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Research on the Service Development Strategy of Manufacturing Enterprises

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***Abstract*—Tianjin connects "made in China 2025", servitization of manufacturing enterprises is imperative. Based on literature review, there are six influencing factors of servitization: enterprise flexibility, service economic level, service policy support, access to resources, science and technology capability, and organizational change ability. Through stepwise regression, analyze the data obtained from the questionnaire. The results show that there are significant factors influencing the servitization of Tianjin manufacturing industry: access to resources, science and technology capability, organizational change ability. In this regard, three relevant policies and suggestions are proposed: strengthen infrastructure construction, improve the talent introduction system, improve the service ecological environment of manufacturing industry, increase the resource access opportunities of manufacturing enterprises., strengthen the training of enterprises' scientific and technological capabilities, and improve the ability of enterprise organization change.**

Keywords—manufacturing enterprises; servitization; influenced factors; stepwise regression

I. INTRODUCTION

The constantly adjusting global economic structure and accelerating economic integration process make the economic status of the tertiary industry more and more important. The world economy is transforming into a service economy which has gradually become the landmark structure of the transition from industrial society to information society. One of the important reasons for the continuous economic growth and social development of developed countries is the rapid development of modern manufacturing service industry. Some of the biggest multinationals that have made the transition, such as Xerox, IBM, HP, SONY and general electric, already generate more revenue from services than from manufacturing. In contrast, the output value of China's service sector as a percentage of GDP has been maintained at around 40%.The ratio of service employment to total employment is less than 34 per cent, while in developed countries the ratio of service employment to total employment has averaged about 70 per cent. In recent years, China's manufacturing strength has been continuously enhanced and many highly competitive industries and their related industrial chains have gradually stood out. However, the development of modern manufacturing service industry is at a low level, with low efficiency and high added value. At present, manufacturing service industry accounts for a low proportion in national economy, which seriously affects the contribution of manufacturing industry to national economy. Now the level of development of manufacturing service industry has become the key to fully release the competitiveness of manufacturing industry.

II. LITERATURE REVIEW

Vandermerwe and Rada (1988) is the first to define Servitization: Servitization is the transformation of manufacturing enterprises from providing goods or goods and additional services to goods service packs. The complete "package" includes goods, services, support, self-service and knowledge, and services dominate the package [1]. Similar to Vandermerwe and Rada, Reiskin et al. defined enterprise servitization as the center of manufacturing enterprises transforming from manufacturing physical products to main service products [2]. Szalavetz [3] divided the manufacturing service into internal service and external service. He believed that the degree of internal service is more and more important to the improvement of the competitiveness of the manufacturing industry. Meanwhile, the degree of external service complexity and importance related to physical products is also higher and higher. Similar to the definition of Szalavetz, Liu Jiguo [4] classified manufacturing service into input service and output service. Input servitization refers to the input of service elements in the production process, and output servitization refers to the service of products. Zhou Yanchun [5] defined the servitization of the manufacturing industry as the dynamic process in which manufacturing enterprises make the maximum realization of enterprise value acquisition and increase competitive advantage, and change the value chain from a manufacturing-centered to a service-oriented one. Shao Anju [6] (2014) made an in-depth analysis of the development status of the equipment manufacturing industry in Shanghai from the theoretical perspective of the service-oriented transformation of the manufacturing industry. He also discusses the opportunity and challenge of Shanghai equipment manufacturing industry in the process of service-oriented transformation and analyzes its advantages and disadvantages. Finally, he puts forward the path, countermeasures and policy Suggestions to promote the service transformation of Shanghai equipment manufacturing

industry. Xu Zhenxin et al. [7] (2016) made an in-depth analysis of a series of important issues such as definition, effect, motivation and upgrade path of manufacturing servitization by summarizing domestic and foreign research results, and the method of fixed effect model is used for empirical study. For each question, he gave a more realistic answer based on the previous one. Linghu Kerui and Jian Zhaoquan [8] (2017) believe that the realization of value creation is the fundamental of manufacturing service. They discuss the value co-creation model of manufacturing industry from the perspective of service ecosystem. First of all, they made an in-depth analysis of the interactive level of value co-creation in the service ecosystem and the service-oriented mode of the manufacturing industry, and then constructed the service-oriented value co-creation mode matrix based on these two dimensions. Through the detailed elaboration and comparison of nine service value co-creation modes, the conclusion drawn at last provides certain theoretical reference and practical guidance for manufacturing industry to realize value co-creation.

III. FACTORS

The main motivation for manufacturing enterprises to implement the service-oriented strategy is as follows: continuously obtaining stable high marginal revenue, increasing differentiated competitive advantage, selling more products through additional services, and improving customer loyalty. However, the servitization of manufacturing industry is a very complex major business model innovation. At present, there are many factors restricting the progress of manufacturing service. By referring to the literature and combining with the actual situation, the restrictive factors are summarized as follows:

A. Enterprise Flexibility

The flexibility of the enterprise can cope with external uncertainties, especially the uncertainty of customer demand. In the process of service, manufacturing enterprises provide services with the uncertainty feature of dynamic adjustment in order to highlight the personalized needs of customers [9]. Manufacturing enterprise flexibility can be divided into: production flexibility, relationship flexibility, structure flexibility, process flexibility. In the process of service, manufacturing enterprises need to be flexible in the aspects of resource acquisition, raw material processing, production planning, product storage and transportation, that is, production flexibility. In order to improve service satisfaction, manufacturing enterprises need to communicate with customers more, so that they can timely and accurately grasp the needs of customers. To be able to communicate in a timely manner when problems arise, enterprises need to be flexible in maintaining cooperative network and other aspects, namely, the flexibility of relations. In order to make service run smoothly, manufacturing enterprises need to constantly adjust their organizational structure, such as department structure increase or decrease or integration, adjustment of rights and responsibilities, and blurring of organizational boundary. In order to enhance service capability, manufacturing enterprises need to realize flexible operation process, that is, process flexibility. Therefore, production flexibility, relationship flexibility, structure flexibility and process flexibility have a positive impact on the servitization of manufacturing industry [9].

B. The Level of Service Economy

Production service industry cluster promotes the transformation and upgrading of manufacturing industry from four aspects: competition effect, specialization effect, learning effect and scale economy effect, among which competition effect and specialization effect are helpful for manufacturing enterprises to implement servitization [12]. The competitive effect reduces the service cost and improves the service outsourcing environment. The professionalization effect will form a kind of forcing mechanism and make the manufacturing enterprise transform to service. Therefore, the higher level of service economy greatly promotes the servitization of manufacturing industry.

C. Supporting Strength of Service-oriented Policies

The government's servitization policy can affect the servitization of manufacturing industry from three aspects: tax system, land use system and financial system [10]. If service enterprises can be identified as high-tech enterprises, there will be a big difference in enterprise income tax. In addition, if double taxation exists for the business tax levied on service outsourcing, the more detailed the enterprise's service division, the heavier the business tax burden. In terms of land use system, the development of the service industry is generally based on the city, and the price of urban land is generally high. In terms of financial system, the fixed assets that can be used for loan mortgage of service enterprises are generally less, and it is more difficult to obtain bank loans. In China's current financial system, financing for services is difficult.

D. Resource Acquisition Opportunities

The servitization of manufacturing industry needs the support of human resources, knowledge resources and infrastructure, and the servitization of manufacturing industry needs the support of manufacturing system, maintenance service, spare parts, logistics service and other cooperative supplier networks [13]. Service-oriented enterprises cannot easily meet the needs of customers by themselves. They need to cooperate with other enterprises, and only in the form of establishing cooperative partner value creation network can they achieve value added. The more opportunity and enterprise has to acquire resources, the easier it is to service.

E. Ability of Science and Technology

Whether the service activities of manufacturing enterprises can be carried out smoothly and efficiently depends largely on advanced science and technology. Advanced science and technology enables manufacturers to make better use of labor, equipment and raw materials to save money and improve product quality. Valeria et al[15](2013) found through research that, although some companies have implemented the service-oriented strategy,

due to poor operation, the product profit is often very low, while some enterprises that make full use of the information exchange technology (ICTS) can obtain higher profits in the process of product servitization. Anna et al[16](2017) found by studying the impact of the Internet on the servitization of manufacturing industry that the servitization of the Internet enables enterprises to extend the value chain so as to better serve customers and increase profits. It can be concluded from the above research that the progress and development of science and technology has changed the production and profit model of manufacturing enterprises. The ability of an enterprise to quickly understand and master new service technology knowledge and to use new technology to continuously improve service system, that is, technology ability, will determine whether the service activities can be carried out smoothly and efficiently.

F. Organizational Change Capability

Organizational change ability is the comprehensive ability of management and organization to make the organization adapt to the changing situation more rapidly and effectively than its competitors (Judge and DougIas 2009)[17]. Organizational change ability is the ability of an organization to propose solutions to internal and external environment changes and successfully implement these changes (Soparnot 2011) [14]. Organizational change capability is an extensive and dynamic multi-dimensional capability, which enables an organization to implement and successfully achieve changes of different types, norms and forms on a sustainable basis (Heckmann et al 2016)[19]. Organizational change capability plays an important role in the economies in transition. Judge et al. (2009) found in their study of various companies in Russia that organizational change ability has a significant positive impact on corporate performance, and organizational change ability is an important attribute regardless of the size of the company. Ramezan et al. (2013) found that the ability of organizational change to explain organizational performance reached 77.3% [18]. Hechmann (2016) demonstrated that organizational change capability has a positive relationship with its change project performance through questionnaire survey of executives in several German manufacturing and processing industries [19]. The implementation of the servitization strategy in manufacturing enterprises is bound to carry out a certain degree of organizational change. The above research shows that the ability of organizational change will have a great impact on the implementation effect of the servitization in manufacturing industry.

IV. EMPIRICAL STUDY

A. Model

A multiple linear regression model was established to explore the impact of each factor on the servitization of the manufacturing industry, taking enterprise flexibility, service economy level, service-oriented policy support, resource acquisition opportunity, scientific and technological capability, organizational change capability as independent variables and service-oriented implementation effect as dependent variables. As follows:

$$soie=\alpha_1 ef+\alpha_2 lse+\alpha_3 so+\alpha_4 rao+\alpha_5 ast+\alpha_6 occ+\varepsilon$$

TABLE I.MENING OF VARIABLE NAME

The variable name	meaning
soie	service-oriented implementation effect
ef	Enterprise flexibility
lse	The level of service economy
so	Supporting strength of service-oriented policies
rao	Resource acquisition opportunities
ast	Ability of science and technology
occ	Organizational change capability

B. Data Acquisition

The data of this paper were obtained by questionnaire survey. The questionnaire USES a five-point system. The object of investigation is the middle and senior management personnel of manufacturing enterprises in Tianjin. 300 valid questionnaires were obtained. The measurement indexes of soie, ef, lse, so, rao, ast and occ were successively derived from literature 9, 20, 20, 21 and 20. The measurement indexes of soie are prepared by themselves according to expert opinions.

C. Sample Reliability and Validity

In this paper, Cronbach's Alpha coefficient is used to test the reliability of the variable. The results are shown in the following table. Cronbach's Alpha of each influencing factor was greater than 0.8, indicating that the questionnaire results had good reliability. The KMO value was greater than 0.7, indicating that the questionnaire had better structural validity.

TABLE II. CRONBACH'S ALPHA

	ast	ef	rao	so	occ	lse	soie
Cronbach's Alpha	.822	.841	.819	.821	.914	.921	.890

TABLE III. THE INSPECTION OF KMO AND BARTLETT

Kaiser meyer-olkin metric to sample enough.	.913
The approximate chi-square	6476.302
Bartlett's test of sphericitydf	528
Sig.	.000

D. Analysis

Spss21 software was used to analyze the data by stepwise regression. The process is as follows.

1) The process of variable filtering: As shown in "Table IV", variable enterprise flexibility was first introduced and model 1 was established. And then the variable that we're

going to introduce is rao, ast and occ. Finally, the variables contained in model 4 are ef, rao, ast and occ.

TABLE IV. INPUT/REMOVE VARIABLES

Model	Input variable	Remove variable	Methods
1	ef	.	Step by step（P of F-to-enter <= .050,P of F-to-remove >= .100）。
2	rao	.	Step by step（P of F-to-enter <= .050,P of F-to-remove >= .100）。
3	ast	.	（Step by step P of F-to-enter <= .050,P of F-to-remove >= .100）。
4	occ	.	Step by step（P of F-to-enter <= .050,P of F-to-remove >= .100）。

a. Dependent variable: soie

2) Model summary information: As shown in "Table V", the "model summary" table shows the fitting of the model. As you can see from the table, from model 1 to model 4, the adjustment of R square increased from 0.435 to 0.534, indicating that the proportion of the total variation explained by the model was larger and larger.

TABLE V. MODEL SUMMARY

Model	R	R square	Adjusted R square	Error in standard estimates
1	.659[a]	.435	.433	.83741
2	.699[b]	.489	.485	.79766
3	.724[c]	.524	.519	.77096
4	.731[d]	.534	.528	.76388

a. Predictor variable: (constant),ef.

b. Predictor variable: (constant), ef, rao.

c. Predictor variable: (constant), ef,rao , ast.

d. Predictor variable: (constant), ef, rao, ast,occ.

e. The dependent variable: soie

3) Analysis of variance: As shown in "Table VI", Anova The table shows the variance analysis results of each step in the regression process. The regression sum of squares in model 4 is greater than the residual sum of squares, indicating that the linear model explains more than half of the total sum of squares. When the regression equation contains different independent variables, the significance probability values are all less than 0.001, so the original hypothesis that the overall regression coefficient is 0 can be significantly rejected.

TABLE VI. ANOVA[A]

model	Sum of squares	df	The mean square	F	Sig.
1 regression	160.578	1	160.578	228.985	.000[b]
residual	208.976	298	.701		
total	369.553	299			
2 regression	180.583	2	90.291	141.909	.000[c]
residual	188.971	297	.636		
total	369.553	299			
3 regression	193.618	3	64.539	108.584	.000[d]
residual	175.935	296	.594		
total	369.553	299			
4 regression	197.417	4	49.354	84.581	.000[e]
residual	172.136	295	.584		
total	369.553	299			

a. The dependent variable:soie.

b. Predictor variable: (constant),ef.

c. Predictor variable: (constant), ef, rao.

d. Predictor variable: (constant), ef,rao , ast.

e. Predictor variable: (constant), ef, rao, ast,occ.

4) Estimation of regression coefficients: As shown in "Table VII", the "coefficient" table gives the estimated regression coefficients of all models. All the coefficients of ef,rao,ast and occ are positive, showing that their impact on manufacturing enterprise servitization is positive. According to the t-test, "enterprise flexibility" is not very significant, "resource access opportunity" and "technology capability" are significant at the level of 0.001, and "organizational change capability" is significant at the level of 0.05. The last one in the coefficient table is a colinear diagnostic statistic, and the expansion factor (VIF) of the four independent variables is less than 5, so there is no colinear between the four independent variables in model 4.

TABLE VI. COEFFICIENT A

Model	Nonstandardized coefficient		Standard coefficient	t	Sig.	Colinear statistics	
	B	*Standard error*				*Tolerance*	*VIF*
1 (constant)	1.643	.169		9.719	.000		
ef	.623	.041	.659	15.132	.000	1.000	1.000
2 (constant)	1.061	.192		5.535	.000		
ef	.453	.050	.479	9.135	.000	.626	1.598
rao	.313	.056	.294	5.607	.000	.626	1.598
3 (constant)	.680	.202		3.362	.001		
ef	.193	.073	.205	2.642	.009	.268	3.734
rao	.315	.054	.296	5.839	.000	.626	1.598
ast	.353	.075	.332	4.683	.000	.321	3.117
4 (constant)	.467	.217		2.151	.032		
ef	.144	.075	.153	1.924	.055	.250	3.996
rao	.302	.054	.283	5.615	.000	.620	1.614
ast	.341	.075	.321	4.566	.000	.320	3.128
occ	.139	.054	.123	2.551	.011	.681	1.469

V. CONCLUSION

Through the above analysis, it is concluded that the main factors influencing the servitization of the manufacturing industry in Tianjin are enterprise flexibility, organizational

change ability, resource acquisition opportunity and scientific and technological ability. The effect of service economy level and service policy support is not significant. The reason may be that China's overall service economy has been improved in recent years, and Tianjin's service policy has been improved day by day. Among the four significant factors that affect the servitization of the manufacturing industry in Tianjin, the most significant ones are resource access opportunity and scientific and technological capability, the second is organizational change capability, and the enterprise has the least flexibility. In order to better cater to consumers and enhance the competitiveness of enterprises, the servitization of manufacturing industry has become an inevitable move for enterprises. Meanwhile, from the perspective of promoting employment, building a manufacturing power and promoting social consumption, it is also the responsibility of the government to guide enterprises to implement the servitization strategy. Combining with the results of empirical analysis, the following Suggestions are proposed:

A. We Must Step up Infrastructure Development, Improve the Talent Introduction System, Improve the Service Ecological Environment of the Manufacturing Industry, and Increase the Access to Resources of Manufacturing Enterprises

Infrastructure, such as transportation, communication and medical services, is fundamental to the existence and development of enterprises. Good infrastructure is conducive to attracting large service enterprises to settle down, and also conducive to the implementation of service-oriented strategy of enterprises themselves. In terms of talent introduction, although the government of Tianjin has issued some policies to attract talents to settle down, compared with some other large and medium-sized cities, it is relatively backward. Therefore, it is suggested that the government should continue to strengthen talent introduction and increase the talent resources needed for the service of the manufacturing industry. At the same time, a platform can be built to facilitate exchanges and cooperation between enterprises in different industries, so as to promote sharing of knowledge resources and circulation of other resources among enterprises.

B. We Must Strengthen the Development of Scientific and Technological Capabilities in Enterprises

The first is to strengthen the cultivation of scientific and technological talents. At present, the technological progress is very fast, and new technological products come out almost every year. In addition to the training of front-line workers and managers on the ability to use new scientific and technological products, the government should also set up corresponding training institutions to regularly train relevant personnel so that they can keep pace with The Times and master new scientific and technological products in a timely manner. Second, enterprises should strengthen the application of new technologies to improve management efficiency. The introduction of new technologies requires a large amount of capital, which should be supported by the government. Special loans and corresponding subsidies should be set up to help enterprises introduce new technologies and improve their scientific and technological capabilities.

C. We Must Improve the Ability of Organizational Change

To improve the ability of organizational change, the balanced development of front-line workers, middle and senior managers is needed. The incoordination of the organizational change ability of front-line employees and middle and high-level managers not only has a negative impact on the reform, but also affects the organizational performance. The government can set up corresponding training institutions to provide training on organizational change for enterprise employees and improve their overall reform ability. In addition, the government can also set up an information exchange platform for enterprises to communicate about the organizational reform problems encountered in the process of manufacturing service.

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