

Does Customer Participation Affect Manufacturing's Service Innovation Performance?

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Keywords: service-oriented logic; strategic flexibility; knowledge-based view; value creation.

Abstract: How to realize service transformation in manufacturing enterprises is a key issue to be solved urgently. The current research on customer participation in service innovation tends to focus on service enterprises. The innovation theory of how to use customers to obtain competitive advantage is still very scarce. Therefore, based on the above-mentioned reality and theoretical background, a theoretical model is established based on the service-led logic and dynamic capability theory to study the impact of customer participation on the service innovation performance of manufacturing enterprises. Using the survey data of 139 manufacturing companies as a sample, the Bootstrap method was used for empirical analysis. The results show that customer participation has a significant positive effect on service innovation performance. Strategic flexibility plays a full intermediary role in the process of knowledge integration between customers and enterprises, and then plays a positive role in manufacturing enterprise service innovation performance.

1. Introduction

The proportion of service economy in GNP in developed countries is much higher than that in manufacturing industry, which has attracted the attention of many scholars. With the development of information technology, innovation presents a systematic, complex and uncertain situation. On the one hand, in order to win competitive advantage, the output of manufacturing enterprises (hereinafter referred to as enterprises) extends to both ends of the value chain, so the output of enterprises often includes products and services. However, enterprises cannot meet the requirements of innovation only by their own resources. They need the support of heterogeneous multi-agent resources. It has become a way for many enterprises to build competitive advantage to bring customers into the innovation process. Chesbrough (2007) believes that the implementation of open strategy is more conducive to maintaining long-term value creation [3]. Therefore, service supply needs to be coupled with external agents, and in the process of interaction, customer information is used to provide, to reduce the uncertainty of innovation. On the other hand, in order to identify the tacit knowledge of customers, enterprises frequently interact with customers to develop new services, assist the realization of customer creativity and provide solutions. At the same time, in order to enhance the absorption of customer knowledge, many enterprises manage customer knowledge, integrate internal and external knowledge to improve service innovation ability [4]. Most of the existing studies focus on network capabilities, relationship perspectives and organizational learning to explain the causes of service innovation performance [5-6]. There are few studies on the impact mechanism between customer participation and service innovation performance. Although many scholars believe that customer participation can achieve value creation and improve service innovation performance, some studies show that there are differences between customers and employees, so there are no responsibilities and channels to achieve the value creation process that should be carried out by employees of enterprises, and only rely on the interactive process of relationship to obtain customers. Resource improves hedonic value and practical value. Therefore, based on dynamic capability theory, strategic flexibility can promote the renewal of organizational practices and help to cope with the

dynamics of external environment [7]. Strategic flexibility is likely to be the key intermediary variable in the interaction between organizations and customers. In addition, some scholars point out that knowledge integration plays an important role in the process of innovation [8]. Collaboration and application of knowledge in the interactive process will determine whether an enterprise can gain competitive advantage [9].

Therefore, based on the existing theoretical basis and service-oriented logic, this paper puts customer participation, strategic flexibility, knowledge integration and service innovation performance under the same research framework, opens the "black box" of how customer participation affects the internal mechanism of enterprise performance, and explores the role path of customer participation, with a view to enterprises. According to their own characteristics, customer participation is managed to provide theoretical reference and policy suggestions for enterprise service transformation.

2. Theoretical Basis and Research Hypothesis

2.1 Theoretical Basis

2.1.1 Dynamic Capability Theory

The theory of dynamic capability, pointing out that the competitive advantage of enterprises is based on unique coordination and combination to cope with complex business environment, including the ability to have heterogeneous resources and how to use these resources (including skills acquisition, learning and organizational intangible resources). According to the above definition, it is not difficult to find that service innovation is to identify customer needs and provide a solution based on their own knowledge and skills, while manufacturing industry pays close attention to product and technology innovation for a long time, and it is easy to form "core rigidity" and "capability trap" the core rigidity is that the core competencies of enterprises cannot meet the changing environment, and they are unwilling to allocate resources to uncertain services when providing services. The capability trap is that all the existing activities of enterprises are centered on product-related knowledge and practices, resulting in organizational inertia when they have a certain scale. The ability to respond to dynamic environments is lost by indulging in existing successful experiences. Strategic flexibility is the ability of an organization to cope with external changes. On the one hand, resource flexibility manifests itself in the applicable scope of existing resources, which makes it easier for enterprises to form the relative redundancy of resources; on the other hand, the service generated by resources is the coordination flexibility realized on the basis of the use of resources, which is embodied in the utilization ability of resources, and the coordination ability of resources and networking within the organization. Therefore, from the perspective of dynamic capabilities, resource flexibility plays a role in breaking the existing organizational conventions, promoting the renewal of conventions, and forming the necessary resources and coordination role for service delivery.

2.1.2 Theory of Knowledge-based View

Knowledge-based theory holds that heterogeneous knowledge is the source of competitive advantage of enterprises. Acquiring different heterogeneous knowledge can make up for the knowledge gap of enterprises. The essence of innovation process of enterprises is the process of searching and absorbing knowledge from outside, transforming and restructuring within enterprises, and finally exporting products and services. When enterprises are service-oriented, they inevitably interact with customers. Customer participation can provide external knowledge, including customer history, customer conceptual creativity, customer skills and product use experience. customer co-creation can create highly relevant but moderately novel knowledge. Customer cooperation closely related to innovative enterprises can obtain higher relevant knowledge at a lower cost. Its impact depends on the richness and scope of communication channels that can be co-created. At the same time, managers Get suggestions on choosing customers and communication channels to

improve the success of customer co-creation plan. Enterprises identify, absorb and share customer knowledge within the organization, and become an important source of enterprise service innovation.

2.2 Research Hypothesis

2.2.1 Direct Effect

Customer information always contains personalized characteristics, so customer information will provide greater value for enterprises. When customers act as information providers, customers participate in the service innovation activities of enterprises in the way of relationship embedding. On the one hand, customer-specific service needs are expressed, and the way of information sharing alleviates the situation of information asymmetry. It is more conducive for enterprises to "focus" on innovative activities in a certain field, and reduces the uncertainty risk of service innovation. When customers act as co-participants, they contact employees in the way of structural embeddedness. Therefore, enterprises are required to have the ability to coordinate resources and identify tacit knowledge in the process of interaction. It believes that relational learning plays an important role in customer-oriented service business of manufacturing enterprises, and has a positive effect on service innovation performance. On this basis, the hypothesis is put forward:

H1: Customer participation has a positive impact on service innovation performance

2.2.2 The Relationship between Customer Participation and Strategic Flexibility

Customer orientation has led manufacturers to increasingly adopt service-based strategies to maintain competitiveness. Salonen found through case studies that manufacturers develop product-related services through specialized service departments, use products to provide services for ties, and use integrated solutions to enhance competitiveness. It believes that the service derivation of manufacturing enterprises is a state of taking into account product manufacturing, service delivery and customer participation. The external differentiation requirements promote the transformation of coordination ability and resources, making it more flexible. Therefore, the hypothesis is put forward:

H2: Customer participation has a positive impact on strategic flexibility.

2.2.3 The Relationship between Customer Participation and Knowledge Integration

Knowledge integration mechanism is defined as "some formal processes and structures that make it easy for enterprises to capture, analyze, interpret and synthesize knowledge about market trends or other aspects". Research shows that customer value creation behavior is driven by customer knowledge, so knowledge transfer occurs in Customer-Enterprise interaction and produces co-evolution. In order to effectively utilize customer knowledge, enterprises manage, absorb and share customer knowledge through knowledge integration. On this basis, the hypothesis is put forward:

H3: Customer Participation Promotes Knowledge Integration.

2.2.4 The Relationship between Strategic Flexibility and Knowledge Integration

That coordination is necessary for the use of distributed knowledge and applications within an organization. Customer participation is essentially a network of connections between a wide range of external entities and organizations. Encouraging cross-border and internal sharing of knowledge is more advantageous to the acquisition of knowledge resources in the network, which greatly increases the flexibility of knowledge integration. There is an obvious positive effect in the acquisition and combination of knowledge. On this basis, the hypothesis is put forward:

H4: Strategic Flexibility Affects Knowledge Integration Forward.

2.2.5 The Relationship between Knowledge Integration and Service Innovation Performance

According to the view of knowledge base, knowledge is an important source of innovation for enterprises. Enterprises manage and share customer knowledge through knowledge integration.

Customer knowledge is organized and structured customer information processed systematically, and is the information of current or hidden preferences of customers. Due to the constraints of resources and knowledge, enterprises cannot have all the knowledge needed for innovation. Customer participation will make up for the lack of enterprise knowledge, provide heterogeneous knowledge, and lead customer participation will have a significant positive impact on the performance of new service development. Knowledge collaboration between customers and enterprises will improve the efficiency of enterprise service innovation. Rate and success rate. On this basis, the hypothesis is put forward:

H5: Knowledge Integration Positive Impact on Service Innovation Performance.

2.2.6 The Relationship between Strategic Flexibility and Service Innovation Performance

The key to the success of the service strategy of manufacturing enterprises lies in the matching of enterprise capability and demand environment. Strategic flexibility is embodied in the ability of organization to share, transform and network its internal resources. When enterprises scan the environment, customer participation has the possession of resource use. In order to integrate and coordinate within the enterprise itself, they need to have a higher level of strategic flexibility. Empirical research supports strategic flexibility in innovation. Based on this, the research hypothesis is put forward:

H6: Strategic Flexibility Positive Impact on Service Innovation Performance of Enterprises.

3. Research and Design

3.1 Theoretical Model

By summarizing the above theories and hypotheses, the theoretical model of this study is summarized as shown in Figure 1.

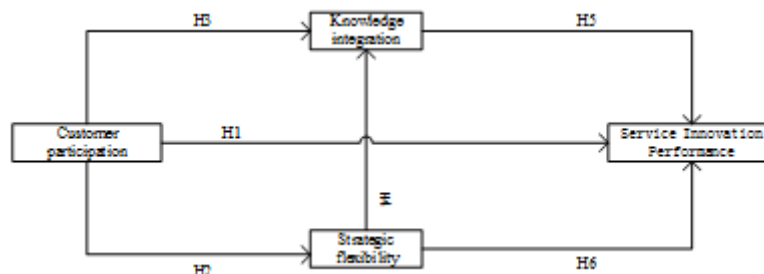


Fig. 1 theoretical model

3.2 Data Collection

The data of this study are questionnaire data, which are obtained by e-mail and online questionnaire. Referring to the existing literature scale, we compiled a questionnaire and conducted a preliminary survey from November 2018 to January 22, 2019. Through the network platform and WeChat, 50 valid questionnaires were collected for project managers of manufacturing enterprises. Combining with relevant research at home and abroad, according to the actual situation of Chinese manufacturing enterprises, the measurement items are revised, and after consulting experts in relevant fields, the contents, questioning methods, formats, accuracy of terms, and comprehensibility of the measurement items are revised several times. Subsequently, 300 questionnaires were sent out by manufacturing enterprises in Sichuan, Shanghai, Guangdong, Hubei and Guangxi, and 208 questionnaires were recovered, of which 139 were valid, with an effective rate of 66.83%.

3.3 Measurement of Variables

In order to avoid the mid-trend effect, Likert 5-point scoring method was used in all the questionnaires in this study. Independent variables: Customer participation was designed by referring to Fang, Peng, Tang Juan, and was measured by six items. Dependent variables: The performance of

service innovation is studied by Wei. Considering both financial and non-financial indicators, four items are used to measure the performance of service innovation projects. Intermediate variables: the scale of knowledge integration reference measured by 8 items; the scale of strategic flexibility was designed, and 8 items were measured. Control variables Enterprise scale. Referring to the research of the number of employees of enterprises is used as the measurement index of enterprise scale, and it is divided into four grades. The value of 100 people is less than 1, 100 people to 499 people is 2, 500 people to 1000 people is 3, and the value of 1000 people is more than 4. Establishment period. The difference between the number of years of establishment and the number of years of investigation is used to convert the results. KMO values of customer participation, strategic flexibility, knowledge integration and service innovation performance were 0.707, 0.760, 0.828 and 0.674, respectively. The chi-square values of Bartlett's spherical test reached very significant levels ($p < 0.001$). The specific test items, reliability and constructive validity of the questionnaire are shown in Table 1.

Table 1. Reliability and validity test results

Variable	item	factor load	alphavalue	CR
Customer participation	We often collect comments and suggestions from retailers and distributors and feedback them to R&D team	0.824	0.752	0.893
	We often give suppliers feedback on the market situation of distributors and retailers	0.608		
	We often collect information about downstream customers' preferences and needs	0.825		
	Customers play a leading role in the service development process of the enterprise	0.828		
	Our R&D staff actively assists customers in the development of service projects	0.797		
	Customers utilize the support of capital enterprise resources to develop new service projects	0.678		
Strategic Flexibility	How Shared the Same Resources within the Company is	0.797	0.785	0.921
	The extent to which the same resource of the company is used to develop, manufacture and sell different products or services is	0.700		
	Cost and difficulty of changing the same resource from one use to another	0.796		
	The time for a company to change the same resource from one use to another	0.723		
	The company allows departments to break the formal working procedures to maintain flexibility and dynamic work	0.746		
	The working mode of the company's internal operation varies from person to person and according to the time.	0.713		

	The company has very smooth internal communication channels and mechanisms	0.812		
	Companies can actively and proactively respond to external competition	0.859		
Knowledge Integration	We establish special platforms and channels to increase knowledge sharing between employees and customers	0.663	0.848	0.884
	We reward customers who promote service innovation by	0.628		
	Employees often communicate with customers to solve problems.	0.691		
	We often analyze customers' past and current purchasing information to fully understand customers' needs	0.717		
	We often conduct market research on customer service demand	0.723		
	The company establishes cross-departmental teams or groups to promote employees' knowledge sharing with customers.	0.747		
	Companies often get customer demand information by leaving messages on websites forums	0.654		
	The company often makes statistical analysis of customer's service demand.	0.762		
	Development of Service Projects Completed in Expected Time	0.759		
innovation performance	Customers are very satisfied with the implementation and cooperation of the project	0.717	0.724	0.831
	Newly developed service projects create or exceed expected revenue of	0.749		
	Customer-to-service quality	0.744		
	We often collect comments and suggestions from retailers and distributors and feedback them to R&D team	0.824		
	We often give suppliers feedback on the market situation of distributors and retailers	0.608		

3.4 Reliability and Validity Analysis

3.4.1 Exploratory Factor Analysis

Before reliability and validity analysis, exploratory factor analysis (EFA) is used to analyze customer participation. Two factors with eigenvalues greater than 1 are extracted. The ratio of cumulative explanatory variance of two factors is 66.98%. The load of all items on the factors they belong to is not less than 0.669, and there is no cross-factor. Phenomenon. EFA is applied to

strategic flexibility. Three factors with eigenvalues greater than 1 are extracted. The cumulative explanatory variance ratio of the three factors is 74.45%. The loads on all items are not less than 0.594, and there is no cross-factor phenomenon. EFA is applied to knowledge integration. Two factors with eigenvalues greater than 1 are extracted. The cumulative explanatory variance ratio of the two factors is 71.37%. The load of all items on the factors they belong to is not less than 0.535, and there is no cross-factor phenomenon. EFA was applied to service innovation performance, and a factor whose eigenvalue was greater than 1 was extracted. The cumulative explanatory variance ratio of factors was 69.61%. The load of all items on their factors was not less than 0.740, and there was no cross-factor phenomenon. All variables can pass EFA test.

3.4.2 Reliability Test

This paper uses SPSS 22.0 to test the reliability of variable measurement. The results show that the reliability of customer participation, strategic flexibility, knowledge integration and service innovation performance are 0.786, 0.819, 0.889 and 0.850, respectively. At the same time, the combination reliability of all variables in this study is above 0.8, which indicates that the measurement of variables has a high reliability. The correlation coefficient of variables in this study is shown in Table 3. From Table 3, we can see that there is a strong correlation between independent variables and dependent variables. Regression analysis can be carried out.

3.4.3 Validity Analysis

The content validity of variable measurement is guaranteed by existing literature, consultation with experts, interviews with business managers and predictive tests. As shown in Table 2, the lowest values of AVE and factor load are 0.699 and 0.654 respectively, which can be tested by aggregation validity. The discriminant validity is shown in Table 2. The square root of each variable AVE is larger than its correlation coefficient with other variables, which can be tested by discriminant validity.

Table 2. Comparison of Pearson Coefficients between Square Roots of AVE Variables and Variables

	Customer Participation	Strategic Flexibility	Knowledge Integration	Service Innovation Performance
Customer Participation	0.765			
Strategic Flexibility	0.510**	0.770		
Knowledge Integration	0.664**	0.584**	0.699	
Service Innovation Performance	0.451**	0.568**	0.658**	0.742

Note: * P < 0.010, * P < 0.050.

3.4.4 Common Method Deviation

In this study, Harman's single factor test was used to test the variation of common methods. Eight factors with eigenvalues greater than 1 were extracted from all variables by non-rotating principal component analysis. The cumulative variance contribution rate was 70%. One factor with the largest explanatory variance explained that 30.8% was less than 40%. There was no single factor explaining most variance variation. Therefore, it can be judged that there is no significant common method variation in this study.

4. Empirical Test

4.1 Statistical Analysis

Table 3 shows the mean, standard deviation and correlation coefficients of each variable. It shows that there is a strong correlation between interpreted variables and interpreted variables, indicating that further regression analysis can be carried out. In addition, by calculating the variance expansion factor VIF of the four regression equations, the VIF ranges from 1.12 to 2.16, indicating that there is no multiple collinearity problem.

Table 3. Variable Descriptive Statistics and Relevant Coefficient Analysis Results

Variable	Me an	SD	Customer Participati on	Strategic Flexibilit y	Knowledg e Integratio n	Innovatio n Performan ce	Time	Si z e
Customer Participation	3.21	0.53	1					
Strategic Flexibility	3.10	0.53	0.51**	1				
Knowledge Integration	3.36	0.54	0.66**	0.58**	1			
Innovation Performance	2.88	0.48	0.45**	0.57**	0.66**	1		
Time	18.7	16.33	0.04	0.01	-0.04	-0.03	1	
Size	2.65	0.98	0.00	-0.07	0.07	0.00	0.3**	1

4.2 Statistical Methods and Results Analysis

This paper uses Bootstrap method to test the mediating effect of strategic flexibility and knowledge integration. Using SPSS22.0 process plug-in tool the results are shown in Table 4

Table 4. Regression Analysis Results

	Model 1	Model 2	Model 3	Model 4	Model5
Customer Participation	H2:0.687***	H3:0.670***		H1:0.278***	-0.022
Strategic Flexibility		H4:0.346***			H6:0.129***
Knowledge Integration					H5:0.233***
Innovation Performance	0.039	-0.0024	-0.003	-0.006	0.000
Size	-0.321	0.524*	0.019	0.031	-0.023
Intercept	13.257	4.512**	11.515	8.947***	5.115***
ΔR^2	0.267	0.538	0.000	0.206	0.485
F	16.276***	38.984***	0.058	11.645***	25.027***

Note: * P < 0.010, * P < 0.050, * P < 0.100.

Model 1 is the regression model of strategic flexibility to customer participation, and model 2 is the regression result of knowledge integration of intermediary variables to strategic flexibility and customer participation. Model 3 is a benchmark model with only control variables. Model 4 adds customer participation on the basis of model 3. Model 5 adds intermediary variables (strategic flexibility, customer participation) on the basis of model 3. Compared with the benchmark model, both model 4 and model 5 increased significantly, indicating that the independent variables selected in this study did improve the explanatory power of the equation, and could affect the explanatory variables of each model.

According to model 1, the regression coefficient of customer participation to strategic flexibility is 0.687, $P < 0.010$, which proves that customer participation has a positive impact on strategic flexibility, assuming H2 is supported; from model 2, the regression coefficient of customer participation to knowledge integration is 0.670, $P < 0.010$, assuming H3 is supported. At the same time, the regression coefficient of strategic flexibility to knowledge integration is 0.346, $P < 0.010$, assuming that H4 is supported.

Model 4 in Table 4-2 shows the effect of customer participation on service innovation. The results show that the regression coefficient of customer participation on service innovation performance is 0.278, $P < 0.010$. The regression coefficients of strategic flexibility and knowledge integration on service innovation performance are 0.129 ($p < 0.010$) and 0.233 ($p < 0.010$) respectively, assuming that H6 and H5 are supported.

5. Conclusion

As shown in Table 4-2, in order to further analyze the existence of intermediary effect, we select customer participation (independent variables), intermediary variables (strategic flexibility, knowledge integration), dependent variables (service innovation performance), control variables (enterprise life, enterprise size) into PROCESS program, model 6, Bootstrapping. Ng method sampled 50,000 times and constructed 95% confidence interval of unbiased correction. The results are shown in Table 5.

Table 5. Indirect Effects of Customer Participation and Service Innovation Performance

Effect Type	Action Path	Effect value (SE)	[LLCI, ULCI]
Direct effect	1	-0.022(0.052)	[-0.126,0.081]
Indirect Effect	2	0.089(0.030)	[0.038,0.159]
	3	0.055(0.019)	[0.026,0.104]
	4	0.156(0.042)	[0.082,0.247]

As shown in Table 4-3, when the mediation variable is added, the direct effect value is -0.022, [LLCI, ULCI] interval is [-0.126, 0.081] does not contain 0, and the direct effect becomes insignificant. The mediation effect exists. In the path of customer participation → strategic flexibility → service innovation performance (path 2), [LLCI, ULCI] is [0.038, 0.159], and does not contain 0, so the intermediary effect exists in this path; in the path of customer participation → knowledge integration → service innovation performance (path 3), [LLCI, ULCI] is [0.026, 0.104], and does not contain 0, so this path does not contain 0. On the other hand, the intermediary effect is significant, knowledge integration plays a complete intermediary role, the effect value is 0.055; on the path of "customer participation → strategic flexibility → knowledge integration → service innovation performance" (path 4) [LLCI, ULCI] is [0.082, 0.247], does not contain 0, so on this path, the intermediary effect is significant.

Firstly, customer participation is of great significance to the performance of enterprise service innovation. Empirical results show that customer participation, strategic flexibility and knowledge integration are positively affecting the performance of service innovation. In the case of customer

participation, enterprises can provide unique information needed to obtain personalized solutions through customer information, which is conducive to identifying the explicit knowledge of customers, meeting different customer needs, and improving customer satisfaction and perceived service quality. Secondly, customer participation promotes enterprises to change existing organizational practices, and to spread knowledge of project solutions to organizations, which is conducive to the formation of core competitiveness.

Secondly, the role of strategic flexibility in organizational knowledge integration is supported, because strategic flexibility plays an important role in breaking the existing capacity rigidity by promoting organizational decision-making flexibility, promoting the renewal of organizational practices. This key intermediary variable is supported in this study. Manufacturing enterprises need to break the existing regulatory conventions to form fully coordinated resources and operational capabilities.

The existing literature usually focuses on the scope of customer participation in service innovation, and the conclusions have limited explanatory effect on how manufacturing enterprises realize service transformation. Based on the theory of enterprise competence and knowledge-based view, this study constructs a "black box", explores the mechanism of customer participation on innovation performance, and promotes the development of service science to service innovation of manufacturing enterprises. At the same time, it provides guidance for enterprises how to use their own capabilities to manage customers.

Acknowledgments

This work was financially supported by Guangxi Natural Science Foundation Program: "Generating Logic of Service Innovation Strategy of Manufacturing Enterprises and Its Influencing Mechanism on Competitive Advantage" (2018GXNSFAA281304), and also supported by Guilin University of Electronic Technology Graduate's Research Innovation Project: "A Study on the Influence Mechanism of Customer Participation on the Service Innovation Performance of Manufacturing Enterprises"(2019YCXS063).

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