

Evaluation and Policy Suggestions on Intellectual Property Audit System of Listed Enterprises in China's SSE STAR Market

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How to cite this paper: Jia, Y. L., & Cao, Y. W. (2021). Evaluation and Policy Suggestions on Intellectual Property Audit System of Listed Enterprises in China's SSE STAR Market. *American Journal of Industrial and Business Management*, 11, 352-363. <https://doi.org/10.4236/ajibm.2021.114023>

Received: March 30, 2021

Accepted: April 19, 2021

Published: April 22, 2021

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Abstract

The establishment of China Science and technology board provides high-tech enterprises with financing channels for listing, and at the same time, many enterprises are sad to audit the relevant audit due to the current intellectual property audit system of the science and technology board. In this context, this paper first combs out the relevant policies and academic research, puts forward the definition of the intellectual property audit system, then uses the fuzzy comprehensive evaluation method to carry out the evaluation of the system, and finally, according to the final evaluation results, puts forward the relevant policy suggestions to improve the system.

Keywords

SSE STAR Market, Intellectual Property, Listing Audit, Fuzzy Comprehensive Evaluation, Policy Suggestions

1. Introduction

On June 13, 2019, China's SSE STAR Market opened, mainly to meet the needs of six fields involving the national strategic layout, such as the new generation of information technology, high-end equipment and new materials. It aims to support enterprises that are in line with China's national strategy, have key core technology, have outstanding scientific and technological innovation ability, mainly rely on core technology to carry out production and operation, have stable business model, high market recognition, good social image and strong growth. While serving the national strategy and building a bridge between capital and technology, it also provides a new choice for domestic enterprises to go public under the background of the escalation of Sino US trade friction (Wu, 2020).

This article is divided into three parts. Firstly, it defines the intellectual property review system for listed companies on the Science and Technology Innovation Board. This definition comes from theoretical research and a review of the actual system. On this basis, the content of the review of the Intellectual Property Review System of the Science and Technology Innovation Board is summarized. Then carry out a fuzzy comprehensive evaluation of the audit content. Finally, policy recommendations are put forward based on the evaluation results.

2. The Definition of Intellectual Property Rights Audit System of Listed Enterprises in China's SSE STAR Market

2.1. Similar Research on Other Securities Sectors

SSE STAR Market has become China's NASDAQ by the industry. It can be seen that the NASDAQ securities market in the United States has important reference significance for China's SSE STAR Market. It is also considered to be the most successful listed market of science and technology enterprises in the world at present (Wu, 2019). Therefore, it is an important reference point for the research of China's SSE STAR Market to include the research of NASDAQ's listing system in the literature review. So, comparative research and special research are the current mainstream research directions.

Shi Yiming made a comparative study on the registration system of SSE STAR Market and NASDAQ. He found that Nasdaq realized the registration system of different levels and different objects through three market levels. Through the dual registration system, that is, the substantive audit of the state and the formal audit of the federal, it supported the high-quality enterprise registration exemption on the basis of the dual registration system Right system and dual track information disclosure system make it more convenient for enterprises to go public, improve the market competitiveness, reduce the listing resistance, strengthen the supervision of listed enterprises and protect the rights and interests of investors (Shi, 2020). Huadingqi also found that Nasdaq has a multi-level internal market, which can better deal with different risk characteristics. By matching the diversified listing requirements of different indicators, it has become a good listing place for global scientific and technological innovation enterprises (Hua, 2015).

Therefore, the reason for Craig's advantages in going to the U.S. is that it benefits from China's approval system (Stephen, 2012). Through EGARCH model, Dynamic Causality Test and other methods, Bong Soo and others found that the US Nasdaq market had a great impact on the establishment and improvement of the securities market in Singapore, Taiwan, South Korea and other countries and regions, which also benefited from the relatively excellent listing system and regulatory system of NASDAQ (Lee et al, 2004). On this point, the research of Li Peixin and others also confirmed that Nasdaq system and environment are significantly better than Singapore and Hong Kong (Li et al, 2012).

Of course, such a mechanism also has the situation of "failure". John found that because of the lighter legal punishment, agency costs, vicious competition

and other reasons, enterprises can easily go public by making false financial statements and stating misleading information (Coffey, 2011). Daniel also believes that this lack of regulation led to the financial crisis in the United States.

2.2. Theoretical Research and Definition of Intellectual Property Audit of SSE STAR Market

Compared with the traditional intellectual property rights for the object of controversy—"intellectual product theory" or "interest relationship theory" (He, 2014). In the series of supporting systems for the listing of SSE STAR Market, although the current SSE STAR Market does not make a systematic and standardized definition of the content of intellectual property audit for the listing of enterprises, in many details, specifications and inquiries, it also conducts audit and inquiry on the objects that are not the traditional sense of enterprise intellectual property.

Sort out all laws, regulations and business specifications, inquiries published by the Shanghai Stock Exchange, and integrate the views of relevant scholars. This paper holds that the audit of intellectual property rights includes both "intellectual product theory" and "interest relationship theory" in the audit of SSE STAR Market listing, which responds to the protection of investors' interests and the purpose of establishing SSE STAR Market from a practical point of view.

Therefore, the intellectual property rights are summarized and sorted out in the detailed rules and inquiry contents in the audit of the science and innovation board, and the listed enterprises (issuers), sponsors and law firms concerned are investigated in the early stage according to the "Rules Governing the Listing of Stocks on the SSE STAR Market of Shanghai Stock Exchange (Revised in 2019)" The research content, laws and regulations, standard announcement and information of listed enterprises have been sorted out.

This paper holds that the intellectual property audit system of enterprises listed on the SSE STAR Market is a part of the registration system of the SSE STAR Market. It includes not only the standards of intellectual property certification for high-tech enterprises in China, that is, the system of intellectual property certification oriented by "intellectual product theory" such as patents, copyrights and trademarks, but also the new regulations "Rules Governing the Review of Offering and Listing of Stocks on the SSE STAR Market of Shanghai Stock Exchange" The internal requirements that directly affect the incubation, achievement, operation and future sustainability of enterprise intellectual property are put forward, that is, intellectual property development investment, intellectual property operation investment, intellectual property income evaluation, intellectual property life cycle and other "interest relationship theory" oriented intellectual property audit system.

3. Contents of Intellectual Property Audit of SSE STAR Market

Although the pilot registration system of SSE STAR Market, securities regulatory

agencies cannot do value judgment instead of investors (Li, 2015). But it is their duty to check whether there is arbitrage to defraud capital. Therefore, the Listing Committee of SSE STAR Market attaches great importance to the intellectual property rights and R & D investment of enterprises applying for listing (Yao & Zhu, 2020). According to the above examples, the intellectual property audit system mainly includes the following aspects:

3.1. Sources of Intellectual Property

Based on the above contents, this paper integrates the problems of most enterprises in the public inquiry letter of Shanghai Stock Exchange, and reviews the sources of intellectual property rights, mainly including: whether there is significant dependence on the core technology of independent intellectual property rights, that is, whether it depends on the transfer and borrowing of intellectual property rights; the number of patents focuses on invention patents, and the types of general patents such as utility model and appearance are not obvious; the number of intellectual property rights is not obvious Whether there are disputes or potential disputes over property rights; the corresponding relationship between core technology and specific intellectual property rights; whether core technology belongs to key recommended areas; clear division of rights and obligations of cooperative R & D; the number of trademarks, geographical indications and non patented technologies.

3.2. Intellectual Property Quality

Technical level and contribution to the industry; advanced technology and specific representation; the strength of core technology mainly focuses on important awards received by enterprises, research projects funded by government, and the number of core journals, the proportion of core technical staff, the qualifications, professional qualifications, scientific research achievements and awards of core technicians.

3.3. Application of Intellectual Property

Whether the enterprise mainly relies on the core technology to carry out production and operation is an important criterion; the proportion of R & D investment in revenue; the number of R & D achievements recognized by the market; whether there are current business risks and future business expected risks; non competition will also be used as an evaluation; the proportion of core technology in revenue.

3.4. Intellectual Property Protection

The internal intellectual property protection and management of enterprises has a profound impact on the future business situation, especially for the high-tech listed enterprises on the SSE STAR Market. Therefore, in the field of intellectual property protection, the main requirements are: whether the core technology of

the current enterprise is mature or not; the institutional arrangement of R & D management; the major adverse changes of the core technical personnel, such as the change of position or shareholding ratio; the management system of enterprise information disclosure; the succession risk of core technology, that is, whether it can support the sustainable growth of the company; and the internal control system of intellectual property.

3.5. Intellectual Property Development

At present, for the long-term consideration of investors, there will be some enterprises which are interrupted to be listed because of the problems of intellectual property development audit in the audit system. In this field, it mainly includes: intellectual property investment; technology innovation mechanism and arrangement; technology reserve arrangement; R & D expenditure capitalization; research project stage and progress.

4. Comprehensive Evaluation of the Intellectual Property Audit System of China's SSE STAR Market Enterprises

4.1. Evaluation Method

4.1.1. Delphi Method

The expert evaluation method is generally based on the subjective judgment of experts, and makes an overall evaluation of the evaluation object by making "scores" and "comments" for the evaluation index. The common methods are Delphi method, scoring method, fuzzy method, weighted scoring method and priority method. Because the form and operation mode of this method are relatively simple and easy to master, it has been widely used in evaluation.

4.1.2. Fuzzy Comprehensive Evaluation Method

Fuzzy comprehensive evaluation method is a comprehensive evaluation method which can effectively evaluate fuzzy and difficult to quantify problems, and has been widely studied and applied in various fields (Ma & Si, 2018). It is a comprehensive evaluation method formed by the intersection of fuzzy mathematics and multi factor evaluation. It uses fuzzy set theory and membership degree theory to evaluate and judge the problems that cannot be accurately quantified by fuzzy language such as good, general and poor description, and turns the qualitative problems into quantitative problems for research. At this time, we need the help of fuzzy comprehensive evaluation new technology. Fuzzy comprehensive evaluation method is based on fuzzy mathematics, the qualitative evaluation index quantitative, a systematic evaluation method (Dong, 2003). It has strong systematicness and clear evaluation results. The main steps of the method are as follows: determine the evaluation factors and their index weights, determine the evaluation level, determine the membership degree, construct the fuzzy relation matrix, and generally determine the comprehensive evaluation results according to the principle of maximum membership degree.

4.2. Fuzzy Comprehensive Evaluation

Fuzzy comprehensive evaluation method is a method to make a comprehensive decision for a certain purpose under the fuzzy environment, considering the influence of various factors. Its characteristic is that the evaluation is carried out object by object, and there is only evaluation value for the evaluated object, which is not affected by the object set of the evaluated object. There are 10 experts in this paper, mainly from the fields of intellectual property, finance and public policy evaluation. After calculation, the authority of experts has passed the test.

4.2.1. Introduction of Experts

There are 10 experts in fuzzy comprehensive evaluation, mainly from the fields of intellectual property, finance and public policy evaluation. The overall education of experts with fuzzy comprehensive evaluation is higher, and the doctoral degree accounts for 80%. Among them, there are 3 in the field of intellectual property, 5 in the financial field, 2 in the field of policy evaluation, and 90% of the experts with deputy senior titles or above. The overall level of the personal situation of experts is higher, which ensures the quality of the final evaluation (Table 1).

4.2.2. Construction of Fuzzy Comprehensive Evaluation Index

1) Determine the evaluation factors and evaluation level

Before the fuzzy evaluation, it is necessary to construct the evaluation factors and form the evaluation factor set Q . The above-mentioned hierarchical index model has established 29 project level indexes, which constitute the fuzzy evaluation factors in this study:

$$Q = \{q_1, q_2, \dots, q_{29}\}.$$

In order to show the actual performance of the evaluation index system of intellectual property audit of listed enterprises on the SSE STAR Market, and to

Table 1. Statistics of experts' personal situation in fuzzy comprehensive evaluation.

content	category	Number	proportion
Gender	male	7	70%
	female	3	30%
Industry area	intellectual property right	3	30%
	finance	5	50%
	Public policy evaluation	2	20%
Education	Postgraduates	2	20%
	Doctoral students	8	80%
	intermediate	1	10%
Title or rank	deputy senior ranks	5	50%
	senior	4	40%

establish comments that can better reflect the index system, combined with the opinions and suggestions of 10 experts interviewed, the evaluation grades of this study are as follows:

$$M = \{\text{very satisfied, satisfied, average, dissatisfied, very dissatisfied}\}.$$

We assign the value according to the comments, see **Table 2**.

2) Determine the degree of membership

In the evaluation, there are two kinds of evaluation methods: single factor and multi factor. Considering the reason of single-layer index, this study adopts the single factor method, and then optimizes the results according to the actual effect. That is to determine the membership degree of a single factor to the set of evaluation grades. Specifically, there is a single factor $C_i (i = 1, 2, \dots, m)$ as a single factor evaluation, from the perspective of factor C_i , the membership degree of the transaction to the selection level $Z_j (j = 1, 2, \dots, n)$ is V_{ij} , so the single factor evaluation set of the i factor C_i is obtained:

$$V_i = (V_{i1}, V_{i2}, \dots, V_{in}).$$

Under the guidance of the above method, after the evaluation of 10 experts, through the above steps, the index evaluation membership table shown in **Table 3** is obtained.

For example, in the indicator of “whether the core technology belongs to the key recommendation field”, 5 experts are “very satisfied” with the indicator, which is recorded as 0.5, 3 experts are “satisfied”, which is recorded as 0.3, and 2 experts are “average”, which is recorded as 0.2. When all the indicators of the project are evaluated, the membership of each indicator is input into MCE software, and then according to the above assignment, the final result can be obtained by inputting the score of each evaluation.

4.2.3. Fuzzy Comprehensive Evaluation

Using the MCE software fuzzy program, choosing the way of weighted average to synthesize the fuzzy operator, the index weight calculated by AHP method in the previous study was input and normalized, and then input according to the above membership degree, combined with the evaluation assignment, the final score of the evaluation index system of intellectual property audit system of listed enterprises on the SSE STAR Market was 8.4421.

The evaluation of intellectual property audit system of enterprises listed on

Table 2. Evaluation table of fuzzy evaluation.

Rating	assignment
very satisfied	10
satisfied	8
average	6
dissatisfied	4
very dissatisfied	2

Table 3. Membership degree of index evaluation.

index	Very satisfied	satisfied	average	dissatisfied	very dissatisfied
Does the core technology belong to the key recommendation field	0.5	0.3	0.2	0	0
Core technology of independent intellectual property	0.3	0.6	0.1	0	0
Number of patents	0.1	0.7	0.1	0.1	0
Intellectual property disputes	0.3	0.6	0.1	0	0
The corresponding relationship between core technology and specific intellectual property	0.2	0.5	0.2	0.1	0
Clear division of rights and obligations of cooperative R & D	0.4	0.5	0.1	0	0
Number of trademarks and non patented technologies	0.2	0.5	0.3	0	0
Proportion of core technology to operating income	0.6	0.4	0	0	0
Mainly relying on core technology production and operation	0.5	0.4	0.1	0	0
R & D investment	0.3	0.5	0.2	0	0
Market recognized R & D achievements	0.4	0.6	0	0	0
Non competition	0.7	0.3	0	0	0
business risk	0.1	0.7	0.2	0	0
Core technical strength	0.2	0.5	0.3	0	0
Proportion of core technical personnel to employees	0.4	0.4	0.2	0	0
Industry technology level and industry contribution	0.6	0.3	0.1	0	0
Technology advanced characterization	0.1	0.4	0.3	0.2	0
Core technical personnel level	0.1	0.6	0.2	0.1	0
Management system of enterprise information disclosure	0.6	0.4	0	0	0
Major adverse changes of core technicians	0.4	0.5	0.1	0	0
Internal control system of intellectual property	0.3	0.6	0.1	0	0
Core technology maturity	0.1	0.5	0.2	0.2	0
R & D management	0.2	0.5	0.3	0	0
Core technology iteration risk	0.6	0.4	0	0	0
Mechanism and arrangement of technological innovation	0.7	0.3	0	0	0
Intellectual property investment	0.4	0.4	0.2	0	0
Stage and progress of the research project	0.1	0.5	0.2	0.1	0
Capitalization of R & D expenditure	0.2	0.4	0.4	0	0
Technical reserve arrangement	0.1	0.6	0.1	0.1	0

the SSE STAR Market belongs to “satisfaction”. It shows that the system can provide some reference value for enterprises that need to be listed, and also provides some thinking direction for the research on the listing system of SSE STAR Market. However, we can also find some deficiencies from the evaluation. In the next chapter, this study will put forward some policy suggestions for the problems reflected in this chapter.

5. Suggestions on the Improvement of the Intellectual Property Audit System for the Listed Enterprises of SSE STAR Market

5.1. Improve and Adjust Relevant Supporting Systems

SSE STAR Market is a pilot system innovation of China's registration system. The key to the success of SSE STAR Market is not to introduce much capital, but to create a market with complete rules, effective supervision, transparent information, rational and healthy, so that SSE STAR Market can become a highland market led by innovation economy (Deng, 2019). Therefore, from the long-term consideration of improving the socialist market economic system, the issue of paying great attention to the intellectual property audit of listed enterprises in the future will be popularized in other securities sectors. The problems found in the current intellectual property system of SSE STAR Market listed companies should be improved, which can provide reference for other securities sectors to accelerate the promotion of intellectual property audit system.

In the face of the enterprises mainly from the intellectual property intensive industries, the intellectual property problems are prominent. First, the deficiencies of the legal aspects such as company law and securities law are improved. As a system innovation, science and innovation board means that the legal framework under the original "approval system" is no longer applicable to the "registration system", and provides legal basis for the intellectual property audit through improving relevant laws and regulations. Secondly, we should establish a system of the intellectual property audit system for the listed enterprises. The current intellectual property audit system for the listed enterprises is scattered among various laws, regulations and announcement norms. These scattered intellectual property rights audits are compiled separately, and a systematic and clear system of the audit of the intellectual property rights of enterprises listed is formulated. In addition, in order to promote the efficiency of listing audit, it is necessary to formulate the intellectual property report of listed enterprises, regularly disclose the status quo of the intellectual property rights of enterprises, and the requirements of the white paper on the status of listed intellectual property rights, and standardize the content and format of the report to describe the status of intellectual property rights of enterprises.

5.2. Dynamic Optimization of Audit System

The study found that, because the current audit only depends on the Shanghai Stock Exchange, the lack of official composite pre-trial body, so when only the Shanghai Stock Exchange audit, there will be some aspects of special emphasis and ignore other more important aspects, so the cascade level performance in the audit weight distribution is not very uniform.

It is suggested that the China Securities Regulatory Commission and the State Intellectual Property Office should jointly communicate with the World Intellectual Property Organization and other international organizations, cultivate a

group of intellectual property service institutions with better service to the financial market, international vision and compound type, and form a multi-channel pre audit mechanism. Through the pre audit mechanism, we can obtain the dynamic of intellectual property rights in the capital market, timely adjust the weight and priority of relevant audit rules, and realize the two-way role of policy closely following the market and policy guiding the market.

We should learn from the grading system of the securities market like NASDAQ in the United States, and of course we should learn from, rather than copy, the experience of NASDAQ in the United States (Zhang, 2020). The intellectual property status of enterprises can be included in the market classification. Through the securities market classification, more market financing opportunities can be provided for more start-up high-tech enterprises and more high-end markets can be opened for many enterprises with good intellectual property construction. So that the technology innovation board enterprises listed in the intellectual property audit, can have a broader choice, but also more optimized audit indicators.

5.3. Improve the Audit Supervision System

In the process of intellectual property audit, the regulatory system needs to be improved. Because the CSRC makes decisions on the basis of the listing audit of the Shanghai Stock Exchange, after its original audit role is “retired”, the CSRC’s decision-making is based on the listing audit of the Shanghai Stock Exchange (Han, 2019), only regulate the distribution of regulatory power to exercise, and lack of supervision of regulatory power (Huang, 2020). In the process of intellectual property audit, organizations such as Sci-tech Innovation Advisory Committee often have strong opinions when they provide opinions and suggestions for the Shanghai stock exchange because of their strong professionalism. They have a strong voice in intellectual property audit, but there is still a lack of supervision. In addition, the existing rules of SSE STAR Market do not specify the intellectual property recognition standards for science and technology innovation enterprises that meet the issuance conditions (Huang & Wang, 2019), this study is mainly based on these policies when it is carried out, so the detailed supervision of the identification of intellectual property needs to be improved.

For improving the regulatory system, the most important thing is to be open, and the information disclosure system of SSE STAR Market is a good medicine. Therefore, it is also of great significance to improve the supervision of intellectual property disclosure. This study suggests that the CSRC and the State Intellectual Property Office establish a joint supervision mechanism of intellectual property information disclosure of listed enterprises on the SSE STAR Market, standardize the scope and depth of intellectual property information disclosure of listed enterprises on the SSE STAR Market, ensure the timeliness of information disclosure, and effectively protect the interests of issuers and investors. On this basis, we should build a third-party intellectual property information dis-

closure platform for enterprises listed on the SSE STAR Market to realize the centralized disclosure of intellectual property information. Establish a third-party intellectual property information disclosure platform, establish a joint information communication mechanism with the Shanghai Stock Exchange and the State Intellectual Property Office, dynamically disclose the changes of intellectual property information during the listing period, and ensure the timeliness and efficiency of information disclosure.

Limitations and Future Directions

At present, there are few researches on the intellectual property rights of the SSE STAR Market, and the application, management, reform and other aspects of the intellectual property rights of the SSE STAR Market are worthy of in-depth study. Secondly, the SSE STAR Market is not only related to intellectual property in the stage of enterprise listing, but also related to intellectual property in the follow-up enterprise operation, delisting and other aspects. There can be more comprehensive research in the future, so as to build the research system of intellectual property of SSE STAR Market.

In addition, starting from this study, the connotation and extension of intellectual property rights listed on the SSE STAR Market are relatively broad, and the research on the evaluation of the construction of intellectual property audit system is also more complex. This study also has many limitations in the construction of the evaluation system, in the definition, index construction and other aspects, it is inevitable to appear subjective color, and many details are not well considered, future research can be more detailed and perfect in the system connotation and index construction.

First, the problem of subjectivity. When the comprehensive calculation is carried out with the method of horizontal paste comprehensive evaluation, the judgment of the degree of membership of the index mainly depends on the experience of experts. However, the fairness, consistency and effectiveness of expert judgment cannot guarantee the quality of a system, so this paper is only a reference. Second, it is difficult to effectively copy the problem of different evaluation results. Public policy evaluation is not only a fact judgment activity, but also a value judgment activity. There is a problem here. Different experts' experiences, knowledge and values are different, so the judgment of the same thing will be different. This will lead to different experts in the same public policy evaluation, the results may be different. Third, because of the lack of a policy text on the intellectual property audit system of the science and technology innovation board, all the above are from the carding of all the systems in this paper. When summing up, it is often subjective, or difficult to make a detailed summary, or trapped by the researchers' own knowledge, so there is a lack of a very objective and scientific research object. However, the focus of this paper on the research perspective is meaningful, hoping that more scholars will improve and enrich it in the future.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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