



Research Paper

Research on the development Trend of BIM Technology based on patent measurement

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ABSTRACT: Starting from the concept of BIM technology, this paper analyzes the legal status, patent types, annual number of applications, geographical distribution of patents, applicants and technical hot spots of BIM patent through patent literature, and finally summarizes the development trend of BIM technology in China based on patent data.

KEY WORDS: Patent measurement; BIM technology; China; Development situation

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I. INTRODUCTION

Autodesk pioneered BIM, the building information model, which has gained worldwide recognition in the industry. BIM technology can help to realize the integration of building information. From the design, construction and operation of the building to the end of the whole life cycle of the building, all kinds of information is always integrated in a 3D model information database. Personnel from design team, construction unit, facility operation department, owner and other parties can work together based on BIM to effectively improve work efficiency, save resources, reduce costs and achieve sustainable development. The core of BIM is to provide a complete building engineering information base consistent with the actual situation through the establishment of virtual building engineering 3D model and the use of digital technology. This information base not only contains geometric information, professional attribute and state information describing building components, but also includes state information of non-component objects (such as space and motion behavior).

Patent literature is the main carrier of science and technology, which integrates technical, legal and economic information and is an important source of obtaining new technical information. The number of patents and the trend of development can reflect the latest development of science and technology in a country and a region. Patent Bibliometrics is an important field of scientometrics. Patent econometric analysis based on the information in the patent document as the foundation, using statistical method, the various indicators of the number of patent analysis report, in order to get a certain evolution route, in the field of technology to determine the most basic, the core of the patent technology, so as to identify the focus of the competition and technical activity and strength, and to assess the competitive situation of industry.

In this paper, from the perspective of patent measurement, combined with the characteristics of BIM technology, in-depth analysis and research will be carried out on the registered BIM technology patents within the territory of China, in an attempt to provide theoretical support for the innovation and improvement of BIM technology. The data in this paper are from the smart bud patent analysis software. By conducting preliminary BIM technology retrieval and removing the retrieval information that does not conform to the research object, a total of 10,454 BIM technology patents registered in China are found. The analysis and research on them are as follows.

II. ANALYSIS AND RESEARCH OF BIM TECHNOLOGY PATENT

2.1 Research on the patent status of BIM Technology

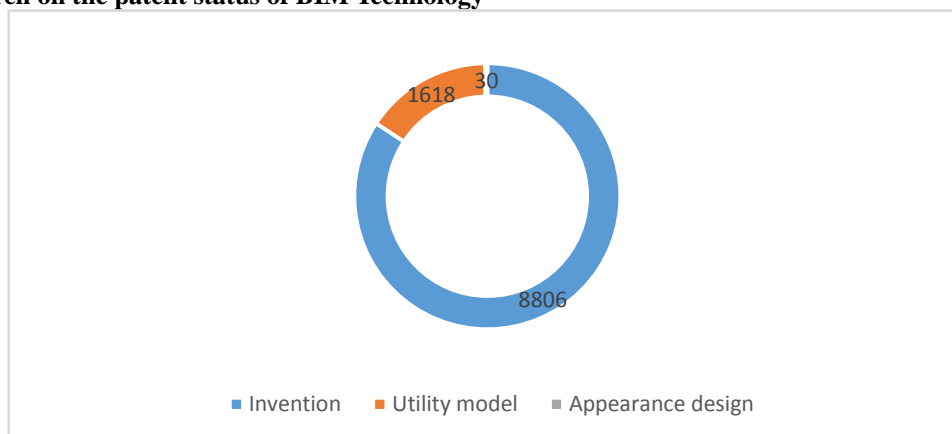


FIG.1 Distribution of BIM technology patent types

BIM technology refers to building information model, and its patent types are mainly composed of inventions, which can be clearly reflected in Figure 1. There were 8,806 invention patents, accounting for 84.2% of all patents, accounting for an absolutely large proportion. It is precisely because of the large proportion of invention patents that BIM core technology is constantly explored and applied in engineering.

Figure 2 shows the legal status of BIM patents. We can see that there are 5,203 patents under review, accounting for half of the total number of patents. As the patent examination has a long period (generally 18 months or so), it reflects that BIM technology patent applications are still very popular at present, and a large number of technology protection schemes are under way. At the same time, we can also see that the development of BIM technology is in the stage of rapid growth, a large number of technology research and development is being carried out, and perhaps more BIM patents will appear soon.

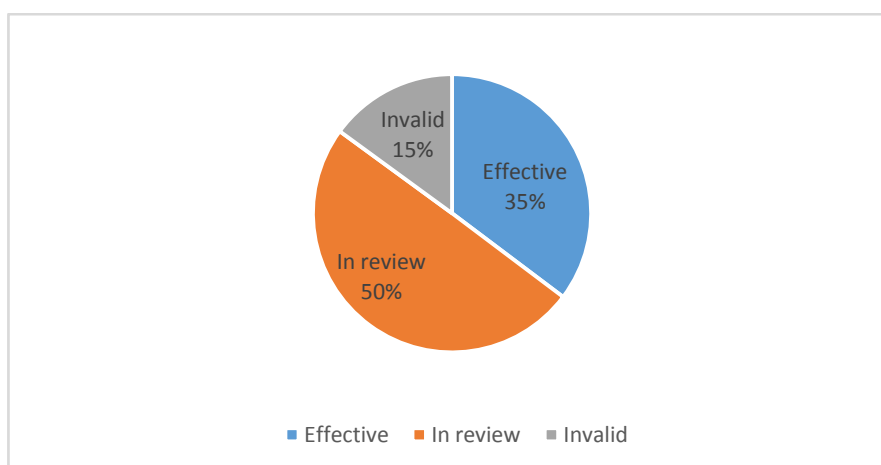


FIG. 2 Legal status of BIM Technology patent

2.2 Annual application volume of BIM technology patent

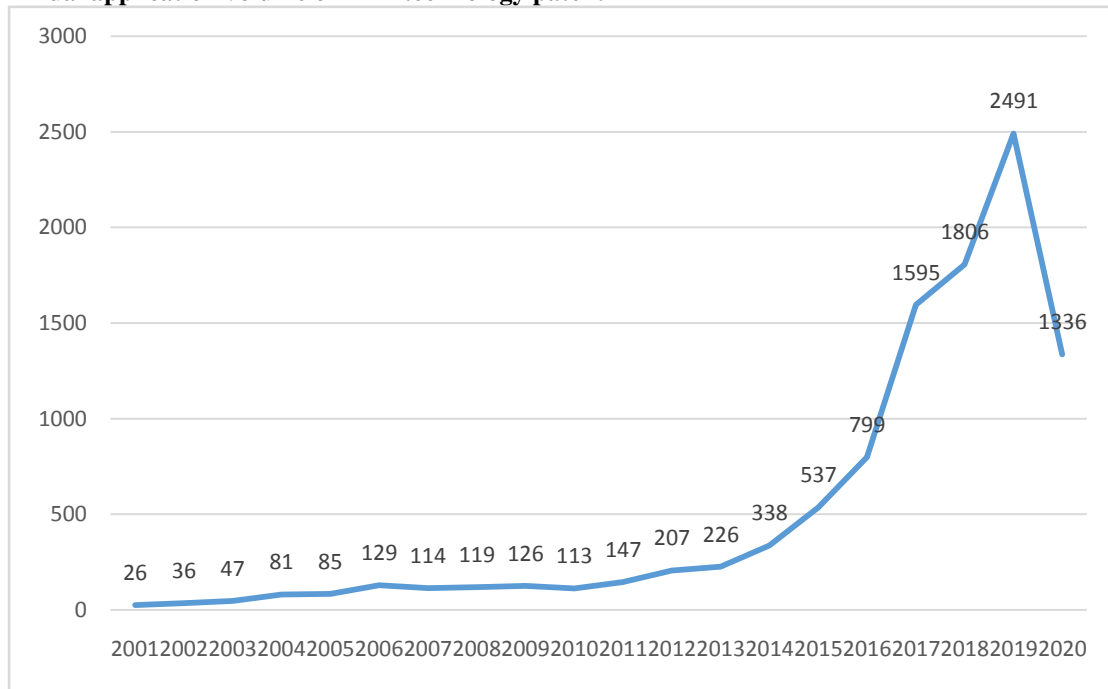


FIG. 3 Annual application of BIM technology patent

Can be seen from the figure 3 BIM technology patent annual filings, BIM technology in the development of China has experienced three stages: from 2001 to 2011 decade, BIM technology in slow development period, due to the generation of an emerging technology, need a technology after a long incubation period, the number of technological achievements is less, the corresponding number of patents. The period from 2012 to 2014 can be regarded as the rapid development period of BIM technology. In a short period of three years, BIM technology patents grow rapidly, which benefits from the recognition of more and more construction enterprises and users on BIM technology and gives birth to the rapid development of BIM technology. From 2015 to now, it can be regarded as the outbreak period of BIM technology, and the technology is still developing rapidly up to now, without any sign of technology decline. Thanks to state and local government level in recent years issued and implemented policies and measures to promote the development of BIM, such as the law of housing and urban-rural development 2015 "about advancing the building information model application guidance" explicitly requested by the end of 2020, should implement BIM technology, enterprise management systems, and other integrated application of information technology, BIM project rate to reach 90%; BIM technology has become a key object of promotion in the construction industry during the 13th Five-Year Plan period (2016-2020), which was released in 2016. In April 2019, the Ministry of Human Resources and Social Security officially released the new BIM occupation -- Building Information model Technician; Again in the same month the ministry issued the industry standard for construction engineering design information model drawing standards and national standard delivery standard for design of building information model, information model drawing standards for design of construction projects is one of the important standards of BIM field, in the delivery standards for design of building information model based on the further deepening and clear the BIM delivery system, methods and requirements, has operation significance in BIM express constraints and guiding role, also for the BIM products become legal standard basis was provided for the deliverables. The introduction of these policies and measures will undoubtedly greatly promote the leapfrog development of BIM technology, and its corresponding patents will also explode.

2.3 Geographical distribution of BIM technology patent applications

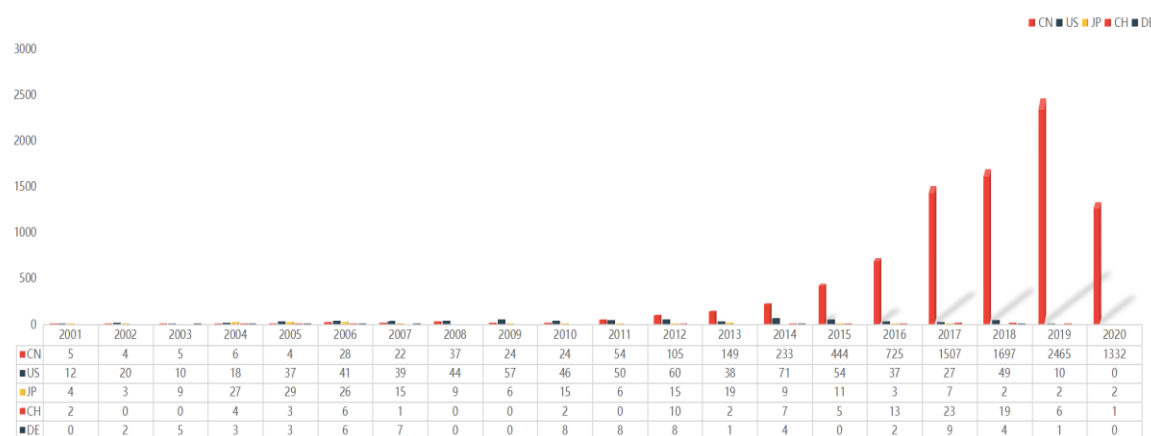


FIG. 4 Geographical (country) distribution of BIM technology patent applications

China, the United States, Japan, Switzerland and Germany are the top five countries in terms of BIM technology patents applied in China. As shown in Figure 4, the distribution of BIM technology patents in these five countries has changed significantly over time. From 2001 to 2011, during the gestation and development period of BIM technology, foreign patents were significantly higher than Chinese patents, which was especially prominent in the United States. However, after 2012, China's domestic patents gradually overtook those of foreign countries. Until recent years, the number of domestic patents in China far left foreign patents behind. Based on the analysis of the reasons, THE BIM technology was first proposed by Autodesk in the United States. In the early stage of the development of BIM technology, the corresponding number of PATENTS in the United States was relatively large and easy to understand. However, in 2012, especially after 2015, the Chinese government introduced a series of policies and measures to stimulate the development of BIM technology. BIM technology has been widely applied in the field of construction in China, and its corresponding r&d investment will also be increased. BIM technology patents will also explode, leaving other countries far behind.

2.4 Analysis of BIM Technology patent applicants

Table 1 Top ten APPLICANTS for BIM Technology patent

Applications	Number of patent
China Seventeen Metallurgical Group Co. LTD	183
China Construction Eighth Engineering Bureau Co.LTD	116
China Construction Eighth Engineering Bureau Co. LTD	108
Zhongmin Zuyou Technology Investment Co. LTD	107
Qiaoduo Tiangong (Shenzhen) Technology Co. LTD	82
Wanyi Technology Co.LTD	78
Guangdong Primus Robot Co. LTD	72
Shanghai Baoye Group Co. LTD	67
Glodon Company Limited	64
China First Metallurgical Group Co. LTD	57

As can be seen from Table 1, the top ten BIM technology applicants are All Chinese enterprises, but their patent ownership accounts for a relatively low proportion of all patents. The top ten enterprises have a total of 934 patents, accounting for 8.93% of the total distributed patents. This shows that in the Chinese market, the competition of BIM technology is still in the primary stage, and there is no technological oligopoly, let alone technological monopoly. Further study of the no.1 China Seventeen Metallurgical Group Co., Ltd. found that the enterprise is a well-known new force on the national capital construction front, and its main business scope covers EPC engineering general contracting, equipment manufacturing and steel structure production, and real estate development. Among its 183 patents, 170 are invention patents, and its patent applications are similar to the trend shown in Figure 3. The number of patent applications has been increasing in recent years, which reflects the company's strong r&d technical strength and good development momentum, and it is expected to become a leader in the field of BIM technology.

2.5 BIM Hot spot analysis

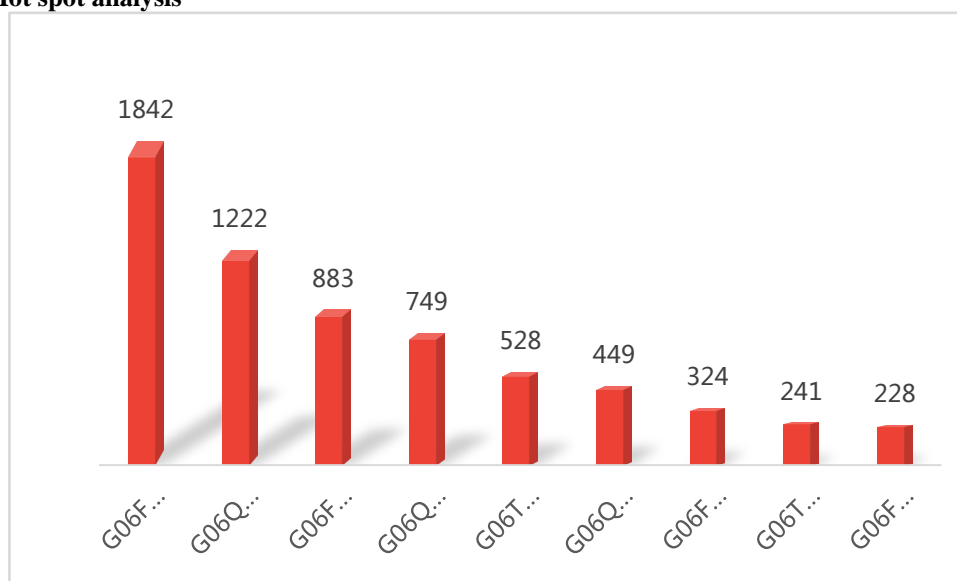


FIG. 5 Top ten HOT spots of BIM patent Technology

Can be seen from the figure 5, BIM technology research hot spot in China mainly concentrated in the computer aided design (G06F17/50), construction (G06Q50/08), architectural design, such as buildings, Bridges, and landscape, the production factory or road design related computer aided architectural design (G06F30/13) and the resources, workflow, personnel, or project management (G06Q10/06), etc. This conform to the requirements of the concept of BIM technology applied in the engineering design, construction and management of digital tools, through the construction of digital, information model integration, in the full lifecycle of project planning, operation and maintenance of the process of sharing and transfer, make the engineering and technical personnel of various building information to make a correct understanding and effective response, as the design team and construction of all parties, including architecture, operating units, main body to provide the basis of collaborative work, to improve production efficiency, save cost and shorten the construction period play an important role.

III. CONCLUSION

However, the development momentum of BIM technology, especially in the past five years with the support of the government, has exploded. This can be fully verified by the legal status and type distribution of BIM patents. It only took a few years for the number of BIM patents to grow from less than 100 applications per year in the first ten years to over 2000, and this trend continues, indicating that BIM technology has been widely concerned and applied in China. In China, THE RESEARCH and development of BIM technology is still in the stage of full market competition, without forming a particularly prominent technological oligopoly or market monopoly. At present, the research focus of BIM technology is still focused on the fields of architectural auxiliary design and project management under the definition of BIM.

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