

# Study on the High Quality Development of the Advanced Manufacturing Industry in Dalian City Based on Model Construction

Xiaonan Fan, Chutong Yu, Xiaona Bao\*  
catfxn@126.com, 1053914756@qq.com, xnbao@126.com

Dalian Polytechnic University School of management Dalian, China

**Abstract**—The government report of the 19th Party Congress clearly points out that China's economy is entering a brand-new development period and is changing from the stage of high-speed growth to the stage of high-quality and rapid development. Although the advanced manufacturing industry in Dalian is also in the process of rapid development from high speed growth stage to high quality development stage, some outstanding problems are also gradually exposed, and the level of high quality development of the advanced manufacturing industry in Dalian is not high. Through constructing a model and regression analysis, this paper puts forward targeted suggestions from government, market and enterprises on how to achieve high-quality development in Dalian's advanced manufacturing industry.

**Keywords**—the advanced manufacturing industry; regional economic quality development; capacity base

## 1 INTRODUCTION

At present, Dalian City is "Made in China 2025 Dalian Action Plan", accelerating the pace of Internet industry towards high-end intensification, helping and promoting the development of the advanced manufacturing industry.

Therefore, how to sustain the development of the advanced manufacturing industry in Dalian, what is the current situation and the future development trend are yet to be clarified and solved.

In this paper, we study the high quality development of the advanced manufacturing industry in Dalian and determine how the current level of high quality development of the advanced manufacturing industry in Dalian is. From the perspectives of government, market and enterprises<sup>[Table1]</sup>, the paper proposes targeted suggestions for the high-quality development of the advanced manufacturing industry in Dalian.

## 2 EVALUATION OF THE LEVEL

### 2.1 Construction of an evaluation system

**Table 1:** Evaluation index system for the level of high-quality development of the advanced manufacturing industries

| Evaluation content  | Primary indicators  | Secondary indicators      | Tertiary indicators  |
|---|---------------------|---------------------------|--|
| Evaluation index system for the level of high-quality development of advanced manufacturing industries <sup>[1]</sup> | High-quality supply | Technological innovation  | New product output value (X1)  |
|   |                     | Green supply              | Comprehensive utilization rate of industrial solid waste (X2)  |
|   |                     | Coordinated development   | Contribution rate of total output value of advanced manufacturing industry (X3)                                |
|   |                     | Shared development        | Proportion of the number of employees in advanced manufacturing industry to the total number of employees (X4) |
|   | High quality demand | Consumption demand volume | Total output value of advanced manufacturing industry (X5)   |
|   |                     |                           | Sales output value of advanced manufacturing industry (X6)   |
|   |                     | Degree of openness        | Export delivery value of advanced manufacturing products (X7)  |

### 2.2 Evaluation process and analysis of results

This paper uses the entropy weight method to evaluate the level of high-quality development of the advanced manufacturing industry in Dalian. <sup>[2]</sup>

#### 2.2.1 Standardization of data

According to the above process of data processing using entropy weight method, the average value of Dalian advanced manufacturing development index can be calculated. <sup>[Table2]</sup>

**Table 2:** Data processing of indicators of high-quality development of advanced manufacturing industry in Dalian

| Year | X1   | X2   | X3   | X4   | X5   | X6   | X7   |
|------|------|------|------|------|------|------|------|
| 2017 | 0.75 | 0.17 | 0.00 | 0.91 | 0.77 | 0.83 | 0.99 |
| 2016 | 0.20 | 0.04 | 1.00 | 0.51 | 0.11 | 0.77 | 0.88 |
| 2015 | 0.21 | 1.00 | 0.20 | 1.00 | 0.58 | 0.71 | 1.00 |
| 2014 | 0.09 | 0.65 | 0.88 | 0.48 | 0.06 | 0.39 | 0.61 |
| 2013 | 0.00 | 0.39 | 0.98 | 0.39 | 0.00 | 0.32 | 0.04 |

### 2.2.2 Dimensionless processing of data

After the simple standardization of the data, the weight of each index in the total index is calculated by using the weight method.<sup>[Table3]</sup>

**Table 3:** Data processing of dimensionless data

| Year | X1   | X2   | X3   | X4   | X5   | X6   | X7   |
|------|------|------|------|------|------|------|------|
| 2017 | 0.12 | 0.06 | 0.00 | 0.15 | 0.15 | 0.12 | 0.15 |
| 2016 | 0.03 | 0.02 | 0.22 | 0.08 | 0.02 | 0.11 | 0.13 |
| 2015 | 0.03 | 0.37 | 0.04 | 0.17 | 0.12 | 0.11 | 0.15 |
| 2014 | 0.01 | 0.24 | 0.04 | 0.08 | 0.01 | 0.06 | 0.09 |
| 2013 | 0.00 | 0.14 | 0.22 | 0.06 | 0.00 | 0.05 | 0.01 |

### 2.2.3 Calculation of the entropy value and weight of the high-quality development of the advanced manufacturing industry in Dalian

Based on the average value of each index, the entropy value and weight of high-quality development of Dalian advanced manufacturing industry are calculated.<sup>[Table4]</sup>

**Table 4:** Entropy values and weights of the high-quality development of the advanced manufacturing industry in Dalian

| Index | entropy value | weight |
|-------|---------------|--------|
| X1    | 0.91          | 0.10   |
| X2    | 0.71          | 0.34   |
| X3    | 0.90          | 0.12   |
| X4    | 0.85          | 0.18   |
| X5    | 0.88          | 0.14   |
| X6    | 0.99          | 0.01   |
| X7    | 0.91          | 0.11   |

### 2.2.4 Comprehensive score of indicators of high-quality development of the advanced manufacturing industry in Dalian

Based on the entropy value and weight obtained, the comprehensive score of each indicator of the high-quality development of the advanced manufacturing industry in Dalian is calculated<sup>[Table5]</sup>, and the following table shows the average of the comprehensive score of each indicator.

**Table 5:** Comprehensive score of indicators of high-quality development of the advanced manufacturing industry in Dalian

| Year | Index score |
|------|-------------|
| 2017 | 0.52        |
| 2016 | 0.37        |
| 2015 | 0.76        |
| 2014 | 0.42        |
| 2013 | 0.33        |

### 3 CAPACITY BASE FOR HIGH-QUALITY DEVELOPMENT OF THE ADVANCED MANUFACTURING IN DALIAN

#### 3.1 Empirical Analysis of Capability Base

##### 3.1.1 Model construction

In this paper, the comprehensive score of the advanced manufacturing quality development level in Dalian is used as the explanatory variable, and the explanatory variables are divided into government (equation 1), market (equation 2), and enterprise (equation 3).<sup>[3]</sup> The equation is

$$Y = f(X_1, X_2, X_3, X_4, X_5, X_6) \quad (1)$$

$$Y = f(X_7, X_8, X_9) \quad (2)$$

$$Y = f(X_{10}, X_{11}, X_{12}) \quad (3)$$

In this paper, we use the logit model.<sup>[4]</sup>

##### 3.1.2 Descriptive statistics

**Table 6:** Descriptive statistics

| Variables   | Min    | Max    | Average   | Standard deviation |
|---|--------|--------|-----------|--------------------|
| Y   | 0.27   | 0.76   | 0.426     | 0.149              |
| R&D Funding(X1)   | 227827 | 567934 | 355610.09 | 133946.198         |
| Number of R&D students(X2)                                    | 16582  | 40655  | 28022.64  | 8554.923           |
| Number of graduate students graduated in the current year(X3) | 6019   | 12543  | 10308.91  | 2319.665           |
| Industrial wastewater treatment rate(X4)                      | 0.731  | 0.990  | 0.945     | 0.075              |
| Proportion of water consumption to total(X5)                  | 0.762  | 0.974  | 0.871     | 0.0753             |
| Wireless TV coverage rate(X6)                                 | 0.984  | 0.999  | 0.997     | 0.004              |
| Number of enterprise units(X7)                                | 946    | 2969   | 1887.91   | 688.008            |
| Foreign investment rate(X8)                                   | 0.263  | 0.972  | 0.707     | 0.230              |
| Ratio of main business income(X9)                             | 0.580  | 0.778  | 0.707     | 0.230              |
| Number of patent applications(X10)                            | 252    | 3540   | 1979.91   | 1094.266           |
| Debt Ratio(X11)   | 0.212  | 0.922  | 0.725     | 0.192              |
| Management cost investment rate(X12)                          | 0.359  | 0.830  | 0.728     | 0.126              |

### 3.1.3 Cointegration analysis

In the time series regression estimation, it is required that the time series must be smooth and free from random and deterministic trends<sup>[Table6]</sup>, otherwise, it will easily lead to the phenomenon of "pseudo-regression".

As shown in Table 7, R1 represents the residuals in the government capability model, R2 represents the residuals in the market capability model, and R3 represents the residuals in the firm capability model. The residual terms in the table all pass the ADF test<sup>[Table7]</sup>, and it can be concluded that there is a long-run cointegration relationship between the variables.<sup>[5]</sup>

**Table 7:** Residual ADF test results

| Variables | ADF       | 5%        | 10%       | P      | Variables |
|-----------|-----------|-----------|-----------|--------|-----------|
| R1        | -3.782134 | -3.320969 | -2.801384 | 0.0274 | stable    |
| R2        | -4.208910 | -3.259808 | -2.771129 | 0.0133 | stable    |
| R3        | -3.644817 | -3.259808 | -2.771129 | 0.0291 | stable    |

### 3.1.4 WLS regression estimation

**Table 8:** WLS regression estimation results

|             | Variables  | Regression coefficient | Standard error | T-statistic |
|-------------|------------|------------------------|----------------|-------------|
|             | Government | LnX1                   | -0.585148***   | 0.105017    |
| LnX2        |            | -1.588443***           | 0.299766       | -5.298944   |
| LnX3        |            | 1.820084**             | 0.498025       | 3.654602    |
| LnX4        |            | 0.103137               | 0.343342       | 0.300391    |
| LnX5        |            | -2.109850**            | 0.897262       | -2.351432   |
| LnX6        |            | 42.23657**             | 16.02202       | -2.636157   |
| C           |            | 5.564128               | 4.000382       | 1.390898    |
|             |            |                        |                |             |
| Market      | Variables  | Regression coefficient | Standard error | T-statistic |
|             | LnX7       | 0.001103               | 0.053411       | 0.020643    |
|             | LnX9       | 0.561919               | 0.470458       | 1.194410    |
|             | C          | -0.733018*             | 0.390996       | -1.874749   |
| Enterprises | Variables  | Regression coefficient | Standard error | T-statistic |
|             | LnX10      | -0.142222**            | 0.036935       | -3.850627   |
|             | LnX11      | -0.132231**            | 0.189120       | -2.699190   |
|             | LnX12      | 0.534923***            | 0.350962       | 3.524161    |
|             | C          | 0.259588***            | 0.252885       | 4.026505    |

Note: \*, \*\*, \*\*\* indicate significant at the 10%, 5%, and 1% levels, respectively

From the regression results in Table 8, the following conclusions can be drawn: the number of R&D personnel, R&D funds, the number of graduate students graduating in the current year, water consumption rate, wireless TV coverage rate, number of patent applications, debt ratio, and overhead investment rate all pass the test, indicating that these indicators have a significant influence on the score of high-quality development level of the advanced manufacturing industry in Dalian, while the data related to industrial scale and economic efficiency capacity do not pass the test<sup>[Table8]</sup>. It indicates that these indicators have less influence on the score of Dalian advanced manufacturing industry's high quality development level in general.<sup>[6]</sup>

## **4 CONCLUSION**

This paper shows that the development of the advanced manufacturing industry in Dalian faces a series of challenges, such as no core key technology, low technological innovation ability, insufficient government information processing ability, inappropriate market scale, and low economic efficiency. It also concludes that improving the high quality development of advanced manufacturing industry requires the government to increase innovation, information processing capability, find an appropriate industrial scale for the high quality development of the advanced manufacturing industry in Dalian, and improve the economic efficiency capability of enterprises.

## **5 POLICY SUGGESTIONS**

According to the above empirical analysis of the current situation, development level and capability base of Dalian advanced manufacturing industry with high quality development and trend analysis of capability structure, the current deficiencies of Dalian advanced manufacturing industry can be concluded.

For improving the high quality development level of the advanced manufacturing industry in Dalian, not only the way and path of development, but also need to improve the policy system and respond to the new national policy to greatly improve the high quality development level of the advanced manufacturing industry. The government needs to improve the relevant policy system and attach great importance to the high quality development of the advanced manufacturing industry, and it needs to expand the market opening capacity and enterprises to increase the investment in innovation technology to promote the process of high quality development of the advanced manufacturing industry in Dalian city as early as possible.

### **5.1 Increase the government's investment in the innovation capacity of advanced manufacturing industries**

Play the leading role of the government in promoting innovation. Therefore, Dalian needs to invest more funds to support the development of the advanced manufacturing industry, such as increasing the investment in cloud computing, big data processing and Internet engineering to eliminate backward industries and technologies; at the same time, the government needs to train more research talents to develop new technologies, expand the policy of recruiting graduate students and increase the investment in R&D funds to provide talents, financial

resources and material resources for the development of the advanced manufacturing industry to realize The development of the advanced manufacturing industry is combined with innovation ability. The government should actively undertake national science and technology projects, actively seek support of human, financial and material resources, and increase more innovation projects. In addition, the government needs to change its functions, integrate resources, coordinate planning and fully collect innovation projects in order to promote the development of the advanced manufacturing industry with high quality.

### **5.2 Reasonable allocation of inputs to improve economic efficiency capacity**

Economic efficiency capacity is a reflection of the high quality development of the advanced manufacturing industry. The enterprise's economic efficiency ability that is too low will not only hinder the high quality development of the advanced manufacturing industry, but also cause the opposite effect on the high quality development level of the advanced manufacturing industry when the difference between input and output is great. Therefore, enterprises need to reasonably allocate the input of the advanced manufacturing industry and get the corresponding output, increase the ratio of main business income, profit, and improve the market policy system, so that the level of high quality development of the advanced manufacturing industry in Dalian can be improved.

### **5.3 Strengthen the establishment of technology innovation service system**

Innovation-driven development of enterprises is the starting point to maintain and improve the high-quality development of the advanced manufacturing industry. The focus of the high quality development of the advanced manufacturing industry is to increase the investment in innovative technology, carry out high technology, and have its own core technology instead of relying on foreign technology. By using the policies provided by the government to complete the technological innovation of each segment of the advanced manufacturing industry, increase the number of patent applications and improve the quality of patents; make up for the shortage of core technology, increase the investment in technological innovation for small and medium-sized enterprises, play the main body and leading position of small and medium-sized enterprises, and encourage them to actively carry out innovation-driven development. Adhere to the joint cooperation of government, market and enterprises, improve government policies, play the direction of market research on technological innovation, and encourage enterprises to complete the innovation of core technology. It is also necessary to increase the number of research projects, the number of researchers, and the internal expenditure of R&D to increase the impact of enterprise capacity on the high-quality development of the advanced manufacturing.

**Acknowledgements.** The National Natural Science Foundation of China (NSFC) Youth Fund Project "Research on Technology Innovation and Productivity Improvement in Real Economy from the Perspective of Financialization" (71703012); Liaoning Provincial Education Department Basic Research Project for Higher Education Institutions (Key Project) "Economic Uncertainty, Financialization of Real Economy and Capital Allocation Efficiency "(J202106); Liaoning Provincial Federation of Social Sciences 2021 Key Commissioned Project "Proposals for Developing High-Tech Service Industry and Enhancing the Role of Supporting Economic Development" (2021slzdwtk-01); Science and Technology Innovation Think Tank Project of Dalian Science Association "Research on Countermeasures for

Improving Innovation Capability of Dalian Manufacturing Enterprises Driven by Digital Transformation" (DLKX2021B07); Dalian Academy of Social Sciences (Research Center) 2021 Project "Research on Countermeasures for High-Quality Development of Dalian Equipment Manufacturing Enterprises in the Context of Digital Transformation "(2021dlsky068).

## REFERENCES

- [1] Grodach, Gibson. Advancing Manufacturing?: Blinkered Visions in U.S. and Australian Urban Policy[J]. Urban Policy and Research,2019,37(3)
- [2] Chun Zhao, Lihui Wang, Xuesong Zhang. Service agent networks in cloud manufacturing: Modeling and evaluation based on set-pair analysis[J]. Robotics and Computer-Integrated Manufacturing, 2020, 65.
- [3] Chunguang Bai, Ahmet Satir. Barriers for green supplier development programs in manufacturing industry [J]. Resources, Conservation & Recycling,2020,158.
- [4] Abramovitz M. Catching Up, Forging Ahead, And Falling Behind[J]. The Journal of Economic History, 1986, 46(2):385-406.
- [5] Surajit Nath, Bijan Sarkar. An Exploratory Analysis for the Selection and Implementation of Advanced Manufacturing Technology by Fuzzy Multi-criteria Decision Making Methods: A Comparative Study[J]. Journal of The Institution of Engineers (India): Series C, 2017.
- [6] Lv Wei. Leading high-quality development of manufacturing industry with innovation[N]. Economic Daily,2019.