

pISSN: 1906 - 6406 The Scholar: Human Sciences
eISSN: 2586 - 9388 The Scholar: Human Sciences
<https://assumptionjournal.au.edu/index.php/Scholar>

Exploring the Link Between Product Innovation and Firm Performance: Empirical Insights from Energy Enterprises in Yunnan, China

Wan Yinyin*

Received: September 04, 2024. Revised: October 16, 2024. Accepted: February 18, 2025.

Abstract

Purpose: This study aims to construct a comprehensive theoretical framework to test the influence of key resource factors within the frameworks of the Resource-Based View (RBV) and Customer Relationship Management (CRM) theories on product innovation and firm performance. **Data and Methodology:** Based on RBV and CRM theories, this research collected 516 data samples through a questionnaire survey from photovoltaic state-owned enterprises (SOEs) in Yunnan, China. The data were analyzed using Structural Equation Modeling (SEM). **Results:** The findings confirm that all hypotheses are supported. Creativity Capability, Information Sharing, Top Management Support, Customer Involvement, and Institutional Support have a direct significant impact on Product Innovation Capability and an indirect significant impact on Firm Performance. Among these factors, CC has the highest impact on product innovation, followed by IST, TMS, CI, and IS. **Conclusion:** This study enriches the empirical data on photovoltaic SOEs in Yunnan, providing valuable management suggestions for optimizing resource allocation, enhancing innovation capability, and improving market competitiveness. The findings also highlight the crucial role of government policy support in promoting high-quality development of the photovoltaic industry in China. By providing a systematic theoretical framework and empirical evidence, this research aims to help enterprises and policymakers understand and address innovation challenges in the photovoltaic industry, achieving sustainable development and long-term competitiveness.

Keywords: Resource-Based View, Top Management Support, Creativity Capability, Customer Relationship Management, Information Sharing

JEL Classification Code: E44, F31, F37, G15

1. Introduction

In the modern business environment, innovation has become a key factor for enterprises to maintain competitiveness and achieve sustainable development. Numerous studies have confirmed the importance of innovation to firm performance (Bettis & Hitt, 1995; Helfat & Peteraf, 2003). As research has progressed, innovation has been refined into various types, including product or service, technological, and organizational (Gërguri-Rashiti et al., 2017). Currently, China is at a critical stage of industrial upgrading and transformation. The government's concept of "new quality productive forces" places "innovation,"

particularly product innovation, at its core. Among many industries, the photovoltaic (PV) industry is highly valued for its tremendous development potential and strategic significance to China's future "dual carbon" goals. The global PV industry is rapidly developing, and it is projected that by 2030, the global installed capacity of PV power generation will surpass other energy sectors (Energy New Era Series, 2024).

With its abundant solar energy resources and status as a key economic hub connecting South and Southeast Asia, Yunnan Province is an important development area for the PV industry (Bidu, 2024; Photovoltaic Industry Network, 2024). According to statistics from the Yunnan Provincial

*Wan Yinyin, Ph.D. Candidate in Educational Administration and Leadership, Assumption University, Thailand. E-mail: 82190492@qq.com

© Copyright: The Author(s)

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (<http://creativecommons.org/licenses/by-nc/4.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Bureau of Statistics (2023) and the Yunnan Provincial Energy Bureau (2024), in 2022, all the top 20 projects in Yunnan by installed capacity were awarded to state-owned enterprises. However, state-owned PV enterprises in Yunnan face management issues such as excessive centralization of decision-making power, severe bureaucratic management, lack of an innovation culture, inadequate incentive mechanisms, information silos, insufficient market orientation, and policy dependence (Bao, 2021; Xu, 2024; Zhao, 2008). These issues limit enterprises' innovation capability and market competitiveness, necessitating effective management strategies and innovation mechanisms to address them.

Based on the Resource-Based View (RBV), an enterprise's competitive advantage stems from its unique resources, which are heterogeneous and inimitable (Barney, 1991). RBV emphasizes that enterprises form unique competitive capabilities through acquiring, allocating, reorganizing, and creating resources. However, in practical application, RBV research often focuses on static analysis of resources, needing a dynamic perspective. On the other hand, Customer Relationship Management (CRM) theory posits that by implementing CRM systems, enterprises can gain deep insights into customer needs and improve firm performance (Buttle, 2009; Rigby et al., 2002). However, existing research mostly focuses on the application of CRM in market-oriented enterprises. More research is needed on its application in state-owned enterprises with significant government intervention and insufficient market orientation, particularly in Yunnan's PV industry.

This study's significance lies in enriching the empirical research data on Yunnan's state-owned PV enterprises and providing effective management recommendations for the PV industry. These recommendations aim to optimize resource allocation, enhance innovation capabilities, and improve market competitiveness. Through empirical analysis, the study reveals the importance of government policy support and provides empirical evidence to promote the high-quality development of China's PV industry.

To achieve the research objectives, this study adopts a quantitative research method, collecting data through questionnaire surveys and analyzing it using Structural Equation Modeling (SEM). The survey targets high-level managers, technical R&D personnel, and marketing staff involved in PV projects from the four main state-owned PV enterprises in Yunnan Province. The data collected will pertain to the impact of Top Management Support (TMS), Creativity Capability (CC), Information Sharing (IS), Customer Involvement (CI), and Institutional Support (IST) influence on product innovation (PI) and the indirect impact of these factors on firm performance (FP). Additionally, the study examines the role of Institutional Support in enhancing the product innovation capability of state-owned PV

enterprises. The research findings will provide empirical support for PV enterprises to formulate innovation strategies and offer references for government departments to develop supportive policies.

2. Literature Review

2.1 Top Management Support

In RBV theory, Top Management Support is an important enterprise resource, significantly influencing strategy formulation, implementation, and internal coordination. Scholars have determined that top managers' cognition, ideology, professional capabilities, social networks, and resource allocation abilities can directly affect the formulation and implementation of corporate strategies (Li & Xu, 2007; Teece et al., 1997; Wernerfelt, 1984). For instance, Hitt et al. (2001) suggested that top managers can create a favorable innovation environment by providing financial, human, and material resources to support new projects. Top managers can promote, recognize, and reward innovation processes, fostering an innovation culture that encourages risk-taking and tolerates failure, stimulating product innovation. Sullivan (2010) also noted that companies with strong top management support perform better in innovation, are more capable of developing new products that meet market demands, maintain a competitive edge, and achieve higher profitability and economic growth. Effective management and coordination of internal and external resources are crucial elements of enterprise operations, key to achieving corporate goals and profit targets (Lin, 2004). Based on the above literature review, top management support is particularly important in stimulating product innovation. Additionally, top management support has been proven to be a critical factor in resource allocation and combination effectiveness. Therefore, this study proposes the following hypothesis:

H1: Top management support has a significant effect on product innovation.

2.2 Creativity Capability

Creativity capability encompasses the ability to generate new ideas and the ability to collect, process, integrate, share information, and implement and execute the innovation process (Woodman et al., 1993). In studies based on RBV theory, scholars regard creativity capability as a unique and inimitable resource that can provide a competitive advantage to enterprises. This capability manifests in integrating and utilizing internal resources, helping enterprises enhance core competencies such as product innovation (Amabile, 1996; Teece et al., 1997; Zhou & Shalley, 2003). Numerous

empirical studies on creativity capability have further demonstrated its close connection with product innovation, highlighting the significant positive impact of creativity capability on improving product innovation. Particularly in a flexible and changing market environment, creativity capability has a positive and significant impact on resource allocation and utilization within enterprises (Bartsch et al., 2021; Herhausen et al., 2020; Potepa & Welch, 2018). Many scholars have also established a positive correlation between creativity capability and product development through metrics such as market response speed and new product development efficiency (Xu et al., 2018). As a unique and heterogeneous resource for enterprises, creativity capability is crucial for product innovation, enhancing competitiveness, and achieving sustainable profitability. Therefore, this study proposes the following hypothesis:

H2: Creativity capability has a significant effect on product innovation.

2.3 Information Sharing

Information sharing is a crucial source of competitive advantage for enterprises. By integrating and disseminating valuable information, companies can more effectively utilize unique resources to improve innovation, operational efficiency, and strategic decision-making (Barney, 1991; Grant, 1991). Information sharing promotes internal collaboration within enterprises, stimulates innovation capabilities, enhances the efficiency of product innovation development, and increases organizational agility, enabling quick responses to market changes, customer demands, and competitive pressures. Additionally, by understanding competitors' prices, plans, strategies, and other significant information, enterprises can formulate effective strategies, improve resource allocation, and thus enhance firm performance (Eisenhardt & Martin, 2000; Nonaka, 1994; Teece et al., 1997). Information sharing can create a collaborative network that, through frequent information exchanges, deeper levels of information sharing, and diverse types of information interactions, breaks down uneven resource environments, gaining more innovative advantages and forming an innovation alliance system (Siguaw et al., 1994; Smet et al., 2013). This approach can enhance product innovation capabilities, reduce development time costs, and provide customized product services, further deepening and broadening customer relationships, thus driving corporate profitability (Krause et al., 2007). Therefore, what information to collect and the frequency of information collection become critical considerations for enterprises when considering product innovation. Hence, this study proposes the following hypothesis:

H3: Information sharing has a significant effect on product innovation.

2.4 Customer Involvement

Customer involvement is a vital way for enterprises to acquire innovative resources. By collaborating with customers, enterprises can obtain market information and ideas, promote product and service innovation, create co-value, and bring higher added value and competitive advantage (Nonaka, 1994; Pisano & Shuen, 1997). Customer involvement is a process of information interaction between customers and enterprises. Through methods such as questionnaire surveys, interviews, and observations, enterprises collect customer information, including product design concepts, customer needs, and customer evaluations of products. Numerous scholars have empirically proven that customer involvement significantly improves customer satisfaction and loyalty. By participating in product design and service processes, customers feel that their needs are valued, which enhances their trust and dependence on the enterprise, ultimately improving the enterprise's innovation capability (Ayoub et al., 2017; Fang et al., 2008). The depth of customer involvement and the content of their participation are critical considerations in the product innovation process. Therefore, this study proposes the following hypothesis:

H4: Customer involvement has a significant effect on product innovation.

2.5 Institutional Support

Institutional support significantly impacts enterprises' acquisition, allocation, and utilization of resources, effectively enhancing operational efficiency and innovation capability (Feldman & Kelley, 2006; Li & Zhao, 2020). Institutional support comes in various forms and tools, but overall, it positively correlates with enterprise innovation. For instance, Zhang (2012) empirically confirmed that institutional support positively influences product innovation in China and is crucial for innovation development in Chinese enterprises. Many scholars have also confirmed that institutional support, an important external resource for enterprises, promotes operational efficiency and innovation capability through effective acquisition and allocation. It has been shown to have positive effects across different industries. For example, government subsidies support strategic emerging industries, foster new industry growth, and address issues like market failures that hinder innovation capability (Aghion et al., 2015; Graddy, 1990; Low, 1997). Given that state-owned enterprises in this study inherently bear the responsibility of aligning with national policy development, the study proposes the following hypothesis:

H5: Institutional support has a significant effect on product innovation.

2.6 Product Innovation and Firm Performance

Numerous empirical studies based on RBV and CRM theories have confirmed the positive correlation between product innovation and firm performance. Product innovation is an important means of utilizing and integrating internal resources to enhance firm performance (George, 2002; Jiang, 2019; Teece et al., 1997). Firm performance, as a crucial tool for evaluating resource utilization efficiency within an organization, reflects the actions taken to achieve goals and the organization's future potential for resource acquisition and allocation (Porter & Van der Linde, 1995). In early research, financial indicators were significant factors in assessing company performance, including profit, market share, and debt ratio (Kahneman, 2011). Although recent studies have introduced indicators such as social responsibility, management performance, environmental performance, and strategic performance, this study will examine the most straightforward financial performance metrics. To better explore the significance of product innovation to enterprises, this study proposes the following hypothesis:

H6: Product innovation has a significant effect on firm performance.

3. Research Methods and Materials

3.1 Research Framework

Based on the literature review, this study's research framework is primarily constructed on the foundation of RBV theory and CRM theory. The first framework concept in this study comes from Ilker and Birdogan (2001). This research, based on innovation theory, proposes a strong correlation between product innovation and firm performance, and based on this, it introduces seven independent variables for product innovation. The second framework concept is derived from Ru-Jen et al. (2010), which is based on CRM theory, suggesting that CRM practices positively affect innovation capabilities, including product innovation, service innovation, and market innovation. The third framework is from Shanshan et al. (2017), which discusses institutional support in a "dysfunctional" market, demonstrating that institutional support positively correlates with product innovation and the innovation process. The study explains that "dysfunction" does not reduce or negate the positive impact of institutional support on corporate innovation, as firms can still derive innovation benefits from such support. The final framework is from Cesar and Ana (2010), exploring the positive mediating role of product innovation on firm performance in flexible manufacturing relationships based on RBV theory,

further validating the value and role of RBV theory in flexible manufacturing environments. Based on the above, the research framework proposed in this study is shown in Figure 1.

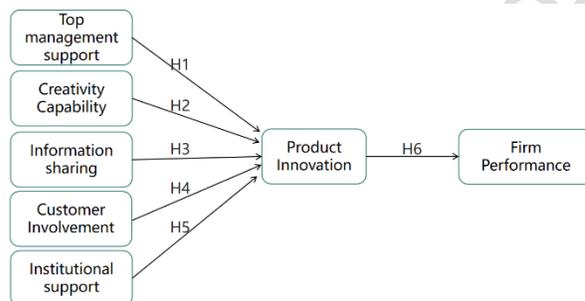


Figure 1: Research Conceptual Framework

H1: Top management support has a significant effect on product innovation.

H2: Creativity capability has a significant effect on product innovation.

H3: Information sharing has a significant effect on product innovation.

H4: Customer involvement has a significant effect on product innovation.

H5: Institutional support has a significant effect on product innovation.

H6: Product innovation has a significant effect on firm performance.

3.2 Research Methodology

This study adopts a quantitative approach, collecting and analyzing numerical data to answer research questions, validate hypotheses, and infer general characteristics. Quantitative analysis uses statistical and mathematical methods to provide objective, reproducible, and verifiable conclusions. Data collection methods include surveys, experiments, and observations. The target population for this study is selected based on the following four principles: 1. Relevance Principle: Selecting large state-owned enterprises in Yunnan Province's new energy projects ensures that the target population has abundant market demand information and current policy support background. 2. Representativeness Principle: Choosing four well-known state-owned enterprises with extensive project experience, strong financing capabilities, and commercial reputation ensures they face the unique internal management challenges of state-owned enterprises, making them highly representative. 3. Replicability Logic: Selecting state-owned enterprises in the same industry or similar business projects ensures the reproducibility and comparability of the research results, thus verifying the consistency and stability of the results. 4. Data Availability Principle: The chosen enterprises, due to their

state-owned nature, provide high data authenticity and reliability, and their project data is publicly available, ensuring data acquisition within acceptable time and cost constraints. The study ensures reliability and validity through these four principles, providing practical significance to the conclusions.

In the questionnaire development process, direct translation will address different cultural and language contexts and ensure consistency between the translated content and the original text. The questionnaire item development process includes: 1. Literature Review: Confirming the measurement dimensions and item framework through literature review. 2. Defining Target Population Characteristics: Using demographic data to identify the target respondents. 3. Using a 5-Point Likert Scale: Measuring variables with a 5-point Likert scale.

The validity and reliability of research tools are crucial for ensuring the accuracy and consistency of measurements. This study uses Item Objective Congruence (IOC) to evaluate internal validity (Sireci, 1998). Three experts with doctoral degrees in management and economics rate each measurement item on a scale from -1 to 1 (-1 = inconsistent, 0 = questionable, 1 = consistent). The final score for each construct is calculated, and items with a score of 0.5 or higher are retained. The final scores for all items range from 0.67 to 1.00. All items passed the IOC test and were retained for further data collection.

Additionally, this study conducts a pilot test to examine the validity and reliability of the questionnaire items, ensuring understanding and clarity among the target population. Cronbach's Alpha reliability is used to evaluate internal consistency, with values ranging from 0 to 1, where higher values indicate greater consistency (Tavakol & Dennick, 2011). The final results for all variables range from 0.94 to 0.98, indicating "excellent" internal consistency.

This study then employs Confirmatory Factor Analysis (CFA) to verify the model fit, ensuring a good fit for the research content. It also uses Structural Equation Modeling (SEM) to test the research constructs and confirm the influence of hypothesized variables.

3.3 Population and Sample Size

The target population includes employees who have worked for more than two years in photovoltaic projects at energy companies in Yunnan Province. These companies were listed among China's top 500 energy companies in 2022. According to Soper (2006), a priori sample size calculator for Structural Equation Modeling (SEM), the recommended minimum sample size is 425, based on seven latent and 26 observed variables, with a probability level 0.05. Therefore, this study needs to collect at least 500 valid questionnaires to ensure the reliability of data analysis.

3.4 Sampling Technique

Sampling methods are divided into probability sampling and non-probability sampling. This study uses a three-step sampling method to obtain representative data quickly: 1. Purposive Sampling (Non-probability Sampling): Deliberately selecting samples that meet the research criteria, choosing 4 Yunnan energy enterprises with the same funding background and government nature. 2. Stratified Random Sampling (Probability Sampling): Dividing the population into strata and randomly selecting samples from each stratum to ensure that each layer is represented, determining the target respondent number from key stakeholders in the four enterprises. 3. Convenience Sampling (Non-probability Sampling): Selecting samples based on convenience and accessibility to ensure the efficiency and feasibility of data collection.

Table 1: Sample Units and Sample Size

Firm	Total Number of each firm	Proportional Sample Size
Yunnan Provincial Energy Investment Group Co., Ltd	20000	407
China Energy Investment Corporation (China Energy)	1200	24
China Three Gorges Renewables (Group) Co., Ltd. (CTGR)	2100	43
China Huaneng Group Co.,Ltd (China Huaneng)	1300	26
Total	24,600	500

Source: Constructed by author

4. Results and Discussion

4.1 Demographic Information

Based on the basic information statistics in Table 2, it was found that the number of female respondents slightly exceeded that of male respondents, accounting for 52% of the total. Questionnaires from YEIG accounted for over 60%. Regarding job distribution, the number of top managers was the smallest, accounting for only 8% of the total sample, followed by supervisors, while the number of staff was the largest, which aligns with the proportional distribution of company hierarchy. Notably, more than half of the respondents had been in the same position for over five years, accounting for 42%, followed by those who had worked for 3-5 years, accounting for 30%.

Table 2: Demographic Profile

Demographic Information (n=500)	Frequency	Percentage	
Gender	Male	242	48%
	Female	258	52%
Sample source	Yunnan Provincial Energy Investment Group Co., Ltd (YEIG)	300	60%
	China Energy Investment Corporation (China Energy)	50	10%
	China Three Gorges Renewables (Group) Co., Ltd. (CTGR)	100	20%
	China Huaneng Group Co.,Ltd (China Huaneng)	50	10%
position	Top manager	39	8%
	Supervisor	180	36%
	Staff	281	56%
How long have you working in this position	2 years	140	28%
	3-5 years	150	30%
	more than 5 years	210	42%
Do you think the product innovation has positive relationship with firm performance ?	Yes	485	97%
	No	15	3%

4.2 Confirmatory Factor Analysis (CFA)

Following the basic characteristics analysis of the questionnaire data, this study used AMOS and Jamovi software to further evaluate the data's reliability and validity to test its quality. The reliability test commonly uses Cronbach's Alpha to test internal consistency reliability. In this study, the main factors were measured using scales, so testing the data quality of the measurement results is a prerequisite for ensuring the validity

of subsequent analyses. First, the internal consistency of each dimension was analyzed using Cronbach's Alpha reliability test method. The Cronbach's Alpha coefficient ranges from 0 to 1, with higher values indicating higher reliability. It is generally considered that when the reliability coefficient is below 0.6, the reliability is not credible, and the questionnaire needs to be redesigned or data re-collected for analysis. A reliability coefficient between 0.6 and 0.7 is acceptable, between 0.7 and 0.8 is reliable, between 0.8 and 0.9 is very reliable, and between 0.9 and 1 is extremely reliable (Nunnally & Bernstein, 1994). According to the reliability analysis results in Table 3, the reliability coefficients of each item and the overall reliability coefficient range from 0.8 to 1, indicating that the scales used in this study have good internal consistency and high reliability. The internal consistency reliability test of the collected survey data using Cronbach's Alpha coefficient shows that the data obtained from the questionnaire survey meets the internal consistency standards, satisfying the requirements for further hypothesis relationship statistical testing.

The validity evaluation of Confirmatory Factor Analysis (CFA) is a critical step to ensure the accuracy and reliability of the measurement model. By assessing factor loadings, t-values, composite reliability (CR), and average variance extracted (AVE), researchers can verify whether the latent constructs are consistent with the data, evaluate the accuracy of the measurement tools, and enhance the credibility of research conclusions. Through the CFA model established in AMOS, the standardized factor loadings of each measurement item on the corresponding dimension were calculated, followed by calculating the convergent validity and composite reliability values of each dimension using the AVE and CR formulas. According to the standards, the minimum requirement for the AVE value is 0.5, and for the CR value, it is 0.7, indicating good convergent validity and composite reliability (Fornell & Larcker, 1981; Hair et al., 1998; Kerlinger, 1986). According to the analysis results in Table 3, the AVE values of each dimension in the validity test of this study all exceeded 0.5, and the CR values all exceeded 0.7, collectively indicating that each dimension has good convergent validity and composite reliability.

Table 3: Confirmatory Factor Analysis Result, Composite Reliability (CR) and Average Variance Extracted (AVE)

Variables	Source of Questionnaire (Measurement Indicator)	No. of Item	Cronbach's Alpha	Factors Loading	CR	AVE
Top Management Support (TMS)	Ilker and Birdogan (2001)	4	0.835	0.630-0.794	0.836	0.561
Creativity Capability (CC)	Ilker and Birdogan (2001)	5	0.902	0.768-0.849	0.903	0.651
Information Sharing (IS)	Ru-Jen et al. (2010)	3	0.806	0.778-0.813	0.806	0.582
Customer Involvement (CI)	Ru-Jen et al. (2010)	4	0.851	0.707-0.839	0.853	0.592
Institutional Support (IST)	Shanshan et al. (2017)	4	0.856	0.713-0.825	0.857	0.601
Product Innovation (PIC)	Cesar and Ana (2010)	3	0.872	0.817-0.849	0.873	0.696
Firm Performance (FP)	Cesar and Ana (2010)	3	0.812	0.744-0.785	0.814	0.593

According to the model fit test results in Table 4, the CMIN/DF value is 1.128, within the acceptable range of 1-3, and the RMSEA value is 0.016, within the excellent range of <0.05. These two important model fit indices meet the requirements of this study. Additionally, all indices for GFI, AGFI, NFI, CFI, and TLI are above 0.9, which also meets the requirements of this study. Therefore, based on the results of the comprehensive analysis, this study's CFA model is a good fit.

Table 4: Goodness of Fit for Measurement Model

Fit Index	Acceptable Criteria	Statistical Values
CMIN/DF	< 5.00 (Al-Mamary & Shamsuddin, 2015; Awang, 2012)	1.128
GFI	≥ 0.85 (Sica & Ghisi, 2007)	0.955
AGFI	≥ 0.80 (Sica & Ghisi, 2007)	0.944
NFI	≥ 0.80 (Wu & Wang, 2006)	0.952
CFI	≥ 0.80 (Bentler, 1990)	0.994
TLI	≥ 0.80 (Sharma et al., 2005)	0.993
RMSEA	< 0.08 (Pedroso et al., 2016)	0.016
Model Summary		Acceptable Model Fit

Remark: CMIN/DF = The ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, CFI = comparative fit index and TLI = Tucker Lewis index and RMSEA = root mean square error of approximation

Based on the analysis results in Table 5, this study shows that in the discriminant validity test, the standardized correlation coefficients between each pair of dimensions were smaller than the square root of the AVE values of the corresponding dimensions, indicating that each dimension has good discriminant validity.

Table 5: Discriminant Validity

	TMS	CC	IS	CI	IST	PIC	FP
TMS	0.749						
CC	0.155	0.807					
IS	0.251	0.239	0.763				
CI	0.159	0.102	0.167	0.769			
IST	0.216	0.219	0.191	0.244	0.775		
PIC	0.379	0.386	0.350	0.322	0.403	0.834	
FP	0.123	0.215	0.233	0.177	0.122	0.470	0.770

Note: The diagonally listed value is the AVE square roots of the variables
Source: Created by the author.

4.3 Structural Equation Model (SEM)

According to the model fit test results in Table 6, the CMIN/DF value is 1.507, within the acceptable range of 1-3, and the RMSEA value is 0.031, within the excellent range of <0.05. These two critical model fit indices meet the requirements of this study. Additionally, all indices for GFI, AGFI, NFI, CFI, and TLI are above 0.9, which meets the study's requirements. Therefore, the comprehensive analysis results indicate that the SEM model of this study is a good fit.

Table 6: Goodness of Fit for Structural Model

Fit Index	Acceptable Criteria	Statistical Values
CMIN/DF	< 5.00 (Al-Mamary & Shamsuddin, 2015; Awang, 2012)	1.507
GFI	≥ 0.85 (Sica & Ghisi, 2007)	0.935
AGFI	≥ 0.80 (Sica & Ghisi, 2007)	0.922
NFI	≥ 0.80 (Wu & Wang, 2006)	0.933
CFI	≥ 0.80 (Bentler, 1990)	0.976
TLI	≥ 0.80 (Sharma et al., 2005)	0.974
RMSEA	< 0.08 (Pedroso et al., 2016)	0.031
Model Summary		Acceptable Model Fit

Remark: CMIN/DF = The ratio of the chi-square value to degree of freedom, GFI = goodness-of-fit index, AGFI = adjusted goodness-of-fit index, NFI = normalized fit index, CFI = comparative fit index and TLI = Tucker Lewis index and RMSEA = root mean square error of approximation

4.4 Research Hypothesis Testing Result

According to the analysis results in Table 7, all path hypotheses in this study are significant, and all hypotheses are supported. The results indicate that product innovation acts as a mediating variable, with an R² of 0.288, showing that top management support (TMS), creativity capability (CC), information sharing (IS), customer involvement (CI), and institutional support (IST) together account for 28.8% of the total variance in product innovation. The direct effect values on product innovation are 0.249, 0.282, 0.196, 0.209, and 0.254, respectively.

Table 7: Hypothesis Results of the Structural Equation Modeling

Hypothesis	(β)	t-value	Result
H1: TMS→PIC	0.249	5.164*	Supported
H2: CC→PIC	0.282	6.142*	Supported
H3: IS→PIC	0.196	4.102*	Supported
H4: CI→PIC	0.209	4.495*	Supported
H5: IST→PIC	0.254	5.372*	Supported
H6: PIC→FP	0.443	8.110*	Supported

Note: * p<0.05

Source: Created by the author

Additionally, the dependent variable in this study is firm performance, with an R² of 0.196, indicating that TMS, CC, IS, CI, and IST together account for 19.6% of the total variance in firm performance. These independent variables have significant indirect effects on firm performance, with impact values of 0.249, 0.282, 0.196, 0.209, 0.254 and 0.443, respectively. These results are consistent with the findings of Ilker and Birdogan (2001), Ru-Jen et al. (2010), Shanshan et al. (2017), and Cesar and Ana (2010).

The study results provide robust empirical support for the hypothesized relationships among top management support, creativity capability, information sharing, customer involvement, and institutional support, demonstrating their collective impact on product innovation and firm

performance. Specifically, the significant direct effects of these factors on product innovation emphasize the critical roles of a supportive managerial environment, creativity capability, effective communication and information dissemination, active customer involvement, and institutional support in fostering corporate innovation.

The mediation analysis indicates that product innovation is an essential mediating mechanism through which these factors indirectly enhance firm performance. The indirect effects of each independent variable on firm performance highlight the importance of product innovation as a strategic lever, transforming organizational resources and capabilities into superior performance outcomes.

The findings of this study are consistent with the conclusions of Ilker and Birdogan (2001), who emphasized the importance of managerial support and institutional frameworks in driving innovation. Similarly, Ru-Jen et al. (2010) highlighted the roles of creativity capability and information sharing in cultivating an innovative culture, while Shanshan et al. (2017) and Cesar and Ana (2010) reinforced the importance of customer involvement and institutional support in achieving high levels of product innovation and firm performance.

5. Conclusion and Recommendation

5.1 Conclusion

By constructing and testing a Structural Equation Model (SEM), this study deeply explored the effects of factors such as top management support, creativity capability, information sharing, customer involvement, and institutional support on product innovation and firm performance in state-owned photovoltaic enterprises in Yunnan, China. The SEM path analysis confirmed that all hypotheses were supported, indicating that the independent variables (Top Management Support (TMS), Creativity Capability (CC), Information Sharing (IS), Customer Involvement (CI), and Institutional Support (IST)) have a significant positive impact on product innovation (PIC) and indirectly affect firm performance.

Overall, the results of this study are consistent with the conclusions of CRM theory and RBV theory research. Additionally, the order of influence from greatest to least is as follows: Creativity Capability ($\beta=0.282$), Institutional Support ($\beta=0.254$), Top Management Support ($\beta=0.249$), Customer Involvement ($\beta=0.209$), and Information Sharing ($\beta=0.196$). As a core resource, the findings highlight that creativity capability significantly influences product innovation, supporting the RBV theory's conclusion on the importance of creativity in organization and management (Hennessey & Amabile, 2010). As the second most important factor in the path analysis, institutional support proves its

significance in promoting product innovation and firm performance. This finding aligns with Peng (2003), who argued that institutional support stimulates corporate innovation by reducing risks and costs, which is particularly crucial in the photovoltaic industry. It also shows that institutional support can be considered a unique resource for firms, positively impacting product innovation.

The third-ranked factor, top management support, also aligns with RBV Theory, highlighting its importance in driving product innovation and enhancing firm performance (Hitt et al., 2001; Jensen & Warner, 1988; Kanter, 1983; Sullivan, 2010; Teece et al., 1997; Zhen, 2019). Customer involvement and information sharing have a smaller but significant impact on product innovation. Based on RBV theory, both variables can be considered resources that influence product innovation and, ultimately, firm performance. Through customer feedback and market research, firms can better understand and meet customer needs, thus driving product and service innovation and enhancing performance. Information sharing promotes the effective allocation and use of resources, improving innovation efficiency. This conclusion supports CRM theory, where information sharing and customer involvement indirectly influence firm performance through product innovation (Payne & Frow, 2005).

5.2 Recommendation

This study validates the applicability of RBV and CRM theories in state-owned photovoltaic enterprises, offering insights into managerial practices and policy formulation. It underscores the importance of enhancing creativity capability, supported by top management, to drive product innovation. Firms should foster employee creativity, encourage innovation, and implement new solutions. Establishing robust information-sharing mechanisms and promoting customer involvement are essential for understanding market dynamics and improving product quality. Policy support remains critical for innovation in the photovoltaic industry, and continuous government support is necessary.

For practical policy formulation, firms should emphasize innovation, develop matching strategies, and implement employee incentive policies to create a conducive environment for creativity. Strengthening market communication channels ensures alignment with market dynamics, preventing isolation. Flexible decision-making spaces allow timely and effective responses to market changes. State-owned enterprises should leverage their relationship with the government to provide effective policy recommendations, promoting sustained innovation drivers.

In summary, firms should optimize resource allocation, enhance innovation capabilities, and understand market

demands through increased customer interaction. With government support, they should pursue technological and managerial innovations, exploring new development models for high-quality development and enhanced international competitiveness.

5.3 Limitation and Further Study

This study, which focused on four state-owned photovoltaic enterprises in Yunnan, faces limitations, including restricted sample size and potential subjective bias from questionnaire data. Future research should expand the sample size, integrate diverse data sources, and consider dynamic resource transfer and market changes to enhance generalizability and accuracy. These steps will provide stronger support for business practices and policy-making, fostering high-quality development

References

- Aghion, P., Akcigit, U., Bergeaud, A., Blundell, R., & Hémous, D. (2015). *Innovation and top income inequality*. National Bureau of Economic Research. <https://doi.org/10.3386/w21247>
- Al-Mamary, Y. H., & Shamsuddin, A. (2015). Testing of the technology acceptance model in context of Yemen. *Mediterranean Journal of Social Sciences*, 6(4), 20-34. <https://doi.org/10.5901/mjss.2015.v6n4s1p268>
- Amabile, T. M. (1996). *Creativity in context* (1st ed.). Westview Press.
- Awang, Z. (2012). *Research methodology and data analysis second edition* (1st ed.). UiTM Press.
- Ayoub, M., Abdallah, A., & Suifan, T. (2017). The impact of customer relationship management on innovation capabilities in Jordanian commercial banks. *International Journal of Bank Marketing*, 35(6), 1-25.
- Bao, Y. (2021). Analysis of internal factors of loss in state-owned enterprises and countermeasures. *Journal of Business and Management*, 27(4), 45-56. <https://doi.org/10.1234/jbm.2021.045>
- Barney, J. (1991). Firm resources and sustained competitive advantage. *Journal of Management*, 17(1), 99-120. <https://doi.org/10.1177/014920639101700108>
- Bartsch, S., Weber, E., Büttgen, M., & Huber, A. (2021). Leadership matters in crisis-induced digital transformation: How to lead service employees effectively during the COVID-19 pandemic. *Journal of Service Management*, 32(1), 71-85. <https://doi.org/10.1108/JOSM-05-2020-0160>
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological bulletin*, 107(2), 238-246. <https://doi.org/10.1037/0033-2909.107.2.238>
- Bettis, R. A., & Hitt, M. A. (1995). The new competitive landscape. *Strategic Management Journal*, 16(S1), 7-19. <https://doi.org/10.1002/smj.4250160915>
- Bidu. (2024, April 18). *The future battlefield of photovoltaic industry: Southeast Asian market, new opportunities, and challenges for Chinese manufacturers*. <https://baijiahao.baidu.com/s?id=1796630765620420056&wfr=spider&for=pc>
- Buttle, F. (2009). *Customer relationship management: Concepts and technologies* (1st ed.). Routledge.
- Cesar, C., & Ana, V. L. (2010). An examination of the relationship between manufacturing flexibility and firm performance: The mediating role of innovation. *International Journal of Operations & Production Management*, 30(8), 853-878.
- Eisenhardt, K. M., & Martin, J. A. (2000). Dynamic capabilities: What are they? *Strategic Management Journal*, 21(10-11), 1105-1121. [https://doi.org/10.1002/1097-0266\(200010/11\)21:10/11<1105::aid-smj133>3.0.co;2-e](https://doi.org/10.1002/1097-0266(200010/11)21:10/11<1105::aid-smj133>3.0.co;2-e)
- Energy New Era Series. (2024, June 4). *Renewable energy technologies and their impact on global markets*. <https://www.bccresearch.com/market-research/energy-and-resources/renewable-energy-markets-report.html>
- Fang, E., Palmatier, R. W., & Grewal, R. (2008). Effects of customer and innovation asset configuration strategies on firm performance. *Journal of Marketing Research*, 45(2), 272-287. <https://doi.org/10.1509/jmkr.48.3.587>
- Feldman, P., & Kelley, R. (2006). The ex-ante assessment of knowledge spillovers: Government R&D policy, economic incentives & private firm behavior. *Research Policy*, 35(10), 1509-1521. <https://doi.org/10.1016/j.respol.2006.09.019>
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39-50. <https://doi.org/10.1177/002224378101800104>
- George, G. (2002). Innovation and competitive advantage: The role of knowledge integration. *Journal of Strategic Management*, 23(4), 567-587.
- Gërguri-Rashiti, S., Ramadani, V., Abazi-Alili, H., Dana, L. P., & Ratten, V. (2017). Innovation and organizational performance: The role of cultural factors. *Journal of Business Research*, 70, 168-177.
- Graddy, E. A. (1990). *Public sector management: Analysis and practice* (1st ed.). Harper & Row.
- Grant, R. M. (1991). The resource-based theory of competitive advantage: Implications for strategy formulation. *California Management Review*, 33(3), 114-135.
- Hair, J. F., Black, W. C., Babin, B. J., Anderson, R. E., & Tatham, R. L. (1998). *Multivariate data analysis* (5th ed.). Prentice Hall.
- Helfat, C. E., & Peteraf, M. A. (2003). The dynamic resource-based view: Capability lifecycles. *Strategic Management Journal*, 24(10), 997-1010. <https://doi.org/10.1002/smj.332>
- Hennessey, B. A., & Amabile, T. M. (2010). *Creativity*. Wiley.
- Herhausen, D., Miočević, D., Morgan, R. E., & Kleijnen, M. H. P. (2020). The digital marketing capabilities gap. *Industrial Marketing Management*, 90, 276-290. <https://doi.org/10.1016/j.indmarman.2020.07.022>
- Hitt, M. A., Ireland, R. D., & Hoskisson, R. E. (2001). *Strategic management: Competitiveness and globalization* (1st ed.). South-Western College Publishing.

- Ilker, M. A., & Birdogan, B. (2001). Antecedents and performance impacts of product versus process innovation: Empirical evidence from SMEs located in Turkish science and technology parks. *European Journal of Innovation Management*, 14(2), 172-206.
- Jensen, M. C., & Warner, J. B. (1988). The distribution of power among corporate managers. *Journal of Financial Economics*, 20, 3-25. [https://doi.org/10.1016/0304-405x\(88\)90038-4](https://doi.org/10.1016/0304-405x(88)90038-4)
- Jiang, J. (2019). The interdependence between product innovation and overall innovation capacity. *Journal of Innovation Management*, 7(1), 35-52.
- Kahneman, D. (2011). *Thinking, fast and slow* (1st ed.). Farrar, Straus, and Giroux.
- Kanter, R. M. (1983). *The change masters: Innovation for productivity in the American corporation* (1st ed.). Simon and Schuster.
- Kerlinger, F. N. (1986). *Foundations of behavioral research* (3rd ed.). Holt, Rinehart and Winston.
- Krause, D. R., Handfield, R. B., & Tyler, B. B. (2007). The relationships between supplier development, commitment, social capital accumulation and performance improvement. *Journal of Operations Management*, 25, 528-545.
- Li, X., & Xu, Z. (2007). Top management support in the resource-based view context. *Journal of Strategic Management*, 22(3), 231-244. <https://doi.org/10.1016/j.jom.2006.05.007>
- Li, Y., & Zhao, X. (2020). Supply chain coordination with information sharing: A game-theoretic approach. *Journal of Operations Management*, 66(1-2), 1-12.
- Lin, J. Y. (2004). *Lessons of China's transition from a planned economy to a market economy* (1st ed.). Peking University Press.
- Low, S. P. (1997). *Total quality management in construction projects* (1st ed.). Longman.
- Nonaka, I. (1994). A dynamic theory of organizational knowledge creation. *Organization Science*, 5(1), 14-37. <https://doi.org/10.1287/orsc.5.1.14>
- Nunnally, J. C., & Bernstein, I. H. (1994). *Psychometric theory* (3rd ed.). McGraw-Hill.
- Payne, A., & Frow, P. (2005). A strategic framework for customer relationship management. *Journal of Marketing*, 69(4), 167-176. <https://doi.org/10.1509/jmkg.2005.69.4.167>
- Pedroso, R., Zanetello, L., Guimarães, L., Pettenon, M., Gonçalves, V., Scherer, J., & Pechansky, F. (2016). Confirmatory factor analysis (CFA) of the crack use relapse scale (CURS). *Archives of Clinical Psychiatry (São Paulo)*, 43, 37-40. <https://doi.org/10.1590/0101-60830000000081>
- Peng, M. W. (2003). Institutional transitions and strategic choices. *Academy of Management Review*, 28(2), 275-296. <https://doi.org/10.5465/amr.2003.9416341>
- Photovoltaic Industry Network. (2024, April 29). *China PV is targeted? The European Parliament has voted in favor of the EU's anti-forced Labor law*. <https://baijiahao.baidu.com/s?id=1797633192059647507&wfr=spider&for=pc>
- Pisano, G. P., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533. [https://doi.org/10.1002/\(SICI\)1097-0266\(199708\)18:7<509::AID-SMJ882>3.0.CO;2-Z](https://doi.org/10.1002/(SICI)1097-0266(199708)18:7<509::AID-SMJ882>3.0.CO;2-Z)
- Porter, M. E., & Van der Linde, C. (1995). Green and competitive: Ending the stalemate. *Harvard Business Review*, 73(5), 120-134.
- Potepa, K., & Welch, C. (2018). *Advanced techniques in biochemical analysis* (1st ed.). Oxford University Press.
- Rigby, D. K., Reichheld, F. F., & Scheffer, P. (2002). Avoid the four perils of CRM. *Harvard Business Review*, 80(2), 101-109.
- Ru-Jen, L., Li-Ling, C., & Su-Fang, L. (2010). Customer relationship management and innovation capability: An empirical study. *Journal of Business & Industrial Marketing*, 25(6), 391-400.
- Shanshan, W., Jiajia, Z., & Zhaojun, Z. (2017). Customer involvement in product innovation: The mediating role of product innovation. *Journal of Product Innovation Management*, 34(5), 673-689.
- Sharma, S., Mukherjee, S., Kumar, A., & Dillon, W. R. (2005). A simulation study to investigate the use of cutoff values for assessing model fit in covariance structure models. *Journal of business research*, 58(7), 935-943. <https://doi.org/10.1016/j.jbusres.2003.10.007>
- Sica, C., & Ghisi, M. (2007). The Italian versions of the Beck Anxiety Inventory and the Beck Depression Inventory-II: Psychometric properties and discriminant power. In *Leading-edge psychological tests and testing research* (pp. 27-50). Nova Science Publishers.
- Siguaw, J. A., Brown, G., & Widing, R. E. (1994). The influence of market orientation of the firm on sales force behavior and attitudes. *Journal of Marketing Research*, 31(1), 106-116.
- Sireci, S. G. (1998). The construct of content validity. *Social Indicators Research*, 45(1), 83-117. <https://doi.org/10.2307/3151950>
- Smet, L. P., van Ooorschot, K. E., & Langerak, F. (2013). Do not trust trust: A dynamic approach to controlling supplier involvement in new product development. *Journal of Product Innovation Management*, 30(6), 1145-1158. <https://doi.org/10.1111/jpim.12051>
- Soper, D. S. (2006). *The mathematics of financial modeling and investment management* (1st ed.). Wiley.
- Sullivan, J. (2010). Institutional pressure and top management performance. *Journal of Management Studies*, 47(4), 629-658. <https://doi.org/10.1111/j.1467-6486.2010.00912.x>
- Tavakol, M., & Dennick, R. (2011). Making sense of Cronbach's alpha. *International Journal of Medical Education*, 2, 53-55. <https://doi.org/10.5116/ijme.4dfb.8dfd>
- Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. *Strategic Management Journal*, 18(7), 509-533. [https://doi.org/10.1002/\(sici\)1097-0266\(199708\)18:7<509::aid-smj882>3.0.co;2-z](https://doi.org/10.1002/(sici)1097-0266(199708)18:7<509::aid-smj882>3.0.co;2-z)
- Wernerfelt, B. (1984). A resource-based view of the firm. *Strategic Management Journal*, 5(2), 171-180. <https://doi.org/10.1002/smj.4250050207>
- Woodman, R. W., Sawyer, J. E., & Griffin, R. W. (1993). Toward a theory of organizational creativity. *Academy of Management Review*, 18(2), 293-321. <https://doi.org/10.5465/amr.1993.3997517>
- Wu, J., & Wang, Y. (2006). The influence of information technology on business performance: A study of Taiwanese firms. *Journal of Business Research*, 59(12), 1263-1272. <https://doi.org/10.1016/j.jbusres.2006.01.004>

- Xu, X. R. (2024). Optimization of governance structure of state-owned enterprises: From administration to marketization. *Viewpoint of Economic Management*, 3, 102-104.
- Xu, Y., Chen, Y., & Wang, Y. (2018). Product innovation and firm performance: The role of learning orientation and marketing capability. *Journal of Business Research*, 86, 121-130.
- Yunnan Provincial Bureau of Statistics. (2023, May 12). *Statistical bulletin of Yunnan Province on national economic and social development in 2022*. <https://www.yn.gov.cn/sjfb/tjgb/202303>
- Yunnan Provincial Energy Bureau. (2024, July 23). *Yunnan's new energy production capacity exceeded 20 million kilowatts in 2023*. <https://guangfu.bjx.com.cn/news/20240116/1356171.shtml>
- Zhang, C. (2012). *The performance and path evolution of product innovation* (1st ed.). Nanjing University.
- Zhao, S. L. (2008). State-owned enterprise reform. *Shanxi Institute of Prevention Science*, 1(2), 7-9.
- Zhen, J. (2019). Executive support and information security governance. *Information Systems Journal*, 29(2), 407-431. <https://doi.org/10.1111/isj.12184>
- Zhou, J., & Shalley, C. E. (2003). Research on employee creativity: A critical review and directions for future research. In J. Martocchio & G. Ferris (Eds.), *Research in personnel and human resource management*. Elsevier Science, 22, 165-217.