On the Service Transformation of Ningbo’s Manufacturing Industry Considering the Potential of Ecological Benefits

Ziyuan Xie, College of Finance and Information, Ningbo University of Finance and Economics, Ningbo, China
Guixian Tian, School of Business, Pingxiang University, Pingxiang, China*
Yongchao Tao, Shandong Marine Economic and Cultural Research Institute, Shandong Academy of Social Science, Qingdao, China

ABSTRACT

This paper puts forward the service transformation approach of Ningbo manufacturing industry considering the potential of ecological benefits. By analyzing the current situation of service-oriented development of Ningbo’s manufacturing industry, this paper summarizes the problems encountered in the process of service-oriented transformation of Ningbo’s manufacturing industry, introduces the concept of ecological benefit potential, combines the characteristics of service-oriented transformation of Ningbo’s manufacturing industry, finds the path of service-oriented transformation of Ningbo’s manufacturing industry, constructs a grey relational model, analyzes the coupling relationship between Ningbo’s manufacturing industry and service industry, and completes an analysis of the ways of transformation of service of Ningbo’s manufacturing industry. The simulation results show that the proposed transformation path method can improve the problems existing in the service transformation of Ningbo manufacturing industry.

KEYWORDS

Green Transformation, Industrial Transformation, Mechanism Research, Ningbo Manufacturing Industry, Service-Oriented Manufacturing Industry

INTRODUCTION

In the post crisis era, with the change of world economic pattern and the acceleration of globalization and informatization, economic transformation has become an inevitable trend of world economic development (Jamison, 2018). At present, China has entered a new stage of transformation. The overall economic operation shows the characteristics of “new normal”, but opportunities and challenges coexist. Facing the international financial crisis, global warming and the pressure of resources and ecological environment, all governments are actively exploring the path of sustainable development.
China is facing the transformation from extensive to intensive, from rural society to urban society, from the first development in the east to regional coordinated development. As national strategies, coordinated development, scientific development and green development have been put forward one after another. In different degrees, problems such as economic growth fluctuation, single industrial structure and ecological environment deterioration have emerged in resource-based regions in China. China is facing the strategic choice of transformation and development (Ye et al., 2020).

With the continuous increase of national income, China’s industrial structure has developed from the stage of “primary industry, secondary industry and tertiary industry” to the stage of “secondary industry, tertiary industry and primary industry”, and finally to the advanced stage of “tertiary industry, secondary industry and primary industry” (Lawton & Mark, 2018). China’s industrial structure is constantly changing. With the increase of the proportion of the tertiary industry, human society has entered the service economy. The high income elasticity and the rate of return on investment of the tertiary industry make the impact of service industry on the national economy more and more obvious. The value created by service has become the first driving force of economic growth. With the development of service economy, the world manufacturing industry has changed greatly. The traditional boundary between manufacturing industry and service industry is disappearing rapidly, and a new economic growth model is emerging. This new economic growth mode emphasizes the high added value generated by service, which is customer-oriented and satisfies customer demand by providing service. With the growth of value created by enterprise services, the organizational structure and management mode of the enterprise itself have changed accordingly. The transformation approach of manufacturing service has become a hot issue in this field (Patrick et al., 2018). At home and abroad, there are a lot of research results on the integration of two industries and the transformation of manufacturing services.

Literature puts forward the path analysis of manufacturing industrial structure transformation based on the calculation and analysis of location entropy (Antonio et al., 2018). This method takes Suzhou and Wuxi as examples, analyzes the R & D investment of the two cities in recent years, analyzes the scientific research personnel and human resource structure of manufacturing enterprises in the two cities, and summarizes the theoretical path of service transformation of manufacturing industry in the two cities according to the service upgrading mode of manufacturing industry in the two cities. This method aims at the analysis of service transformation of manufacturing industry in Suzhou and Wuxi, and completes the analysis of transformation path of the two cities. However, this method has great limitations. It only analyzes part of the manufacturing enterprises in the two cities, and the survey data has some problems. Literature puts forward the analysis of the northeast manufacturing service transformation (Geraldine et al., 2018). The northeast manufacturing industry is in the transition stage from structural imbalance to optimization and rebalancing. The transformation needs to step out of the dilemma of resource mismatch, comparative advantage trap and insufficient innovation ability. Through the reform of resource supply side, readjust the allocation of resources among industries, regions and enterprises, stimulate the vitality of enterprises through system reform, promote the transformation of traditional manufacturing to intelligent manufacturing, and increase the integration of manufacturing and service industries. Based on the difficulties faced by the manufacturing industry in Northeast China, this method puts forward the corresponding transformation path. But the transformation path proposed by this method is theoretical and practical. Literature proposes to carry out Internet revolution, integrates new generation technology with manufacturing industry, promotes the development of traditional manufacturing industry, changes production mode, business model and manufacturing transformation (Ryan et al., 2018). With the help of the Internet platform for procurement, online and offline marketing, improve the operation efficiency and promote the integration of all links; In terms of management, the Internet updates the traditional management concept of manufacturing enterprises, improves the information management system of manufacturing enterprises, and forms a flat management organization of manufacturing enterprises. This method
effectively uses the Internet platform, but there are some errors in the traditional manufacturing characteristic analysis, resulting in the method cannot be applied accurately.

Based on the advantages of the above-mentioned service-oriented transformation path of manufacturing industry, this paper studies the service-oriented transformation of Ningbo manufacturing industry from the perspective of the potential of ecological benefits, and puts forward an analysis of the service-oriented transformation path of Ningbo manufacturing industry considering the potential of ecological benefits. Based on the theory of economics and sustainable development, comparative analysis, empirical analysis, case analysis and quantitative economic analysis, this paper discusses the basic theory of green transformation of Ningbo’s resource-based regions, including green transformation of resource-based industries, green transformation of economic growth mode, green integration of scientific and technological innovation, and institutional innovation New green leading, etc. The combination of resource-based economic transformation and green development, the implementation of green transformation, the promotion of the traditional and resource dependent “black” development model to the ideal and innovation driven “green” development model, and the realization of a win-win situation of economic development and ecological environment protection have important theoretical value for improving the theory of sustainable development of resource-based regions and guiding the scientific development of resource-based regions Value and practical significance.

ANALYSIS ON THE CURRENT SITUATION OF MANUFACTURING SERVICE IN NINGBO

Analysis of Ecological Benefits in Ningbo

Table 1 shows the evaluation results of regional integration development level of Zhejiang Province in 2018 released by Zhejiang Economic and Information Technology Commission (2019):

In 2018, the integration development level index of Ningbo and Hangzhou is 71.32, ranking the second, and they are in the first echelon together. From the perspective of sub indicators, the basic environment index of Ningbo’s integration is 18.79, which is in the second place, second only to Hangzhou. Ningbo’s basic environmental problems are mainly in the aspects of industrial application and application benefits, showing a low mismatch with the basic environmental ranking. Although

<table>
<thead>
<tr>
<th>Region</th>
<th>2017 Index</th>
<th>2018 Index</th>
<th>Basic Environment</th>
<th>Industrial Application</th>
<th>Application Benefit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hangzhou</td>
<td>78.93</td>
<td>85.71</td>
<td>19.10</td>
<td>43.50</td>
<td>23.11</td>
</tr>
<tr>
<td>Ninbo</td>
<td>76.16</td>
<td>80.95</td>
<td>18.47</td>
<td>43.04</td>
<td>19.43</td>
</tr>
<tr>
<td>Jiaxing</td>
<td>68.06</td>
<td>72.50</td>
<td>17.04</td>
<td>43.14</td>
<td>11.56</td>
</tr>
<tr>
<td>Huzhou</td>
<td>66.39</td>
<td>69.89</td>
<td>17.00</td>
<td>42.23</td>
<td>11.44</td>
</tr>
<tr>
<td>Wenzhou</td>
<td>66.59</td>
<td>66.32</td>
<td>16.98</td>
<td>42.11</td>
<td>11.32</td>
</tr>
<tr>
<td>Shaoxing</td>
<td>65.32</td>
<td>65.36</td>
<td>15.03</td>
<td>41.20</td>
<td>11.97</td>
</tr>
<tr>
<td>Jinhua</td>
<td>63.15</td>
<td>60.59</td>
<td>15.36</td>
<td>40.96</td>
<td>10.32</td>
</tr>
<tr>
<td>Taizhou</td>
<td>60.87</td>
<td>53.69</td>
<td>16.00</td>
<td>39.25</td>
<td>10.05</td>
</tr>
<tr>
<td>Hengzhou</td>
<td>60.78</td>
<td>50.69</td>
<td>14.36</td>
<td>39.23</td>
<td>9.32</td>
</tr>
<tr>
<td>Lishui</td>
<td>56.69</td>
<td>50.32</td>
<td>13.96</td>
<td>30.62</td>
<td>8.95</td>
</tr>
<tr>
<td>Zhoushan</td>
<td>55.36</td>
<td>50.36</td>
<td>12.69</td>
<td>35.96</td>
<td>9.36</td>
</tr>
</tbody>
</table>
the basic conditions of Ningbo’s integration of industrialization and industrialization are good, it does not play a very good role in practical industrial application and output benefits.

**Analysis on The Current Situation of Ningbo Manufacturing Service Industry**

In 2018, Ningbo’s GDP was 461.965 billion yuan, an increase of 8.3% over the previous year. Among them, the added value of the primary industry is 12.365 billion yuan, with a growth rate of 3.2%; The added value of the secondary industry is 2.103 billion yuan, with a growth rate of 7.1%; The added value of the tertiary industry is 235.936 billion yuan, with a growth rate of 9.6%. The proportion of the city’s economic and industrial structure is 2.7%: 45.36%: 54.35%, of which the proportion of the tertiary industry is 1.7 percentage points higher than that of the previous year, as shown in Figure 1:

As can be seen in Figure 1, in 2018, Ningbo achieved an industrial added value of 15.326 billion yuan, an increase of 6.3% over the previous year, 4779 Industrial Enterprises above Designated Size, and an industrial added value of 190.326 billion yuan, an increase of 6.3% over the previous year.

**Problems in The Service Transformation of Ningbo Manufacturing Industry**

Even if Ningbo manufacturing enterprises have the necessary conditions for the implementation of service, they also encounter some problems that hinder their transformation in the specific implementation process (Marc-Andre et al., 2018; Jenni et al., 2018), mainly including:

1. Organizational culture

   The organizational culture of traditional manufacturing industry emphasizes efficiency and economic scale, which believes that the diversification and flexibility of operation need to increase the cost of enterprises. Ningbo manufacturing industry is no exception. Its services are regarded as cost accessories.

Figure 1. GDP and growth rate of Ningbo in 2013-2018
(2) Uncertainty avoidance in manufacturing enterprises

The manufacturing enterprise’s uncertainty avoidance tendency determines its sensitivity to change. For enterprises with low risk and irresistible, the high risk brought by service-oriented products cannot be accepted. The traditional manufacturing industry is not optimistic about the value benefits created by services.

(3) Industrial chain problems

The service-oriented manufacturing industry has changed the process of each link in the industrial chain, affected the long-term cooperation relationship of the industrial chain, made the whole industrial chain wash and shuffle, and produced the conflict of interest.

In order to speed up the process of service-oriented transformation of manufacturing industry, Ningbo Municipal Party committee and municipal government and relevant departments have actively formulated various policies to create favorable conditions for service-oriented transformation of manufacturing industry in Ningbo. In July 2015, Ningbo municipal government issued the 2015 annual implementation plan for cultivation and development of top ten emerging industries in Ningbo, which proposed three major tasks: strengthening project driving, platform construction and enterprise cultivation. In March 2016, Ningbo municipal government issued “three year action of Ningbo City to accelerate the development of information economy (2016-2018)”, which emphasizes to adhere to the guidance of information technology, take “intelligent manufacturing” and “Internet +”, and comprehensively deepen the wide application of information technology in various fields. In July, Ningbo municipal government issued the action plan for the development of service industry in Ningbo in 2016. The document pointed out that it is necessary to speed up the development of six major productive service industries, namely, information service industry, financial service industry, modern logistics industry, science and technology industry industry, cultural industry and business service industry. In September, the 13th five year plan for building a strong industrial city in Ningbo pointed out the key points of industrial development. First, it is necessary to cultivate and develop new industries such as new generation information technology and Internet of things industry, high-end equipment manufacturing industry, new energy, etc.; Second, it is necessary to transform and upgrade traditional industries; Third, it is necessary to actively develop productive service industry and pay attention to regional spatial layout. We will focus on key links such as technological innovation, intelligent manufacturing and green manufacturing, and promote the construction of a strong industrial city.

The promulgation of the above policy planning provides a good policy environment for the transformation and upgrading of the industrial economy. From the above government’s policy planning, it is not difficult to see that promoting the deep integration of industrialization and informatization and the transformation and innovation of manufacturing services are the important contents of building a modern industrial system in Ningbo, and the core measures to realize the revitalization of Ningbo regional economy.

THE TRANSFORMATION METHOD OF NINGBO MANUFACTURING SERVICE

Concept of Ecological Benefit Potential

(1) The most typical characteristics of ecological resource-based regions are: the concentration and concentration of elements to the resource sector, resulting in excessive dependence of resource-based regions on the resource sector. Reasons:
(2) The rising price of mineral products has brought about the change of trade price ratio between different sectors. Under the joint action of factor flow and consumption, the factors flow and gather from other sectors to resource sectors, and the international competitiveness of manufacturing industry has declined, resulting in “anti-industrialization”;

(3) In mineral development, the asset specificity is strong, including the material asset specificity of the enterprise, the organic composition of capital is high, the fixed asset investment, especially the one-time investment ratio is significant, and the use of equipment is single; In mineral development, the human asset specificity is also strong, whether it is technicians or miners, who have been mainly engaged in technical work and development activities related to mineral resources for many years. It is difficult to adapt to the work of other industries; In addition, the resource industry families formed around resource extraction, such as primary processing, supporting facilities, production services, etc., have a strong asset specificity; In addition, the regional level of life facilities and location specificity lead to a huge precipitation cost in the resource sector, which restricts the transformation of elements;

The absorption effect, stickiness effect and lock-in effect of the resource sector and its resource industry family lead to the stagnation of elements in the resource sector (McAllister et al., 2018; Kerr et al., 2018; Juan-Manuel et al., 2018).

The above reasons are that the key elements are locked in the resource sector, forming a single industrial structure, and making the manufacturing industry and agriculture fall into the resource advantage trap. Taking Ningbo as an example, during the period of 1992-2016, the proportion of mining industry added value to industrial added value is on the rise (see Figure 2) as a whole, especially since 2000, the proportion of mining industry has continued to rise, from 27.9% to 63.4% in 2011, with an average annual increase of 3.23 percentage points, including 11 percentage points in 2008; The proportion of manufacturing industry has continued to decline, from 2000 55.4% in 2011 decreased to 31.7% in 2011, with an average annual decrease of 2.15 percentage points. If the primary processing industry of resources, i.e. resource industry family, is taken into account, the proportion will be larger. The proportion of coal (carbon), coking, metallurgy (gold) and electricity (power) in the industrial added value of Ningbo will increase from 61.8% in 1992 to 2016, while the proportion of manufacturing industry other than coking and metallurgy will decrease from 37.7% in 1992 to 37.7% in 2011 13.6%. Resource sector or resource industry family accounts for the absolute proportion of industrial added value, manufacturing industry is significantly “squeezed out” and there is “anti-industrialization” phenomenon (Nachiket et al., 2018).

In the long run, the ability of resource-based regions to resist market risks is declining, which is prone to economic growth fluctuations and “resource curse” phenomenon. Excessive dependence on the resource sector will cause fluctuations in regional economic growth and reduce regional anti-risk capacity. From the comparison of Ningbo’s economic growth with that of the whole country since the founding of new China (see Figure 3), the trend of Ningbo’s economic growth is highly correlated with that of the whole country, but the fluctuation range of Ningbo’s economic growth is significantly higher than that of the whole country.

**CONSTRUCTION OF GREY CORRELATION MODEL**

On the basis of the above analysis, the gray correlation model is constructed to analyze the service transformation path of Ningbo manufacturing industry. A series of cooperation between manufacturing industry and service industry, combined with the characteristics of the two, according to the current situation of Ningbo manufacturing industry service development, the gray correlation model is used to analyze it (Caroline & Mark, 2018). The calculation process is as follows:
Figure 2. Changes in internal structure of Ningbo Industry in 1992-2016

Figure 3. Trends in Ningbo’s Economic Growth 1992-2016 and its Comparison with the Country
(1) First, determine the reference data and comparison data columns. The independent variable comparison data is listed as service industry $F$ series, and the dependent variable comparison data is manufacturing industry $Z$ series.

(2) Then, each index in the sequence is dimensionless. In this paper, we use the method of mean value to deal with the original data in a radical and dimensionless way, and divide the index value of each column by the mean value of each column.

(3) Finally, the poor students should answer the difference series. Compare the difference between the comparison sequence and the reference sequence to get the absolute value. Namely:

$$\Delta = \left| K_i^F(t) - K_j^Z(t) \right|$$

(1)

In the formula, $K$ indicates the standardized value of manufacturing service transformation economic indicators in Ningbo.

The maximum value of each column is:

$$\Delta_{\text{max}} = \max_i \max_j \left| K_i^F(t) - K_j^Z(t) \right|$$

(2)

The minimum value of each column is:

$$\Delta_{\text{min}} = \min_i \min_j \left| K_i^F(t) - K_j^Z(t) \right|$$

(3)

At this point, the correlation coefficient is calculated by using the correlation degree, that is:

$$\varpi_{ij}(t) = \frac{\Delta_{\text{min}} + p \times \Delta_{\text{max}}}{|KF_i(t) - KZ_j(t)| + p \times \Delta_{\text{min}}}$$

(4)

In the formula, $p$ represents a standardized coefficient, between 0.5~1, $\varpi_{ij}(t)$ show $t$ the correlation coefficient at the moment, the larger the value is, the stronger the correlation (Jing & Li, 2016).

On the basis of the above correlation degree, get the correlation matrix $A$, it reflects the coupling relationship between Ningbo manufacturing industry and service industry, namely:

$$A = \frac{1}{n} \sum_{i=1}^{n} \varpi_{ij}(t)$$

(5)

In the formula, when $0 \leq A \leq 1$, Prove that $F_i$ and $Z_j$ are related, the larger the value is, the higher the relevance is. When $0 \leq A \leq 0.35$, the correlation between them is the worst, when $0 \leq A \leq 0.65$, Moderate correlation, when $0.65 \leq A \leq 0.85$, it has a strong correlation.

On the basis of correlation matrix, the average value can be calculated by row and column
\[ \varphi_i = \frac{1}{n} \sum_{i=1}^{n} A_{ij} \quad (i = 1, 2, 3, ... n; j = 1, 2, 3, ..., m) \]  

(6)

\[ \varphi_j = \frac{1}{m} \sum_{j=1}^{m} A_{ij} \quad (i = 1, 2, 3, ... n; j = 1, 2, 3, ..., m) \]  

(7)

According to its size and corresponding scope, we can see the most important correlation factors between manufacturing industry and service industry. On this basis, the co-scheduling model is constructed, namely:

\[ \beta(t) = \frac{1}{m \times n} \sum_{j=1}^{n} \sum_{j=1}^{n} a_i(j)(t) \]  

(8)

In the formula, \( \beta(t) \) is a service-oriented dispatching of Ningbo’s manufacturing industry, \( a_i \) is the degree of coordination. According to formula (8), the coupling degree of development coordination between Ningbo manufacturing industry and service industry can be analyzed.

**EXPERIMENTAL ANALYSIS**

**Experimental Environment**

In order to verify the effectiveness of the proposed method, a simulation experiment is carried out. Three manufacturing enterprises in industrial parks of Ningbo were selected as the sample enterprises. The experiment was carried out on the MATLAB platform. The operating system of the experiment was Windows XP system. Its running memory was 8 GB and CPU was 3.6 GHz. Spss 20.0 software was used for data statistical analysis. The experiment was carried out by questionnaire.

**EXPERIMENTAL PARAMETERS**

This study takes manufacturing enterprises in three industrial parks in Ningbo as samples. A total of 250 questionnaires were sent out, 221 were collected, and 196 valid questionnaires were sorted out. The sample distribution is shown in Tables 2 to 4.

**EXPERIMENTAL ENVIRONMENT**

**Reliability and Validity Analysis of Different Methods**

In order to verify the validity of the proposed method, the reliability and validity of the proposed method, are analyzed (Antonio et al., 2018; Geraldine et al., 2018; Ryan et al., 2018). Among them, the reliability and validity values below 0.7 belong to the poor level, between 0.7 and 0.9 belong to the good level, between 0.9 and 1 belong to the very good level. The experimental results are shown in Figure 4:

It can be seen from the analysis of Figure 4 that under the same conditions, the reliability of the proposed method, are different (Antonio et al., 2018; Geraldine et al., 2018; Ryan et al., 2018). Among them, in 10 experiments, the range of reliability and validity of the proposed method is 0.9-1;
In 10 iterations of the method in (Antonio et al., 2018), the range of values is less than 0.7 for three times and 0.7-0.9 for five times. Among them, there are two values ranging from 0.9 to 1; Among the 10 iterations of (Geraldine et al., 2018), there are five values ranging from 0.7 to 0.9; Among the 10

<table>
<thead>
<tr>
<th>Industries of enterprises</th>
<th>frequency</th>
<th>Effective percentage</th>
<th>Effective percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrical machinery</td>
<td>36</td>
<td>18.4</td>
<td>18.4</td>
</tr>
<tr>
<td>Footwear industry</td>
<td>66</td>
<td>33.7</td>
<td>52.1</td>
</tr>
<tr>
<td>Clothing</td>
<td>34</td>
<td>17.3</td>
<td>69.4</td>
</tr>
<tr>
<td>Medical manufacturing</td>
<td>1</td>
<td>5</td>
<td>69.9</td>
</tr>
<tr>
<td>Communication computer</td>
<td>5</td>
<td>2.6</td>
<td>72.5</td>
</tr>
<tr>
<td>Glasses</td>
<td>11</td>
<td>5.6</td>
<td>78.1</td>
</tr>
<tr>
<td>Instruments and Apparatuses</td>
<td>8</td>
<td>4.1</td>
<td>82.2</td>
</tr>
<tr>
<td>New materials</td>
<td>3</td>
<td>1.5</td>
<td>83.7</td>
</tr>
<tr>
<td>Chemical fiber</td>
<td>2</td>
<td>1.0</td>
<td>84.7</td>
</tr>
<tr>
<td>Nonferrous Metals</td>
<td>5</td>
<td>2.6</td>
<td>87.3</td>
</tr>
<tr>
<td>Printing business</td>
<td>3</td>
<td>1.5</td>
<td>88.8</td>
</tr>
<tr>
<td>Plastic</td>
<td>5</td>
<td>1.0</td>
<td>91.4</td>
</tr>
<tr>
<td>Cultural and educational supplies</td>
<td>3</td>
<td>2.6</td>
<td>93.4</td>
</tr>
<tr>
<td>Transportation equipment</td>
<td>10</td>
<td>1.5</td>
<td>94.9</td>
</tr>
<tr>
<td>Total</td>
<td>196</td>
<td>100</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of years of establishment</th>
<th>frequency</th>
<th>Effective percentage</th>
<th>Effective percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 3 years</td>
<td>28</td>
<td>14.3</td>
<td>14.3</td>
</tr>
<tr>
<td>4-6</td>
<td>54</td>
<td>27.6</td>
<td>41.8</td>
</tr>
<tr>
<td>7-10</td>
<td>35</td>
<td>17.9</td>
<td>59.7</td>
</tr>
<tr>
<td>11-15</td>
<td>32</td>
<td>16.3</td>
<td>76.0</td>
</tr>
<tr>
<td>16-20</td>
<td>47</td>
<td>24</td>
<td>100</td>
</tr>
<tr>
<td>More than 20</td>
<td>196</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Current incumbency of enterprises</th>
<th>frequency</th>
<th>Effective percentage</th>
<th>Effective percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 100</td>
<td>55.1</td>
<td>55.1</td>
<td>55.1</td>
</tr>
<tr>
<td>101-300</td>
<td>32.1</td>
<td>32.1</td>
<td>87.2</td>
</tr>
<tr>
<td>301-700</td>
<td>10.2</td>
<td>10.2</td>
<td>97.4</td>
</tr>
<tr>
<td>701-1000</td>
<td>1.0</td>
<td>1.0</td>
<td>98.5</td>
</tr>
<tr>
<td>More than 1000</td>
<td>1.5</td>
<td>1.5</td>
<td>100</td>
</tr>
</tbody>
</table>
iterations of (Ryan et al., 2018), there are six values ranging from 0.7 to 0.9 and four values ranging from 0.7 to 0.9. In contrast, the reliability efficiency of the proposed method is better than the other three methods. This is because the proposed method has conducted sufficient research before the service-oriented transformation of Ningbo manufacturing industry, improved the reliability of the data, and then improved the reliability and validity of the proposed method.

Correlation Analysis of Different Methods

In order to verify the effectiveness of the proposed method, the correlation degree of the proposed method, are analyzed (Antonio et al., 2018; Geraldine et al., 2018; Ryan et al., 2018). The higher the correlation degree is, the better the comprehensive performance of the method is. The experimental results are shown in Figure 5:

<table>
<thead>
<tr>
<th></th>
<th>frequency</th>
<th>Effective percentage</th>
<th>Effective percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10%</td>
<td>93</td>
<td>47.4</td>
<td>47.4</td>
</tr>
<tr>
<td>10%-20%</td>
<td>64</td>
<td>32.7</td>
<td>80.1</td>
</tr>
<tr>
<td>20%-30%</td>
<td>25</td>
<td>12.8</td>
<td>92.9</td>
</tr>
<tr>
<td>More than 30%</td>
<td>14</td>
<td>7.1</td>
<td>100</td>
</tr>
</tbody>
</table>

Figure 4. Comparison of reliability and validity of different methods
From the analysis of Figure 5, we can see that there is a certain gap in the relevance degree of manufacturing service by using four methods. Among them, the correlation degree of the proposed method is up to 98%, showing a continuous and stable growth; The correlation degree of the (Antonio et al., 2018) method is up to 93%, but its fluctuation range is large; The correlation degree of the (Geraldine et al., 2018; Ryan et al., 2018) method is up to 81%, and the fluctuation range is large; In contrast, the proposed method has the highest correlation degree for Ningbo manufacturing service, and is relatively stable. This is because the proposed method constructs the gray correlation model, obtains the sequence and so on, thus enhances the analysis correlation degree.

**Accuracy Analysis of Obtaining Standardization Coefficient $p$**

Standardization coefficient $p$ can effectively reflect the intensity of integration between Ningbo’s manufacturing industry and service industry. For this reason, four methods are used to obtain the value. The higher the accuracy, the higher the effectiveness of the proposed method. The experimental results are shown in Figure 6:

Analyzing the data in Figure 6, we can see that there are some differences in the accuracy of obtaining standardization coefficient by four different methods. From the curve trend in the figure, all have the trend of first increasing and then decreasing, and the accuracy is not low (Antonio et al., 2018; Geraldine et al., 2018; Ryan et al., 2018). However, the accuracy of the proposed method is relatively high, and the curve trend is stable, which verifies the scientific validity of the proposed method.

**CONCLUSION, POLICY SUGGESTION AND PROSPECT**

**Conclusion**

Based on the current situation and empirical research, this paper studies the current situation of the integration of manufacturing enterprises in Ningbo and the service-oriented transformation mode, as well as the differences between the two mechanisms. Through the questionnaire survey and analysis of 15 manufacturing industry samples in Ningbo Light Industry Park, high tech economic zone and Economic Development Zone Industrial Zone, it is found that the two kinds of integration have different functions for different types of service transformation: the two kinds of integration for service

![Figure 5. Correlation degree comparison of different methods](image)
transformation based on product efficiency improvement. For large and medium-sized enterprises with advantages in information resources, we will promote the construction of demonstration projects of intelligent manufacturing, encourage enterprises to vigorously promote new technologies in cloud computing, big data and other fields, set a model for Ningbo intelligent manufacturing, and strengthen the research and application publicity of typical enterprises. For the small and medium-sized enterprises with relatively weak foundation, we should encourage step-by-step “machine replacement”, further promote automation to improve efficiency, participate in the construction of e-commerce system, and improve internal and external management level through informatization.

**Proposal**

In view of the service transformation of Ningbo's manufacturing industry, the following suggestions are put forward:

1. In order to realize the value and innovation of products, Ningbo manufacturing industry should grasp the new trend of service development accurately.
2. Recognize the characteristics of the industry, analyze the conditions of the enterprise itself, and accurately position the service.
3. Change the traditional business philosophy and profit-making methods, and realize service innovation.
4. Excavate and integrate the internal and external resources of the enterprise to transform and upgrade the business model of the manufacturing industry.
OUTLOOK

This study makes a case and Empirical Study on the current situation of the integration of the two manufacturing enterprises in Ningbo, the mode of service-oriented transformation and the mechanism between the two. However, due to the limitation of time, energy and research ability, there are some shortcomings in this study, which need to be expanded and improved in the future research.

This paper mainly empirically analyzes the effect of the integration on different types of service transformation methods, but does not make a more detailed sub factor division for the integration of independent variables.

(1) The balance and complementary effect of using learning and exploring learning are ignored.
(2) For the sample sampling problem, the effective questionnaire is less than 200, and the number of samples needs to be expanded in the future. In addition, there are great differences in the industries to which the sample objects belong, and no more detailed difference analysis has been made.

FUNDING AGENCY

The publisher has waived the Open Access Processing fee for this article.

ACKNOWLEDGEMENTS

This work was supported by National Social Science Foundation (Project approval number: 18BJY028) and Research Project of humanities and social sciences in universities of Jiangxi Province (Project approval number: JC18102).
REFERENCES


