Study on the Coupling Relationship Features and Mechanism of Action of Badminton Patent Research and Development from the Perspective of Scientific and Technological Innovation Base on Big Data Perspective

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Abstract-Through searching, screening and selected the data of authorized invention patent, utility model patent of badminton from 2002 to 2019 in China national intellectual property patent database. Statistical method is used to calculate, analyze and build multiple linear regression model and the relationship between technological achievements and factors influencing badminton patent. On this base from the theoretical level, the study explored the coupling relationship and mechanism of action between the number of invention patent of badminton and influential factors such as frequency of citations of the patent families, international patent classification numbers, frequency of cited patent families, the number of inventors, which provides reference and conclusion for research and development of proprietary technology of sports under the situation of high-quality development of sports industry in China.

Keywords- badminton; patent research and development; coupling relationship: mechanism of action.

1. Introduction

From the new trends in the development of sports around the world, the research and development of sports patented technology and its continuous and widespread evaluation of competitive sports, national fitness, and the sports industry have formed new features that are prominent in the development process of sports, and their competitiveness has increasingly become an influence. The key factors for the core development of competitive sports, national fitness and sports industry. As one of the dominant sports in China, the badminton has experienced decades of improvement and development. It not only shows the level of sports technology and continuous achievements, but also reflects the invention patents and practical practicality of popular badminton technical equipment in the south. The oncology science and technology support obtained from new patents, design patents and their applications are inseparable. At present, it is expected that we need to further conduct in-depth research on the relevant factors and interrelationships and characteristics that affect the research and development of patented technology achievements in badminton sports, combined with the

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possible social impact relationships behind the shared ball patent research and development process, etc., which will help to grasp and deepen understand and improve the signs of the rules and characteristics of shared ball patent research and development.

2. Literature review

From foreign research literature, K.Debackere focus on the research mainly discusses the relationship between science and technology through the reference analysis of patents[1]. B. Van Looy found that there is a close relationship between a country's technical performance and scientific ability [2]. On the whole,foreign scholars have very few documents on the research and development results of patented technologies for sports related to the sports industry. Domestic scholars mainly focus on two aspects to carry out research. One is focusing on the development trend of domestic sports patent results. Haijun Wu started from domestic sports equipment patents and analyzed the entire sports equipment patent situation and its overall situation, providing reference for the purchase, development, patent application, etc. of sports equipment [3]. In view of the promotion path of scientific and technological achievements transformation, Honghua Qiu explored the scope of patent transfer in Chinese sports industry mainly focusing on utility models, invention applications and invention authorization scope from the perspective of Chinese effective patent mining. On this basis, combined with relevant enterprises in the sports industry, In the fields of patent advantages of universities and individuals, paths and strategies for the transformation of scientific and technological achievements have been proposed [4]. Yi Wang et al. [5] believed that the development trend of Chinese sports patents from 1985 to 2016 showed a polynomial function growth trend, and its technological development showed a good trend of overall stable development; they also analyzed the uneven regional distribution of sports patents in China and its reasons.

The second is to focus on the quantitative evaluation and analysis of the competitiveness of sports patented technologies. Zhaoyong Zhou et al. [6] adopted a patent competitiveness evaluation model to study the patent competitiveness of domestic and foreign listed sporting goods companies, and believed that there is a big gap between the patent competitiveness of domestic companies and multinational companies. The fundamental reason is that invention patents the overall quantity and quality are low. It is recommended that domestic enterprises attach great importance to patent research and development and effectively improve the quantity and quality of the three types of patents to further effectively enhance the overall competitiveness of patents. Qing Yang et al. [7] constructed 10 indicators in three dimensions of innovation scale, quality, and benefit based on patent indicators to build a comprehensive index system for the technological innovation capabilities of the sports industry. They established an evaluation model by introducing the close value evaluation method, and targeted table tennis have carried out quantitative empirical research on ball and football projects, and better grasped the characteristics of Chinese sports technology innovation, in order to achieve the purpose of promoting the improvement of sports technology innovation level. Yongzhi Jiang et al.[8] carried out a quantitative analysis of the relevant patented technology achievements of 13 sports colleges in China and concluded that the level of technological innovation applied for patents by sports colleges is not high, and they receive low attention and recognition, reflecting that sports colleges and universities The technical content of patents needs to be further improved, and further attention and efforts must be made to guide the application of core patents to enhance

technological innovation capabilities. Yu Ming et al.[9][10] believe that to improve the level of scientific research, on the basis of strengthening the "production, academia and research" model, expand the scope of sports equipment patent research and development in universities and other scientific research institutions, and build a "cross-platform hybrid R&D model" , promotes multi-level cooperation between different R&D entities, is conducive to technology diffusion among R&D entities, and promotes technological innovation related to sports equipment in China.

From the retrieval and analysis of existing domestic and foreign relevant literature, although many experts and scholars have explored sports patent technology, competitive sports equipment research and development, and the sporting goods industry from their own perspectives through theoretical and empirical research on different topics. The conclusions and suggestions could be forward on issues such as the laws and characteristics of development, and provided reference points for subsequent research. However, the previous research has shortcomings, mainly to explore and grasp relevant issues at a systemic level. The development rules and characteristics of patent research and development results in sports projects, as well as the coupling relationship of invention patent research and development, their mutual influence, mechanism of action, and the logical relationship of interactive development, still appear to be lacking in research breadth and depth.

To this end, from the perspective of sports science and technology innovation, this study has carried out research on the relevant factors affecting the research and development of badminton invention patents in China and their possible coupling relationships and performance characteristics,in which has not result in previous research. This objectively provides with a larger space for active and in-depth research, and also constitutes the logical starting point of this study.

3. Materials and Method

The data for this study comes from the database of the Intellectual Property Office of China, which can search for invention patents, utility model patents, and design patents in China. The database not only supports logical combinations, but some patents are also manually indexed, such as indexing of institutional attributes. For this reason, we chose the National Patent Charges Database as the data source for constructing badminton patent technology, laying the necessary foundation for in-depth and reliable demonstration for subsequent accurate data processing and analysis.

3.1. Search method

1)The date of badminton patent for invention in domestic, in which it can be collected from the National Intellectual Property Office. For analyzing and treating normalize, this study eliminated the date which is not issued by the National Intellectual Property Office that is not a patent number starting with "CN".

2)According to the eight technical categories of the International Patent Classification, the definitions of sports shoes, electronic equipment, venue equipment, clothing, shoes and hats, sports equipment, etc. involved in badminton sports are determined, as well as the search ideas, strategies and keywords.

3)The time span is determined it is a total of 18 years from 2002 to 2019 and the number of badminton invention patent authorizations.

4)The collection of national invention authorization patent data that reflects an important reflection of patent quality is the collection data range required for this study.

3.2. The guideline of independent variable selection

The study regards on the selection of independent variable in the process of building the multiple linear regression model of badminton patent for invention, as the following guideline:

1)The independent variable must have a significant effect on the dependent variables which is presented high linear correlation.

2)The linear correlation between independent variables and dependent variables must be reality not in form.

3)The relation between independent variable should be mutual exclusiveness, which is the relevance of correlation between independent variables should be weak than the relevance of correlation between independent variables and dependent variables.

4)The independent variables have complete statistical data and its predicted value can be easily determined.

3.3. Data processing

According to the needs of this study task, the statistical multi-variable data was processing methods to analyze the relationships between several related random variables and the reflected data characteristics, hoping to select the dependent variable from many variables which showed statistically significant independent variable.

First,A series of data of badminton invention patents as dependent variables and other independent variables were set up through SPSS19 statistical software.

Then, each time a new variable is introduced in SPSS19, the significance test was re-performed for all the independent variables in the new equation during the independent variables filter.

Third, the significance level of the eliminated variables is 0.10, such as P≥0.10, then the variable is eliminated from the equation, and the significance level of the eliminated variable must be greater than the significance level of the selected quantity [11-13].

Through repeated calculations after many rounds, the ideal result would eventually appear until no significant variables were eliminated from the regression equation, and no significant variables were introduced into the regression equation.

4. Results and Discussion

4.1. Multiple linear regression statistical model and relationship between badminton invention patent technology achievements and factors affecting R&D

Table 1 Test of multiple linear regression model

Model	Correlation coefficient- R	R-square	Adjusted R-square	estimated standard error
1	0.996	0.992	0.990	2.1745

Table 2 Analysis of variance

Model	SS	DF	MS	F	P
Regression	8060.305	4	2015.07	426.142	0.000
Residual	61.472	14	4.729		
Total	8121.778	18			

Tables 1 and 2 both show the specific test results of the multiple linear regression model obtained, in which the adjusted R2 is 0.990, the statistic F value is 426.142, and the corresponding significance probability $P = 0.000 < 0.001$; indicating that the equation obtained the overall effect of regression is obvious and the regression model is effective.

Table 3 Coefficient tests of multiple linear regression model

Model	Nonnormalized coefficient Standardization coefficient			T	Significance
	B	Standard error	Bata		
Constant	0.296	0.979	-	0.302	0.087
Citation frequency of family patent	0.091	0.019	0.548	4.848	0.000
International Patent Classification	0.113	0.030	0.321	3.712	0.003
The Cited Frequency of Family Patent	-0.044	0.013	-0.104	-3.308	0.006
Person-time of Invention Patent	0.078	0.029	0.189	2.731	0.017

Table 3 shows the test results of each regression coefficient in the multiple linear regression model. The coefficient tests of the independent variables " Citation frequency of family patent ", "International Patent Classification", " The Cited Frequency of Family Patent ", and "Person-time of Invention Patent" all reached the significance level, indicating that these four independent variables are closely related to the dependent variable "Badminton Patent Invention Authorization" There is a significant linear correlation between them, and the regression coefficients are 0.091, 0.113, -0.044, and 0.078 respectively; and the coefficient test P of the independent variables "Citation frequency of family patent " and " International Patent Classification " that reflect badminton patent authorization are respectively equal to 0.492 and 0.465, both greater than 0.10, indicating that the linear correlation between these two independent variables and the dependent variable "Invention patent authorization" is not

significant and they are eliminated. From this, we finally obtain the stepwise regression statistical model of this study, whose dependent variable and the four independent variables is:

$$Y = 0.296 + 0.091X1 + 0.113X2 -0.044X3 + 0.078X4$$

From this statistical model, we believe that not only each regression coefficient has passed the significance test, but the order of the standardized partial regression coefficients in the regression equation also shows that the order of variables that has the greatest impact on the dependent variable "invention patent authorization" is " Citation frequency of family patent " and "International Patent Classification" come second. The third most influential factor is " The Cited Frequency of Family Patent ". The less influential factor is " Person-time of Invention Patent ". Based on this, we believe that during the 18 years from 2002 to 2019, the most positive key factor in the growth of the number of badminton patents successfully developed by sports science and technology personnel in China is obviously closely linked to the citation frequency of the badminton invention patent family. At the same time, each the formation of a badminton ball patent is also closely related to influencing factors such as the distribution of the number of international patent classifications, the number of family patent citations, and the number of inventors.

Although we have established a multiple regression equation at the statistical level and made a technical discussion on the relationship between badminton patent R&D results and influencing factors, we still need to make necessary explanations for the possible existence of invisible influencing factors. To this end, we further analyzed and discussed the coupling relationship between the number of badminton invention patents and citation frequency of family patent, the number of international patent classification, the cited frequency of family patent, and person-time of invention patent.

4.2. The coupling relationship between the number of badminton invention patents and related factors such as the citation frequency of family patent, person-time of invention patent, and the cited frequency of family patent.

Regardless of whether university research team, enterprise R&D team, or individual conducts R&D, it is inseparable from an effective grasp of the R&D status and trends in relevant R&D fields. Among them, there are not only patent document searches conducted by scientific and technical personnel before the development of badminton patents, but also division of labor and cooperation within the R&D team, and focused use of citation frequency of family patent and the cited frequency of family patent scientific measurement indicators that are important and representative in the evaluation of invention patent results, conducting relevant frequency analysis on badminton patented R&D patented technologies.

At the same time, the badminton patent invention research and development team were gradually formed and continuously expanded through the conception, creativity, design and implementation of the scientific and technical personnel in the process of badminton patent research and development, as well as the subsequent patent application until the patent was approved and authorized, and promoted the number of inventors. improvement and the continuous emergence of patented inventions. This coupling relationship mainly appears at two levels: Firstly, it mainly reflects the basic characteristics of badminton patent research and development in China, that is, the internal demand driven by badminton patent research and development and the external demand of the sports industry and the high-quality development

pattern of the sports industry are sports technology. This is due to the dual basis and deep-seated driving factors for personnel to choose badminton patent research and development. Secondly, scientific and technological personnel, as actual research and development subjects, choose badminton sports projects to demonstrate the inherent inevitability of invention patent research and development methods, which reflects and forms the following characteristics of the entire patent research and development process. The distinctive endogenous characteristics of accumulation, continuity, plurality and transcendence.

1)The basic characteristic of badminton invention patent research and development is that it reflects the cumulative nature of inheritance.

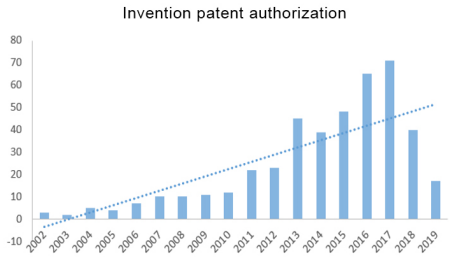

Figure 1 Trend chart of growing of the number of badminton patent grants from 2002 to 2019

The understanding of badminton technical equipment, equipment research and development status, and the characteristics and trends of technological changes by sports science and technology personnel is a gradually clear and complete process. It is accompanied by the various scientific and technological achievements formed by previous research and development and the rich knowledge formed over the long years. It is a process of improvement based on colorful new understandings and new concepts, and it can only be understood by sports science and technology personnel. Starting from the reality of sports industry, the historical development of sports industry and the strength of sports science and technology research and development, combined with the development characteristics and laws of badminton sports, sublate and innovate on the basis of existing knowledge and achievements.

On the basis of previous research and development, future developers have integrated badminton patented technology research and development knowledge at different stages, times, and research and development scenarios, found systematic connections between patented technology knowledge, and gradually formed breakthroughs in research and development practice. In the process of achieving a cumulative superposition effect, strengthening and improving the research and development system of badminton patented technology.

From Figure 1, we can see the cumulative characteristics of badminton invention patent research and development from the beginning of this century to the present. It is manifested in the accumulation of individual badminton patent technology achievements which is people have entered areas that have not been recognized before, reflecting the badminton invention patent authorization at that time. Technical achievements are obviously few, and their basic characteristics are single-digit slow growth. With the gradual accumulation of experience of R&D subjects, information and new understandings of patent authorization results are obtained one after another, which promotes the improvement and accumulation of people's understanding

of the research and development of these patented technologies, although this accumulation level cannot exceed the practice of R&D subjects, reaching a certain level. Therefore, the R&D results of these patented technologies often exist relatively independently at first, and the intrinsic connection between their R&D patented technologies at the innovation level has not yet been revealed. As R&D personnel, their understanding of patented technologies is always related to the development stage of a certain R&D. Corresponding to the relevant factors of the object, whether the R&D subject is a scientific research team or an individual, each has this or that understanding and the degree of technical reserve it possesses, reflecting the essential characteristics of the badminton patented technology of the R&D object.

The cumulative nature of research and development of badminton invention patent technology is manifested as comprehensive accumulation. When this accumulation reaches a certain level, the thinking of the research and development subjects will enter a more advanced stage of understanding, and they will actively grasp the overall new understanding of badminton patent technology research and development from the essential connections between different technical fields and even different sports specialties. Faced with the multi-system, multi-series sports industry, sports industry development landscape, and patent R&D technological achievements derived from related sports projects, the content of badminton patent R&D subjects has gradually shifted from singularity to comprehensiveness, to system integration, and to key technologies. and a complex synthesis of overarching knowledge within a range of subdivided technical areas. In this way, it is possible for people to shift from being based on a single theory to being based on multi-dimensional theories, leading to a shift from a relatively closed system to a multi-dimensional open system that is constantly expanding and gradually forming cross-integration with it.

2) Continuity of research and development of badminton invention patents

From Figure 1, we can observe the continuity trend of badminton invention patent research and development. This basic feature reflects that each stage of the research and development of badminton invention patents in China in the past 20 years is an indispensable part of the whole. It is the inevitable result of continuous exploration at different times and stages before it, and may have an impact on the next stage. Patented technology research and development has a positive impact.

The important reason why researchers of badminton invention patents can continue to achieve new results is that they can perceive the continuity of development between the present self and future self of individuals or teams and pay attention to the relationship between the two. The developers have self-understanding and judgment on the research and development trends and directions in the field of badminton invention patent technology, as well as scientific and technological research and development knowledge reserves and research capabilities, self-scientific and technological exploration and behavioral decision-making.

From this, we believe that the continuity of the badminton invention patent research and development in the past 20 years truly demonstrates the historical inevitability of the close integration and interactive development of sports science and technology progress and sports industry.

3) The diversity of badminton invention patent research and development

From the beginning of this century to the present, the various related badminton patented technology R&D personnel have provided many inventions patented technological achievements with innovative value to the sports industry. Viewed horizontally, the technical distribution of these achievements not only involves all eight categories of the International Patent Classification, but also continues to deepen and expand vertically, forming various subdivided technical fields, showing a cumulative increase. The number of badminton invention patents the increase has provided diversified choices for badminton patent research and development, allowing badminton patent research and development to continuously open up new realms and new fields, providing new and colorful results for future research and development directions.

The International Patent Classification (IPC) is an internationally used patent document classification and retrieval tool, which contains many patent information records. Each record corresponds to a certain technical theme and contains the patentee's specific design information [14]. This research searches and arranges badminton invention patent documents through the IPC classification table. It can conveniently and quickly obtain invention patent technology and legal information, which will help to further understand and grasp the dynamic development fields involving badminton invention patent technology, and statistics here on this basis, we make corresponding evaluations on the breadth and depth of research and development of technical levels in each field, as shown in Table 4 and Figure 2

Table 4 Class Statistics of IPC of Badminton Patent in China（2002-2019)

Technical classification	Section	Class	Subclass	Main group	Subgroup
Human Necessities	A	9	10	44	49
Performing Operation, Transporting	B	21	11	48	41
Chemistry, Metallurgy	C	6	7	37	15
Textiles,Paper	D	4	6	6	13
Fixed Constructions	E	4	5	11	11
Mechanical engineering, Lighting	F	10	7	14	13
Physics	G	9	15	19	42
Electricity	H	4	6	10	12
Total	8	34	17	76	90

The relationship between subsequent new results and the original results is not a simple substitution, but a coexistence relationship. Although the history of badminton invention patent research and development is not long in China. It has initially formed a classification covering all eight patent technologies, which truly reflects the diversity of badminton patent technology research and development ideas, methods and means, making various achievements in the

technology of developers. In the process of formation and expansion, they complement each other and learn from each other, showing the strong vitality of different scientific and technological characteristics. From this, we believe that the R&D and exploration of badminton patented technology cannot originate from a single demand but is diverse. It not only reflects the diverse value needs of the sports industry and the development of the sports industry, but also shows that the participating R&D groups and individuals have a strong understanding of the technical requirements and concerns of the badminton project. Different understanding or willingness of market demand. The source of changes and processes in the understanding of badminton invention patent research and development, comes from specific research and exploration practices. This kind of activity has an extremely wide scope and extremely complex content. In terms of nature, it also involves multiple directions involving different natural science and technology factors.

Due to the diverse characteristics of exploration and understanding of badminton invention patent research and development, it is not only reflected in the diversity of understanding subjects in sports science and technology research and development, but also involves the diversity of different participating groups or personal interests. At the same time, it is also accompanied by the gradual deepening of research and development. The plurality of new knowledge values. In the research and development of badminton invention patent technology, the understanding methods of research and development groups or individuals and the specific technology research and development methods are multiple and complementary. It often involves a more complex field, so there is no single all-encompassing method. Many methods can be used for reference and are common to each other, which also indicates that technologies and methods from different disciplines can be cross-integrated and applied in the patent research and development of different sports.

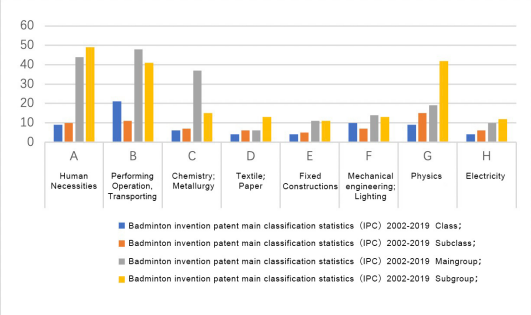

Figure 2 Class Statistics of IPC of Badminton Patent in China

From Figure 2, we can clearly see that the related technology distribution characteristics of different departments, major categories, subcategories, large groups and subgroups involved in the badminton invention patent technology form a tree similar to a tree with lush branches and leaves. It reflects that behind the authorization of each invention patent, there is strong support from different technology clusters. It fully reflects that the multiple technical paths and methods adopted in the research and development of badminton invention patent technology are complementary rather than mutually exclusive. With the continuous development of new methods, the integration and synergy between emergence and original methods further enriches, supplements and improves the system of various technical methods. We believe that with the

development of understanding and experience accumulation of invention patent technologies involved in badminton sports, the diversity of system methods will become more and more mature and perfect, which will further influence and promote the methods and means required for the research and development of sports patent technologies. The mutual transplantation and penetration between them enable R&D personnel to use more flexibly and select multiple methods under the guidance of specific R&D tasks and goals in a wider range, and then develop more products to meet the needs of the sports industry and sports industry. The research and development results of patented technology have gradually highlighted three basic characteristics of the coupling relationship between the number of badminton invention patents and the number of international classification numbers from 2002 to 2019:

First, the pace of invention and technology innovation around badminton sports projects is accelerating, and the correlations between various technologies are becoming increasingly complex and changeable. The correlations and couplings between technologies will also have an impact on technology diffusion, application, and it has had a positive effect and influence on the continuous integration and interaction between different disciplines and technologies.

Second, the coupling relationship between badminton invention patent results and R&D influencing factors reflects the degree of interdependence between them. This kind of interactive penetration and application in the badminton patent R&D process of professional technologies from different disciplines reflects the high degree of collaboration between all parties involved in R&D activities. It reflects that the more intensive the exchanges and interactions between R&D technology groups, the greater the coupling intensity between them.

Third, a badminton patent contains more different technologies, and the higher the function and value of this technology can be reflected, and it can be applied to more different scopes and scenarios, further reflecting the functional richness of each patented technological achievement.

4) The transcendence of badminton invention patent research and development

The results of the badminton invention patent developed by sports science and technology personnel not only reflect the reality of the development of the sports industry and sports industry, but also reflect the improvement of innovative awareness of the in-depth involvement of science and technology and its combination, which inevitably includes the construction of sports industry, sports industry and science and technology. Figure 3 shows the distribution characteristics of the R&D focus of badminton invention patents - an essential category for human society. It shows the functional series characteristics of badminton invention patents under 10 different main classification numbers, which helps us gain an in-depth understanding of the actual existence of R&D. And used this to form analysis and judgment of invention patents, constructed a state where the reality of badminton patent research and development has not yet occurred, sports R&D personnel in a certain historical era and stage of social development based on their own development needs, combined with the needs of the sports science and technology R&D environment Conditions to gain forward-looking understanding of future badminton patent research and development prospects and implementation approaches.

Figure 3 also shows that badminton invention patents mainly present 10 different patent function series, which are mainly concentrated on the necessary categories of human society. From left to right, each patent classification number reflects a different research and development focus. It’s continuous the number of patents that appeared gradually increased from 11 to 39, and the

corresponding year of appearance of each functional series patent also showed that the minimum cumulative attention was 2 years, and the maximum continuous cumulative attention was 12 years. This largely reflects the continued attention of scientific and technical personnel to the hot spots, difficulties, and key issues in the research and development of patented technologies of these 10 different functional series and different classification numbers.

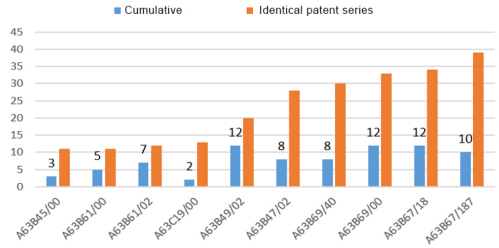

Figure 3 Badminton Patent —distribution of the development highlight of necessity category in human society

Table 5 reflects that the scientific and technological personnel's innovative awareness of the research and development of badminton invention patents has transcended the time and space boundaries from the beginning of the 21st century to the present, and has exceeded the progress of the sports industry and the sports industry's realistic needs for sports science and technology progress in the research and development of badminton patent technologies. The actual progress of the industry is ahead. In other words, on the basis of gradually understanding the history and reality of the development of badminton, the R&D personnel have better grasped the development trend of the close integration of badminton project development and technological progress, surpassing the three levels of badminton in competitive sports, national fitness, and sports industry. Based on the actual development status, we conceptually stay ahead of the development process of badminton to pre-imagine its possible scientific and technological progress and development direction, innovative results and implementation methods, thus achieving the purpose of constructing the future in advance. It can be seen that transcendence is based on sports practitioners' profound understanding of the subject and object of sports development practice and their mutual relationship.

The transcendence of badminton patent technology research and development is first reflected in the transcendence of the practical understanding of badminton development by those engaged in scientific and technological innovation. The realization of scientific and technological innovation construction in badminton is a normative prediction with a specific direction. Based on the actual and future needs of badminton and the actual possibilities of the main abilities of scientific and technological personnel, further exploring how to achieve the future desired by sports practitioners. However, the practical activities of badminton patent technology research and development are always carried out in a limited time and space, which is an inevitable limitation of historical and realistic development. Sports practitioners must transcend the limitations that may arise in the practice of scientific and technological innovation and guide the research and development practice of badminton patented technology in a direction beneficial to the progress of sports science and technology.

Secondly, it is also reflected in the self-transcendence gradually formed and condensed in the process of developing badminton patented technology. As the active cognitive subject of sports practitioners, the pursuit of continuous development and continuous transcendence is its important characteristic.

Table 5 shows the focus distribution of badminton invention patent technology research and development with different IPC numbers and the years in which scientific and technological personnel continue to concern. It is clearly that it is the sports scientific and technological personnel who continue to concern on the changing characteristics of badminton patented technology and regard this pursuit as a purpose and Motivation is continuously developed and gradually realized in the continuous research and development of badminton patented technology, so that the scientific and technological rational understanding of sports science and technology personnel shows a proactive trend, and they consciously plan and formulate higher goals in the future, and produce badminton patents. In the process of gradual accumulation of technological achievements and innovation and development, we constantly promote and surpass ourselves in the implementation of positive understanding and proactive behavior.

Table 5 Distribution of the development highlight in different IPC of badminton patent

No.	Patent name	IPC numbers	Year of continuous concern
1	Badminton automatic recycling and supply device	A63B45/00; A63B67/187; G06K9/62	3
2	Badminton racket frame torsional strength testing machine	A63B61/00; A63B61/02	5
3	Badminton spray glue drying box	A63B61/02; A63B61/04; A63B49/02; A63B49/08; F16M13/04; A63B102/04	7
4	Badminton racket sharing reservation disinfection system	A63C19/00; A63C19/06; A63B69/40; A63B47/02; A63B67/187	2
5	Badminton game data record management system	A63B49/02; A63B71/06; G07C1/22; G01B21/32; G01L5/00; G01C21/18; A63B102/04	12
6	Badminton court anti-collision system based on identity authentication	A63B47/02; A63B67/187; A63B69/00	8
7	Racketless badminton sparring device	A63B69/40; A63B67/187	8
8	Badminton motion trajectory tracking method, system, media and equipment	A63B69/00; A63B67/187; A63B102/04	12
9	Newest badminton barrel	A63B67/18; A63B67/187	12
10	Badminton court inquiry method, device and system	A63B67/187	10

Third, it is the transcendence gradually formed in the research and development process of badminton's patented technology that makes this understanding of the progress of sports science and technology conducive to the leading role in the development of related sports.

Figure 4 shows the distribution of citations and citation frequencies related to family patents in the development process of s badminton invention patents. During the 14 years from 2006 to 2019, the citation frequency and citation frequency of the badminton family patent increased

gradually. In the first 10 years, the growth was relatively flat from figure 4. However, by 2015, both the citation frequency and the citation frequency of the family patent decreased. There has been a relatively large increase, and the former has a significantly greater growth rate than the latter. This means that the output of badminton invention patent technology achievements has received more widespread attention from others and received more normative references and references, forming a badminton industry. Healthy competition in patent R&D will help the badminton patent R&D community grow in interactive integration and become a new guiding breakthrough.

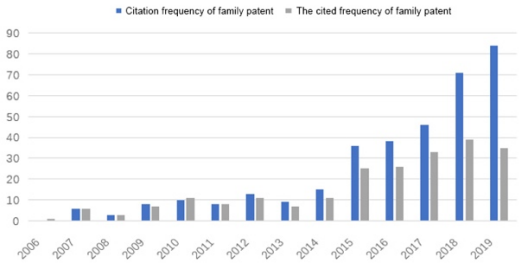

Figure 4 Frequency of citations of the badminton patent families and frequency of cited patent families

Badminton patent technology innovation and research and development can help sports practitioners deepen their understanding of the characteristics, related influencing factors and characteristics of their own and predecessors' scientific and technological innovation, and explore the various problems that R&D subjects often face when promoting scientific and technological innovation activities. Related factors and controllable conditions, and then through efforts to continuously forge ahead and improve these conditions, promote higher improvements in sports science and technology progress, in order to continuously obtain new breakthroughs in scientific and technological research and development and technological innovation. As a result, the continuous improvement in the quantity and quality of badminton patented technology innovation and research and development results has strongly promoted the development of badminton itself and the advancement of the sports industry and sports industry practice, showing the guiding role and power of sports science and technology progress. In this sense, the greatest inspiration given to us by the transcendence of innovation and research and development of badminton patented technology is that only by strengthening comprehensive and pioneering research can we truly meet the actual development needs of the sports industry, sports industry and sports science and technology progress. Although From reality to future goals is both a complex understanding process and an arduous practical process for sports R&D personnel. Among them, we will face the intertwined influence of accidental and inevitable factors in the process of R&D activities, and we will also face various difficulties that constantly arise. However, the realization of future goals will always be completed in twists and turns, which requires R&D personnel to have both thinking and practice. Have a proactive attitude.

To sum up, we believe that the relevant coupling relationships reflected in the development process of badminton invention patents have derived and formed corresponding interactive mechanisms, which are mainly through the number of badminton patent inventors, the number of citations of family patent technology, the number of citations of family patents, The

International Patent Classification Number's direct path and indirect path to the increment of badminton invention patents coexist, and the inevitable characteristics of the development process of badminton invention patents are gradually unfolded, which constitutes the internal logical relationship of the mechanism of action, which can be summarized as the following two point:

First of all, the number of person-time of Invention patent, the number of cited frequencies of family patent, the frequency of family patent citations, and the international patent classification number are the necessary conditions and material basis for the increment of badminton invention patents, reflecting the relationship between the independent variables of the influencing factors and the dependent variable of badminton invention patent authorization. important position in the relationship.

Secondly, the number of person-time of Invention patent, the number of cited frequencies of family patent, the frequency of family patent citations, the international patent classification number and its patent R&D functional activities have a positive effect on the quality and quantity of badminton invention patents, mainly through direct paths and indirect paths. The direct path refers to the direct impact of changes in the number of inventors in badminton invention patent R&D activities on badminton invention patents. The indirect path refers to the impact of changes in the international patent classification number, the frequency of family patent citations, and the cited frequencies of family patent of badminton.

5. Conclusions

In the past 20 years since entering the 21st century, the quantity and quality of research and development of badminton invention patent technology achievements have generally shown a trend of increasing year by year in China. Among them, the number of family patent citations, the number of international patent classification numbers, the number of family patent citations, and the number of invention patents constitute the important factors affecting the increase in badminton invention patent authorization.

The dual basis and deep driving factors that promote sports science and technology personnel to engage in badminton patent research and development mainly come from the internal demand driven by badminton patent research and development and the external demand under the high-quality development pattern of the sports industry and sports industry.

As the main body of actual research and development, sports science and technology personnel took badminton invention patents as the research and development object, followed the objective laws of sports patent technology research and development, and grasped and demonstrated the accumulation, continuity, diversity, and transcendence of the entire sports patent research and development process. It’s distinctive characteristics and its inherent development inevitability.

The coupling relationship characteristics and mechanism of badminton patent R&D from the perspective of technological innovation can not only fully reflect the inevitable trend of closely integrated development of sports patent technology R&D and the sports industry, but also an inevitable choice to meet the development needs of the sports industry and national fitness. It should be It has become the only way to improve the quantity and quality of sports invention

patent technology achievements under the high-quality development pattern of sports industry in the new era.

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