Study on Technical Standards Implementation Benefit Evaluation Practice

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Abstract. This paper has successively analysed and compared the practice of the United Kingdom, Germany, France, Canada, Japan, ISO and other countries and organizations in the evaluation of standardization economic benefits. And then a new method is proposed for large enterprises to carry out technical standard implementation benefit evaluation. Finally, case study for power company A and B validates the effectiveness of the proposed method.

1. Introduction
The evaluation of the effectiveness of the implementation of technical standards is a worldwide problem. Experts and scholars at home and abroad have started research in this field since the 1960s, and have achieved a series of theoretical and practical results. In [1], the mechanism of the improvement of corporate standard economic benefits to machinery manufacturing enterprises is analysed, and a method of maximizing economic benefits through moderate standardization is proposed. In [2], an economic evaluation model for international standardization to support the decision-making process of technology development and standardization is put forward. While in [3], the benefits of environmental management standard ISO 14001 are discussed, and its effect on improving business performance is analysed. Finally, how standardization of equipment specifications for procurement can benefit the industry is reviewed [4]. This chapter will systematically analyse the theoretical and practical research results in this field at home and abroad, and propose relevant experience enlightenment for the systematic evaluation of the implementation of the company's technical standards.

2. Benefit evaluation practice of standard implementation in typical countries

2.1. UK, Department of Trade and Industry
In 2005, the Department of Trade and Industry (DTI) adopted the standard quantitative contribution method to evaluate the contribution of standards to the growth of labor productivity. Using the data from 1948-2002, a model for evaluating the relationship between production labor growth and standards was established. The number of effective standards is composed of the total number of standards published in a certain period minus the number of standards terminated and abolished, showing the existence of standards and productivity Positive and statistically significant relationships. The economy obtains economic output through invested capital (K), labor force (L), and total factor productivity, while progress and improvements in some areas benefit from the impact of standards and other factors, such as R & D, the introduction of foreign technologies and patents. DTI used the idea of calculating economic output in the economic field to study the effect of standardization on economic growth, and
measured it using the Cobb-Douglas function. According to the study, the standard contributed 8.2 billion pounds out of the 29 billion pounds in UK GDP growth in 2013.

2.2. German, Standardization Institute
In 1999, the German Institute for Standardization (DIN) carried out a two-year study on "total economic benefits of standardization" in Germany, Austria, and Switzerland, using economic methods to analyze the economic development from 1960 to 1996, in which the capital and labor Factors of production and technical progress indicators of business sector are applied[5]. DIN is also based on macro data, using the transformation formula of the Cobb-Douglas production function, namely, regression analysis to calculate the contribution rate of each production factor to the entire economic growth, and the study of the economic benefits of German standardization. The standards are related, and the contribution of the standards to the growth rate of the German economy’s annual output value is calculated. The results of the study show that standardization has contributed 0.9% of the German economy’s annual growth rate of 3.3%, accounting for about 30% of the real GDP’s average annual growth. It is estimated that the economic benefit of standardization is about 1% of GDP. Since this method only considers the impact of the number of standards, macro-trigger evaluation of the economic benefits of the standards from the national level is not applicable to the evaluation of the economic benefits of the enterprise standards.

2.3. French, Standardization Association
In 2009, the French Association for Standardization (AFNOR) used Total Factor Productivity (TFP) as a measurement indicator and conducted a study on the impact of standards on macroeconomic growth based on macroeconomic data from 1950 to 2007[6]. The research results show that the contribution rate of standardization to the French economy is 0.81%. In addition, for every 1% increase in the number of standards, total factor productivity increases by 0.12%. Total factor productivity refers to the ratio of output to total factor input; sources of total factor productivity include technological progress, organizational innovation, specialization, and production innovation (including standardization). The output growth rate exceeding the factor input growth rate is the total factor productivity growth rate. From the perspective of economic growth, productivity, capital and labor factors contribute to economic growth. From an efficiency perspective, productivity is equal to the ratio of output in the national economy to the total input of various resource elements within a certain period of time. Essentially, it reflects the ability and effort of a country (region) to rid itself of poverty, backwardness, and economic development in a certain period of time. It is a comprehensive reflection of the role of technological progress in economic development.

2.4. Japan, Industrial Standards Association
In 2007, the Japan Industrial Standards Association (JSA) conducted a study on the economic benefits of international standardization activities and the relationship between standardization and macroeconomics[7]. Japan uses the standard effect-cost method to calculate the economic benefits of international standards. Based on the economic benefits of Japan’s participation in the preparation and revision of international standards (the economic benefits brought to Japan from the rise of Japanese standards to the associated intellectual property rights, the reduction of technical barriers, etc.), minus the cost of preparing and revising international standards (standard development Project investment costs, such as possible meetings, manpower, travel, trials), the difference is the economic benefits that international standards can bring. The research results show that Japan will promote the transformation of a Japanese national standard (JIS) into an international standard, and reflect the country’s superior technology and product parameters into the international standard, which can generally bring 30 billion yen (equivalent to RMB 2 billion) economic benefits. When involving large-scale special products and industries, it can generate hundreds of billions of yen in economic benefits. As for the relationship between standardization and macroeconomics, Japanese research shows that the adoption of national standards can increase opportunities for trade, promote scientific research, and promote technological innovation and economic growth. Therefore, it is more important than corporate patent strategies.
2.5. **International Organization for Standardization (ISO)**

In 2010, the International Organization for Standardization (ISO) for the first time shifted the focus of its research to a single organization dominated by enterprises, and released a set of enterprise standardization economic benefit evaluation methods[8]. This method is based on value chain theory for research and development. At the microeconomic level, research can also be conducted on the entire industry, with the goal of helping companies or industries clarify the value created by standards. The assessment steps include determining the industry’s value chain, clarifying the impact of standards on the company’s main business functions and related activities, determining key performance indicators and value drivers, and calculating the impact on profits before interest and interest and tax amortization. Standard economic benefits are summarized. At present, the ISO organization has adopted this method in 10 countries and 11 companies in different industrial sectors. For most cases, the overall benefits brought by the standard account for 0.5% -4% of the company's annual sales.

3. **A new method of technical standards benefit evaluation**

Based on the previous research, this paper proposed a new method to evaluate the benefits of applying technical standards on large enterprise. First, systematically sort out the value chain composition of the enterprise's main business and the application of technical standards in the main business. Second, clarify the impact of the technical standards on the main business benefits, and construct the comprehensive benefit index system of technical standards of the company's main business. Third, according to the contribution of technical standards to grassroots business activities, the benefits of systematic implementation of technical standards are stripped. Finally, based on the contribution rate of technical standards to the grassroots business activities, through the layer-by-layer collection and delivery of all levels of business, the overall contribution rate of the systematic implementation of technical standards to the main business is obtained. The economic and social benefit index system of technical standards of the enterprise are shown in figure 1 and 2.

![Figure 1. Economic benefit evaluation index system](image_url)
Figure 2. Social benefit evaluation index system

After obtaining all the data of index system of technical standards of the enterprise, the economic and social benefit of large enterprise can be reached by the equation below [9].

\[
F_s = \sum_{k=1}^{K} f_{s}^{\text{ben-bus}} \left[ \sum_{j=1}^{J} f_{s}^{\text{bus-bus}} \left( \sum_{i=1}^{I} f_{s}^{\text{bus-sta}} \cdot \eta_i \right) \right] \tag{1}
\]

Where \( F_s \) is the implementation benefit \( s \), its benefit is contributed by the first-level business \( k = 1 \ldots K \). \( f_{s}^{\text{ben-bus}} \) is the contribution of the first-level business \( k \) to the implementation benefit \( s \). \( f_{s}^{\text{bus-bus}} \) is the contribution of business \( j \) to the first-level business \( k \). The contribution of the standard in the underlying business \( j \) is obtained by multiplying \( f_{s}^{\text{bus-sta}} \), the contribution of the corresponding technology standard (cluster) \( i \), by its time correction factor \( \eta_i \).

4. Benefit Evaluation of Standard Implementation Practice

To validate the effectiveness of the proposed method, this paper has chosen power company A and B for case study. Since it is hard to get all the input data for the evaluation index system, some key indicators whose input data is available are chosen in this case study, as shown in table 1 and table 2.

Table 1. Company A's 2012 and 2017 benefit index data

| Type            | Primary indicator                     | Secondary indicator                          | 2012       | 2017       | Difference |
|-----------------|---------------------------------------|----------------------------------------------|------------|------------|------------|
| Economic Benefit| The company's operating income         | Grid business profit (0.1 Billion yuan)      | 10.49      | 30.64      | 20.15      |
| Social Benefit  | Clean energy                           | Clean energy consumption (10MWh)             | 6.3        | 16.6       | 10.3       |
|                 | Power supply quality                   | City network power supply reliability rate (%) | 99.913     | 99.996     | 0.083      |
|                 |                                       | Rural power supply reliability rate (%)      | 98.757     | 99.55      | 0.793      |
Table 2. Company B's 2012 and 2017 benefit index data

| Type               | Primary indicator                        | Secondary indicator                      | 2012  | 2017  | Difference |
|--------------------|-----------------------------------------|------------------------------------------|-------|-------|------------|
| Economic Benefit   | The company's operating income          | Grid business profit (0.1 Billion yuan) | 59.6  | 72.02 | 12.42      |
| Social Benefit     | Clean energy                            | Clean energy consumption (10 MWh)       | 65.1  | 245.7 | 180.6      |
|                    | Power supply quality                    | City network power supply reliability rate (%) | 99.988 | 99.999 | 0.011 |
|                    |                                         | Rural power supply reliability rate (%)  | 98.348 | 99.959 | 0.611      |

It can be seen that the benefit brought by the technical standard to grid business profit is evident in both company A and B. While the benefit brought by the technical standard to clean energy consumption for company B is higher than the benefit to company A.

5. Summary

Through the analysis of domestic and foreign evaluation methods and the practical application of the proposed method, we found that for the standard benefit evaluation of power grid companies, we must solve three problems. First, in the implementation of the evaluation dimension and indicators of efficiency, we can refer to the domestic and international common practices and national standards classification, and then set a sound dimension of benefit evaluation. Second, in terms of channels for obtaining business process data of enterprises, a combination of statistical data and survey analysis can be used to obtain business process data. Thirdly, in terms of the evaluation model of the systematic implementation of technical standards, the comprehensive value chain method can be considered as a tool.

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References

[1] Wu L. (2019) Research on Standardization Strategy of Improving Economic Benefits of Machinery Manufacturing Enterprises in China. In: 2019 4th International Conference on Mechanical, Control and Computer Engineering (ICMCCE). Hohhot, China, pp. 1057-10574.
[2] Kim Y., Kim H. S., Jeon H. and Sohn S. Y. (2009) Economic Evaluation Model for International Standardization of Technology. IEEE Transactions on Instrumentation and Measurement, 58:657-665.
[3] Link S., Naveh E. (2006) Standardization and Discretion: Does the Environmental Standard ISO 14001 Lead to Performance Benefits? IEEE Transactions on Engineering Management, 53:508-519.
[4] Dorigan J. A., Barros R. M. d. (2014) A Process Model for Standardization and Increase in the Requirements Quality. IEEE Latin America Transactions, 12:1502-1507.
[5] Dresden, Karlsruhe. (2000) Economic Benefits of Standardization. Bemh Verlag, Berlin.
[6] Allen R H, Sriram R. (2000) The Role of Standards in Innovation. Technological Forecasting and Social Change, 64: 171-181.
[7] Lecraw, Donald J. (1984) Some Economic Effects of Standards. Applied Economics, 16: 507-522.
[8] Henk D V. (1999) Standardization: A Business Approach to the Role of National Standardization Organizations. Springer, Boston.
[9] Liu H. (2016) Case study on standardization benefit assessment of thermal power enterprise based on ISO value chain. Stand Science, 3:9-14.