

Construction and Application of Patent Valuation Index System--A Case Study of Xuji Group

Bo Feng^{1,3}, Ting Huang³, Junwen Feng^{2,3*}

¹School of Intellectual Property, Nanjing University of Science and Technology, Nanjing 210094, China

²School of Economics and Management, Nanjing University of Science and Technology, Nanjing 210094, China

³Nanjing Audit University Jinshen College, Nanjing 210023, China

*Corresponding Author.

Abstract:

With the continuous progress and development of China's social economy and scientific and technological innovation, intangible assets gradually become more and more important from the psychological viewpoint. The importance of intellectual property rights gradually emerged. Patent right improves the technological innovation ability of enterprises to some extent, promotes the progress of science and technology and the rapid development of economy, and is a precious wealth in the current society. In recent years, the discussion of patent value based on psychological expectation is in full bloom, so people pay more and more attention to the evaluation of patent right. Patent right value can be judged from psychological expectation viewpoints. This paper applies the Analytic Hierarchy Process (AHP) to construct the patent evaluation index system, and find the weight value for each index. Patent evaluation indexes are selected and analyzed. A scientific and systematic patent evaluation index system is constructed, the weight coefficient of each index is calculated based on psychological expectation judgment, and the actual value of patent is estimated by AHP, which provides a new idea for patent evaluation. Finally, take Xuji Group as an example to evaluate its patent value. This paper analyzes and studies the patent value evaluation index system and calculates the specific patent value. A systematic and comprehensive and scientific index system model is constructed, and a case study is analyzed and evaluated by using this model. This study provides a new way of thinking for patent valuation. In addition, it is very necessary to determine the patent technology sharing rate and construct a detailed scientific weight index system.

Keywords: *Intangible assets, Patent right, Value assessment, Index system, Xuji Group.*

I. INTRODUCTION

With the development of the globalization of knowledge economy, intangible assets are becoming more and more important components of many enterprises to create value and sustainable management and development. In many studies at home and abroad, with the further development of technology, the importance of intellectual property is becoming more and more obvious. Patent is an indispensable part of intangible assets. In the era of knowledge economy development, patent has a certain weight in the academic and industrial circles. As the resources which can bring economic benefits in the intangible

assets of enterprises, the intrinsic value of patent rights has attracted more attention and attention.

China's patent management system, which was first established in 1984, is now nearly 30 years old. After China's accession to WTO, the number of patent applications and licenses in China has achieved a leap in growth every year. In 2012 alone, the State Intellectual Property Office officially authorized 653,000 national-level invention patent applications, and 217,000 national-level invention patents have been approved. Meanwhile, the number of international PCT applications in China has accounted for 9.6 percent of the total number of applications, ranking among the highest in the world. However, many scholars point out that the value of Chinese patents is mostly at a low level, among which 50% or even 80% are useless patents without any value. In the case of so many patents, how to effectively evaluate the value of patents is a major problem in the academic and industrial circles. Because the characteristics of patent such as technicality, legality, effectiveness and regionalism are very obvious, its value can be evaluated only when it is specifically involved in economics, law and related application fields. Therefore, it is a very difficult problem to evaluate the value of a patent in our daily life. At present, in addition to the traditional cost method, income method and market method, there are more in-depth study of the index system method, fuzzy comprehensive evaluation method and real option method. Different evaluation methods have their different application scope, have their advantages and disadvantages. As more and more attention is paid to the protection of patent right, it is extremely urgent to establish a perfect index system of patent value evaluation.

With the progress of technology and the rapid development of all walks of life including information and communication, intangible assets are becoming more and more important. Intangible assets have gradually become a very important part to show the comprehensive strength of an enterprise. Therefore, the research direction of asset appraisal also includes a lot of intangible assets. As the comprehensive strength of China's economy grows stronger and stronger, the number of patent transactions also shows a rising trend, and the market's demand for patent value evaluation is constantly expanding and increasing. Therefore, this study is more logical and practical.

Before the basic rules of evaluation in China are promulgated, the Ministry of Finance has issued corresponding regulations and rules to regulate the work behavior of evaluators, which has played a role in improving the quality of evaluation and cultivating the sustainable development of market economy. At present, although there are rules in principle for the evaluation of intangible assets, there are no rules in principle for other intangible assets such as patents. Therefore, with the rapid expansion of intangible assets evaluation, patent rights play an important role in intangible assets, and it is necessary to develop a professional evaluation system to evaluate, which is the common voice of industry experts, which is of great help to improve the evaluation of patent value.

In today's era of rapid social and economic development, the importance of patent is becoming more and more obvious. Patent has gradually become an important factor to promote economic development and bring economic benefits to individuals and enterprises. At the same time, China's patent undertaking is also developing rapidly. In this case, an objective and scientific patent evaluation index system and evaluation

method should be established as soon as possible. In the process of patent production, implementation and management, the comprehensive strength of China's patent protection and the competitiveness of science and technology and economy are correctly evaluated in different regions and enterprises. How to grasp the economic function of patent right comprehensively; How to make a decision scientifically, guide correctly, formulate and carry out effectively all need this kind of evaluation index system. At the same time, set up a patent evaluation index system also has certain rules and requirements, should show the concept of scientific development and the correct achievements view, especially in the rapid development of China's patent cause, need to pay attention to should not just pay attention to quantity, and should pay more attention to practical results, improve the quality, comprehensive, coordinated and sustainable development.

II. RELEVANT LITERATURE REVIEW

According to the development of industrial property rights, China summarizes the characteristics of industrial property rights valuation, which has the characteristics of purpose, timeliness, consultation and estimation. At present, many areas are looking for the use of property rights market, in order to serve the search for diversified investment subjects, of course, this is also an effective way to express and expand the function of enterprise industrial property rights market. It is feasible to use present value of income method, current market price method and replacement cost method to evaluate the value of industrial property under the large Approach. However, the evaluation method should be selected comprehensively according to the specific type, evaluation purpose and environment.

Patent value evaluation for enterprises of the patent right and the right protection of foreign loans and financing etc. provides a reliable service and guarantee for the enterprise the patentee in overseas for the transfer of the patent provides sufficient value basis, the factors influencing its patent value very much, they mainly include the class number of factors, comprehensive factor, quality factor, and value factors, etc. However, how to efficiently make full use of these elements to build a set of highly operable patent value assessment system is the key to build a patent value assessment system. Patent value evaluation for enterprises of the patent right and the right protection of foreign loans and financing etc. provides a reliable service and guarantee for the enterprise the patentee in overseas for the transfer of the patent provides sufficient value basis, the factors influencing its patent value very much, they mainly include the class number of factors, comprehensive factor, quality factor, and value factors, etc. However, how to efficiently make full use of these elements to build a set of highly operable patent value assessment system is the key to build a patent value assessment system. In the 1870s America was best known for its patent scoreboard, created by American intellectual property consultants. This method mainly selects patent value evaluation indexes, such as patent number, citation index, patent growth rate, impact index, number of patents of the same family, scientific correlation degree and the corresponding technology life cycle. This method has been widely used in the field of patent value evaluation.

Markus R [1] extracted specific patent evaluation value indicators, and the direct influence of these value indicators on patent evaluation value is analyzed accurately by using "probability regression

method". Hou J. L. [2] discussed the factors that can affect the patent value, which are divided into four main factors: patent technical factor, market factor, legal factor and patent technology transfer. Kimura T. [3] used technical indicators and economic indicators to measure and evaluate the practical application value of a patent. Of course, there are still many experts and scholars in China who have analyzed the main influencing factors of patent value and established the evaluation system of patent value. Shao Y. [4] analyzed the patent value index system from the input, operation, protection, output and benefit, and then these indexes are used to establish a complete and scientific patent value index system. At the same time, the contribution of patent to society is also studied. Wan X.L. [5] divided the evaluation index system into three parts: market, right and law, and the value of patent is calculated. Lu C.Y. [6] divided the patent value index into three parts: self-index, other patent value index and patent citation index, and the patent value index system is established on this basis. Li Z.Y. [7], on the basis of technology, competition, market and law, established the method of estimating patent value. Hu Y.J. et al [8] established the model of patent value evaluation, and adopted the comprehensive index to reflect the patent value. The study found that the higher the comprehensive index, the greater the patent value; Wang H.H. [9], through literature analysis, presented a method of calculating the value of patents, which adopts the indicators of patent citation, number of employees, patent citation and patents of the same family. Ye C.M. [10], based on the analysis of patent quality, quantity and performance, established a patent valuation system. He Y.L. [11] analyzed and studied foreign patent valuation systems and summarizes them, including patent quantification, patent citation index, etc. Shu [12] introduced the three-level evaluation index system of enterprise patent, in which the main indexes include patent quantity index, patent technology life cycle index, market factor index, etc. Zhang Y.Q. [13], based on the analysis of legal factors, market factors, risk factors and technical factors, established a patent valuation model. Yang D.D. [14], on the basis of the three types of patent quantity, patent quality and patent value, established a patent value model. Li C.Y. [15] et al. divided the patent value index into six types of indicators, such as science, citation and content, and studied the evaluation of patent value.

To sum up, in the current some patent evaluation index, some only consider the patent quantity, quality, or to the market all aspects such as the influence of business operation and management, also have been build up comprehensive patent evaluation index system, the value of the documents is still cannot be negative, but these evaluation method still exists some disadvantages, such as difficulty in the extraction of indicators, inaccurate data; Research with subjective factors; The index has some limitations; Index complex, difficult to operate and other problems.

Patent value evaluation index system is a complete set of index system that can reflect the overall characteristics of patent value, and has mutual relevance and advantages. The value of patents should not only include the economic value, legal value and technical value of patents, Bessen J. [16] shown that there should be a certain correlation between the value of patent and the patentee, the patent value of the strong patentee is far greater than that of the weak patentee. Bessler W. [17] shown that the size of patents of the same family, the number of backward references and the forward direction of patents can accurately reflect the patent value. The more times the patent is used or cited, the higher the probability of whether the patent is a basic patent or not, and the higher the scientific and technical value will be. Lee Y.G. [18]

did an in-depth study of the patent citation times and patent in the economic, technical value of the mutual influence between the results, and shown that the number of other patents cited and other patents in the technical value is proportional to the relationship; Silverberg G. [19] evaluated the creative value of patent in practice is by using patent citation. Harhoff D. [20] found that there is a certain relationship between forward citation and backward citation of patents and the technological value in patents. The number of patents of the same family can directly reflect the competitiveness of an international market. Criscuolo P. [21] choose a patent with high value evaluated by ternary family patent; Deng Yi [22] shown that a patent with a European patent family is more valuable.

Zhang T., Li G. [23] studied the enterprise intellectual property value and its evaluation, and put forward that patent value is a kind of general reference to the economic benefits that patent is expected to bring to users or resource owners and a kind of performance under the realistic market environment. Zhao C. [24] and Ma Z.M. [25] did the patent value evaluation of the real options method using the real option method to build the model of patent value evaluation, the method of the enterprise management personnel in the manufacturing and product development input and the options in the process of decision-making, considering their patent is regarded as a kind of to evaluate enterprise investment opportunities.

This paper designs the index system of patent value evaluation, expounds the necessity of constructing the model, the principle of constructing and the selection of specific index. Built a patent value evaluation model, the patent value can be divided into technical value, market value, power value of the three major categories, then use chromatography analysis, finally the patent value can be calculated, and using the Xu Ji group as the case, according to this article build evaluation model of any patent value assess Xu Ji group estimates.

III. DESIGN OF PATENT VALUE EVALUATION INDEX SYSTEM

3.1 Design Purpose

One is to evaluate the overall comprehensive ability of a patent in different regions of the world or in various products and industries from an objective, scientific, comprehensive and fair perspective.

Secondly, it is in accordance with the requirements of the socialist concept of scientific development for our country to develop and implement the patent strategy, which should cover the country, industry and company enterprise patent strategy of three dimensions level), and for the mass group provides scientific data and technical support, to strengthen the country, the industry and regional independent research ability and promote economic growth and promote played a leading role.

Thirdly, as a part of the national social and economic evaluation system, patent rights can increase their fame in national science and technology as well as various economic activities and promote the development of research activities of relevant departments.

3.2 Design Principles

3.2.1 Objectivity

The evaluation index system of patent value should be objective, because it should be based on actual statistical data and avoid subjective factors or arbitrariness as far as possible.

3.2.2 Scientific

Patent value evaluation index system should be scientific, it embodied in the following main features: system fully, from several aspects, such as science, technology, economy and trade system comprehensively considering various indicators, based on the patent value evaluation index system is established, and in other areas, such as information technology continues to improve. Attach importance to quality and function, take patent quality and value as research focus, and design the whole quality index system. The organic combination of quantity and rate, quantity usually refers to the total amount, evaluation of a person's overall strength; Rate can be used to evaluate the relative strength: the organic combination between quantity and rate will form a more objective and scientific evaluation index system of patent value.

3.2.3 Practicability

The index system of patent value evaluation should be practical, which is closely linked with daily activities such as scientific and technological innovation, economic and trade activities.

3.2.4 Guidance

The index system of patent value evaluation should be instructive, which is embodied in its guiding role in the development of science and technology, social development and trade promotion, and has far-reaching influence.

3.3 Selection and Analysis of Specific Indicators

The value of a patent depends mainly on three factors:

(1) Technological value refers to the value brought to people by patents and the characteristics of technologies themselves. Innovation is the core content of a patent, and they are also an important part of its value and significance.

(2) Market patent value refers to the expected investment and other expected economic benefits that may be directly brought by the relevant patented technology in the process of directly realizing its industrialization, commercialization and marketization application. Only when the patented technological

achievements are fully transformed and become technical productive forces can they have the opportunity to truly fully display and highlight their value of existence. Because our country enterprise products using the international patent technology eventually expected economic benefits mainly came from the current international patent competition in the market, so the enterprise use international patent technology development manufacturing enterprise products and the processing environment and the current international patent competition in the market situation is also one of the most important and the key factors influencing the market directly.

(3) Value of rights refers to the value naturally generated by the right holder's authorization under the law. Patent right can only be effective within the time limit prescribed by law as a legal right. Patent right is also a kind of monopolistic behavior. Under the restriction and protection of relevant national laws, both the owner and user of patent can rely on monopoly to implement and obtain other monopolistic interests.

IV. CONSTRUCTION OF PATENT VALUATION MODEL

4.1 Construction of Patent Value Evaluation Index System

According to the timeliness, uncertainty and fuzziness of patent value mentioned in this paper, we need to establish a relatively scientific, objective and feasible evaluation index framework system, and use qualitative and quantitative mutual combination and hierarchical analysis and other evaluation methods to effectively evaluate these patent values. In China at present, patents are mainly divided into three forms, namely invention patent, utility model patent and design patent. Compared with the other two patent evaluation types, the current invention patent evaluation system has the advantages of higher technical content and greater value, so this paper mainly establishes the evaluation index system for these two invention patents. Based on the analysis of the previous section, the index system of patent value evaluation is obtained, see Table I.

Table I. Patent value evaluation index system

THE EVALUATION OBJECT	LEVEL INDICATORS	THE SECONDARY INDICATORS
The patent value, U	Technical value U ₁	Degree of innovation, U ₁₁
		Technical content, U ₁₂
		Maturity, U ₁₃
		Scope of technical application, U ₁₄
		Degree of substitutability, U ₁₅
	Market value U ₂	Marketability, U ₂₁
		Market demand degree, U ₂₂

		Degree of market monopoly, U_{23}
		Market competitiveness, U_{24}
		Profit sharing ratio, U_{25}
		Residual economic life, U_{26}
	Value of rights U_3	Patent independence, U_{31}
		Scope of patent Protection, U_{32}
		License implementation status, U_{33}
		Patent family size, U_{34}
		Remaining period of validity, U_{35}
		Degree of firm legal position, U_{36}

4.2 Determine the Weight of Evaluation Indicators

Here introduces a kind of hierarchical analysis method, and ask an expert to put all of the indicators system of various factors were compared between the two, gives a relatively reasonable and objective quantitative results (multiple index after scoring, can draw an average), form a judgment matrix, thus the weight of each factor is calculated. Numbers are used as the evaluation scale, as shown in Table II below.

TABLE II. The scale

Scale a_{ij}	Meanings
1	The same degree of importance when compared
3	the former is more important than the latter
5	The former is obviously more important than the latter
7	former is much more important than the latter
9	the former is extreme important than the latter
2,4,6,8	Represents the intermediate value of the two levels above
$a^{-1}ij$	Represents the importance of comparing the exchange order of the corresponding two factors

The above table α_{ij} is the comparison result of the influence degree of the i th factor and the j th factor on the factors of the previous level in the same level. Through pairwise comparison, a judgment matrix A

can be formed:

$$A = \begin{bmatrix} \alpha_{11} & \alpha_{12} & \dots & \alpha_{1n} \\ \alpha_{21} & \alpha_{22} & \dots & \alpha_{2n} \\ \dots & \dots & \dots & \dots \\ \alpha_{n1} & \alpha_{n2} & \dots & \alpha_{nn} \end{bmatrix} = (\alpha_{ij})_{n \times n}$$

Where, $a_{ij} > 0$, $a_{ij} = a_{ji}^{-1}$, $a_{ii} = 1$

In the patent value evaluation index system shown in Table III, the degree of influence of each first-level indicator on the evaluation object, and the degree of influence of each second-level indicator on U_1 The degree of influence on U_2 And the degree of influence on U_3 The following judgment matrix is obtained through expert scoring method. Here with U_1 , for example, the judgment matrix is A as follows:

U_1	u_{11}	u_{12}	u_{13}	u_{14}	u_{15}
u_{11}	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}
u_{12}	a_{21}	a_{22}	a_{23}	a_{24}	a_{25}
u_{13}	a_{31}	a_{32}	a_{33}	a_{34}	a_{35}
u_{14}	a_{41}	a_{42}	a_{43}	a_{44}	a_{45}
u_{15}	a_{51}	a_{52}	a_{53}	a_{54}	a_{55}

Calculate the feature vector of the i th factor:

$$w_i = \frac{\{\prod_{j=1}^n \alpha_{ij}\}^{\frac{1}{n}}}{\sum_{k=1}^n \{\prod_{j=1}^n \alpha_{kj}\}^{\frac{1}{n}}}$$

So the eigenvectors of matrix A are: $w = (w_1, w_2, \dots, w_n)^T$, and then its maximum characteristic root is calculated as: $\lambda_{max} = \frac{1}{n} \sum_{i=1}^n \frac{(Aw)_i}{w_i}$

When $CR < 0.1$, the matrix A passes the test, then the vector feature $CR = \frac{CI}{RI} w = (w_1, w_2, \dots, w_n)^T$, where consistency index RI can be obtained by referring to Table III, $CI = \frac{\lambda_{max} - n}{n - 1}$

TABLE III. Average random consistency index RI

n	1	2	3	4	5	6	7	8	9
RI	0	0	0.58	0.90	1.12	1.24	1.32	1.41	1.45

4.3 Comprehensive Evaluation

We have established the patent value evaluation index system, which is regarded as the evaluation

index set, and then estimated the weight of each index according to the analytic hierarchy process. This paper sets up:

The weight of each indicator in U is $W = \{W_1, W_2, W_3\}$. $W_1 = \{w_{11}, w_{12}, w_{13}, w_{14}, w_{15}\}$, $W_2 = \{w_{21}, w_{22}, w_{23}, w_{24}, w_{25}, w_{26}\}$, $W_3 = \{w_{31}, w_{32}, w_{33}, w_{34}, w_{35}, w_{36}\}$.

The value of a patent is always unstable, and the factors it generates and influences and its value can change over time. The relative deviation distribution degree between the actual evaluation value and the final preliminary evaluation value is used to design the grade of five evaluation values, which constitutes the evaluation set $V = (\text{very low, low, reasonable, high and very high})$, and then the weight of each indicator is integrated to obtain U_i . The comprehensive evaluation result is: $B_i = W_i * R_i$.

In terms of patent value evaluation, its first-level index U_1 , the evaluation matrix constituted by each second-level single indicator is:

$$R_1 = \begin{bmatrix} r_{11,1} & r_{11,2} & r_{11,3} & r_{11,4} & r_{11,5} & r_{11,6} & r_{11,7} \\ r_{12,1} & r_{12,2} & r_{12,2} & r_{12,4} & r_{12,5} & r_{12,6} & r_{12,7} \\ r_{13,1} & r_{13,2} & r_{13,2} & r_{13,4} & r_{13,5} & r_{13,6} & r_{13,7} \\ r_{14,1} & r_{14,2} & r_{14,2} & r_{14,4} & r_{14,5} & r_{14,6} & r_{14,7} \\ r_{15,1} & r_{15,2} & r_{15,2} & r_{15,4} & r_{15,5} & r_{15,6} & r_{15,7} \end{bmatrix}$$

The fuzzy evaluation result for U_1 is: $B_1 = W_1 * R_1 = [w_{11}, w_{12}, w_{13}, w_{14}, w_{15}]$, the other two are calculated in this way. According to the U_i , the evaluation matrix $R = (B)$ of U is constructed $(B_1, B_2, B_3)^T$, the final comprehensive evaluation result for U can be calculated: $B = W \cdot R = [W_1, W_2, W_3] * [B_1, B_2, B_3]^T$.

V. APPLICATION CASE ANALYSIS OF PATENT VALUATION

5.1 Company Profile

Xuji Electric Co., Ltd., as one of the key technology and equipment localization bases of the national power system, is also considered to be the most comprehensive competitive enterprise in China's power equipment engineering industry. From a traditional power equipment manufacturing plant, the company has gradually grown into the most powerful enterprise in the field of power equipment supporting services in China, and is the only enterprise in China that simultaneously masters the technology and products related to primary and secondary power supply equipment. In China's current power equipment engineers and industry has the most variety, the most complete specifications, the best supporting services of professional producers. Among them, the power system equipment is not only an important basis for the development of Xuji Electric, but also a key part of the development of Xuji Electric, and Xuji electric products occupy a very large market share in the market.

The products of Xuji Electric have been highly appraised in the market for many years and have established a good reputation brand image of the production enterprise in many people's hearts. Company's power products are widely used in the three gorges in Shanxi, Daqin railway, Wuhan, Guangzhou and other countries travel intercity passenger special line, etc. hundreds and provincial and municipal key projects of local governments across the country, and its products export to many advanced countries and developed regions, at home, such as China power system, a professional and highly technical industries and some parts of the product at present in our country not only won universal recognition, and development needs power management industry for many years practical experience and good corporate reputation from generation to generation, Company management brand development gradually formed and a necessity for the company through the industry to create the vast number of users and the Chinese enterprise management personnel to test for quite a long practice, therefore, a good enterprise management brand advantage, China must be ensure enterprise in the domestic market, expanding the basis of access to keep expanding and improving.

In recent years, as a national manufacturing industry of the electrical Xuji flags, constantly strengthen their own scientific and technological innovation, increase investment in research and development, with the national major technical equipment localization strategic deployment as the foundation, has been to the west to east gas pipeline, a large regions and countries such as the south-north water diversion project provides a complete set of equipment, so as to alleviate the situation of energy production and consumption distribution imbalance in our country, improve the whole social development level of the power industry to improve and have made great contributions.

5.2 Main Business and R&D of Xuji Company

Xuji group's research and development production and technical sales business scope including China smart grid change distribution, smart grid, using power, dc power grid transmission process control and environmental protection, industrial and urban transportation smart grid, power supply, etc., the company core technology for the production and service sales closely around China intelligent distribution network and special high pressure to build a smart grid, in many key projects in the construction of the organization of the project related enterprise has accumulated a complete set of substation equipment and large key project execution of the project implementation, management of related enterprise technical knowledge and management experience, Gradually developed and formed a large professional management team with specialized equipment and fine technology, good organization and execution ability, and fully equipped with long-term management ability to undertake various large engineering projects. Xu Ji electric research and development is one of the core strategic target of enterprise for the general customers to provide electrical system research and development of new pattern scheme and the whole system complete, the full use of the introduction of absorption and development at home and abroad advanced technology products research and development of project management ideas and systems on the basis of the production process, establish development up a completely new integrated with Chinese Xu Ji electrical technology unique style type electrical product design research and development technology service system, formed a very rich innovative electrical product development revolutionary technological innovation drive mechanism,

for the whole industry bigger and stronger has laid a solid foundation. The company has advanced equipment and first-class production technology level, such as surface mounting production line, and established a good professional technology production platform. At the same time, our company also provides customers with advanced testing and testing facilities, so as to effectively make strict quality testing and safety testing for each link in the process of product development and production operation of our company.

5.3 Evaluation Process

5.3.1 Financial status analysis

Financial accounting analysis, accounting analysis, also called financial statements is through data collection and analysis to check the large listed companies in the overall annual financial accounting statements of the company and its related data and accounting data, and make full use of the combination of other effective accounting information, according to a set of scientific, systematic and accurate for the company's financial management evaluation criteria, using a set of system scientific and reasonable financial analysis method, through the comprehensive comparison methods to analyze the company of a set of management and operation of accounting service principal business results, cash flow and the overall situation of financial management and other important accounting data, Thus, we can analyze and accurately measure the overall financial operating status of any large listed company. Value evaluation, judgment and risk prediction are carried out on the overall financial operation, historical data and development trend of the whole business development process of the company.

(1) Profitability analysis

The data got from the financial reports are shown in Table IV.

TABLE IV. Profitability analysis

The report date	2020-12-31	2019-12-31	2018-12-31	2017-12-31	2016-12-31
Profit margin on Total Assets (%)	4.78	3.28	1.88	4.45	6.58
Profit margin of main business (%)	19.7	17.5	16.79	19.78	22.69
Net Profit margin on Total Assets (%)	5.03	3.33	1.83	4.61	7.02
Profit margin on cost (%)	9.2	6.08	4.26	8.45	12.71
Operating margin (%)	7.94	5.42	3.75	7.63	10.07
Main business cost rate (%)	79.82	81.96	82.59	79.38	76.73
Net profit margin on sales (%)	7.17	4.87	3.33	6.6	9.79
Return on Equity (%)	8.26	5.24	2.57	8.1	12.31
Return on equity (%)	228.51	174.24	142.59	170.41	187.02
Return on net assets (%)	25.05	20.25	17.21	21.15	24.98

Return on Assets (%)	13.71	11.64	9.86	11.22	13.19
Gross margin on sales (%)	--	--	17.41	20.61	23.27
Proportion of three expenses (%)	7.88	8	9.68	10.63	11.54
Proportion of non-main business (%)	2.25	1.44	5.08	0.55	11.2
Proportion of main business profit (%)	242.9	318	424.67	257.76	200.88

The profit margin of the company's main business continued to decline in 2017 and 2018, and began to rise from 2019, which indicates that the overall profitability of Xuji Electric is not very stable. ROE began to decline sharply in 2017 and reached its lowest point in 2018. After that, roe began to rise slowly and remained basically the same in 2020 as in 2017.

(2) Solvency analysis

The data got from the financial reports are shown in Table V.

TABLE V. Solvency analysis

The report date	2020- 12-31	2019- 12-31	2018- 12-31	2017- 12-31	2016- 12-31
Current ratio (%)	2.07	2.15	1.98	1.83	2.04
Quick ratio (%)	1.7	1.82	1.7	1.59	1.72
Cash ratio (%)	25.66	21.32	15.73	18.74	29.87
Interest payment multiple (%)	3992.56	14976.71	897.3	1905.4	2492.8
Asset-liability ratio (%)	45.26	42.5	42.7	46.93	47.2
Long term debt to working capital ratio (%)	--	--	--	--	--
Shareholders' equity Ratio (%)	54.74	57.5	57.3	53.07	52.8
Long term debt ratio (%)	--	--	--	--	--
Ratio of shareholders' equity to fixed Assets (%)	575.8	664.92	681.75	678.17	730.95
Debt to owners equity ratio (%)	82.69	73.91	74.51	88.42	89.4
Ratio of long-term assets to long-term funds (%)	--	--	--	--	--
Capitalization ratio (%)	--	--	--	--	--

Ratio of net fixed Assets (%)	51.55	50.83	51.28	53.62	52.22
Capital immobilization ratio (%)	30.26	27.68	27.92	26.74	26.12
Equity ratio (%)	73.71	67.95	74.19	88.13	79.98
Liquidation value ratio (%)	--	--	--	--	--
Proportion of fixed assets (%)	9.51	8.65	8.41	7.83	7.22

The quick freeze ratio and current ratio of a company can reflect the short-term solvency of the company. It can be seen from Table V that the current ratio of Xuji Electric has been stable at around 2, which is very close to 2. The repayment of long-term solvency can generally be seen from the asset-liability ratio. As can be seen from Table 5, the asset-liability ratio of Xuji Group was relatively high in 2016 and 2017, but gradually stabilized after 2018.

(3) Operation capacity analysis

The data got from the financial reports are shown in Table VI.

TABLE VI. Analysis of operating capacity

The report date	2020-12-31	2019-12-31	2018-12-31	2017-12-31	2016-12-31
Accounts receivable turnover (times)	1.4	1.23	0.94	1.22	1.25
Accounts receivable turnover days (days)	257.95	292.73	384.49	294.82	287.4
Inventory Turnover (times)	4.04	4.53	3.91	4.46	3.95
Fixed assets Turnover ratio (times)	7.71	8.03	6.78	9.26	9.49
Total Asset Turnover (times)	0.7	0.68	0.55	0.7	0.72
Inventory turnover days (days)	89.01	79.48	92.11	80.65	91.2
Total asset turnover days (days)	513.04	525.78	654.66	515.91	501.88
Current Asset Turnover ratio (times)	0.84	0.81	0.65	0.81	0.83
Current assets turnover days (days)	429.59	441.88	555.98	443.68	435.31
Return on operating cash flow of assets (%)	0.05	0.01	0.03	0	0.09
Ratio of operating cash net flow to net profit (%)	0.98	0.15	1.69	0.05	1.33
Operating cash net flow to debt ratio (%)	0.1	0.01	0.07	0	0.18
Cash flow ratio (%)	11.55	1.29	7.47	0.49	20.65

XuJi Group of accounts receivable turnover days in 2018 revealed a sharply rising trend, but fell in 2020, the rest of the year in a stable state, the basic enterprise inventory turnover days, and the rest of the

year except 2018, total assets turnover ratio basically in a state of decline, shrinking its inventory pressure, flow ability is better.

5.3.2 Evaluation of patent value

According to the patent value evaluation index system constructed in Chapter 4, according to the experts' scoring, we reasonably determine the weight of the evaluation index, and then bring the main data of Xuji Group into the evaluation model, and finally calculate the patent value.

Firstly, experts' opinions are listened to, and the average value is calculated by expert scoring method. Then, the weight of each indicator layer is calculated, and the results are shown in Table VII.

TABLE VII. Consistency test

A	B1	B2	B3	B4	The weight
B1	1	1/3	1/5	3	0.122
B2	3	1	1/3	5	0.263
B3	5	3	1	7	0.558
B4	1/3	1/5	1/7	1	0.057
$\lambda_{max} = 4.118, CI=0.0395, RI=0.90, CR=0.043 < 1$, the test passed					

Finally, the weight value of each indicator is obtained according to the previous indicator system, as shown in Table VIII.

Table VIII. Patent value evaluation index system and its weight

The evaluation object	Level indicators	The secondary indicators	The weight
The patent value	Technology value	Degree of innovation	0.099
		Technical content	0.065
		maturity	0.043
		Scope of technical application	0.008
		Degree of substitutability	0.031
	The market value	Marketability	0.213
		Market demand degree	0.141
		Degree of market	0.020

		monopoly	
		Market competitiveness	0.093
		Profit sharing ratio	0.062
		Residual economic life	0.030
	The right value	Patent independence	0.010
		Scope of patent Protection	0.005
		License implementation status	0.032
		Patent family size	0.007
		Remaining period of validity	0.047
		Degree of firm legal position	0.021

The weight number can be determined as follows: A=(1.8, 1.2, 1,0.8, 0.6).Finally, the weight of evaluation factors and the matrix are comprehensively calculated, and the comprehensive evaluation result can be obtained as B=W×R=(0.145, 0.252, 0.302, 0.161, 0.140). At the same time, the factor weight of comment set A=(1.8, 1.2, 1,0.8, 0.6). According to the formula:

$$C = \frac{0.145 \times 1.8 + 0.252 \times 1.2 + 0.302 \times 1 + 0.161 \times 0.8 + 0.140 \times 0.6}{0.145 + 0.252 + 0.302 + 0.161 + 0.140} = 1.0784$$

$$E = C * E0 = 1.0784 \times 500 = 5392 \text{ (ten thousand yuan)}$$

VI. CONCLUSION

This paper analyzes and studies the patent value evaluation index system and calculates the specific patent value: firstly, it builds a systematic and comprehensive and scientific index system, and then calculates the weight coefficient of each index through analytic hierarchy process; In this method, the primary evaluation value, the deviation grade and the value of the patent value are designed comprehensively, and then the final value of the patent is estimated by using the final comprehensive evaluation results, and then the case is analyzed and evaluated by using this model.

Each patent evaluation index is not a separate entity, so they need to be linked together in application. Patent systems vary from country to country, and patents in some countries only refer to invention patents, not utility models and designs. Some of these indicators involve legal factors, so there are certain differences in the definition and terminology of these indicators in different countries, as well as differences in patent types and systems, which need special attention.

This study provides a new way of thinking for patent valuation. In addition, it is very necessary to determine the patent technology sharing rate and construct a detailed scientific weight index system.

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