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Qiang Fu

China National Institute of Standardization, Beijing, 100191, China, fuqiang@cnis.gov.cn

Jianqiang Ji

National University of Defense Technology, 410073, China

Lijun Wang

China National Institute of Standardization, Beijing, 100191, China

Hui Liu

China National Institute of Standardization, Beijing, 100191, China

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The Empirical Research of Standards Economic Benefits Evaluation Based on the Value Chain¹

Qiang Fu¹, Jianqiang Ji², Lijun Wang¹, Hui Liu¹

¹China National Institute of Standardization, Beijing, 100191, China

²National University of Defense Technology, 410073, China

Abstract: By analyzing the evaluation method and indicator system of standardization economic benefits based on relevant national standards and existing literature, we found that all exist such problems as the evaluation system is not scientific, the applicability of the evaluation method is not good enough and the evaluation content is not comprehensive. The theory of standardization economic benefits evaluation based on the value chain proposed by ISO is applied in this paper to analyze the mechanism of standards' impact on all aspects of the value chain. This paper takes Shandong Luyang Co., Ltd., Joyoung Co., Ltd., Shandong Haoyue Resin Co., Ltd., Zibo Bona Science and Technology Development Co., Ltd. as samples, empirically analyzes the economic benefits brought by standards to enterprises.

Keywords: standards; value chain; economic benefits

As an integral part of national strategy, competition of standards is playing a more and more important role in economic developments of modern states. How to evaluate the impacts of standards, particularly the economic benefits of standards has always been one of the research focuses in theory circle and reality circle. Even though some relevant scholars have come up with some evaluation methods, there's still no systematic method in standards economic benefits evaluation. Based on the method of evaluate standardization economic benefits proposed by ISO, this paper analyzes theoretical foundation of this method, and carries out empirical analysis of four representative enterprises with the questionnaire investigation method, in order to provide lessons for methods of standardization economic benefits evaluation of China.

1. RESEARCH STATUS OF STANDARDS ECONOMIC BENEFITS EVALUATION

In general, the current standards economic benefits evaluation in existing literature mainly focuses on two aspects: state and enterprise. National level, namely evaluate the benefits of GDP brought by standardization from the macroscopic perspective of the whole country. For example, DIN carried out a two-year "Standardization General Economic Benefits Research" in Germany, Austria and Switzerland, which shows that 1/3 of Germany's GDP growth is brought by standardization. Early researches in other countries also suggest that standardization investments can lead to significant GDP growth. Some other researches indicate that national economic benefits brought by standardization accounts for 1% of GDP. Besides, the input-output ratio of standardization in Japan, USSR, and France is respectively 1: 10, 1: 7.5 and 1: 20, while that of America is 1: 50.

Corporate level, namely evaluate the benefits of GDP brought by standardization from the microscopic perspective. At the microscopic level, countries in the world have successively come up with evaluation and calculation methods on standardization economic benefits. Japan put forward *Simple Economic Benefits Calculation Methods of Varieties on Corporate Level* and *Importance Evaluating and Order of Priority*. America came up with *Calculation Methods of Savings on Corporate Level* and listed 9 formulas on evaluating

standardization savings. China has started relevant jobs on standards development and impact evaluation since the 1980s. Between 1983 and 1984, China successively released three standards on evaluating, demonstrating and calculating standardization economic benefits, namely GB 3533.1: 1983 *Evaluation Principles and Calculation Methods of Standardization Economic Impacts*, GB 3533.2: 1984 *Demonstrating Methods of Standardization Economic Impacts* and GB 3533.3: 1984 *Collecting and Processing Methods of Standardization Economic Impacts Data*.

With the development of standardization, these standards need to be revised and improved, and given systematic thinking and research on the basis of standardization development and impacts evaluation. 2009, China issued GB/T 3533.1: 2009 *Standardization Economic Benefits Evaluation Part1: Principles and Calculation Methods* to replace GB/T 3533.1: 1983 and GB/T 3533.2: 1984. GB/T 3533.1: 2009 state standard and corresponding companion standards listed 6 formulas to calculate evaluation index and 36 formulas to calculate economic benefits. 2010, ISO proposed standardization economic benefits evaluation based on the value chain, which has received wide attention in standards circle. (See the second part of this paper).

There are still many problems in the existing economic benefits evaluation methods and index systems: (1) Unscientific evaluation standard systems. In terms of our country's evaluation rules of standardization economic benefits GB/T 3533.1: 2009, there are still many drawbacks in its evaluation index systems. Based on static analysis, some index systems lack for horizontal comparison functions, have high extent of overlapping in its internal index, and have serious index redundancy. (2) Low applicability. Most of the existing evaluation methods are drawn from other countries. However, due to differences in standardization administrative systems and standardization development level, not all the research methods and research conclusions from developed countries are applicable to developing countries. (3) Incomplete evaluations contents. Standards have impacts on the whole process. Former researches put more emphasis on impacts of some link of value chain rather than impacts of the whole value chain, therefore some standardization economic benefits evaluation is only confined within a short time and a local scope, which may lead to evaluation results obvious deviated from normal range².

2. STANDARD ECONOMIC BENEFITS EVALUATION METHODS BASED ON VALUE CHAIN

In March 2010, ISO proposed this standards economic benefits evaluation method to be used by member states of ISO on such research. From August 2011 and June 2012, China undertook the "ISO Standards Economic Benefits Research" project, which took Xinxing Ductile Iron Pipes Co.,Ltd and Dalian Shipbuilding Industry Co.,Ltd as samples and applied the method based on value chain theory to quantify and study enterprise's economic benefits brought by standards.

According to the research findings: economic benefits brought by standards accounts for 0.67% of annual revenue of Xinxing Ductile Iron Pipes Co.,Ltd. Research scope of Dalian Shipbuilding Industry Co.,Ltd is confined to impacts on research and development operations brought by standards, which brought 12.19% economic benefits of its annual revenue. Besides, Qi Binfang and Song Mingshun et al. used this method to analyze economic benefits of Livy(Jiaying)Garments Co.,Ltd brought by ISO 9001 standards system, which shows that the economic benefits of sample enterprises brought by ISO 9001 standards system accounts for 9.27% of the company's annual output value.

2.1 Basic principles of standards' impacts on enterprises economic benefits

With standards as the guide of interaction among enterprises, it's easy for enterprises to know how to interact with other enterprises, namely standards define the collection of choices and promote ordering of the whole

²Zhang Li-fei, Zeng De-ming, Zhang Yun-sheng, Economic Benefits Evaluation of Technology Standardization, Statistics and Decision, 2007(22), P149-151.

trading system. Order principle of standards system holds that the orderliness of system is the reflection of the organic links among system elements. With an orderly and stable relation among different system elements, the whole system has specific direction of motion, which suggests that this system with high orderliness is stable and efficient, and vice versa. Standardization system cyclically moves forward from disorder to order, and transferred from order to high-level order. Corporate standards systems should guarantee orderliness of enterprises and be coordinated with enterprises and supply chain standard system, so as to promote the orderly development of industrial clusters (See Figure1)³.

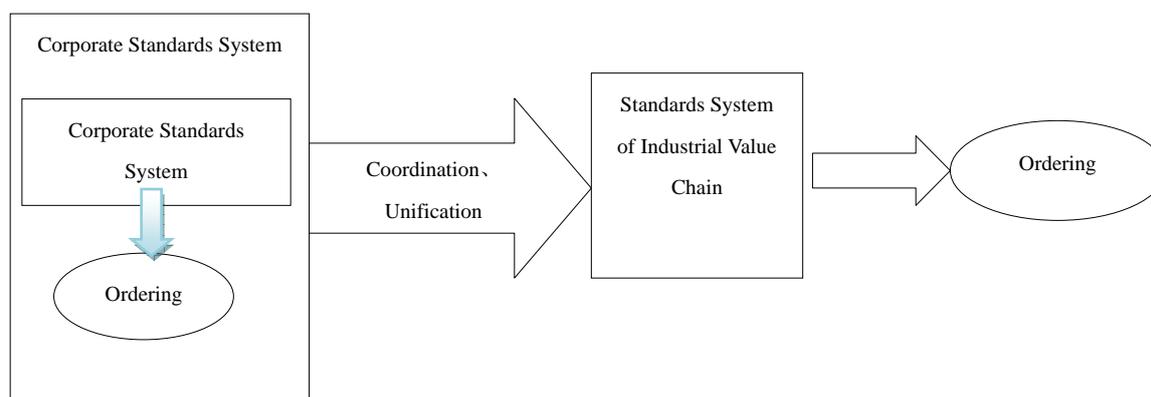


Figure1. Orderly Process of Standards System

Under the circumstance of market economy, industrial value chain division requires that member enterprises (including enterprises of similar products and upstream and downstream enterprises) form highly specialized division and cooperation systems. From the longitudinal view, products from upstream enterprises and downstream enterprises are complimentary and complimentary products have compatibility, with unitary standards as underlying conditions of compatibility. From the horizontal view, to realize substitutes of different manufacturers within the same industry also should guarantee the compatibility, which also needs standardization. For example, business process of equipment manufacturing enterprises from designation, blank manufacturing, parts processing, product assembly and marketing to after-sale technical service involves many manufacturers on the supply chain. Without unified and coordinated standards, all the manufacturers can't realize division and cooperation and can't establish competition system based on the supply chain. The implementation of standardization effectively reduced transaction cost among different enterprises, make the market economy run better, and promote the development of industrial economy. Enterprises with advanced technology can also play a leading role in standards by changing from enterprise standards into actual market standards, so as to direct standards in the whole industry and finally drive the whole industry by using the theory of network impacts to control the development of upstream and downstream enterprises in the industrial chain and relevant industries.

2.2 Confirm impacts of standards

Standards affect economic benefits of enterprises in every stage of the whole value chain. We should ascertain the impacts of standards on every business function and relevant activities. When we ascertain the impacts of standards, we should compare business functions before the enterprise takes standards and that after the enterprise takes standards, know service condition of standards taken by enterprises in the whole value chain, and the changes brought by standards. To study operation and determinants of the value chain, some scholars

³Li Su-ying, Li Qing-man. Approaches Study on How Standardization Improve Competition of Equipment Manufacturing Industry. Business Research, 2006 (17): 75—78.

come up with the value chain dynamics mechanism, which divides the value chain into the value chain driven by suppliers and the value chain driven by consumers.(See Graph1)⁴

Graph1. Enterprise Value Chain

	Value Chains Driven by Suppliers	Value Chains Driven by Consumers
Powerhouse	Industrial Capital	Business Capital
Core Competence	Research and Development	Brand (Product) Design and Marketing
Means of Control	Industrial Standards (Technical Standards)	Industrial Standards (Product Standards)
Typical Industry	Steel、Electronics	Toys、Apparel
Typical Enterprise	Huawai、Baosteel	Wahaha、Lining

Of Course, different standards have different impacts on every stage of the whole value chain. It's impossible to classify every standard into one unique category completely and exclusively, since every standard involves several aspects of economy, which is a challenge to empirical analysis. However, we should consider comprehensively every stage of the whole value chain.

According to the partitioning method, enterprise value chain includes management, research & development, engineering, purchasing, internal logistics, production/operation, external logistics, marketing and sale, and services. However, not all enterprises includes the above nine stages, with some enterprises only having some stages of the whole complete process.

Management stage. With the implementation of standardization management, enterprises can have a clear functional division, less communication cost, and improved assessment and evaluation system, as well as supervision and management system, so as to greatly improve enterprise management level, improve management efficiency and save management cost.

Research and development stage. Containing information about development levels of relevant technologies and research status, standards play the same role as patent documents, which provides underlying basis for thought innovation of researchers. After standardization, technical knowledge can be freely changed among different researchers, so as to effectively save flow of information and costs in the process of innovation.

Engineering stage. Standardization management can improve bidding rate of capital construction of enterprises and shorten construction period of projects.

Purchasing stage. Standards can impact on engineers through different ways. One of the important aspects is that standards cut varieties of products, and reduce differences among products. Namely, after the implementation, enterprises can human labor, material and financial resources in aspects of purchasing, including: raw material, replacement parts, stockpiles and machinery equipment, which will improve economic benefits of the whole enterprise.

Internal logistics stage.By implementing standardization, we can have better product quality, specification, more orderly procedure, easier coordination mechanism among different departments within the enterprise, smooth information communication and easier interior circulation, so that the enterprise can receive relevant benefits from activities as warehousing, stock control, raw material QA inspection and returns.

Production stage. Standardization reduce numbers of system components, and the use of standard parts increase the possibilities of combination of single parts, both of which can provide the advantage of specialized

⁴Hou Jun-jun, Song Tao, Zhang Chuan. Mechanism Research on Industry Value Chain Distribution Applied with Standards. Science and Technology Progress and Policy, 2008 (5): 78—82.

production and the possibility of mass production, so as to reduce cost, cut price, expand the scope of potential consumers, and improve productivity.

External logistics. After the implementation of standardization, enterprises have a better coordination capability of enterprises in inventory management, delivery vehicles scheduling management, order processing as well as transportation, and higher management efficiency and lower cost.

Marketing and sales stage. Standardization helps to regulate market structure and market competition order to make different enterprises orderly compete with each other. Under the constraints of standards and standardization, marketing stages of enterprises focus more on market segments, so that different types of products have clearer consumer targets. Besides, standards can effectively fight counterfeit behaviors in products market, protect the legitimate rights and interests of consumers, and keep orderly market competition, so as to cost of market supervision and management to enterprises and improve economic benefits.

Service stage. By the horizontal view, standardization has unified requirement on every part of all products that it can shorten the time of after-sales maintenance and guarantee, reduce time and manpower cost of after-sales service department and increase accuracy rate of successful repairmen. From the longitudinal view, standardization can provide accurate assurance service for the product life cycle, and greatly enhance after-sales service levels and capabilities of enterprises.

2.3 Operation methods

Comprehensively consider the impacts of standards on every stage in the whole value chain. Evaluation procedure includes: identify value chain of industries and enterprises; clarify impacts of standards on major business functions and relevant activities of enterprises; identify value drivers and key performance indicators; calculate impacts of every standard on EBIT, summarize economic benefits of standard at enterprises level. Specific to value chain, we should sum up all economic benefits produced by every stage of the whole value chain, and figure out standardization economic benefits of the whole industry.

3. EMPIRICAL ANALYSIS

Evaluation standard of enterprises economic benefits is that we should compare the current enterprises economic benefits with those of the same period in the previous year and average level of the same industry. Evaluation index of enterprises economic benefits mainly includes: outcome index of production and operation, index of consumption and consumption impacts, index of capital occupation and occupation impacts. Comprehensive analysis of enterprises economic benefits means a comprehensive analysis of profitability, growth, liquidity, safety and productivity of enterprises⁵.

Shandong Luyang Co., Ltd was built in October, 1984 and went public in 2006. In 2011, Shandong Luyang Co., Ltd formally established phase-1 project of architectural thermal-insulating board project with an annual output of 100,000 tons basalt fibers (mineral wool). By the end of 2013, Shandong Luyang Co., Ltd has had the production capability of 100,000 tons basalt fibers. Established in 1994, Joyoung Co., Ltd is a modern enterprise focused on research, production and sales of healthy catering appliances. Joyoung Co., Ltd successfully launched in Shenzhen Stock Exchange, with market capitalization over 10 billion RMB. Sales of Joyoung Co., Ltd had kept steady increasing, with a sales volume of over 5 billion RMB in 2012. Built in 1998, Shandong Haoyue Resin Co., Ltd has been reconstructed several times. Since the end of 2010, Shandong Haoyue Resin Co., Ltd started high-absorbent resin project with an annual yield of 40,000 tons. This project invested 98 million RMB, built 20400 square meters plants and assistance buildings, and bought more than 130 sets of equipments. Established in 2012, Zibo Bona Science and Technology Development Co., Ltd is the only

⁵Zhou Sheng-li, Evaluation Standard and Analysis Method of Enterprises Economic Benefits, Manager, 2011(11), P212.

high-tech industry that has patent and standards on the energy ceramic technological achievement among the ceramic industry in the world.

Based on analysis of value chain, this paper takes Shandong Luyang Co., Ltd., Joyoung Co., Ltd., Shandong Haoyue Resin Co., Ltd., Zibo Bona Science and Technology Development Co., Ltd. as samples to study evaluation results of economic benefits of every stage. For Shandong Luyang Co., Ltd, impacts of value chain's economic benefits brought by standards are mainly reflected on the following aspects: management, research and development, infrastructure project, inbound logistics, production/operation, marketing/sales. For Joyoung Co., Ltd, value chain's economic benefits brought by standards are mainly reflected on research and development, production/operation and management. For Shandong Haoyue Resin Co., Ltd, value chain's economic benefits brought by standards are mainly reflected on marketing/operation. For Zibo Bona Science and Technology Development Co., Ltd, value chain's economic benefits brought by standards are mainly reflected on marketing/operation and purchasing.

Through questionnaire survey⁶ and field research, impacts of standards on the above four enterprises value chain economic benefits are shown in the graph2. As is shown in graph2, standards do produce huge economic benefits to enterprises. For example, the production value of Shandong Luyang Co., Ltd is as high as 8,135,520,000RMB, while the production value of Zibo Bona Science and Technology Development Co., Ltd is as high as 306, 430,000 RMB, which is the lowest among the four enterprises. Besides, from a comparative perspective, standards have different impacts on every stage of the whole value chain. In terms of Shandong Luyang Co., Ltd, Joyoung Co., Ltd, and Shandong Haoyue Resin Co., Ltd, standards have the most obvious impacts on production/operation, research and development, and management, which is the proof that standardization do improve production, research and management efficiency. In addition, standardization does improve one country's competitiveness, which is also one of the important national development strategies.

Graph2.Impacts of Standards on Economic Benefits of Enterprises Valve Chain

Stages of Value Chain	Impacts of Standards on Economic Benefits of Enterprises Valve Chain							
	Shandong Luyang Co., Ltd		Joyoung Co., Ltd		Shandong Haoyue Resin Co., Ltd		Zibo Bona Science and Technology Development Co., Ltd	
	Figure	Rate	Figure	Rate	Figure	Rate	Figure	Rate
Management	455.51	5.6	84.15	21.5	8.5	1.1	—	—
Research and Development	1653.80	20.3	119.44	30.5	9.47	1.2	—	—
Infrastructure Project	1085.22	13.3	—	—	—	—	—	—
Purchasing	72	0.9	18.96	4.8	11.10	1.4	94.29	30.8
Inbound Logistics	767.56	9.4	53.02	13.5	9.53	1.2	64.35	21.0
Production/Operation	2485.96	30.6	102.48	26.2	47.88	6.0	—	—
Outbound Logistics	65.47	0.8	—	—	18.28	2.3	—	—
Operation/Sales	1450	17.8	—	—	683.92	85.9	142.94	46.6
After-sales Service	100	1.2	13.45	3.4	7.46	0.9	4.85	1.6
Total	8135.52		391.50		796.14		306.43	

Notes: the unit of the figure list is 0,000RMB, the unit of the rate list is %, “—” means data unavailability or there's no impacts of standards to this value chain.

⁶Due to limitations on space, the questionnaire is not listed in the article, readers can contact the author on request.

If we consider the scale of the above four enterprises and give a relevant evaluation by comparison among these enterprises, we can get contribution rates of standards to each enterprise, as is shown in graph3. From graph3, we can see that, considering the scale of enterprise, standards have higher contribution rate to high-tech industries. With a comprehensive analysis of graph3 and graph2, we can see that, for capital-intensive and technology-intensive enterprises, the implementation of standardization can greatly improve production efficiency and economic benefits of enterprises.

Graph3. Contribution Rate of Standards to Enterprises Economic Benefits

Year	Annual Sales Revenue (0,000RMB)			
	Shandong Luyang Co., Ltd	Joyong Co., Ltd	Shandong Haoyue Resin Co., Ltd	Zibo Bona Science and Technology Development Co., Ltd
2009	77720	17620		550
2010	90246	21322	9576	650
2011	96268	17220	11338	1050
2012	97701	23000	14882	1650
Average Number of Recent 4 years	90483.75	19790.5	11932	1350*
Contribution Rate of Standards	8.99%	1.98%	6.67%	22.69%

Notes: As the annual sales revenue of Zibo Bona Science and Technology Development Co., Ltd has a huge increase, we only take the average number of 2011 and 2012 as the test bench of contribution rate. In terms of the average number from 2009 to 2012, the contribution rate of standards is as high as 31.4%.

4. CONCLUSIONS

The theory of standardization economic benefits evaluation based on the value chain proposed by ISO is applied in this paper to analyze the mechanism of standards' impact on all aspects of the value chain. Through questionnaire survey and field research, this paper takes four enterprises as samples and empirically analyzes impacts of standards on enterprises economic benefits. The research suggests that standards can produce great impacts on enterprises economic benefits, particularly on those high-tech industries. Besides, standards have different impact on every state of the whole value chain, and the stages of production, research and development and management are easier to be effected by standards.

Of course, just as other evaluation methods of standards economic benefits, the evaluation method in this paper is also confronted with a common difficult problem, namely how to distinguish differences of standards and differences of other elements. Standards produce economic benefits by combining itself with other production factors (like capital and labor force). However, some relative studies always attribute cost savings and higher work efficiency to the implementation of standardization without knowing that this is the result of combination of standards and other factors. In aspects like data statistics, model selection and data analysis, what evaluators should pay special attention to is how to accurately evaluate standardization economic benefits and reflect the actual contribution of the factor of standards⁷. What is more, whether a standards economic benefits evaluation method is successful or not is dependent on sample selection and data quality. Therefore, we should have a reliable analysis of obtained data, calculate errors, or use alternative approximate methods.

⁷Zhang Li-fei, Zeng De-ming, Zhang Yun-sheng, Economic Benefits Evaluation of Technology Standardization, Statistics and Decision, 2007(22), P149-151.

Through analysis of standardization economic benefits evaluation from the macro and micro level, we should conduct the evaluation research on hierarchical standardization economic benefits. At the same time, we should take disadvantages of standard into consideration as much as possible and pay close attention to beneficiary and scope affected by standardization activities when evaluating standardization economic benefits.

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