

Research on Industrial Safety Evaluation Model under the Restriction of Resources and Environment

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Abstract—In the current, global economy is facing resources and environment constraints increasingly strong, under the background, low carbon economy and green development become a trend. Industrial safety is becoming one of the hot issues of concern of many scholars, including that of Industrial Safety Evaluation Index System becoming research focus. Therefore, this study on the basis of domestic and industrial security assessments, considering the ecological balance, resource constraints, environmental pollution and other factors and promote the sustainable development of our industry. Through analysis includes external security and industrial industry internal security, external security mainly refers to external control industry, competitiveness and external dependence, the internal security is the basis of internal industry influence industry and sustainable self-development and other factors of on, by taking expert scoring and analytic hierarchy process (AHP) combined approach to building the index system and model resource and environmental constraints of industrial safety assessment, and by comparing longitudinal and transverse compare overall judgment of a State in which the industrial safety the overall state and propose certain measures for its future development.

Keywords—Global Resources ; Environment Constraints ; Industrial Safety Indicators ; Assessment Model ; industrial security

I. INTRODUCTION

The international wide attention on the country's economic security issues began in the end of the 20th century, and it has been widespread concern in government, academia, whether developed or developing, or national markets for the maintenance of their national interests, adhere to the country's economic sovereignty, enhance participation competitive purposes, gradually this factor into industrial safety in national strategic or government decisions, and the trend has continued to strengthen. China's current economy is facing energy consumption continues to grow, further increasing environmental pollution, international trade in greenhouse gas emissions need to take responsibility and pressure will be increasing, faced with the supply of resources, pollution, ecological environment and trade of carbon emission constraints have become increasingly severe, which added a little uncontrollable factors as Chinese industry against foreign risks, but also cause more serious impact to some extent on the

security of China's industrial development. Therefore, in the increasingly tight resource and environmental constraints of the situation, to build industrial safety evaluation system, which is not only conducive to the construction and improvement of the domestic industry, the system of economic theory, and further enhance the industrial development of theoretical guidance for national economic development; and is conducive to enhancing sustainable development of our national economy, and enhance international competitiveness, and so has important theoretical and practical significance.

II. BASIC FRAMEWORK AND MODEL OF INDUSTRIAL SAFETY EVALUATION SYSTEM UNDER RESOURCE AND ENVIRONMENTAL CONSTRAINTS

In the study of industrial security issues, While we need to clear the connotation of industrial safety, which means under conditions of economic globalization, domestic industries can withstand unfavorable factors at home and abroad to maintain a balanced industrial development through a variety of ways, either by the supply of resources in the development process^[2]; On the other hand, we need to sort out in advance on the basis of research, that is He (2008) systematic and testability industrial safety evaluation index system research; Department of Commerce Bureau of Industry Injury Investigation (2008) and Jin (2006) Improve safety assessment of traditional industries, further complement the impact of government's macro policies on industrial safety. Xu (2008) and easy name, Wang (2007), respectively, ecosystems and resource constraints from the perspective of proposed industrial safety evaluation index system for industrial safety evaluations provide new ideas and methods^{[3]-[6]}. Zhang Kai et al. (2012) from the perspective to build a low-carbon industrial safety evaluation system, discusses the impact of environmental pollution and resource supply constraints on carbon emissions in industrial safety, and social security from the industrial, economic security and ecological safety of three aspects to build analysis^[7]. Against pollution and global warming increasingly ecological environment, more and more scholars began to focus on the supply of resources and ecological environment, thus believe that the supply of resources, environmental pollution and greenhouse gas emissions

has become an important factor affecting the industrial security^{[8]-[9]}. Therefore, we should consider the ecological balance, resource constraints, environmental pollution and other factors and promote the sustainable development of our industry. Also, industrial safety should specifically include external security and industrial industry internal security, external security mainly refers to external control industry, competitiveness and external dependence, industry internal security refers sustainability industry and the internal influence their own development. Based on comprehensive consideration of the content and impact of industrial safety factors, we constructed the index system and model resource and environmental constraints of industrial safety assessment.

A. Industrial safety evaluation index system

According to industry security content, in accordance with scientific and comprehensive combining, scalability and practicality combined qualitative and quantitative indicators, principles of short-term and long-term industrial safety industrial safety combination^[10], based on the perspective of resource and environmental constraints, we build industrial safety assessment system (see Table 2), including industrial and domestic development environmental Assessment (S1), industrial Sustainable Development Capacity assessment (S2), the international competitiveness of industry assessments (S3), external dependence industry assessment (S4) and industrial control assessment (S5) in five areas.

TABLE 1 INDUSTRIAL SAFETY EVALUATION SYSTEM UNDER THE PERSPECTIVE OF RESOURCES AND ENVIRONMENTAL.

Industrial safety evaluation index system	Evaluation	Influence factors	Quantifiable indexes
	Industrial domestic development environment S_1	Market environment S_{11}	Domestic market demand growth rate X_1
			Domestic market share X_2
			Industrial concentration X_3
			Related industrial competitiveness X_4
			Labor cost X_5
			Capital cost X_6
			Human capital X_7
	Industrial sustainable development capacity S_2	Government regulation environment S_{12}	Chinese government performance evaluation index X_8
			The proportion of industrial policy number X_9
			Energy consumption per unit of output value X_{10}
		Resource consumption and reuse S_{21}	value added per unit of output water consumption X_{11}
			Resource recycling rate X_{12}
			Sewage emissions per unit of output X_{13}
			Gas emissions per unit of output X_{14}
	Industrial international competitiveness S_3	Pollutant emissions S_{22}	Carbon emissions per unit of output X_{15}
			Total industrial output value X_{16}
			Industrial profit margin X_{17}
			Labor productivity X_{18}
			Return on assets X_{19}
		Industrial reality competitiveness S_{31}	The number of patent ownership X_{20}
			The proportion of R & D expenditure in the cost X_{21}
			Innovative product profitability X_{22}
			The proportion of professionals X_{23}
			Trade competitiveness index (TSC) X_{24}
	Industrial external dependence S_4	International trade competitiveness S_{32}	Revealed comparative advantage index (RCA) X_{25}
			International market share X_{26}
			Export dependence S_{41}
			Industrial export external dependence X_{27}
			Import dependence S_{42}
	Industrial control S_5	Capital dependence S_{43}	Industrial import external dependence X_{28}
			Industrial capital external dependence X_{29}
			Industrial technology external dependence X_{30}
			Industrial energy external dependence X_{31}
			Foreign market share X_{32}
		Technology dependence S_{44}	Foreign technical control rate X_{33}
			Foreign brand share X_{34}
			Foreign equity control rate X_{35}
			Foreign country concentration X_{36}
		Energy dependence S_{45}	
		Market control S_{51}	
		Technical control S_{52}	
		Brand control S_{53}	
		Equity control S_{54}	
		Country control S_{55}	

1) Industrial domestic development environmental evaluation

Domestic Domestic development environment is the basis for the survival of the industry, including the impact of a financial environment, environmental factors of production, market demand environmental and industrial policy environment for the development of industrial safety and so on. From the market environment (S_{11}) and government regulation environment (S_{12}) two aspects of the industry were evaluated domestic development environment, including the domestic market demand growth (X_1), the domestic market share (X_2), industrial concentration (X_3), Related industrial Competitiveness (X_4), labor costs (X_5), capital costs (X_6), human capital (X_7), the Chinese Government performance Assessment Index (X_8) and the proportion of the number of industrial policy (X_9) nine quantifiable indicators.

2) Industrial sustainable development capacity evaluation

Industrial sustainable development capacity is the guarantee for the industry to obtain long-term competitive advantages. From resource consumption (S_{21}) and environmental pollution (S_{22}) both to examine the capacity for sustainable development of the industry, including the energy consumption per unit of output (X_{10}), the added value of water consumption per unit of output (X_{11}), resource recycling rate (X_{12}), water emissions per unit of output (X_{13}), the amount of emissions per unit of output (X_{14}) and carbon emissions per unit of output (X_{15}) and six other quantifiable indicators.

1) Industrial international competitiveness evaluation

Industrial international competitiveness is the comparative productivity of one country's particular industry relative to foreign competitors, reflecting the international market share and profitability of the products of the industry. Our comprehensive evaluation index and industrial needs on the basis of safety assessments of existing international competitiveness of the industry, we use industry output (X_{16}), Profit Margin (X_{17}), labor productivity (X_{18}), return on assets (X_{19}), the number of patents ownership rate (X_{20}), R & D expenditure as a percentage proportion of the cost (X_{21}) Innovative product profitability (X_{22}) and proportion of professional personnel (X_{23}) and other indicators to measure the competitiveness of the industrial reality (S_{31}), with the trade competitiveness index (TSC) (X_{24}), revealed comparative advantage index (RCA) (X_{25}) and international market share (X_{26}) to measure industrial competitiveness in international trade (S_{32}), which constitute the industrial international competitiveness evaluation.

2) Industrial external dependence evaluation

The primary indicator of the external dependence mainly reflects the degree of dependence of the industry on international markets and the negative impact brought by transnational factors. Industrial external dependence and industrial survival safety degree change in the opposite direction, namely, the higher the industrial external dependence, the more susceptible to transnational

negative factors, the lower the industrial survival safety degree. External dependence Industry (S_4) including industry export dependence on foreign (X_{27}), industry's dependence on foreign imports (X_{28}), industry's dependence on foreign capital (X_{29}), industry's dependence on foreign technology (X_{30}) and the dependence on foreign energy industry (X_{31}) and other five indicators.

3) Industrial control evaluation

Industrial control index mainly assesses the influence and control degree of foreign capital on the safety of industry, and this paper uses foreign capital equity control rate (X_{32}), foreign capital technical control rate (X_{33}), foreign capital brand share (X_{34}), foreign capital country concentration (X_{35}) and foreign capital market (X_{36}) share to reflect this aspect.

B. Industrial safety evaluation Method and model

1) Industrial safety evaluation method

About industrial safety indicators processing method can generally be divided into two types^{[11]-[13]}. First, the industrial safety indicators approach divided into three categories, namely for the completion of indicators and predictive self-learning functions, such as self-averaging regression method, DEA model etc; for complete screening and classification of indicators, such as regression analysis, factor analysis and the like; and more integrated indicators and targets weight distribution is very important step, which are commonly used quantitative methods with a conventional multi-index integrated approach, AHP (AHP), etc^[14], but due to the quantitative analysis of these methods it is difficult to operate, in the safety evaluation of the outcome of the current industry has not use these methods to determine the weight of each index. Second, the commonly used is an expert score, there is a big subjectivity to some extent, thereby affecting the accuracy of the industrial safety evaluation results^[15]. Therefore, this article draw on previous research, according to research needs, using first score on the basis of expert on the use of the Analytic Hierarchy Process (AHP) to study.

2) Industrial safety evaluation model

Based on the above Industrial safety evaluation method and index system, we initially construct the following industrial safety evaluation model:

$$S = f(S_1, S_2, S_3, S_4, S_5) = aS_1 + bS_2 + cS_3 + dS_4 + eS_5 \quad (1)$$

$$\text{And, } S_1 = \sum w_i s_{1i} \quad (2)$$

$$S_2 = \sum x_j s_{2j} \quad (3)$$

$$S_3 = \sum y_k s_{3k} \quad (4)$$

$$S_4 = \sum z_l s_{4l} \quad (5)$$

$$S_5 = \sum v_m s_{5m} \quad (6)$$

$$(i, j, k, l, m = 1, 2, 3, 4, 5)$$

$$a + b + c + d + e = 1 \quad (7)$$

$$\sum w_i = \sum x_j = \sum y_k = \sum z_l = \sum v_m = 1$$

Among them, S is the industrial safety degree; S_1 is the industrial domestic development environmental evaluation value; S_2 is the industrial sustainable development capacity

value; S_3 is the industrial international competitiveness evaluation value; S_4 is the external dependence evaluation value; S_5 is the industrial control evaluation value; a , b , c , d and e is respectively the coefficient of primary index S_1 , S_2 , S_3 , S_4 and S_5 ; S_{1i} , S_{2j} , S_{3k} , S_{4l} and S_{5m} is respectively the corresponding secondary indicator under each primary indicator; w_i , x_j and y_k is respectively the coefficient of secondary indicators.

III. CONCLUSION

On the basis of the establishment of evaluation index system and evaluation model, we can divide the industrial safety state into security, basic security, insecurity and crisis or divide into a number of security levels. We can compare the comprehensive index value of the comparison year with the comprehensive index value of the base period through the longitudinal comparison, and can also compare the comprehensive index value of the country with the comprehensive index value of other countries through the horizontal comparison, so as to determine the overall state of the country's industrial safety.

Nowadays, Today, whether in domestic or international, supply of resources, environmental pollution, ecological destruction and greenhouse gas emission constraints and other factors of industrial development is increasing, it can not be underestimated, and therefore the ecological safety of industrial safety as an evaluation is essential of. From the overall situation model and evaluation system, the measure of resource consumption and pollution emissions does not conflict with other quantitative indicators, and has a certain relevance. Thus, after the addition of the ability to indicators of sustainable development of the industry in the industrial safety assessment system, make industry more perfect safety measure, thus more conducive to sustainable development and competitiveness of the industry. Of course, given the resource supply "environmental pollution and greenhouse gas emissions constraints on their industrial development plays a decisive role, we need further consideration in the future when building scientific and effective industrial safety quantitative evaluation system, we need to industry Safety evaluation of future trends, dynamic process of industrial safety evaluation, industry type, etc. to differentiate different designs for a strong program..

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