 2022).

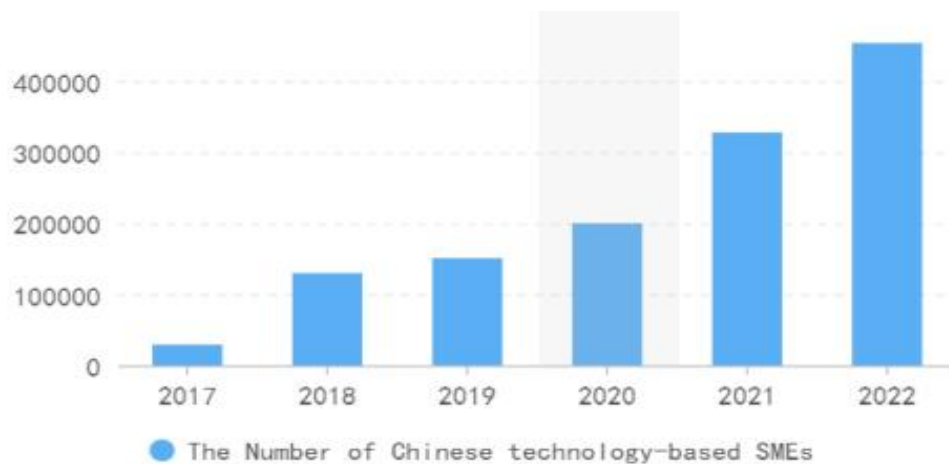


Figure 1.4 The number of Chinese technology-based SMEs

Source: Official website of China Science and Technology Department

As we all know, technology-based SMEs have a high technological content, strong innovation capabilities, and are innovative entities with great vitality and potential. Technology-based SMEs have become an important carrier for cultivating new development momentum in China during the economic transformation stage (official website of the People's Government of the People's Republic of China, 2023). Currently, Chinese technology-based SMEs complete 65% of invention

patents, over 75% of technological advancements, and 80% of new products in China (Feng et al., 2022). The new driving force behind technical innovation is large-scale, broadly based technology-based SMEs, which hold the key to achieving the sustainable development of the Chinese economy (Peng et al., 2021). Therefore, technology-based SMEs were an essential part of significant motivators for Chinese economic and sustainable development (Zhou et al., 2021).

In terms of regional distribution, Jiangsu Province, Guangdong Province, Shandong Province, Zhejiang Province, Hubei Province, Shanghai City, Henan Province, Hunan Province, Anhui Province, Beijing City, Shaanxi Province, and Sichuan Province account for 18.16%, 11.79%, 7.95%, 7.72%, 7.66%, 5.53%, 4.87%, 4.87%, 5.00%, 3.84%, 3.81%, and 3.32% of Chinese technology-based SMEs. According to the above data, the concentration of Chinese technology-based SMEs primarily occurs in areas with a high concentration of retail industries and a rapid development of e-commerce in China.

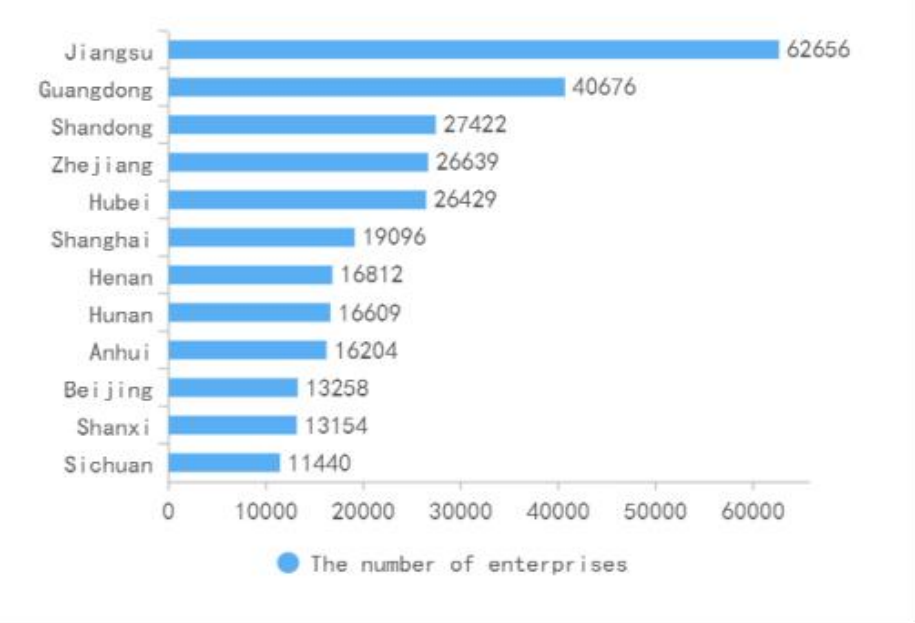


Figure 1.5 The number of Chinese technology-based SMES by province
(January-June 2023)

Source: Department of Science and Technology of Hunan Province website

As shown in Figure 1.6, according to data from QiChacha, the main types of technology-based SMEs are nine industries: opto-mechatronics, new materials, electronic information, biomedicine, modern agriculture, resources and environment, new energy, high efficiency, and energy saving (Zhou & Dai, 2023). Other industries are also involved, but the number is relatively small because these five industries have high technical demand, high imitation of technological innovation, heterogeneous requirements of industry products, etc. Technology-based SMEs generally engage in biological research, software technology development, e-commerce data software, etc.

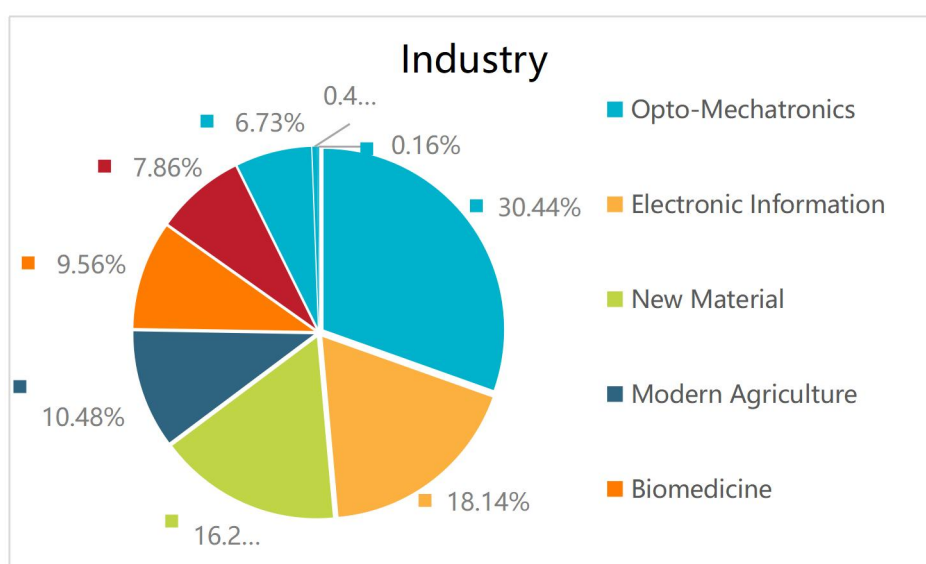


Figure 1.6 The main industries of Chinese technology-based SMEs

Source: Official website of China Science and Technology Department

As one of the largest innovative countries, numerous technology-based SMEs have emerged in China over the past few decades (Zhou et al., 2021). Previously, the sustainability of technology-based SMEs had captured the interest of many scholars and practitioners. According to Sharifa K Mousa and Mohammed Othman (2020), enterprises should opt for a path of green, low-carbon, and sustainable development,

particularly in light of the dual carbon backdrop. Currently, for many organizations, sustainability has become an essential business strategy and aim (Amjad et al., 2021). The previous study found that COVID-19 outbreaks caused severe survival pressure on technology-based SMEs, which we see mainly in the reduction of development capacity, operation capacity, profitability, and debt servicing capacity (Zou et al., 2023). Technology-based SMEs play a crucial role in driving green innovation but often lack the necessary resources and strategies to achieve sustainability goals. Green innovation strategy, which focuses on eco-friendly product development and sustainable processes, has been identified as a key driver of sustainability. Similarly, green intellectual capital—the knowledge, skills, and capabilities related to sustainability—enables firms to develop innovative green solutions. Furthermore, green HRM fosters a pro-environmental culture by promoting sustainable employee practices. Therefore, studying the green-related driving factors for sustainable performance of Chinese technology-based SMEs has important theoretical and practical significance.

Three factors led to the selection of Chinese technology-based SMEs for this study. Firstly, 454000 technology-based SMEs in China dominate the market, accounting for 80% of new products in the country (Zou et al., 2023). Secondly, even though the sector contributes significantly to the nation's economy, the environment is deteriorating (Feng et al., 2022). Thirdly, the use of outdated technologies and inefficient resource management continue to hinder the adoption of sustainable practices (Peng et al., 2021). As such, there is a need to understand why the adoption rate is low and what the drivers of sustainable practices are to achieve sustainable benefits for the business community, ecosystem, and society.

1.2.3 Three Spheres of Sustainability Drivers

According to Yusoff et al. (2018), the framework of sustainable growth of SMEs should incorporate three spheres of the SMEs, i.e., the human resources, the enterprises, and the relationship with the eco-systems and external environments of SMEs (Yusoff, Omar, Zaman, et al., 2019). Based on this model, the present research applied the concept and classified them according to strategic level factors, resource level factors, and management level factors. Previous studies have shown that adopting a green innovation strategy has a positive impact on sustainable performance at the strategic level (Wang & Juo, 2021); a green innovation strategy has become fundamental for enterprises to promote green transformation (X. Zhang et al., 2022). While pursuing economic growth and enterprise development, the green innovation strategy focuses more on improving the utilization rate of natural resources and reducing the cost of environmental pollution (Zhang & Zhu, 2019). Due to its significant impact on both economic and environmental performance, the green innovation strategy plays a crucial role in the coordinated development of both approaches (Hou et al., 2022). It represents a novel approach to achieving green development and is an essential choice for enterprise transformation and upgrading. There still needs to be more research on how the green innovation strategy affects the development of technology-based SMEs.

At the resources level factor, green intellectual capital, as a "green" concept, can fundamentally influence the organization's green behavior. This prompts enterprises to allocate the majority of their resources towards green product development, green technology research, and green process application, while also paying special attention to the overall greenness of the research process (Yusliza et al., 2020). In general, the academic community has confirmed the positive effect of

green intellectual capital on corporate performance (Haldorai et al., 2022a). In addition, green intellectual capital can also improve corporate environmental and economic performance (Chawewong & Naipinit, 2023). Scholars confirmed that green intellectual capital can strengthen organizational capabilities to adhere to environmental performance standards and ensure that their operations cause the least harm to nature (Wei et al., 2023). Thus, research on the impact of green intellectual capital on the performance of manufacturing companies or resource-based companies has always been a hot topic, and many scholars have confirmed the positive effect of green intellectual capital on the environmental performance of manufacturing companies or resource-based companies (Asiaei, Bontis, et al., 2022; Mansoor et al., 2021). However, the current literature on the relationship between green intellectual capital and the performance of technology-based SMEs is insufficient. Therefore, we still need to conduct a more in-depth analysis of how green intellectual capital affects sustainable performance.

At the management level factor, it is shown that green human resource management (GHRM) indirectly contributes to environmental performance (Nisar et al., 2021). External policies such as tax reduction, financial assistance, and credit support, as well as internal measures such as reputation management, digital transformation, and internal control, can effectively alleviate the survival pressure of technology-based SMEs (Zou et al., 2023). GHRM practices are essential for predicting environmental performance, as they impact various aspects of an organization such as the overall supply chain, production, waste management, culture, values, strategies, and employee behaviors (Benevene et al., 2021). Additionally, GHRM facilitate the implementation of green policies and practices through their different practices, such as recruitment, compensation, rewards, and exit policies

(Saeed et al., 2019). Clearly, there are implementation-related issues that require further scrutiny. Hence, the research will focus on the green innovation strategy, green intellectual capital, and green human resource management, examining their respective links to sustainable performance at the strategic, resource, and management levels. Therefore, Chinese technology-based SMEs have a significant contribution to China's economy, but they need to be socially responsible to achieve sustainable performance.

1.3 Preliminary Study

A preliminary study was conducted to gain a clear and complete picture of sustainability by the managers or leaders in the Chinese technology-based SMEs for the research interest. As a result, the study framed a more realistic problem statement for this research. In this preliminary study, the respondents were four senior managers from four different Chinese technology-based SMEs. Several questions were posted to the managers from four technology-based SMEs to understand their perspectives on sustainable performance, the challenges they face, and the factors that drive their adoption of sustainability within technology-based SMEs in China. Furthermore, the preliminary study ensured the understanding and importance of promoting sustainable performance among senior managers in technology-based SMEs. The permission was obtained for the preliminary study's conduct from the four technology-based SMEs' HR departments by sending the five questions through email. The email addresses of these four respondents were provided by these four technology-based SMEs.

The five questions are prompted as below:

1. What is your view on sustainability in your organization?

2. What kinds of sustainable practices does your organization implement?
3. What motivates sustainable performance by your organization?
4. What are your organization's challenges in improving sustainable performance?
5. What resource constraints do you face in your organization?

1.3.1 Findings of Preliminary Study

The findings of the preliminary study showed the challenges and problems technology-based SMEs are facing, their sustainability and opinion about the internal and external resources, the issues in improving sustainable performance, and resource constraints. Four senior managers of technology-based SMEs provided the information.

Technology-based SMEs 'A'

The senior manager of technology-based SMEs 'A' views sustainability as a phenomenon in which we can collaborate and interact with customers to produce high-quality products, thereby sustaining our business. In terms of sustainable practices, they rely on the management of product quality, effective customer service, and other relevant strategies. Additionally, the company leverages government support to drive sustainable performance. The company's primary challenges include a shortage of technical expertise and a skilled workforce, as well as insufficient funding for research and development. In technology-based SMEs, the primary resource constraints are intangible assets such as knowledge, skills, and relationships, with a particular emphasis on environmental considerations.

Technology-based SMEs 'B'

The senior manager of technology-based SMEs 'B' believes that sustainability is about ethics and transparency when dealing with suppliers and customers. In terms

of sustainable practices, it is based on ensure safety and reduce environmental pollution. In addition, it also uses environmental strategy and promote employees to develop environmentally friendly behaviours through publicity and education to motivate sustainable performance. The main issues faced by the company is environmental strategies are not fully implemented for various reasons related to sustainability. The main resource constraints in technology-based SMEs 'B' are environmentally friendly equipment and employees' green innovation capabilities.

Technology-based SMEs 'C'

The senior manager of technology-based SMEs 'C' believes that as trustees and vicegerents, it is our responsibility to establish a just social and economic condition that ensures the rights and interests of other inhabitants, not only for current but also future generations. Sustainable practices focus on producing energy-saving products and reducing carbon emissions. Furthermore, the company implements environmental regulations to limit environmental pollution behaviors, thereby promoting sustainable performance. The primary challenges the company faces are the high cost of environmental protection and the lack of sufficient funds to purchase environmental protection equipment. Technology-based SMEs face major resource constraints due to the incompatibility of received technology with current demands, leadership's limited understanding of sustainability, and the complexity of implementing environmental policies.

Technology-based SMEs 'D'

The senior manager of technology-based SMEs 'D' views sustainability as one of our core values, ensuring that our operations guide us towards environmental, social, and economic sustainability. Sustainable practices focus on increasing the production of cleaning equipment through technological innovation and promoting

environmentally friendly behavior among employees through various methods. Additionally, the company establishes clear goals and objectives for sustainable performance and regularly monitors progress to encourage sustainable behaviour. The company's primary challenges include an imperfect green human resources management system and a shortage of green transformational leaders. The primary resource constraints in technology-based SMEs 'D' are the implementation of a comprehensive green human resources management model and the conscious environmental protection behaviors of employees.

1.3.2 Implication of Preliminary Study

The findings of the preliminary study indicate that Chinese technology-based SMEs are promising and innovative. However, they continue to encounter obstacles and issues like insufficient technical expertise and skilled workforce, inadequate funding for R&D, incomplete implementation of environmental strategies, exorbitant environmental protection costs, and insufficient funds for purchasing environmental protection equipment. Additionally, they struggle with an imperfect green human resources management system and a shortage of green transformational leaders. The resource constraints are the intangible assets like knowledge, skills, and relationships, with a focus on environmental concerns, employees' green innovation capabilities, transformational leadership, and green human resource management practices.

This preliminary study reveals that while Chinese technology-based SMEs are innovating, they don't appear to be sustainable in the long run. Good customer management, environmental strategy, energy-saving products, green intellectual capital, and environmentally friendly behavior may contribute to sustainable practices. From the preliminary study some factors including green innovation strategy, green intellectual capital, and green human resource management,

contribute to the sustainable performance. This study aims to shed light on the practical importance of implementing green innovation in technology-based SMEs, while also examining the elements that support sustainable performance from a pragmatic standpoint.

1.4 Problem Statement

Given the growing focus on global sustainable development, it is now imperative for organizations to undergo a green transformation. Meanwhile, technology-based SMEs are more vulnerable to COVID-19 shocks because of their small scale of operation, rapid liquidity, and weak risk tolerance (Zhang & Tong, 2021). In addition to the COVID-19 pandemic, China's technology-based SMEs have faced numerous challenges. First, the reduced revenue and customer spending expectations. This is particularly evident in the Asia Pacific region, where 61% of companies expect that reduced demand due to COVID-19 will affect business performance (Zou et al., 2023). Second, Chinese technology-based SMEs have significantly reduced their production and operations. During COVID-19, lockdown measures and prevention and control policies had a severe impact on enterprises' production and operations (Bastas & Garza-Reyes, 2022). Third, the company experienced production delays and escalated expenses. Specifically, the disruptions in global supply chains have posed challenges for technology-based SMEs in acquiring essential raw materials and components, resulting in delays in production and increased expenses. Consequently, there has been a lack of timely arrival of crucial raw materials, leading to unproductive production lines, delayed fulfillment of orders, diminished customer satisfaction, and ultimately hindered economic performance (Zou et al., 2023).

In recent years, Chinese technology-based SMEs in China face significant challenges in achieving sustainable performance, struggling to balance economic viability, environmental responsibility, and social impact. Financially, limited access to green financing and high operational costs force SMEs to prioritize short-term survival over sustainability investments and low R&D spending further hinders green innovation adoption (Liu et al., 2024). Environmentally, these SMEs contribute heavily to pollution and resource depletion but lack the technical expertise and financial capacity to implement eco-friendly practices (Zou et al., 2023). Regulatory compliance also adds financial strain, discouraging proactive environmental initiatives. Socially, many SMEs lack structured CSR programs, fair labor practices, and employee engagement in sustainability efforts, weakening their corporate social responsibility impact (Bastas & Garza-Reyes, 2022). The core issue is that SMEs view sustainability as a cost rather than an investment, leading to low adoption of green innovation and fragmented sustainability strategies. Without strong policy support, financial incentives, and a sustainability-driven mindset, SMEs will struggle to achieve long-term sustainable performance (Albloushi et al., 2023). To navigate these challenges, firms must enhance innovation, strengthen compliance, optimize supply chains, and integrate sustainability into their core strategies.

Furthermore, the study of sustainable performance among technology-based SMEs remains inadequate. Previous studies on sustainable performance have mostly focused on manufacturing (Li et al., 2023; Qiu et al., 2020; Wang & Li, 2021; Yang et al., 2022), resource-based enterprises (Liu et al., 2024), the service sector (Jyoti & Khanna, 2021; Sharifa K Mousa & Mohammed Othman, 2020), or other industries. In terms of enterprise scale, most studies on sustainable performance focus on large or medium-sized enterprises (Kumar et al., 2019), and few scholars focus on SMEs,

especially technology-based SMEs. Some scholars pointed out that these enterprises play an essential role in society and economy, particularly in the technology sector (Ibidunni et al., 2018). Consequently, there is a scarcity of available data on these topics, particularly in the context of technology-based SMEs (Cui et al., 2016; Khan et al., 2023; Kumar et al., 2019; Yao et al., 2020; Zhang, 2020). Therefore, we must examine these enterprises to identify the factors that drive their sustainable performance (Awwad Al-Shammari et al., 2022; Mahmood & Nasir, 2023). Meanwhile, many studies have proven that green innovation has a positive effect on environmental or economic performance, and green innovation is viewed as the solution to address the problem (Ahmed et al., 2021; Yusoff, Omar, & Zaman, 2019). There is a need to measure the drivers and effects of green innovation on sustainable performance.

Last, although the concept of sustainability has existed since the 19th century, there have been no conclusive findings on the driving factors that influence sustainable performance. Some researchers argue that variables like green innovation strategy (Jiang & Kim, 2020), green intellectual capital (Calic & Mosakowski, 2016; Danso et al., 2020; Hong et al., 2019; Kuckertz & Wagner, 2010), and green human resource management (Obobisa et al., 2023; Sun et al., 2019) influence the interest in sustainable performance. According to the preliminary study's findings, these companies identified the implementation of environmental strategy, green resource capabilities, environmentally friendly management, innovation capability, and environmental behavior as the primary drivers of sustainable performance within their organizations.

According to Henao et al. (2019), the overall sustainability assessment results are low. This is because the industries had prioritized only to the economic and

environmental aspects (Aftab et al., 2022; Ryu & Sueyoshi, 2021). Most of the previous studies have investigated rely on one dimension of sustainable performance, such as environmental performance (Alshebami, 2023; Ryu & Sueyoshi, 2021; Simmou et al., 2023; Yadiati et al., 2019). To bridge this gap, this study integrates social performance with the economic and environmental dimensions. This approach provides a more comprehensive understanding of how the driving factors influence sustainable performance across the three dimensions. This study explores various internal and external driving factors at strategic, resource, and management levels in which these are the driving factors that may improve the three aspects of sustainable performance namely economic performance, environmental performance, and social performance among technology-based SMEs in China.

At the strategic level, most literature highlighted the need to build green service systems, reduce environmental damage, and promote the development and application of low-carbon green technology (Alnaim et al., 2022; Feng et al., 2022; Song & Yu, 2018) to facilitate sustainable practices. Yet, as an environmental strategy, the green innovation strategy guides enterprises to reduce the environmental damage caused by their production and operation activities (Sun & Sun, 2021). Technology-based SMEs in China face increasing pressure to improve their sustainable performance across economic, environmental, and social dimensions. However, achieving sustainable performance remains challenging due to unclear mechanisms linking green strategies to sustainability outcomes.

At the resource level, according to Asiaei et al. (2021), understanding how green intellectual capital is transformed into value creation and environmental performance is essential for understanding the difficulties faced by companies in their past efforts to address sustainability issues. Presently, there is a lack of study

investigating the connection between green intellectual capital, green innovation, and sustainable performance. Hence, this study examines the concept of green intellectual capital in the specific setting of technology-based SMEs in China. The primary focus is on understanding its function as a catalyst for green innovation, with the ultimate objective of attaining favorable outcomes in terms of economic, environmental, and social performance.

As for the management level factor, Zaid et al. (2018) discovered that GHRM has emerged as a new trend of successful management combines and integrates environmental management and sustainable performance in a bid to support organizational performance. Furthermore, However, there is a dearth of research on the relationship between GHRM and sustainable performance, specifically focusing on how and to what extent these policies and practices can enhance the sustainable performance of organizations (Marrucci et al., 2021). The authors invited future research to provide insights into how GHRM are oriented towards the circular economy, as well as how and why these topics are related to sustainable performance.

Prior studies have demonstrated that green innovation frequently serves as a mediating variable. Green innovation has a favorable impact on corporate sustainable development and acts as a complete mediator in the interaction between total quality management and corporate sustainable development (Albloushi et al., 2023). According to Khan et al. (2021), green innovation acts as a complete mediator in the connection between financial resources and financial performance. However, it only partially mediates the relationship between financial resources and environmental performance. According to Guo et al. (2020), green innovation has a restricted role in connecting environmental strategy and management with the performance of Chinese enterprises. Prior studies suggest that green innovation plays a crucial role in

enhancing sustainability, yet its mediating effect between driving factors and different sustainability dimensions remains underexplored. Specifically, it is unclear to what extent green innovation mediates the relationship between key drivers—green innovation strategy (strategic level), green intellectual capital (resource level), and green human resource management (management level)—and the three dimensions of sustainable performance (economic, environmental, and social performance).

To sum up, with increasing global environmental concerns, businesses—especially technology-based SMEs—face mounting pressure to integrate green practices into their operations. However, the mechanisms through which green strategies drive sustainable performance remain unclear. While prior research has examined sustainable performance, few studies have explored how green-related driving factors—such as green innovation strategy, green intellectual capital, and green human resource management—collectively influence economic, environmental, and social performance. Moreover, the role of green innovation as a mediator in this process is underexplored. To bridge the gap, the study aimed to examine the relationship between the key drivers at the strategic level factor (green innovation strategy), the resource level factor (green intellectual capital), and the management level factor (green human resource management) and green innovation; the relationship between green innovation and sustainable performance; and the mediating role of green innovation.

1.5 Research Objectives

The purpose of this study is to deeply explore whether green innovation strategy, green intellectual capital, green human resource management, and green