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Scenario analysis on China's alternative fuel vehicle industry risk identification

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ABSTRACT

Alternative fuel vehicle industry, as one of China's strategic emerging industries, the development process will be faced with many risks, according to the characteristics of the industry, identify the risk scientific and timely, and take appropriate measures to ensure the realization of industry's planning and goals, continuously upgrade the industry's international competitiveness, has vital significance of realizing the sustainable development of economy. On the basis of earlier studies' review, this paper use scenario analysis method to identify the risk of China's alternative fuel vehicle industry.

Keywords: Alternative fuel vehicle industry; Risk identification; Scenario analysis

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INTRODUCTION

With the rapid expansion of total economic output, China's oil consumption increased year by year. Car is the main force of oil consumption. China's automobile production and sales has been ranked first in the world since 2009. The data prediction of the NDRC Energy Research Institute shows that the number of China's automobile on the road will reach 1.5 billion by 2020. The rapid growth of automobiles will result in oil consumption exceeding 2.5 billion tons, accounting for the country's total oil demand in 57%, and will further aggravate the carbon emissions and environmental problems, increasing difficulty of realization of China's carbon emission reduction targets.

In the context, to accelerate the development of alternative fuel vehicle industry becomes the inevitable choice to break this plight. At the same time, China's alternative fuel vehicle industry future development has a high degree of uncertainty, according to the characteristics of the industry, identifying the risk scientific and timely, and takes appropriate measures to ensure the realization of industry's planning and goals, continuously upgrade the industry's international competitiveness, has vital significance of realizing the sustainable development of economy.

EXPERIMENTAL SECTION

Scenario analysis is a process of analyzing possible future events by considering alternative possible outcomes. Thus, the scenario analysis doesn't try to show one exact picture of the future. Instead, it presents consciously several alternative future developments. Consequently, not only a scope of possible future outcomes is observable, also the development paths leading to the outcomes. In contrast to the prognoses, the scenario analysis does not rely on historical data and does not expect past observations to be still valid in the future [1-3].

Scenario analysis is mainly used in the field of strategic management, policy analysis, risk assessment, decision management, sustainable evaluation and a lot of studies emphasizing on environmental and energy issues [4-8]. Scenario Analysis method is also a hotspot in the research of alternative fuel vehicle industry [4,9-13].

As one of strategic emerging industry, the future development of China's alternative fuel vehicle industry has a high degree of uncertainty. There are many key questions should be answered: How about the future five to ten years' development of industry? What is the detailed risk form? What are the key risk factors need to focus on? Under the effect of these factors, how to evolve about the risks? Based on the answers of those questions, we can form a relatively comprehensive and clear understanding of the alternative fuel vehicle industry risk in China. Due to the development of industry is in the initial stage, being lack of date and documentation, and the future development is closely related to industry stakeholders' daily and future decision, scenario analysis is the applicable method to the emerging industry risk, through analysis and identify the uncertainty and the key risk factors, to develop scenario logic and analyze future risk scenario.

3. Key risk factors identification

3.1Collect and survey of risk factors

Through the network literature database and expert interviews as many channels as possible to collect information on the risk of alternative fuel vehicle industry, it sum up the description of risk. In order to facilitate the design of questionnaire and reduce time occupied of respondents, it finally summarizes the 32 risk factors.

The aim of questionnaire designed is to score the level of uncertainty and impact of risk factors, identify the high impact and high uncertainty factors for constructing scenarios.

The 4 dimensions of 32 risk factors are collected, including technical, market, industry security and policy. Questions are about future scene description, and in interrogative forms for inspiration respondents' thought, through respondents' answer to judge the future of next 5 - 10 years' China alternative fuel vehicle industry development. The answer to each question in the questionnaire contains the possibility and impact level, the probability value range is 0 - 10, where 0 represents no possible, 10 represents entirely possible. By 0 – 10, the probability from low to high; The impact levels range from 1-5, 1 represents the impact level very low, 5 represents very high, and from 1 - 5 express the impact increased. At the same time, in order to follow the principle of consistency, when the respondent does affirmative (near 10 probability)answer to each question, it means that the respondent is optimistic about the prospects for the development of industry, the negative direction (near 0 probability) answer, means pessimistic about the industrial development.

The survey selected 20 experts from fields of car manufacturers, suppliers, universities, the relevant government departments, experts and representatives of consumers.

3.2. Key risk factors identification and scenario variables determination

After survey 20 experts from different fields, scoring 32 risk factors in the impact level and probability, use the follow formula for data processing:

$$\bar{x} = \frac{1}{n}\sum_{i=1}^{n} x_i \tag{1}$$

$$s = \sqrt{\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2} \tag{2}$$

In the formula, $\bar{x}$ represents the mean of a set of raw data, n represents the number of a group of data, s represents a set of raw data standard deviation.

Using the capital M stands for mean, SD for standard deviation.

According to the survey data, this paper from three aspects, i.e. uncertainty levels, dissension level and impact level defines factor's categories.

i) For uncertainty:

When 4<M<6, high uncertainty, it means that it is very difficult to determine the specific events (factors) is good or bad for industry development; When 6<M<7 or 3<M<4, moderate uncertainty, be difficultly determined; When M>7 or M<3, low uncertainty, be easily determined.

ii) For dissension:
Standard deviation represents the average dispersion of variable value from the mean value. When standard deviation is greater, the differences between variable values will increase. We can specifically take two values of total standard deviation 2.0715and the average standard deviation1.8662 as the point of reference.

When SD>2.0715, it means high dissension level in respondents; When SD<1.866, it means that the level of dissension is relatively low; When 1.866<SD<2.0715, it means that dissension is in the middle level.

So, when the respondents' probability scoring value standard deviation is greater, it means that the difference between respondents is larger.

iii) For impact level, take the total mean 4.1531 as the reference point:
When I>4.153, high impact to industry; When I<4.153, low impact to industry.

According to the rule mentioned above, this paper calculates the corresponding level of each risk factor, and devises the factor into 10 categories.

Through the above analysis, the 10 non important factors (with low impact to industry) of 32 risks have been removed; will do not be considered in risk scenario analysis. And in the rest of important high impact factors, this paper selects 15 risk factors as the basic variables.

Table 1. The basic scenarios variables and the corresponding risk factors

Basic variables	Factor feature			The selected risk factors
	impact	uncertainty	dissension	
Technical risk	high,	high	high	u1
	high,	medium	high,	u2, u3, u5, u6
Market risk	high,	high,	high,	u14
	high	high,	low	u18
	high,	low	high,	u8, u9
	high	medium	high,	u15, u16, u19, u25
Policy and environmental risks	high	high,	high,	u30
	high	high,	low	u31

The characteristics of these factors are: uncertainty and/or dissension levels are high (see Table1). And the remaining 7 risk factors, their impact is characterized by high level, but with low or medium uncertainty levels and/or low or medium dissension levels, can be called as the trend scenarios variables (see Table 2).

Table 2. Trend scenarios variables and the corresponding risk factors

Trend variables	Factor feature			The selected risk factors
	impact	uncertainty	dissension	
Market risk	high,	Low(good trend)	medium	u23
	high	Low(good trend)	low	u27
	high,	medium	medium	u10, u13, u24
Policy and environmental risks	high	Low(bad trend)	Low	u20
	high	Low(good trend)	low	u28

4. Develop scenario logic and analysis the scenario content

The technology risk, market risk, the policy environment risk of three types of scenarios variables construct three uncertain axis respectively, from the risk perspective, each axis has three kinds of outcomes: high, medium, and low.

4.1. Develop scenario logic

The three uncertainty axis each with three outcomes, through permutation and combination, 27 scenarios are constructed. According to the consistency principle, eliminate the scenarios with three uncertain axis force inconsistency. After screening, finally retained 18 risk scenarios, the named scenarios and the corresponding industry risk degree are shown in Figure 1. Due to the limited space, this paper does not make specific description of each scenario.

4.2. Analysis of risk scenario

Due to the environment, policy, technology and market changes, risks are constantly changing. Therefore, the actual future scene is all kinds of scenarios in the conversion of non-stop, and even repeatedly. Figure 1 illustrates those conversions. In Figure1, the three set of vertical letters represent a scenario, in which three letters from top to bottom respectively represent the technology risk, market risk, and policy risk outcomes, H represents high, M is medium, L

is low. We set the conversion rule: each axis risk changes in gradual way, each conversion can only have one result change, and only one level change. As shown in Figure1, after each time conversion, there can be only one letter to change, and can't jump level change. According to the rule, drawing conversion risk scenario paths, in Figure1, a bidirectional arrow is a conversion path, for example, from the collapse risk to the technology & market risk is a conversion path, whereas the opposite process is anther conversion path too. Therefore, we can call it as the 18 scenarios decomposition scenario or section scenario. From the dynamic point of view to analyze scenario, we introduce the development path, i.e. the different conversion paths connected end to end constitutes a development path (see Table3).

Table3. The basic types of risk development path

Path type	Path examples	Features
Aggressive	1→2→4	After conversion, gradually reduce risk
Regressive	4→2→1	After conversion, increasing risk
Repetitive	1→2→1	After conversion, back to a previous state
Tortuous	4→11→5	After a conversion, risk reduction, after anther conversion, the degree of risk and return to the state before the first conversion, but the main risk type changed.

For easy analysis, now only use the numbers in front of the scenario name stand for the corresponding scenario. Combination of different path will be different dynamic scenario. Because of the limited space, this paper only selects one development path (shown in bold line in Figure1) for analysis the future risk scenario. The specific selected track is 2 (technical & market type risk) to 4 (technical type risk) to 9 (boundary type risk) to 12 (policy support boundary type risk) to 15 (technical medium type risk) to 18 (low risk). Concrete analysis is as following: At present, China's alternative fuel vehicle industry is at risk of technology & market type [17],

Specifically, although China has made great progress in the new energy technology, the research still needs to be in the key technology and core technology, technological innovation system is not perfect; the gap between the car manufacturers and the international giant is still big; industries overly depend on policy support; alternative fuel vehicle purchase and use cost is still high, related facilities imperfect, industry chain is not complete, no innovative business model, the huge gap between market promotion effect and the expectations; the problem of repetitive construction is outstanding [17].Although China has promulgated series of policies, due to the early development has a lot of uncertainty, the risk of policy at the moderate level. After a period of development, because the policy favorable effect gradually appears, basis and supporting facilities gradually improved, people purchase intention strengthen gradually, alternative fuel vehicle market shows signs of rising, the market risk from high risk to moderate level, namely the risk is 4 (technical type risk). Because of the policy is more direct intervention in the market, the power of industry innovation is insufficient, technical risk remains high; after a period of time, because the technology achieved progress, coupled with previous policies and market development support, technology risk reduction for moderate level, namely the risk become 9 (boundary type risk), the so-called boundary type of risk can be understood as the industry development in the key period. The industry has formed a certain foundation, but all aspects of industry have risks. The development trend rising or falling is difficult to be determined; at the critical time, the international and domestic political and economic environment continued good momentum, in order to further boost the development of alternative fuel vehicle industry, through summarizing the earlier development experience, China timely issued a series of policies, but the policy inclination to make indirect regulation and control role, letting market mechanism to play a greater role, and the expected result of the policy is easy to be foreseen, policy risk is gradually lower, namely transit to 12 (policy support boundary type risk), on this basis, the alternative fuel vehicle market is full of vitality, the business model is becoming more and more mature, infrastructure and facilities more perfect, new automobile sales grow significantly, different regions through the adjustment and integration of its advantages, emerge several alternative fuel vehicle industry cluster, individual enterprises grow rapidly, market share gradually improve. Although the development of alternative fuel vehicle industry make a spurt of progress in foreign countries, and increase the intensity of strategic layout in China, China has made corresponding protection policy, coupled with further strong industrial base, it can resist the risk of industrial safety, the overall market to further reduce the risk for degrees, it is converted to 15 (technology medium type risk); industrial development and technological progress is mutual promoting, Relying on independent innovation master core technologies, the autonomy of technology greatly enhanced, technical risk is further reduced, the new vehicles low cost advantage to be further enhanced, the development of the whole industry at low risk, that is converted to 18(low risk).From the analysis of the development path can be seen, this track reflect industry growth is mainly driven by the policy, and then make the market as soon as possible to grow, and the technology is synchronously develop, the whole track is an aggressive path.

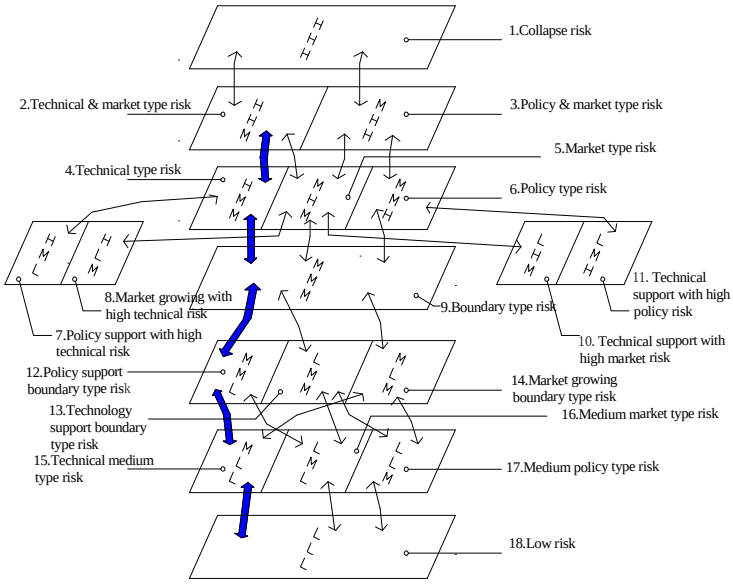

Figure 1. Scenario analysis on China's alternative fuel vehicle industry

If the technology is developing rapidly, development path will be along the technical risk from high quickly convert to medium, and soon turned into low path, and the market and policy risks on the basis of technology gradually transition. Similarly, if the market mechanism has good play, development path will be along the rapid reduction of market risk. Of course, the actual development path may also be not fully aggressive, may be more twists and turns, or even go backwards or be repeated, have a great chance, but only a final actual path.

CONCLUSION

This paper uses scenario analysis on the alternative fuel vehicle industry risk identification, on the one hand, through survey of various stakeholders, to identify important uncertainties, on the other hand, it gives the future risk situations and risk scenario development path, this method can be used to overcome the drawbacks of previous risk research methods. Just like risk evolution, industry risk identification is a dynamic process. According to the changes of the internal and external environment of industry, it needs to timely identify the changes of important risk factors, to implement new scenario analysis, and to better guide the reality.

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