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IPM ON BUSINESS SUCCESS OF TECHNOLOGY INNOVATION KNOWLEDGE INTENSIVE SMEs IN CHINA

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Abstract

In recent decades, China's economic landscape has undergone a significant transformation, shifting from a manufacturing-based model to a knowledge-driven economy. This shift has been largely propelled by knowledge-intensive small and medium-sized enterprises (SMEs) whose ability to innovate is crucial for maintaining competitive advantages in both domestic and global markets. These enterprises, characterized by their reliance on skilled personnel, cutting-edge technologies, and continuous innovation, have become vital players in China's economic development. As China's prominence in the global value chain increases, so does the importance of managing intellectual property (IP) effectively to safeguard and capitalize on these innovations. This study focuses on the critical role of Intellectual Property Management (IPM) in fostering business success among these knowledge-intensive SMEs in China.

Keywords: Patents, Trademarks, Business Secrets， Management, IP, Business Success, IPM, SMEs.

1. INTRODUCTION

The study identifies patents, trademarks, and business secrets as the primary components of IP that significantly influence business success. It also explores the mediating role of IPM organizations in this relationship. The results indicate that effective IP management systems enhance the impact of these IP components on business success, highlighting the importance of a well-structured IPM organization. Specifically, the research demonstrates that IPM organizations not only protect intellectual assets but also strategically utilize them to foster innovation and maintain a competitive edge. The findings confirm that robust IP management practices are essential for the growth and sustainability of knowledge-intensive SMEs.

Based on these insights, the study provides practical recommendations for SMEs and policymakers. For SMEs, it emphasizes the need to develop comprehensive IPM strategies that include protecting and leveraging patents, trademarks, and business secrets. It also suggests enhancing IP awareness and capabilities among employees and management. For policymakers, the study advocates for stronger legislative frameworks and support systems to protect IP and encourage innovation. This includes improving the enforcement of IP laws and providing resources for SMEs to develop their IPM capabilities.

2. LITERATURE REVIEW

2.1 Technology Innovation in Knowledge-Intensive Enterprises in China

With Earth's resources being limited and historically over-exploited, sustainable economic development has become essential. This has led to the growth of knowledge-intensive

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enterprises, which enhance product output and reduce resource wastage. These enterprises are crucial for upgrading industrial structures, adding value, and reducing resource consumption. The OECD and China define knowledge enterprises based on intellectual property and associated rights. In China, knowledge-intensive enterprises are defined as those driven by knowledge capital, with knowledge elements crucial for development and operations, and knowledge achievements as their primary output.

2.2 Patent

In the rapidly changing business world, patents have become increasingly crucial for technical protection and financing. Recognizing their importance, the state has elevated patents to a legal status to safeguard them. Thus, patents are a significant aspect of enterprise management, particularly for knowledge-intensive enterprises.

A patent grants innovators exclusive rights to their inventions or drugs (Gupta et al., 2015). It provides exclusive control over an idea or innovation (Hall, 2014) and is a key tool for protecting unique features and diverse industrial applications (Kunamneni et al., 2018). Patents also offer inventors a way to profit from their investments, preventing others from exploiting their ideas (Kitch, 2020).

The protection of trade secrets involves multiple dimensions. Abd Jalil & Hassan (2020) highlight the importance of technical security measures such as encryption, secure networks, and firewalls to prevent information theft. They also emphasize the need for a sound confidentiality system, including access control, employee training, and confidentiality agreements to ensure only authorized personnel have access to trade secrets. Legal policies, like confidentiality clauses in employment contracts and intellectual property laws, are crucial to protect trade secrets from infringement.

2.3 Business success

Successful enterprise intellectual property (IP) rights enhance innovation, technological advancements, and competitiveness. Business success can be defined as the capacity to manage IP effectively in a globalized market, fostering employment growth and reducing unemployment. This requires strategies considering economic growth, government spending, inflation, human resources, population, industrialization, trade openness, foreign investment, and global value chains (Dmitriev et al., 2020; Wattanapruttipaisan, 2004). Effective IP management also involves international collaboration and political stability to promote economic integration (Ivanova et al., 2021).

Effective IP management must adapt to the cyclical nature of technology (Cao & Zhao, 2011) and recognize the importance of technical innovation in increasing firm value (Liu et al., 2018). Research shows a significant link between R&D investment and market value, suggesting that high-tech firms' R&D spending can boost stock prices. Technological innovation enhances enterprise value by improving production efficiency and overall firm efficiency (Akhmetshin et al., 2017). Proper IP management promotes innovation and creates more business value.

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2.4 Research conceptual framework

Based on the drawing upon the study's findings, a model is constructed to elucidate the interconnections among patent management, trademark management, business secret management, and business success.

Patent management, trademark management, business secret management, when considered as an independent factor, has the potential to significantly impact the business success. The IPM organization as a mediating variable include areas such as financing valuation, Unified defense of rights and enterprise standards, ultimately influencing the overall business success.

The current study examined the mediating effect of IPM organization on the relationship between intellectual property and business success. The study model encapsulates the interplay between business success, patent management, trademark management, business secret management, and IPM organization, employing theoretical deduction and research hypotheses as illustrated in Figure 2.1.

The current study offers a thorough review of the existing literature on each subtopic, including the testing of multiple hypotheses and the presentation of a theoretical framework for further investigation.

Based on the theoretical framework being developed, the following hypotheses were generated for testing:

H1: Patent has a positive direct effect on the Business success.

H2: Trademark have a positive direct effect on the Business success.

H3: Business secret has a positive influence on the Business success.

H4: Intellectual property organization/system has a positive influence on the business success.

H5: Intellectual property organization/system mediates the relationship between Patent and Business success.

H6: Intellectual property organization/system mediates the relationship between Trademark management and Business success.

H7: Intellectual property management organization/system mediates the relationship between Business secret management and Business success.

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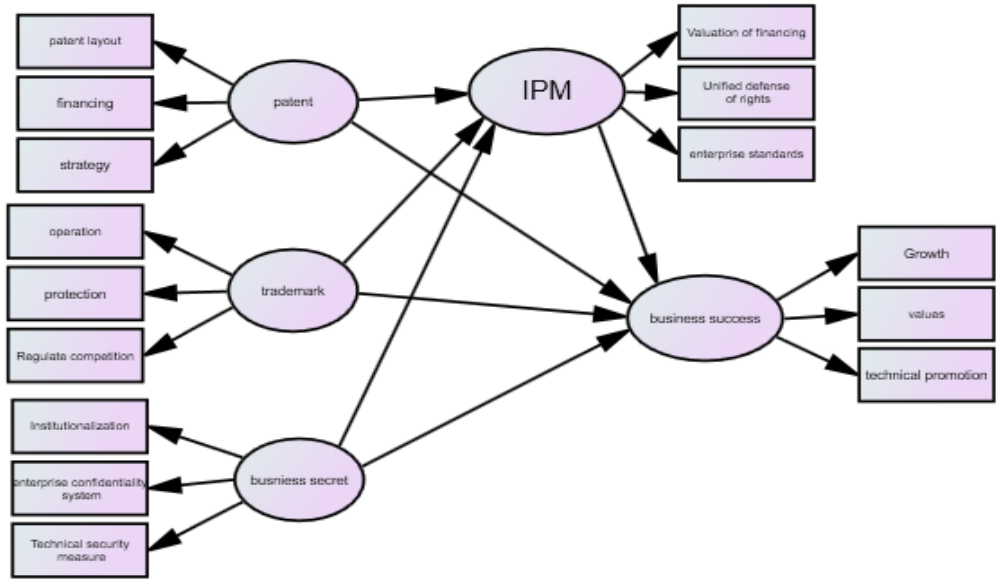

Figure 2.1: Research conceptual framework

3. METHODOLOGY

The research paradigm adopted for this study falls under the purview of pragmatic research. The pragmatic approach is chosen because it allows the use of both qualitative and quantitative research methods. The main objective of this study is to investigate how various factors such as Patent， Trademark, Business secret, Intellectual property organization/system and business success promoted intellectual property management in technology innovation knowledge intensive SMEs in China.

The Mixed Research Method is selected for this study to provide a comprehensive, multifaceted understanding of the complexities that govern the success of intellectual property management in technology innovation knowledge intensive SMEs in China. This section elaborates on the specific elements that justify the use of this hybrid methodology, distinct from purely quantitative or qualitative methods.

By testing the correlation analysis, it is concluded whether there is a significant positive correlation. Research conclusions need to be drawn through linear regression. Using multiple linear regression model analysis, we can analyze the objective evaluation of the information leadership and management effectiveness of managers of college art major teachers to prove the authenticity and credibility of the results and ensure the availability of data. After the model is determined, researchers need to further test the model's structural validity. The structural validity tested mainly includes two aspects: convergent validity and discriminant validity. The structural validity of the measurement model can be tested through exploratory factor analysis and confirmatory factor analysis. Convergent validity mainly uses confirmatory factor analysis (CFA). (Arbuckle J, 2008, pp.41-57).

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4. RESULTS

This research utilized mixed methods, combining qualitative and quantitative approaches. Qualitative analysis involved NVivo software to establish a conceptual model of "agricultural supermarket docking". Quantitative analysis employed questionnaire surveys and statistical analysis, including structural equation modeling using SPSS and AMOS software. Content, structure validity, and reliability of the questionnaire were ensured through expert evaluation and pilot testing.

Qualitative data from interviews and quantitative data from surveys were analyzed and discussed. Qualitative analysis utilized Grounded Theory on interview records, while quantitative analysis employed structural equation modeling to test hypotheses. Descriptive statistics, confirmatory factor analysis, and SEM were conducted. Bootstrapping and multi-group analysis were employed to test mediating and moderating effects respectively. Results were summarized and discussed comprehensively.

The coding comparison query results was conducted by software NVivo in this study to test reliability, as shown in Table 4.1. It can be seen that Kappa values of the coding comparison from two researchers were all above 0.8, so the interview analysis in this study had excellent reliability.

Table 4.1: Coding Comparison Query

ID	Kappa	Agreement (%)	A and B (%)	Not A and Not B (%)	Disagreement (%)	A and Not B (%)	B and Not A (%)
F1	0.9963	99.88	21.47	78.4	0.12	0	0.12
F2	1	100	0	100	0	0	0
M1	0.274	88.83	2.44	86.38	11.17	0	11.17
F3	0.227	90.29	1.81	88.48	9.71	2.38	7.33
M2	1	100	0	100	0	0	0
M3	1	100	0	100	0	0	0
M4	1	100	0	100	0	0	0
M5	0.8826	97.27	12.07	85.2	2.73	1.44	1.29
F4	0.9229	97.97	14.56	83.41	2.03	1.79	0.24
M6	0.8553	93.06	36.23	56.83	6.94	1.65	5.29
F5	1	100	0	100	0	0	0
M7	1	100	0	100	0	0	0
M8	1	100	0	100	0	0	0
M9	1	100	0	100	0	0	0
M10	1	100	0	100	0	0	0
F6	1	100	0	100	0	0	0
F7	1	100	0	100	0	0	0
F8	1	100	0	100	0	0	0
M11	0.9044	95.41	37.68	57.73	4.59	2.66	1.93
F9	1	100	0	100	0	0	0

Note. Adopted From Software NVivo.

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Descriptive statistics analysis was employed to describe demographic profile of respondents, all measurement variables and correlations between variables.

1) Descriptive Statistics of Demographic Profile

In this study, data from the first part of 320 valid formal scale questionnaires about respondents' demographic profile was analyzed by frequency and percentages through software SPSS, which including gender, age, average monthly disposable income, education background and profession. The statistical results were shown in Table 4.2.

Table 4.2: Sample Characteristics Analysis

Profile	Category	Number	Percentage (%)
Gender	Male	164	42.9
	Female	218	57.1
years of working	15-20 years old	114	29.8
	10-15 years old	113	29.6
	1-5 years old	65	17
	5-10 years old	73	19.1
	More than 20 years	17	4.5
Average monthly disposable income	Below 5000 yuan	94	24.6
	5001-10000 yuan	109	28.5
	10001-20000 yuan	97	25.4
	More than 20000 yuan	82	21.5
Education background	Senior high school and below	97	25.4
	College degree	105	27.5
	Bachelor degree	88	23
	Graduate degree	92	24.1
Profession	School student	25.7	25.7
	Office worker	25.9	25.9
	Freelance	25.1	25.1
	Others	23.3	23.3

Note. Adapted from SPSS Software Result (N=320).

According to the data given, we can see that 42.9 percent of the respondents are males and 57.1 percent are females. The proportion of women is slightly higher than that of men. The year of working distribution of the objects is relatively uniform. 29.8% were between 1 and 5 years old, 29.6% between 5 and 10 years old, 17% between 10 and 15 years old, 19.1% between 15 and 20 years old, and 4.5% over 20 years old. The average monthly disposable income of the respondents is more evenly distributed. The income level below CNY 5,000 accounted for 24.6%, the income level between CNY 5,001 and CNY 10,000 accounted for 28.5%, the income level between CNY 10,001 and CNY 20,000 accounted for 25.4%, and the income level above CNY 20,000 accounted for 21.5%. The educational background of the respondents is relatively diverse. High school or below education accounted for 25.4%, junior college education accounted for 27.5%, bachelor degree accounted for 23%, and master degree or above accounted for 24.1%. The occupational distribution of respondents is relatively even. Students accounted for 25.7 percent, office workers 25.9 percent, freelancers 25.1 percent, and

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other occupations 23.3 percent. In general, the distribution of the demographic profile of the respondents in this study conformed to the actual situation. According to the scoring criteria of Likert scale, respondents generally adapted to the questionnaire, and the questionnaire was effective.

2) Descriptive Statistics of Measurement Items

Measurement items were analyzed by means and standard deviation (S.D.) through software SPSS.

In this study, the correlation coefficients of each latent variable were constructed and compared with the square root of AVE value. The comparison results were shown in Table 4.3. The square root of AVE of all variables was greater than the correlation coefficient between variables. Thus, there was a good discriminant validity among these six measurement models.

Table 4.3: Discriminant Validity Test Result

Variables	Characteristic	Financing	Strategy	Operation	Protection	Regulate competition	Technical security measure	Enterprise confidentiality system	Institutionalization	Enterprise standards	Valuation of finance	Unified defense of rights	Growth	Values	Technical promotion
Characteristic	0.01														
Financing	0.37	0.21													
Strategy	0.10	0.69													
Operation	0.03	0.29	0.14												
Protection	0.01	0.24	0.13	0.56											
Regulate competition	0.03	0.19	0.10	0.47	0.49										
Technical security measure	0.00	0.23	0.13	0.51	0.43	0.68									
Enterprise confidentiality system	0.02	0.22	0.12	0.64	0.47	0.55	0.12								
Institutionalization	0.04	0.18	0.09	0.52	0.53	0.44	0.52	0.47							
Enterprise standards	0.08	0.11	0.08	0.01	0.02	0.57	0.52	0.67	0.45						
Valuation of finance	0.04	0.00	0.04	0.18	0.09	0.52	0.53	0.29	0.52	0.48					
Unified defense of rights	0.22	0.12	0.64	0.47	0.08	0.03	0.04	0.24	0.45	0.67	0.54				
Growth	0.18	0.09	0.52	0.53	0.35	0.34	0.03	0.19	0.53	0.44	0.33	0.35			
Values	0.11	0.08	0.01	0.02	0.49	0.55	0.01	0.23	0.13	0.51	0.59	0.36	0.60		
Technical promotion	0.29	0.52	0.48	0.21	0.47	0.55	0.33	0.11	0.13	0.55	-0.11	-0.01	0.20	0.20	0.33

Note. Adapted from Amos Software.

Content validity refers to the appropriate degree to which the item samples the scope of the content to be studied (Ni, 2009). Because the scales used in this study were changed by referring to relevant domestic and foreign literatures, and pilot test and IOC was carried out to test the items, the content validity was guaranteed to a certain extent.

To sum up, six measurement models in this study were met criteria which had good reliability, content validity, structure validity, convergent validity and discriminant validity, indicating they could be used for further structural equation modeling (SEM) analysis in the follow step.

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4.1 Performing of Structural Equation Modeling

After measurement models has been confirmed above, structural equation modeling would be performed to verify the fitness of the research model and the research hypotheses by software AMOS 24.0.

In this study, structural equation modeling with maximum likelihood method was used to verify direct effects between the exogenous potential variables and the endogenous potential variables. Indirect effects of independent variables on the dependent variable through the mediators were verified with bootstrapping method by AMOS (Fang et al., 2014). Percentile and bias-corrected bootstrapping at a 95% confidence interval was performed with 5,000 bootstrap samples, which followed the suggestions of Preacher and Hayes and calculated the confidence interval of the lower and upper bounds to test whether the indirect effects were significant (Hayes, 2013).

1) Definition and Identification of Structural Equation Modeling.

In this study, using software AMOS, maximum likelihood method (ML) was adopted to analyze 12 measurement models in conceptual framework except for moderating variable homogeneity, because moderating effect was analyzed by multi-group analysis in SEM.

First, the measurement models were identified. There were 15 measurement models,

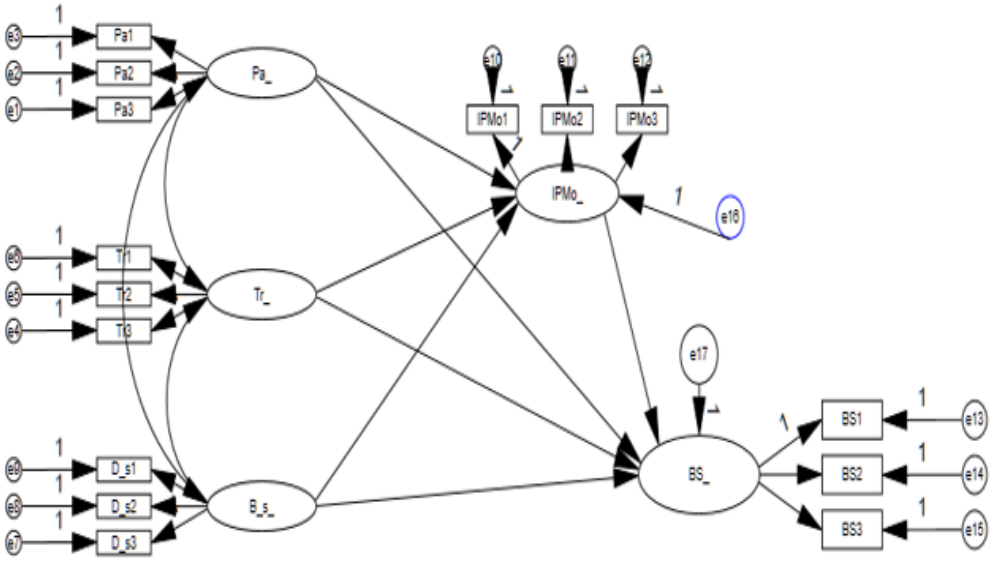

Figure Error! No text of specified style in document..**1: Identification of Measurement Models in CFA**

Note. Adapted from Amos Software.

According to Gerbing & Anderson (1985), every three measurement items respectively indicate that each factor has at least three indicators, and the errors are not correlated. It can be seen that each index has five toilet spirit items, and all errors are uncorrelated. Thus, the measurement

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model was successfully identified.

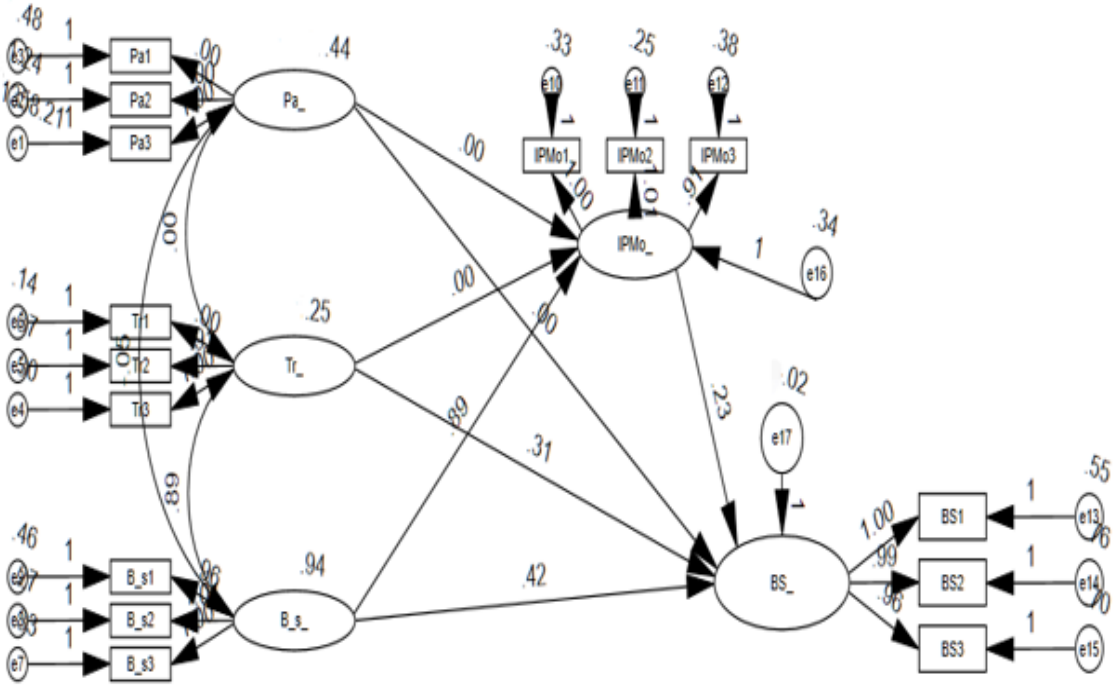

Figure 4.2: Output of CFA Model of Independent Variables

Note. Adapted from Amos Software.

Second, the measurement models were analyzed by software AMOS with maximum likelihood method (ML). The confirmatory factor analysis results of the data obtained from the formal investigation with 320 validate questionnaires were shown in Figure 4.2.

As can be seen from Table 4.4, according to model fit index and criterion of confirmatory factor analysis (CFA), both the absolutely model fit index (χ^2/DF =2.712, GFI=0.933, AGFI=0.98) and the incremental model fit index (CFI=0.911 NFI=0.933, RMSEA=0.052) all reached satisfactory criteria. Thus, the measurement model in this study fitted well.

Table 4.4: Model Fit Index of Independent Variables

Model Fit	Absolutely Model Fit					Incremental Model Fit		
	χ^2	DF	χ^2/DF	GFI	AGFI	CFI	NFI	RMSEA
Criterion	-	-	1<χ^2/DF<3	>0.9	>0.9	>0.9	>0.9	<0.08
Results	1121.5	320	2.712	0.933	0.98	0.911	0.933	0.052

Note. Adapted from Amos Software and Hair et al.

3) Path Analysis and Main Hypotheses Test

For path analysis and testing of related direct hypotheses, AMOS, a structural equation analysis software, was used in this study. The maximum likelihood method was specifically adopted.

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The analysis results were shown in Table 4.5 As can be seen from Table 4.5 according to criteria of the standardized factor loading for each item, based on the analysis results, the hypotheses and their corresponding results are as follows:

H1: There is a significant positive relationship between Pa(Patent) and BS (Business success). The estimated parameter is 0.299 with a standard error of 0.105. The t-value is 2.833, and the p-value is 0.005. The hypothesis is supported.

H2: There is a significant positive relationship between Tr (Trademark) and BS (Business success). The estimated parameter is 0.203 with a standard error of 0.05. The t-value is 4.026, and the p-value is <0.001 (indicated by ***). The hypothesis is supported.

H3: There is a significant positive relationship between Bs (Business secret) and BS (Business success). The estimated parameter is 0.271 with a standard error of 0.12. The t-value is 2.256, and the p-value is 0.024. The hypothesis is supported.

H4: IPMo (Intellectual property management organization/system) mediates the relationship between Pa (Patent) management and BS (Business success). The estimated parameter is 0.171 with a standard error of 0.074. The t-value is 2.316, and the p-value is 0.021. The hypothesis is supported.

H5: IPMo (Intellectual property management organization/system) mediates the relationship between Pa (Patent) management and BS (Business success). The estimated parameter is 0.213 with a standard error of 0.036. The t-value is 5.899, and the p-value is <0.001 (indicated by ***). The hypothesis is supported.

H6: IPMo (Intellectual property management organization/system) mediates the relationship between Tr (Trademark) management and BS (Business success). The estimated parameter is 0.211 with a standard error of 0.021. The t-value is 3.444, and the p-value is <0.001 (indicated by ***). The hypothesis is supported.

H7: IPMo (Intellectual property management organization/system) mediates the relationship between Tr (Trademark) management and BS (Business success). The estimated parameter is 0.198 with a standard error of 0.034. The t-value is 3.675, and the p-value is <0.001 (indicated by ***). The hypothesis is supported.

Table 4.5: Model Fit Index of Independent Variables

Hypothesis	Path	Significance Estimation of Parameter					Hypothesis Result
		Un-std.	S.E.	t-value	P	Std.	
H1	BS<-Pa	0.299	0.105	2.833	0.005	0.319	Support
H2	BS<-Tr	0.203	0.05	4.026	***	0.252	Support
H3	BS<-Bs	0.271	0.12	2.256	0.024	0.276	Support
H4	Pa<- IPMo	0.171	0.074	2.316	0.021	0.17	Support
H5	BS<- Pa<- PMo	0.213	0.036	5.899	***	0.246	Support
H6	Tr<- IPMo	0.211	0.021	3.444	***	0.123	Support
H7	BS<-Tr<- IPMo	0.198	0.034	3.675	***	0.216	Support

Note. Adapted from Amos Software. *p<0.1, **p<0.05, ***p<0.01.

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In summary, according to the hypothesis testing results, it can be concluded that H1, H2, H3, H4, H5, H6 and H7 hypotheses are supported.

5. CONCLUSION

5.1 Cssion of qualitative analysis results

According to the qualitative analysis results of NVivo 11 software, the Business success affecting the intellectual property management of smes is identified, including Patent, Trademark, Business secret, it is concluded that the relationship between Intellectual property management organization/system and Patent directly affects Business success.

Intellectual property management organization/system positively affects Trademark and Business success; Intellectual property management organization/system positively moderates the intensity of Patent's influence on Business success. Finally, the theoretical model and research hypothesis affecting the intellectual property management mechanism of SMEs are put forward.

5.2 Discussion of quantitative analysis results

According to results of quantitative analysis, through structural equation modeling (SEM) statistical analysis method by software SPSS and AMOS including descriptive statistics analysis and performing of structural equation modeling with 320 valid respondents, main effect hypotheses, mediating effect hypotheses and moderating effect hypothesis were tested.

According to the descriptive statistics of the demographic profile, the distribution of the respondents is consistent with the reality and can support the research. According to the descriptive statistics of the measured items, the mean value of the four variables is higher than the mean value.

From the correlation of variables, there was a significant correlation between internal variables and external variables in this study (all $p<0.01$), which was in line with theoretical expectations. After CFA test, the 6 measurement models in this study (except the regulating variables) all meet the criteria of reliability, content validity, structure validity, convergence validity and discriminant validity, which can be used for the next structural equation modeling (SEM) analysis.

Using structural equation model and maximum likelihood method, AMOS software was used to test the main hypotheses. In order to further verify the mediating role of perceived value and management purchase intention, based on the suggestion of Preacher and Hayes, we use maximum likelihood estimation and bootstrap program to repeat sampling 5000 times (Li, 2011).

The confidence interval and bias correction interval were set to 95% to test the mediating effect. In this study, AMOS software was used to analyze the impact of intellectual property on the success of intellectual property management in Chinese smes. The test results of the research hypothesis are summarized in Table 5.1.

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Table 5.1: Results of Hypothesis Test

NO.	Research Hypotheses	Result
H1	Patent has a positive direct effect on the Business success.	Support
H2	Trademark have a positive direct effect on the Business success.	Support
H3	Business secret has a positive influence on the Business success.	Support
H4	Intellectual property management organization/system has a positive influence on the business success.	Support
H5	Intellectual property management organization/system mediates the relationship between Patent management and Business success.	Support
H6	Intellectual property management organization/system mediates the relationship between Trademark management and Business success.	Support
H7	Intellectual property management organization/system mediates the relationship between Business secret management and Business success.	Support

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