

# Evaluation of Local Transformation Ability of Technological Achievements Based on Entropy Method

Xiaoyu Wang<sup>1</sup>, Yuxin Zhao<sup>1,2,\*</sup>, Qian Wang<sup>1</sup>

<sup>1</sup>Dalian Neusoft University of Information, Dalian, Liaoning, China

<sup>2</sup>School of Maritime Economics and Management, Dalian Maritime University, Dalian, Liaoning, China

\*Corresponding author. e-mail: zhaoyuxin0318@163.com

## ABSTRACT

The transformation of technological achievements is an important task for the national economy. It transforms technological achievements into actual productivity. In this paper, the entropy method is used to take the technological achievements of Dalian, Liaoning as the research object, and the local transformation ability of Dalian technological achievements from 2015 to 2019 is evaluated according to the established evaluation index system. Through the evaluation, a multi-dimensional analysis was carried out, and the problems in the local transformation and development of Dalian's technological achievements were found, and the existing problems were analyzed to find out the root causes of the problems. Finally, based on the development status of the local transformation of technological achievements in Dalian, the development path and countermeasures for the transformation of technological achievements are proposed.

**Keywords:** *Technological Achievements, Transformation, Entropy Method*

## 1. INTRODUCTION

The local transformation of technological achievements refers to the process of applying the achievements of technological innovation to production and life, and is the process of transforming the achievements into actual productivity [1]. To promote the high-quality development of the national economy, we must attach importance to the transformation of technological achievements, combine scientific research and production, put technological achievements into the market, and transform them into productive forces, thereby supporting industrial transformation and upgrading and economic structure adjustment, and giving better play to the impact of technological innovation. Therefore, evaluating the ability of local transformation of technological achievements and proposing the path and countermeasures for the development of local transformation of technological achievements has become an urgent problem to be solved [2]. This article takes Dalian City as the research object, and evaluates the level of local transformation of technological achievements in Dalian City.

Daniela (2018) analyzed the quantitative and qualitative data of 60 American universities and determined the transformation model of university technological achievements [3]; Nevens (2013) and others believe that enterprises should put the transformation of technological achievements in the first place, and the transformation of achievements will promote enterprise innovation and development [4].

Domestic scholars have also produced many research results on the development of advanced manufacturing. Zhao Xicang et al. (2013) analyzed the influencing factors of the transformation of technological achievements in Jiangsu Province, and believed that government support, human support, financial support and technological environment are important influencing factors; Zhao Rui et al. (2020) used the method of quantitative policy text to comprehensively analyze the policy environment of financial support for the transformation of technological achievements from the three perspectives of policy objectives, support strength and policy guarantees.

## 2. CONSTRUCTING AN EVALUATION INDEX SYSTEM FOR THE LOCAL TRANSFORMATION ABILITY OF TECHNOLOGICAL ACHIEVEMENTS IN DALIAN

Constructing a systematic evaluation index system is very important for evaluating the ability to transform scientific and technological achievements. This article reads relevant data from the Dalian Statistical Yearbook, and draws on the evaluation index system proposed by domestic scholars, and establishes three first-level indicators and 11 second-level indicators. The evaluation indicators of achievement transformation are shown in Table 1.

**Table 1.** An Evaluation Index System for Local Transformation Ability of Outcomes

| Primary indicators   | Secondary indicators  | Weight  |
|--|---|---------|
| Investment indicators for transformation of technological achievements             | R&D personnel full-time equivalent  | 0.0900  |
|  | The Number of R&D projects  | 0.0878  |
|  | The number of scientific and technological progress   | 0.0899  |
|  | The number of scientific and technological progress awards above the provincial level (items) | 0.0905  |
| The output results of the transformation of technological achievements             | Number of patents granted   | 0.0953  |
|  | Technology market transaction price   | 0.0900  |
|  | High-tech industry revenue (100 million yuan)   | 0.0914  |
|  | The output value of high-tech industry as a percentage of GDP (%)                             | 0.0937  |
| Environmental Factors Influencing the Transformation of Technological Achievements | Intensity of R&D funding  | 0.0906  |
|  | R&D personnel accounted for the proportion of employed persons                                | 0.0877  |
|  | GDP per capita  | 0.09258 |

(1) Investment in the transformation of technological achievements

Because there are many factors that affect the local transformation of technological achievements, it is not possible to use only one technological achievement input index in the evaluation [5]. There are a total of four indicators for the transformation of technological achievements in this indicator system to evaluate the transformation ability.

(2) The output results of the transformation of technological achievements

The output of the transformation of technological achievements adopts 4 indicators to measure the level of local transformation of technological achievements. Through these indicators. These indicators are used to isolate the shortcomings of the output results of the transformation of technological achievements, and provide a basis for local transformation.

(3) Environmental influencing factors

Environmental influence factors play a decisive role in the local transformation of technological achievements, and are an important influence factor [6]. In this indicator system, R&D investment intensity, per capita GDP and other indicators are used for evaluation.

### 3. EVALUATION OF DALIAN'S LOCAL TRANSFORMATION ABILITY OF TECHNOLOGICAL ACHIEVEMENTS BASED ON ENTROPY METHOD

This article is based on the statistical data of Dalian City from 2015 to 2019 for a total of 5 years for research and analysis. The data is mainly read from the Dalian Statistical Yearbook from 2015 to 2019, and

most indicators are obtained through relevant calculations using these data.

There are many ways to evaluate the transformation of results, and all of them are different [7]. This article uses the entropy method to evaluate the local transformation ability of Dalian's scientific and technological achievements.

#### 3.1 Evaluation Process and Results

(1) Determination of Index Weight

Calculate the proportion of the index in the i-th year under the j-th index, and the calculation formula is as follows:

$$X_{ij} = \frac{A'_{ij}}{\sum_{i=1}^n A'_{ij}} \quad (1)$$

Calculate the entropy value of the jth index, the calculation formula is as follows:

$$Y_j = -K * \sum_{i=1}^n X_{ij} \ln(X_{ij}) \quad , K = \frac{1}{\ln m}, 0 \leq Y \leq 1 \quad (2)$$

The entropy value of each index is shown in Table 2.

Use the following formula to calculate the difference of the J index:

$$e_j = 1 - y_j \quad (3)$$

Use the following formula to calculate the weight of each indicator:

$$W_j = \frac{e_j}{\sum_{j=1}^m e_j}, j = 1, 2, \dots, m \quad (4)$$

**Table 2.** The entropy value of the local conversion index of the achievements in Dalian

| index   | Entropy value |
|---|---------------|
| R&D personnel full-time equivalent  | 0.880944153   |
| The Number of R&D projects  | 0.883900931   |
| The number of scientific and technological progress   | 0.881111904   |
| The number of scientific and technological progress awards above the provincial level (items) | 0.880243094   |
| Number of patents granted   | 0.873825598   |
| Technology market transaction price   | 0.880947255   |
| High-tech industry revenue (100 million yuan)   | 0.879096867   |
| The output value of high-tech industry as a percentage of GDP (%)                             | 0.876034763   |
| Intensity of R&D funding  | 0.879689803   |
| R&D personnel accounted for the proportion of employed persons                                | 0.883958376   |
| GDP per capita  | 0.877602776   |

Table 1 shows the weight results of each evaluation index for the transformation of scientific and technological achievements.

(3) Calculate the total score of local conversion ability

The following is the formula for calculating the total score of the local transformation ability of scientific and technological achievements:

$$P_i = \sum_{j=1}^m W_j * X_{Ij} \quad (I = 1, 2, \dots, n) \quad (5)$$

See Table 3 for the total scores of local transformation capabilities of technological achievements from 2015 to 2019.

**Table 3.** Evaluation results of local transformation of technological achievements in Dalian

| Particular year | comprehensive |         | Investment index |         | Output results |         | Environmental factors |         |
|-----------------|---------------|---------|------------------|---------|----------------|---------|-----------------------|---------|
|                 | Score         | ranking | Score            | ranking | Score          | ranking | Score                 | ranking |
| 2015            | 0.1698        | 5       | 0.0654           | 4       | 0.0690         | 3       | 0.0354                | 5       |
| 2016            | 0.1752        | 4       | 0.0723           | 3       | 0.0552         | 5       | 0.0476                | 4       |
| 2017            | 0.1836        | 3       | 0.0642           | 5       | 0.0611         | 4       | 0.0583                | 3       |
| 2018            | 0.2211        | 2       | 0.0808           | 1       | 0.0792         | 2       | 0.0612                | 2       |
| 2019            | 0.2503        | 1       | 0.0754           | 2       | 0.1061         | 1       | 0.0687                | 1       |

### 3.2 Analysis of Evaluation Results

The change trend of local transformation of technological achievements in Dalian is shown in Figure

1. The change trend of each evaluation index is shown in Figure 2.

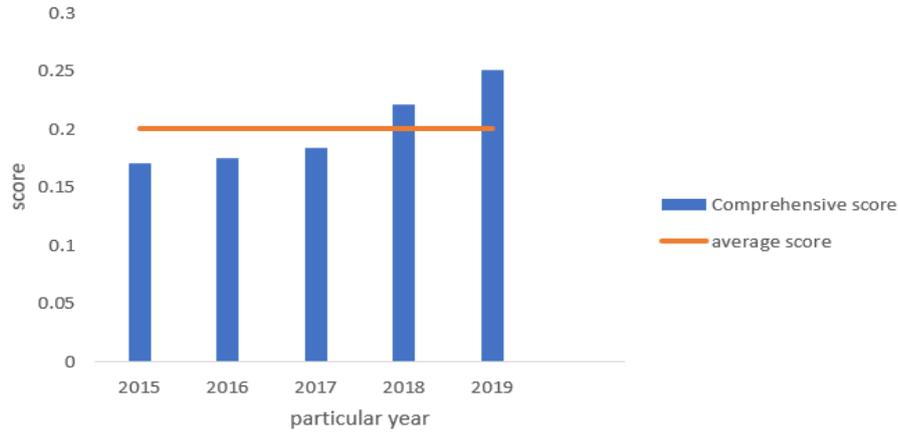


Fig. 1. The overall trend of local transformation of technological achievements in Dalian

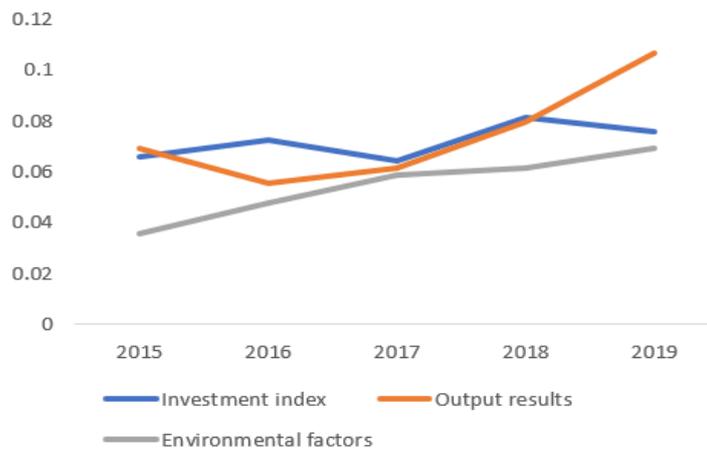


Fig.2 Trends of Evaluation Indexes for Local Transformation Ability of Technological Achievements in Dalian

#### 4. DEVELOPMENT COUNTERMEASURES AND SUGGESTIONS FOR THE LOCAL TRANSFORMATION OF DALIAN TECHNOLOGICAL ACHIEVEMENTS

The local transformation of technological achievements in Dalian is in a continuous development trend. Although it experienced a low development in 2017 and the development pressure is very high, the current development trend is improving. Therefore, the following development countermeasures are proposed.

(1) Increase investment in the transformation of technological achievements. Pay attention to the quantity and quality of patent applications, strengthen the investment in basic research; in addition, pay attention to scientific research personnel, introduce high-level scientific research talents, increase scientific research awards, and improve scientific research capabilities, so as to improve the local transformation ability of technological achievements in Dalian [8].

(2) Enhancing the policy support environment for the local transformation of technological achievements. A series of policies must be introduced and improved to

support the transformation of achievements; special funds and rewards must be set up to encourage the transformation of technological achievements; the government, research institutes and other relevant institutions must support each other, and the government must provide strong policy environmental guarantees to improve technology Local transformation capabilities of results [9].

(3) Enhancing Big Data Analysis of Achievement Transformation [10]. Establish a big data platform for the transformation of technological achievements, through data analysis, clarify the problems in input, output, policy environment and other aspects of the transformation of achievements, pinpoint weaknesses, solve the problems in a targeted manner, and solve the specific problems of the transformation of technological achievements.

#### 5. CONCLUSION

This paper establishes an evaluation index system for the transformation of technological achievements, conducts a multi-dimensional evaluation of the transformation ability of technological achievements in

Dalian, and puts forward suggestions for the transformation of technological achievements in Dalian. In the follow-up, we will continue to improve the evaluation indicators for the transformation of technological achievements, so as to more accurately evaluate the transformation ability of technological achievements and solve the problems existing in the transformation of technological achievements.

## ACKNOWLEDGMENTS

This work was supported by 2021 Dalian Science and Technology Innovation Fund Project (2021JJ13FG94).

## REFERENCES

- [1] Mihaela Caramihai (Guda), Narcisa Melania Tănase, Anca Alexandra Purcărea, "Proposals for Improving Innovation and Technology Transfer Policies in Romania". *Procedia Engineering*, 2017(181), pp.984-990.
- [2] Robertson, Thomas S and Gatignon, Hubert. "Technology Development Mode: A Transaction Conceptualization". *Strategic Management Journal*, 1998(19), pp.515 -531.
- [3] Baglieri, Daniela; Baldi, Francesco; Tucci, Christopher L. "University technology transfer office business models: One size does not fit all". *Technovation*.2018, pp.51-63.
- [4] Nevens T M. "Commercializing technology: What the best companies do". *Harvard Business Review*, 2013, 68(4), pp.154-163.
- [5] Kevin De Moortel, Thomas Crispeels. "International university- university technology transfer: Strategic management framework". *Technological Forecasting and Social Change*, 2018 (135), pp.145-155.
- [6] Matthew Good, Mirjam Knockaert, Birthe Soppe, Mike Wright. "The technology transfer ecosystem in academia. An organizational design perspective". *Technovation*, 2019 pp.35-50.
- [7] Rory P.O, Shea, Thomas J. Allen, Arnaud Chevalier, Frank Roche. "Entrepreneurial orientation technology transfer and spinoff performance of U. S. universities". *Research Policy*, 2005 (34), 994-1009.
- [8] Jeannette A. Colyvas. "From divergent meanings to common practices: The early institutionalization of technology transfer in the life sciences at Stanford University". *Research Policy*, 2007(36), pp.456-476.
- [9] Eric. W. "R&D efficiency and economic performance: across-country analysis using the stochastic frontier approach". *Journal of Policy Modeling*, 2007(29), pp.345-360.
- [10] Michael Danquah. "Technology transfer, adoption of technology and the efficiency of: Empirical evidence from sub Saharan Africa". *Technological Forecasting and Social Change*, 2018(131), pp.175-182.