

Article

A Study on the Impact of Institutional Support on the Servitization Transformation Performance of Manufacturing Firms—Based on a Dual Mediation Model of Business Model Innovation and Technological Innovation

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Citation: Cao, H.; Fang, Y.; Sun, J. A Study on the Impact of Institutional Support on the Servitization Transformation Performance of Manufacturing Firms—Based on a Dual Mediation Model of Business Model Innovation and Technological Innovation. *Sustainability* **2022**, *14*, 14349. <https://doi.org/10.3390/su142114349>

Academic Editor: Grigorios L. Kyriakopoulos

Received: 9 October 2022

Accepted: 29 October 2022

Published: 2 November 2022

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Abstract: The servitization transformation of manufacturing enterprises serves as an important impetus for the current high-quality development of the manufacturing industry. Relying on the institutional-based view, this paper investigates the effect of institutional support on the servitization transformation performance of manufacturing enterprises and the mediating function of business model innovation and technological innovation in the course of this procedure. The study demonstrates that both formal and informal institutional support have significant positive influences on servitization transformation performance, and the active effect of informal institutional support is stronger; institutional support has significant positive effects on business model innovation and technological innovation; and business model innovation and technological innovation mediates among institutional support and servitization transformation performance. This study analyzes the mechanism of the influence of institutional support on the servitization transformation performance of manufacturing enterprises, which thus enriches literature related to servitization transformation in manufacturing enterprises and provides some insight to help managers in manufacturing enterprises perform servitization transformation activities through business model innovation and technological innovation with institutional support.

Keywords: formal institutional support; informal institutional support; business model innovation; technology innovation; servitization transformation performance

1. Introduction

China's economic advancement is undergoing a shift from high growth to high-quality construction. As the chief source of China's economic growth, the manufacturing industry needs to be promoted unswervingly. At present, the service transformation of manufacturing enterprises has been a major trend in worldwide industrial growth [1,2], while the report of the 19th National Congress of the Communist Party of China has also proposed to promote the integrated growth of advanced manufacturing and modern service industries [3]. The strategic guidelines of Made in China 2025 clearly state that the provinces should promote the transformation of China's production-based manufacturing industry to service-based manufacturing [4]. The convergence of the manufacturing and service industry can increase the proportion of service elements in manufacturing enterprises, shift the business focus of manufacturing enterprises from production to service [5], improve the additional value of products [6], and subsequently ascend the high-value chain of the industry to facilitate the high-quality construction of the manufacturing industry. In the Industry 4.0 era, as companies develop personalized solutions that require collaborative innovation, integrated supply chains, and interconnected production resources [7], the servitization transformation of manufacturing companies profoundly affects the overall operation of the social economy through labor utilization, capital accumulation, and technological advances,

and this impact cannot be underestimated [8]. The service transformation of manufacturing enterprises is influenced by environmental, technological, and organizational factors [9].

Institutional support is an environmental change confronting manufacturing firms during the course of servitization transformation that can help manufacturing firms stimulate the innovation behavior of themselves, cope with difficulties in the process of servitization transformation, as well as enhance servitization transformation performance. Researchers have demonstrated that the innovation potential of enterprises is easier to develop in a relatively mature institutional environment, which can promote the development of enterprises and improve their performance level [10,11]. The majority of the currently available research on institutional support has been centered on firms' innovation performance [12–14], organizational performance [15], and commercialization performance [16], thus confirming the significant impact of institutional support on performance from an institutional perspective; existing studies on servitization transformation performance have attached importance to firms' operational capacity [17,18], responsiveness [19,20], and other internal capabilities, thus confirming multiple factors that affect servitization transformation performance; however, the aforementioned studies do not address the association of institutional support of servitization transformation performance. Therefore, the relationship between the two needs to be studied in depth. On this basis, the issue regarding the mediatory role of business model innovation and technological innovation still needs to be clarified. Business model innovation and technological innovation are effective tools for companies to cope with internal and external changes and can help them adjust their development direction quickly and operate sustainably in the midst of change. Then, the issue of whether they are instrumental in how external institutional support impacts internal servitization transformation performance and the specific mechanism still requires further study.

Based on the above, this paper constructs a model of manufacturing enterprises' servitization transformation performance by relying on the institutional foundation view, conducting an in-depth investigation into the effectiveness between formal institutional support and informal institutional support on manufacturing enterprises' servitization transformation performance, and further analyzing the intermediation function for business model innovation and technological innovation on this basis to provide some thoughts for manufacturing enterprises to carry out servitization transformation. Major theoretical contributions to the research are, firstly, to study the institutional support process of servitization transformation of manufacturing enterprises using the institutional foundation view to determine the significant implications on formal and informal institutional support on the performance of servitization transformation, which thus remedies the neglect of the influence of institutional support during previous servitization transformation studies. Second, as business model innovation and technological innovation are internal methods for strengthening the servitization transformation performance of manufacturing enterprises, this emphasizes the importance of innovation for service transformation and the need for manufacturing enterprises to pay attention to internal innovation issues with institutional support, which in turn helps manufacturing enterprises raise their service transformation performance and remedies the problem of neglecting innovation in previous service transformation.

2. Literature Review and Research Hypothesis

2.1. Theoretical Basis

In modern industrial organization theory, Harvard University scholars have proposed the "Structure-Conduct-Performance" analysis paradigm (SCP). The main standpoint of this paradigm is that a firm's market behavior is influenced by the market structure, and any market conduct taken by a firm affects firm performance [21]. The improvement of the SCP analysis paradigm, taking into account the actual state of economical evolution in China, can make the study more adaptable to the current domestic development scenario. Li and Zhao (2016) transformed the SCP paradigm into an "Institution-Conduct-Performance"

research paradigm in the context of transition economies, analyzing the process by which institutional support affects organizational performance [15]. This paper extends the “Institution-Conduct-Performance” research paradigm to “Institutional Support-Firm Innovation Conduct-Service Transformation Performance” to investigate how institutional support can enhance servitization transformation performance by influencing business model innovation and technological innovation.

2.2. Institutional Support and Servitization Transformation Performance

Institutional support reflects the support and protection provided by government departments throughout the production and operation process of firms, which in turn remedies the consequences arising from the imperfection of the institutions for companies [22]. Government departments have a critical function in the course of the formulation of the system; therefore, whether companies can obtain the support of the system has a direct implication on the existence and development of the company [23]. All activities of enterprises are carried out under the institutional environment set by government departments, and being supported by the system can help enterprises avoid uncertainties and improve their competitiveness. Particularly in the transition period, on the one hand, the enterprises undergoing the transition are supported by the system and thus receive resources and policies, which enables them to obtain scarce resources and reduce the risks in the production and operation process [24], thus improving their performance; on the other hand, the enterprises undergoing the transition can, to a certain extent, grasp the information favorable to the development of the transition in advance [25] to ensure they can make timely responses to specific situations.

Institutional support is divided into formal institutional support and informal institutional support, both of which have influenced servitization transformation performance in different ways. To visually help readers understand and grasp the impact of two forms of institutional support on the performance of servitization transformation, this paper draws on the case of Wang et al. (2016) in *Manufacturing servitization in the Asia-Pacific* [26] and illustrates it in the context of the research topic of this paper.

Envision Energy Technology Co., Ltd. is currently among the top three wind turbine suppliers in China and the largest smart energy asset management service company in the world. The National Development and Reform Commission issued the “National Development and Reform Commission notice on wind power construction management requirements”, requiring the domestic wind power equipment localization rate to reach 70% or more [27]. China’s National Ministry of Finance issued the “Notice of the Ministry of Finance on the Issuance of the 2022 Renewable Energy Tariff Surcharge Subsidy Local Funds Budget”, which allocates monthly subsidy funds to wind power and other power generation projects to vigorously develop the wind power industry. In May 2022, the National Development and Reform Commission and the National Energy Administration issued the “Implementation Plan on Promoting the High-Quality Development of New Energy in the New Era”, which states that green power pilots should be carried out to guide enterprises toward the use of green electricity to manufacture products and provide services. The aforementioned government policies and financial subsidies have provided formal institutional support for the rise and service-oriented transformation of Envision Energy. Further, the informal institutional support Envision received can be illustrated by the example of the exploration of distributed wind power in cooperation with the Jiangyin Municipal Government since 2017. Since distributed power generation had not yet emerged in China at that time, there was still a lack of exploration, and Jiangyin Municipal Government still had a wait-and-see attitude towards building-distributed power generation. Envision actively negotiated with Jiangyin Municipal Government, proposed reliable technical solutions, established good political connections, and convinced the Jiangyin Municipal Government to promulgate the “Jiangyin Distributed Wind Power Feasibility Plan”, and subsequently obtained the commercial opportunity to establish distributed motors in Jiangyin Port [28], which relieved the pressure of local electricity

consumption and promoted local energy saving and emission reduction. In the process of servitization transformation, Envision has made targeted penetration of key links in the wind power industry chain, dividing the product life cycle into wind farm project preparation, wind farm construction, and wind farm operation and maintenance, focusing on supply-side innovation. Based on the analysis of the entire wind power industry chain, it was found that the expansion of the scope of servitization to the entire life cycle of products can maximize customer satisfaction and provide tailor-made wind power solutions for specific market segments and the special needs of customers [26].

Formal institutional support is one of the key signs that the government is providing economic support [29], including the provision of programs and policies, information technology, and financial support that is conducive to business development. Actions by government departments, such as providing loans to firms and granting licensing status [22], can help firms reduce risks in the production and operation process and drive them to innovate, thus improving their performance [30]. Formal institutional support provides companies with more options and enables them to find the best solution for their transformation through trial and error. The initiative of formal institutional support is in the hands of government departments, and manufacturing companies need to judge whether the formal institutional support provided by government departments is beneficial to the transformation of the company and then carry out the transformation activities. However, in most cases, the policies and financial support provided by government departments are conducive to the service transformation of manufacturing enterprises. On this basis, this paper proposes the following hypothesis:

H1a: *Formal institutional support has a positive impact on servitization transition performance.*

Unlike formal institutional support, the initiative of informal institutional support is in the hands of enterprises, which can obtain support from government departments by establishing a good relationship with them [31]. Informal institutional support manifests itself in its reliance on emotional and behavioral connections between companies and government departments, rather than formal regulations, systems, etc. By establishing good relationships and rapport with government departments, firms are able to obtain informal institutional support to a certain extent. After obtaining informal institutional support, enterprises can form political connections with government departments [32], and further obtain information that is beneficial to the development of enterprises through political connection behavior, which can promote enterprises to carry out original innovation [33] and improve their competitive advantages [34]. At the same time, the enterprise's stakeholder enterprises can also reach a consensus with the enterprise, establish a good partnership, and promote cooperation between enterprises. Therefore, in this paper, informal institutional support is defined as special support or resources obtained by firms through the establishment of political ties with government agencies at the local or national level [35] for business cooperation [36], the identification of potential business opportunities in government development plans [37] etc., and is a reflection of political actions taken by firms on their own initiative [25]. When enterprises form a stable relationship with government departments and stakeholders, they can further obtain more support, to a certain degree, so as to foster the transformation and development of enterprises. Therefore, manufacturing companies need to manage their relationship with government departments during the transformation to servitization, establish political connections, and obtain information that is beneficial to the companies to help them make decisions and improve the performance of servitization transformation. For this purpose, in this paper, the following assumption is made:

H1b: *Informal institutional support has a positive impact on servitization transition performance.*

2.3. Institutional Support and Business Model Innovation

Business model innovation is the thoughtful reconfiguration of one or more logical bases of commercial benefits to companies, consumers, and other interested parties [38]. The focus of business model innovation is to transform the logic of valuation creation of the enterprise before by using the inner and outer resources of the firms to design a new value chain system, and then realize the innovation of business model [39]. Hence, the process of business model innovation is compromised in terms of the institutions in the environment that companies operate in. Traditional institutional theory suggests that legitimation holds a prominent role in business model innovation [40]. Within the context of business model innovation, legitimation can be comprehended in terms of the specific social system's perceptions and assumptions regarding the methods and outcomes of business model innovation. That is, business model innovation does not only concern the behavior of the firm itself and will be supported or constrained by the system in the process. When a firm's business model innovation is favored by the institution, the firm has the capability to perceive the requirements and anticipations of the institutional environment for the firm and thus design the business model according to the information provided by the institutional environment [41]. This also places a demand on how companies can build a stable business model based on gaining legitimacy [42]. Companies should choose different ways to build business models based on the legitimacy of different system circumstances, focusing upon the resources and capabilities they can provide when facing the impact of formal institutional environments, while actively seeking network reconstruction opportunities when facing the impact of informal institutional environments [43]. When dealing with how different types of institutional support impact on business model innovation, it is also relevant to focus on the implication that business model innovation has on institutional support. The existing institutional support will be affected and changed even after the business model innovation, and then the business model will need to be innovated twice to adapt to the new institutional environment [44]. Regardless of the changes in institutional support, business models will be influenced by institutions to innovate. Based on this premise, in this paper, the following proposition is made:

H2: *Institutional support has a positive impact on business model innovation.*

2.4. Institutional Support and Technological Innovation

Technological innovation in enterprises requires, in principle, a strong resource base that can guarantee the continuity for technological innovation initiatives in the enterprise. Technological innovation requires, on the one hand, the improvement of products and services on the basis of the existing ones and provide high-quality ones; on the other hand, technological innovation requires being attentive to the current market, the ability to meet consumer needs [45] and forging new offerings and services. This also means that technological innovation in enterprises is a huge investment, but it does not guarantee effective output and has great risks. For most firms, especially those in transition, the resource base available does not support the firm's innovation activities. In this case, enterprises can strengthen their resource base to a great extent if they can obtain institutional support [46]. To a certain extent, the government sector holds many scarce resources, which enterprises also need for their innovation activities. Getting institutional support can also make up for the problem of enterprises' own resources, reduce the risk of their innovation, raise their awareness of technological innovation, and promote their technological innovation behavior. At the same time, the market mechanism in which technological innovation takes place is not always effective, thus increasing the rent-seeking costs for firms and consequently undermining their technological innovation capacity [47]. In this case, it is necessary to regulate the system by providing financial support, project support, and information support to make up for the lack of market, to improve the willingness of enterprises to carry out technological innovation, and thus promote their technological innovation behavior.

For enterprises, technological innovation not only requires the support of formal systems as enterprises also prefer the support of informal systems. Through informal institutional support, firms can obtain better resource conditions or learn about the latest policies faster than other firms so that they can adjust the direction of technological innovation and improve their competitiveness in a timely manner. In addition, government departments and their officials can gain relevant political benefits in the development of local enterprises [48], so they are also willing to form political ties with local enterprises and give certain informal support to local enterprises, especially technologically innovative enterprises, to stimulate their technological innovation activities. Based on this premise, the hypothesis is formulated as thus:

H3: *Institutional support has a positive impact on technological innovation.*

2.5. The Mediating Role of Business Model Innovation and Technological Innovation

Unlike previous service companies, while the service transformation of manufacturing companies does not directly provide a new type of service, it does provide additional services based on manufacturing companies' products or technologies [49]. Therefore, the business model and technology for manufacturing companies also determines the performance of service transformation of manufacturing companies. Even if a manufacturing company has no experience in providing services, it can improve the performance of service transformation through business model innovation and technology innovation. As servitization is a multi-subject-oriented strategy, the implementation of service activities requires manufacturing companies to innovate the business model elements [50]. The shift from a linear servitization strategy to a more sustainable service-oriented business model that provides resource efficiency-related services to customers will be the most resilient and profitable in the future [51] and is one of the challenges companies will face with a servitization-based business model. Companies with business model innovation can, on the one hand, promote servitization transformation performance by looking internally at all the value activities of the enterprise and innovating core processes to integrate and form a value chain [52]; on the other hand, they can look externally at the market environment faced by the enterprise and innovate or reconfigure the business resources of the enterprise according to the market they serve, thus promoting servitization transformation [53]. Technologically innovative companies are able to identify the current technological problems in their businesses, learn quickly, update the currently available technologies and products, and provide services to match them. At the same time, service improvement brought about by the technological progress of the enterprise can also gain the trust of customers, which can help the enterprise establish a long-lasting cooperation with customers and indirectly improve the performance of the enterprise service-oriented transformation [54].

In summary, institutional support relies on the advantages of the system to give effective help to manufacturing enterprises by making up for the shortcomings of existing policies and reducing the risks involved in the transformation process, thus improving the performance of servitization transformation. Formal institutional support provides policy, project, and financial support to drive service transformation through systematic support, while informal institutional support provides more information and timely responses through political connections between enterprises and government departments. However, external institutional support alone does not necessarily improve the service transformation performance of manufacturing enterprises; it needs to be combined with internal business model innovation and technological innovation. After obtaining institutional support, enterprises need to apply the obtained institutional support in servitization transformation and promote servitization transformation performance by converting the obtained institutional support through business model innovation and technological innovation. Business model innovation, as an intermediate strategic action linking the support provided by the system with the firm's own business model, allows firms to translate the ability to detect and analyze institutional support into specific strategic actions that take advantage of these developments [55]. Innovating the shift of existing business models toward servitization

and focusing on the business model elements of the enterprise's servitization transformation process promotes servitization transformation performance [7]. Government support and investment contribute to the entrepreneurial spirit of enterprises and promote technological innovation [56], while technological innovation can rely on relevant policies and programs provided by the government system, combined with the direction of servitization transformation and attachment of service elements to technological innovation to achieve the result of technology and service co-innovation [57]. Relying on business model innovation and technological innovation, manufacturing enterprises can make full use of the support given by the system to achieve the goal of service transformation. Accordingly, in this paper, the hypotheses below are proposed:

H4a: *Business model innovation plays a mediating function between institutional support and servitization transformation performance.*

H4b: *Technological innovation plays a mediating function between institutional support and servitization transformation performance.*

Combining the above hypotheses, the frame of research constructed for the paper is depicted in Figure 1.

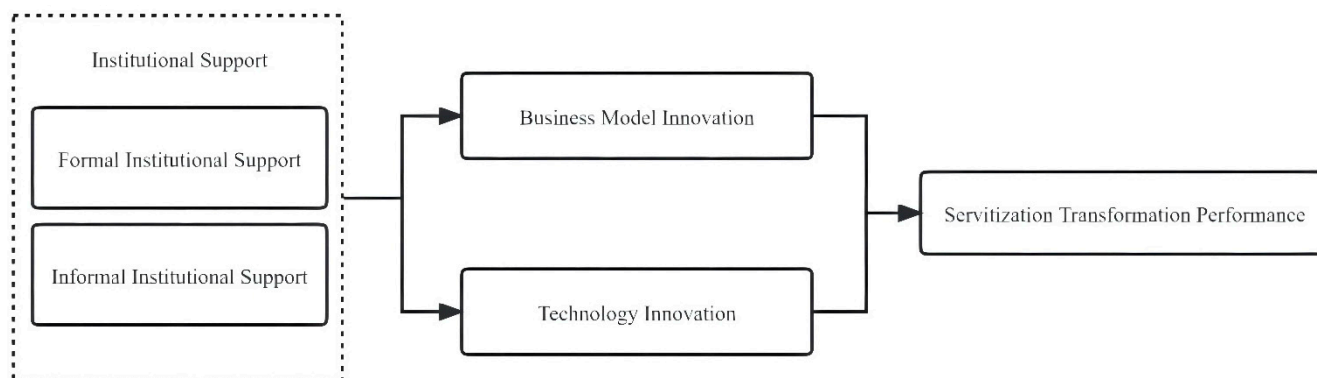


Figure 1. Research framework.

3. Research Methodology

3.1. Sample and Data Collection

Preliminary questionnaires were formed by first combining proven scales of domestic and foreign scholars and modifications by experts, and then conducting pre-research. A total of 100 valid questionnaires was collected from a small sample through online pre-study and analyzed for reliability. The reliability results show that, on the one hand, the Cronbach' α values of formal institutional support, informal institutional support, business model innovation, technological innovation and service transformation performance are all greater than 0.7 (0.878, 0.926, 0.930, 0.929, 0.917, in that order), which validates the stability and reliability of the scale. On the other hand, the results of KMO-Bartlett's spherical test showed that the KMO values were all greater than 0.7 (0.723, 0.718, 0.814, 0.779, and 0.848, in that order), and all of them were significant at the 0.001 level, thus validating the validity of the scale. The final questionnaire was formed by further refining the measurement questions through pre-study. Among them, the basic information of the respondents' enterprises are single-choice questions, and other variables are measured by Likert 5-point scale, in which 1 to 5 indicate "very unconformity", "unconformity", "Fair", "Conform", and "Very Conform". Each variable contains 3–7 items, and the variables are measured in multiple ways.

The sample data of this study are mainly from the Shandong, Hebei, and Jiangsu regions, and the research subjects are the manufacturing enterprises in the above regions that choose service transformation. The questionnaires are collected through two channels: the alumni and MBA students who meet the requirements on the university platform and

the personal social connections of the authors. From September to November 2020, a total of 400 questionnaires were distributed, and the questionnaires were set up with a reverse question test filtering mechanism to remove short response times, complete duplication of answer options, reverse question test failures, contradictory content responses, and incomplete questionnaires, with a total of 310 valid questionnaires recovered, with a valid recovery rate of 77.5%. The basic situation of the sample is shown in Table 1. The Harman one-way test was used to test whether the data had homophily bias, and by analyzing the unrotated factors of all question items, it was observed that the first principal component constitutes 46.2% of the total variance, which was less than 50%, indicating that the data did not have any problems with homophily bias.

Table 1. Sample statistics.

Sample Classification		Number	Proportion
Nature of enterprise	State-owned enterprises	74	23.9%
	Private enterprises	187	60.3%
	Three-funded enterprises	42	13.5%
	Others	7	2.3%
Enterprise size	Small Business	62	20.0%
	Medium-sized enterprises	178	57.4%
	Large Enterprises	70	22.6%
Year of enterprise establishment	5 years or less	55	17.7%
	6–15 years	166	53.6%
	16 years and more	89	28.7%
Type of industry	Communication electronics manufacturing	23	7.4%
	Chemical and chemical manufacturing	41	13.2%
	Universal Machinery Manufacturing	47	15.2%
	Electronic mechanical and device manufacturing	39	12.6%
	Transportation device manufacturing	47	15.1%
	Metal and non-metal manufacturing	47	15.1%
	Specialized device manufacturing	33	10.7%
	Furniture device manufacturing	21	6.8%
	Other Manufacturing	12	3.9%

3.2. Variable Measurement

Institutional support. The scales of Li and Atuahene-Gima (2001) [58], Peng and Luo (2000) [59] and Chen (2020) [60] were used to measure formal institutional support and informal institutional support, which consisted of 8 items. Formal institutional support includes five items, such as “government departments provide relevant policies and programs for the development of this enterprise”, while informal institutional support includes three items, such as “this enterprise has a good relationship with government departments”.

Business model innovation. The scale of ZOTT and Amit (2008) [57] was used, which includes four items, such as “The firm’s business model employs innovative transaction methods”.

Technological innovation. The scale of Camison and Villar-Lopez (2014) [61] was borrowed and included four items, such as “This firm invests a lot of money in technological research and development”.

Servitization transformation performance. Drawing on the scales of Oliva, Gebauer, and Brann (2012) [62] and Tian (2012) [63], including “increasing effectiveness in providing product or service solutions”, “increasing performance in providing products or services” and “increasing customer satisfaction with the product or service” and seven other items.

Control variables. In this paper, the characteristics of the firm and the size of the enterprise were set as control variables to exclude any effect on the performance of servitization transformation.

4. Empirical Results and Analysis

4.1. Reliability and Validity Analysis

The reliability test was performed on the 23 measurement items with a KMO value of 0.865 and a significance of less than 0.001 for Bartlett's test. Six factors had eigenvalues greater than 1 and there was no cross-loading. Next, further reliability and validity tests were conducted, with the results shown in Table 2. First, the alpha reliability factors of each variable were greater than 0.8 and the combined reliability CRs were higher than 0.9, suggesting good reliability of the scale. Secondly, the factor loadings of all measurement entries were higher than 0.6 and the AVE values were greater than 0.6, demonstrating that the convergent validity of the scale was favorable. Finally, the correlation coefficients among the factors were lower than the square root of AVE (see Table 3), indicating good discriminant validity of the scale. In conclusion, the reliability and validity of the scale were good.

Table 2. Results of reliability and validity tests of the scale.

Variables	Measurement Question Items	Factor Load	α Value
Formal Institutional Support AVE = 0.696 CR = 0.919	Government departments have provided relevant policies and projects for the development of this enterprise	0.899	0.886
	The government sector provides the necessary information and technology for the development of this enterprise	0.898	
	The government sector has provided financial support for the development of this enterprise	0.908	
	Government departments have provided assistance to introduce technology and techniques for this enterprise	0.790	
	Government departments provide assistance for IP protection for enterprises	0.646	
Informal Institutional Support AVE = 0.840 CR = 0.940	Our company takes various measures to build relationships with government departments at all levels	0.944	0.902
	The company has a good relationship with government departments	0.956	
	The relationship with government departments is important to the development of this enterprise	0.846	
Business Model Innovation AVE = 0.850 CR = 0.958	The business model of our company uses an innovative trading approach	0.950	0.940
	The business model of our company can provide value-added products or services	0.962	
	The business model of this enterprise has a new way of profitability	0.946	
	The business model of this enterprise has a new profit point	0.823	
Technology Innovation AVE = 0.834 CR = 0.953	Our company is always quick to identify customer needs	0.947	0.931
	Our company offers favorable remuneration to our R&D staff	0.943	
	Our company has invested heavily in technology research and development	0.929	
	This enterprise cooperates with universities and research institutions to innovate	0.829	
Servitization Transformation Performance AVE = 0.671 CR = 0.935	Annual sales revenue growth becomes larger after servitization transformation	0.782	0.918
	Main business profit margin growth becomes faster after servitization transformation	0.783	
	The profitability is increasing after servitization transformation	0.817	
	The share of service revenue in revenue is increasing	0.849	
	The effectiveness of providing product or service solutions continues to improve	0.827	
	The performance rate of the product or service provided is increasing	0.845	
	Customer satisfaction with the product or service is constantly increasing	0.828	

Table 3. Means, standard deviations and correlation coefficients of each variable.

Variables	Mean	SD	1	2	3	4	5	6	7	8	9
Nature of Enterprise	1.940	0.680	1								
Enterprise Size	2.030	0.653	−0.186 **	1							
Year of Enterprise Establishment	2.110	0.674	−0.163 **	0.472 **	1						
Industry Type	4.600	2.184	0.152 **	−0.009	0.032	1					
Formal Institutional Support	4.392	0.465	0.095	−0.089	−0.037	0.115 *	0.834				
Informal Institutional Support	4.297	0.540	−0.009	−0.058	−0.001	0.037	0.442 **	0.917			
Business Model Innovation	4.302	0.545	0.006	−0.049	−0.060	0.048	0.408 **	0.526 **	0.922		
Technology Innovation	4.256	0.513	−0.031	−0.003	−0.086	0.067	0.442 **	0.472 **	0.546 **	0.913	
Servitization Transformation Performance	4.324	0.488	0.040	0.003	−0.042	0.051	0.468 **	0.489 **	0.569 **	0.611 **	0.819

Note: *, ** denote $p < 0.05$, $p < 0.01$, respectively; diagonal bold values are square root of AVE.

4.2. Descriptive Statistical Analysis

The means, standard deviations, and correlation coefficients of the variables are shown in Table 3. It can be found that formal institutional support and informal institutional support ($r = 0.442$, $p < 0.01$), business model innovation ($r = 0.408$, $p < 0.01$), technological innovation ($r = 0.442$, $p < 0.01$), and servitization transformation performance ($r = 0.468$, $p < 0.01$) are significantly positively correlated. Informal institutional support and business model innovation ($r = 0.526$, $p < 0.01$), technological innovation ($r = 0.472$, $p < 0.01$) and service transformation performance ($r = 0.489$, $p < 0.01$) were statistically significant and positively associated. Also, business model innovation and technological innovation ($r = 0.546$, $p < 0.01$) and servitization transformation performance ($r = 0.569$, $p < 0.01$) were significantly positively associated, and finally, technological innovation and servitization transformation performance ($r = 0.611$, $p < 0.01$) were significantly positively associated.

Further tests for the multicollinearity problem show that the maximum values of VIF for the explanatory variables of each regression model are 1.384, 1.570, 1.670, and 1.612, respectively, all of which are lower than 3, illustrating that no multicollinearity problem exists.

4.3. Regression Analysis

Using cascade regression analysis, this research tests the hypotheses by controlling for variables such as firm nature and firm size, and Table 4 shows the test results.

Table 4. Regression analysis results.

Variables	Business Model Innovation		Technology Innovation		Servitization Transformation Performance			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
Nature of Enterprise	−0.015	−0.019	−0.055	−0.066	0.030	0.018	0.025	0.047
Enterprise Size	−0.028	0.023	0.043	0.093	0.035	0.087	0.079	0.047
Year of Enterprise Establishment	−0.051	−0.066	−0.118	−0.131	−0.056	−0.069	−0.044	−0.012
Industry Type	0.051	0.012	0.079	0.035	0.048	0.001	−0.003	−0.014
Formal Institutional Support		0.218 ***		0.295 ***		0.314 ***	0.233 ***	0.186 ***
Informal Institutional Support		0.430 ***		0.345 ***		0.355 ***	0.195 ***	0.205 ***
Business Model Innovation							0.373 ***	
Technology Innovation								0.434 ***
F	0.519	23.590 ***	1.323	22.543 ***	0.468	24.252 ***	31.118 ***	35.936 ***
R-squared	0.007	0.318	0.017	0.309	0.006	0.324	0.419	0.454
ΔF		69.269 ***		63.892 ***		71.389 ***	49.176 ***	71.960 ***
ΔR-squared		0.312		0.292		0.318	0.095	0.130

Note: *** indicates $p < 0.001$; diagonal bold values are square root of AVE.

The influence of institutional support on servitization transformation performance. Model 5 examines the influence of control variables on servitization transformation performance, and model 6 adds institutional support to model 5. Comparing model 5 and model 6, it is evident that the control variables have no significant effect on servitization transformation performance, and formal institutional support ($\beta = 0.314$, $p < 0.001$) and

informal institutional support ($\beta = 0.355, p < 0.001$) have a significant positive effect on servitization transformation performance, which is similar to the findings of Wang et al. (2022) [64]. Hypotheses H1a and H1b were tested. Furthermore, the informal system is more supportive of influence, meaning that informal institutions are more supportive than formal institutions. The possible reason for this is that political connections reduce the failure rate of service transformation more [65] and mitigate the risks associated with corporate change [66].

The influence of institutional support on business model innovation. Models 1 and 3 investigated the influence of control variables on business model innovation and technological innovation, and the results showed no significant effect of control variables on business model innovation and technological innovation. Institutional support was added to this, and the results showed that formal institutional support ($\beta = 0.218, p < 0.001$) and informal institutional support ($\beta = 0.430, p < 0.001$) had a significant positive effect on business model innovation; and formal institutional support ($\beta = 0.295, p < 0.001$) and informal institutional support ($\beta = 0.345, p < 0.001$) also had a significant positive effect on technological innovation, consistent with the findings of Zhang et al. (2017) [67]. Hypotheses H2 and H3 were tested.

The mediating function of business model innovation and technological innovation. From the above analysis, it is clear that institutional support has a significant positive effect on both business model innovation and technological innovation, and business model innovation and technological innovation also have a significant positive effect on servitization transformation performance. In order to verify the mediating function of business model innovation and technological innovation in institutional support and servitization transformation performance, the servitization transformation performance is taken as the dependent variable, and for the control variables, institutional support is added to the model in turn, and then business model innovation and technological innovation are added, respectively. By comparing model 6 and model 7, it can be seen that business model innovation ($\beta = 0.373, p < 0.001$) has a significant positive effect on servitization transformation performance. Formal institutional support ($\beta = 0.233, p < 0.001$) and informal institutional support ($\beta = 0.195, p < 0.001$) still have a significant positive effect on servitization transformation performance, but the regression coefficients β of the formal and informal institutional support on servitization transformation performance decrease from 0.314 (model 6) and 0.355 (model 6), respectively, to H4a, as has been verified. By comparing model 6 and model 8, it can be seen that technological innovation ($\beta = 0.434, p < 0.001$) has a significant positive effect on servitization transformation performance. Formal institutional support ($\beta = 0.186, p < 0.001$) and informal institutional support ($\beta = 0.205, p < 0.001$) still had a significant positive effect on servitization transformation performance, but the regression coefficients β of formal and informal institutional support on servitization transformation performance decreased from 0.314 (model 6) and 0.355 (model 6), respectively, to 0.186 (model 8) and 0.205 (model 8), indicating that technological innovation acts as a mediator in the influence of institutional support on servitization transformation performance. H4b is verified.

4.4. Robustness Test

To further verify the dual mediation function of business model innovation and technological innovation, this study used the Bootstrap method with a 95% confidence interval to randomly select 5000 samples for robustness testing, and Table 5 demonstrates the results. In the verification of the mediating function of business model innovation and technological innovation on formal institutional support and service transformation performance, the efficacy value of formal institutional support on service transformation performance is 0.195 with a 95% confidence interval [0.088, 0.298], which does not contain 0. The direct effect is significant, and the 95% confidence interval for the mediating functions of business model innovation and technological innovation are [0.069, 0.191] and [0.114, 0.241], both of which do not contain 0 and have significant indirect effects; thus, business model

innovation and technological innovation mediate the effect of formal institutional support on the performance of service transformation, which is in accordance with the outcomes of the regression analysis. In the verification of the mediating function of business model innovation and technological innovation on informal institutional support and servitization transformation performance, the effect value of informal institutional support on servitization transformation performance is 0.150 with a 95% confidence interval [0.040, 0.262], which does not contain 0, and the direct effect is significant, and the 95% confidence interval of the mediating function of business model innovation and technological innovation are [0.071, 0.196] and [0.110, 0.226], both of which do not contain 0 and have significant indirect effects; thus, business model innovation and technological innovation mediates effect of informal institutional support on the performance of servitization transformation, which is also in accordance with the outcomes of the regression analysis.

Table 5. Robustness tests for two-mediator effects.

Paths	Effect Value	Standard Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Formal Institutional Support → Servitization Transformation Performance	0.195	0.054	0.088	0.298
Informal Institutional Support → Servitization Transformation Performance	0.150	0.056	0.040	0.262
Formal Institutional Support → Business Model Innovation → Servitization Transformation Performance	0.126	0.032	0.069	0.191
Formal Institutional Support → Technology Innovation → Servitization Transformation Performance	0.175	0.033	0.114	0.241
Informal Institutional Support → Business Model Innovation → Servitization Transformation Performance	0.129	0.032	0.071	0.196
Informal Institutional Support → Technology Innovation → Servitization Transformation Performance	0.166	0.030	0.110	0.226

5. Research Conclusions and Implications

5.1. Research Conclusions

This study relies on the institutional foundation view, targets manufacturing firms, constructs a model of manufacturing enterprises' servitization transformation performance, investigates the effects of formal institutional support and informal institutional support on manufacturing enterprises' servitization transformation performance, and further analyzes the dual mediating roles of business model innovation and technological innovation across institutional support and servitization transformation performance. The findings show that (1) both formal and informal institutional support contribute significant positive influences on the servitization transformation performance among manufacturing firms, and the positive influence of informal institutional support is stronger. (2) Institutional support significantly and positively impacts business model innovation and technological innovation. (3) Business model innovation and technological innovation mediate the relationship between institutional support and service transformation performance of manufacturing enterprises.

5.2. Theoretical Contributions

First, relying on the institutional foundation view [68], this paper selects manufacturing enterprises in servitization transformation as the research object from the enterprise

level, and investigates the impact of external institutional support on internal servitization transformation performance by constructing a model of manufacturing enterprises' servitization transformation performance. It is indicated in the results that both formal institutional support and informal institutional support contribute a positive effect on the servitization transformation performance of manufacturing firms, and the impact of informal institutional support is greater than that of formal institutional support. It indicates that both the systematic support of formal institutional support and the politicized connection of informal institutional support can obtain political resources [69], promote manufacturing enterprises to implement internal innovation events during the process of servitization transformation, shift the focus of enterprises from products to services [70], and improve the servitization transformation performance [66]. While previous studies on the servitization transformation of manufacturing enterprises have focused on the study of internal resource mobilization [71] and market responsiveness [72,73], this paper distinguishes itself from previous studies on the internal capabilities of enterprises and shifts the research direction to the external institutional environment of enterprises, investigates the viewpoint of external institutional support to enhance the performance of servitization transformation of manufacturing enterprises, and enriches the investigation of the servitization transformation of manufacturing enterprises at a level for institutional support.

Second, this article investigates the effect of institutional support on business model innovation and technological innovation, and the study finds that institutional support positively promotes firms to engage in business model innovation and technological innovation. The results illustrate that formal and informal institutional support can help manufacturing firms obtain external help, reduce the risk of firm innovation [74], alleviate the financial pressure on corporate innovation [75], stimulate firms' willingness to innovate [76], and thus promote their innovative behavior. Specifically, institutional support indicates that the current institutional environment in which firms operate expects manufacturing firms to pay attention to service elements [77], and firms will move closer to service when innovating business models [78] for the sake of institutional support. Further, institutional support can also bring a great deal of resources to firms, reduce the cost of innovation [79], and promote firm innovation, while good institutional support can also offer a stable innovation environment [80,81] and motivate firms to innovate and stimulate the motivation of enterprise innovation. The study confirms that institutional support is closely related to business model innovation and technological innovation, and good institutional support promotes business model innovation and the technological innovation of enterprises.

Finally, this article investigates the mediating role of business model innovation and technological innovation between institutional support and service transformation performance of manufacturing firms by using business model innovation and technological innovation as mediating variables. The results suggest that business model innovation and technological innovation mediate the relationship between institutional support and the service transformation performance of manufacturing firms. From the results, it is clear that institutional support influences the service transformation performance of manufacturing enterprises, and institutional support provides an innovative environment for manufacturing enterprises, which is advantageous for business model innovation and technological innovation, and further enhances the service transformation performance of manufacturing enterprises. This result demonstrates the structure of "institutional support-firm innovation behavior-service-transformation performance", which shows that the innovation behavior of firms plays a mediating role; that is, institutional support can influence business model innovation and the technological innovation of manufacturing firms to improve service transformation performance.

The servitization transformation of manufacturing is an important way for China's economy to seize the opportunity of green development and achieve cleanliness. The research in this paper helps to reveal the mechanism and evolutionary process of heteroge-

neous institutional support for servitization transformation mediated by business model innovation and technological innovation, and deepens the relationship between formal institutional support represented by systemic support and informal institutional support represented by political linkages and the performance of servitization transformation. The Chinese economic system differs from other countries in that China has the influence of simultaneous economic system and social structure transformation and large population size; therefore, the transformation of manufacturing servitization in China also produces certain differences from other countries. This study enriches and expands the theoretical exploration of manufacturing servitization transformation in an economic system with Chinese characteristics, alleviates the relationship between institutional support from the Chinese government and manufacturing servitization transformation strategies, and has theoretical reference implications for the Chinese government to improve institutional support.

5.3. Policy Implications

On the one hand, for government departments, they should adopt a combination of formal institutional support and informal institutional support to promote manufacturing enterprises to execute internal innovation initiatives and improve performance in the service transformation of manufacturing enterprises. Government departments ought to attach importance to the service transformation of manufacturing enterprises and provide certain assistance to boost the quality of manufacturing growth via promoting the service transformation of manufacturing enterprises, thus promoting qualitative progress of Chinese economics. In terms of formal institutional support, service transformation of manufacturing enterprises can provide local jobs, enhance people's welfare and stimulate local economical expansion. In terms of informal institutional support, government departments should maintain close contact with local enterprises and establish a good government-enterprise relationship so that they can understand the current situation of enterprises and solve problems in a timely manner. However, it should be noted that the entirety of institutional support should be based on formal institutional support and supplemented by informal institutional support to ensure that the service transformation of manufacturing enterprises enjoys more policies in relevant documents and regulations, while political ties are to ensure that government departments are in contact with manufacturing enterprises.

On the other hand, manufacturing enterprises should balance internal and external institutional support, and at the same time, carry out innovation activities within the enterprise to improve the performance of service transformation. For external institutional support, enterprises should actively seek external institutional support, obtain more policies, projects, and technology support from government departments, and establish good political ties with government departments, maintain communication in daily production and operation processes, and make full use of institutional support to improve service transformation performance. For internal innovation, enterprises should fully mobilize the willingness to innovate within the enterprise and carry out internal business model innovation and technological innovation activities that build on institutional support. Further, enterprises should emphasize the service element of enterprises on the basis of legality, shift the focus of enterprises from products to services, and improve the added value of products, and at the same time, make efforts to learn current advanced technologies, upgrade technologies, and realize technological innovation. In addition, manufacturing enterprises should also establish a coordination mechanism for servitization transformation, which can combine institutional support and internal innovation organically, and flexibly adjust the process of enterprise servitization transformation to improve the performance of manufacturing enterprises' servitization transformation.

5.4. Research Shortcomings and Prospects

This article investigates the impact of institutional support on the service transformation performance of manufacturing firms; however, some shortcomings still remain. To begin with, this article investigates the influence of institutional support on the service

transformation performance of manufacturing firms within the domestic scenario, but whether the effect is consistent in other national and regional contexts remains to be studied in depth. Second, this paper used a questionnaire survey to collect data, which was affected by the survey time and other conditions, and analyzed cross-sectional data; however, institutional support may have different effects in different periods of service transformation of manufacturing enterprises; hence, further research is needed to supplement longitudinal tracking data. Finally, as the current research has demonstrated the interactional effect of business model innovation and technological innovation on enterprise performance, subsequent research can further investigate the impact of the interaction between the two on the performance of service transformation of manufacturing enterprises.

Author Contributions: Conceptualization, Y.F. and J.S.; formal analysis, Y.F. and J.S.; investigation, Y.F. and J.S.; writing—original draft preparation, Y.F. and J.S.; writing—review and editing, Y.F. and J.S.; visualization, Y.F. and J.S.; supervision, H.C.; project administration, H.C.; funding acquisition, H.C. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by the Natural Science Foundation of Shandong Province, grant number ZR2021MD073.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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