Research on innovation mode of new material enterprises under the background of big data

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Abstract. In the background of big data, the innovation process of new material enterprises is the result of full and effective integration of many external forces. This paper analyzes the impact and challenges of the emerging big data phenomenon on new material enterprise innovation, including internet plus, material genome project and so on. This paper also puts forward the mechanism of external driving force for innovation of new material enterprises in the big data environment, and discusses the influence of DMAIC model on the decision-making of new material enterprises. Finally, the paper expounds how to establish a multivariate and opening innovation platform for new material enterprises based on big data ecosystem under the two major support systems of internet of things and cloud computing, so as to make full use of various big data resources to serve the innovation and development of new material enterprises.

1. Introduction
New materials is one of the most important fields of green development in the world, and it is the most basic and cutting-edge field to seize the commanding heights of economic and technological competition and enhance the core competitiveness. As a strategic emerging industry, new materials is one of the key directions of industrial development transformation and economic structure adjustment. The development of new material industry needs micro level enterprise growth as support. How to promote the growth of new material enterprises has always been the concern of the government and enterprises [1]. New material technology is the key symbol of a country's scientific and technological development level. The discovery, invention and application of new materials are closely related to technological revolution and industrial transformation. Accelerating the development of new materials is of great strategic significance for promoting technological innovation, supporting industrial upgrading and building a manufacturing power [3].

New material enterprises are the core part of the real economy, and also the main battlefield of technological innovation and equipment application. The informatization and automation of new material enterprises have accumulated rich and diverse data resources, which has become the basis for promoting the integration of big data and new material enterprises. Under the background of high-quality development in the new era, the unsustainability of the traditional development mode of new material enterprises is increasingly obvious. In order to achieve sustainable economic development, it
is necessary to optimize the structure of new material enterprises and explore the innovative development mode of new material enterprises under the background of big data [2].

2. Bottlenecks in the development of new material enterprises

2.1. Traditional R & D mode leads to slow upgrading of new materials

The essence of material research and development is to explore the internal relationship among material composition, technology, organizational structure, performance and service behavior. Generally, it is possible to successfully realize the market application of new materials only through basic research, application basic research, pilot study, system integration and verification, and industrial manufacturing. For a long time, the "stir fry style" trial and error method has been used in the development of new materials. On the basis of the existing basic theory and experience of materials, a large number of consumptive experiments are carried out to repeatedly adjust various process parameters such as composition, temperature, time, heating / cooling rate and field effect, so as to realize the regulation and optimization of material structure and performance. This kind of R & D mode often consumes a lot of resources, energy, time and manpower, which makes it difficult for the market to accept the R & D cost, and even more difficult to realize the experiments under some extreme conditions. Even some of the current computing tools, due to various limitations, are difficult to be widely promoted in academia and widely recognized by industry. The traditional material R & D model has not adapted to the rapid development of industry, and has increasingly become a bottleneck restricting the development of technology and industry [4].

2.2. The traditional production mode is difficult to meet the market demand of new materials

The traditional material production is to produce the finished product in the factory by casting, forging, welding and other material forming technology and turning, milling, grinding and other mechanical processing methods. In this process, subject to the equipment processing capacity and material diversification, some materials or parts can be produced by traditional methods, but the production input is high, the production cycle is long, and sometimes the material utilization rate is even less than 30%. In the production process, a lot of energy resources are consumed, the cost is high, and the products are lack of market competitiveness. Some personalized or complex shape products are difficult to produce, even can not be produced by traditional production methods. The traditional production mode is difficult to meet the requirements of any time, any place and any field, and can not meet the needs of the new material market [6].

2.3. The situation of new materials is grim, and the independent innovation of key materials is poor

New materials are the foundation of new industries, and material innovation is the core of various technological revolutions. In terms of integrated innovation, various relevant data, resources and research forces are scattered, and independent intellectual property rights are lacking, which makes it difficult to realize integrated application; in terms of introduction, digestion, absorption and re-innovation, China has been blocked by developed countries for a long time. The lack of independent innovation has brought some problems to the new material industry, such as the low self-sufficiency rate of key materials, the serious lack of core technology and the control of core patents. Statistics show that 2% of the 130 kinds of key materials needed in China are completely blank. Although 54% of them can be supplied in China, the quality consistency is poor, and only 14% of them are fully self-sufficient [5]. The situation in the field of new materials in China is grim, and the lack of key new materials restricts the improvement of China's industrial capabilities in the fields of information, energy, environment, transportation, medicine, national defense, etc., and has become a serious threat to national security and social and economic development.

3. Big data promotes mode change of new material enterprises
Big data, known as the "oil of the new era", is an important input factor to improve the production efficiency of new material enterprises; At the same time, the relevant investment around the application of big data and the new business state formed in the process will become an important force for the transformation and upgrading and structural optimization of new material enterprises.

3.1. Big data promotes the change of new material R & D mode
The rapid development of modern information and communication technologies such as cloud computing, Internet of things, mobile Internet and intelligent sensing terminal makes it possible to seamlessly connect, process and efficiently utilize information resources in the process of new material development and application. The Internet plus is promoting the construction of material genetic engineering under the integrated information platform, effectively integrating existing materials research equipment and strength, and carrying out a comprehensive reform of the material research mode, providing integrated, networked, data and resource sharing platforms for new material innovation, supporting new cross disciplinary, cross organizational and cross regional collaborative innovation. Based on cloud computing and mobile Internet, it integrates computing Materials Science software with different functions and performances to build a high-throughput computing simulation platform for materials; based on cloud computing and mobile Internet, it integrates general and special material databases to build a high-throughput material data platform; it uses modern information technologies such as the Internet of things, cloud computing, mobile Internet and intelligent terminals to realize and modernize The deep integration of material preparation equipment and detection equipment can realize the remote, efficient, real-time transmission and integration of large-scale data, intelligent data processing, storage and utilization, and build a high-throughput experimental detection information platform for materials. "Internet plus" has caused qualitative change in material research and development mode. It has brought about a fundamental change in research efficiency and achieved the "multi, fast, good, saving" and material customization of material development. High throughput composite materials research and development mode has been widely used in the research and design of functional materials, structural materials and catalyst materials, and has been widely accepted by the scientific and industrial circles[6].

![Diagram](Image)

Figure 1. Elements of big data business model of new material enterprises and their collaborative relationships.

3.2. Big data business model of new material enterprises
The maturity of big data business model of new material enterprises can be reflected in the following three levels:

The first level is to realize the data collection and monitoring of the whole business process. In the whole process of the existing business operation, the data collection and dynamic monitoring of each business link are realized. Through the traditional statistical analysis method, the data statistics of each business link is realized, and the dynamic monitoring and real-time insight of the existing business process are achieved [7].

The second level is to realize business optimization based on big data analysis. At this stage, enterprises have the ability to apply big data analysis tools to specific business operations, and constantly analyze the key pain points of poor business operation. These analysis results will help business operations to be continuously optimized and improved.

The third level is data value-added and business reconstruction. This is the advanced stage of data application. On the basis of big data business operation analysis, enterprises derive a series of data analysis results and value-added products for business operation, market trend and customer habits. In turn, these data analysis results can be applied to the innovation of enterprise business model, which will reshape the business model and generate new markets and services [8].

Through the innovation of big data business model and the development of big data technology, we can obtain more comprehensive and complete customer data from the market than ever before.

4. Innovation mode of new material enterprises under the background of big data

The massive data generated by customers, suppliers and their own operations are increasing at an alarming speed. How to use these huge data is an urgent problem for enterprises. There are two types of data, one is the traditional structured data, the other is the unstructured data which occupies an increasing proportion of data. Now the most important problem is how to use big data technology for data mining, and how to analyze data, how to extract valuable data to help enterprises make decisions. Considering these problems, when enterprises deal with big data, they not only consider the technical level, but also consider the big data processing under the business model [10].

![Figure 2](image-url)
4.1. Influence path analysis of big data on Structure Optimization of new material enterprises

Big data and product innovation. In the era of digital economy, consumers pay more attention to user experience, and personalized customization demand is an important driving force for the transformation of new material enterprises. Personalized product design enhances the interaction between enterprises and users. Users enter the process of product value creation, which is conducive to enhance user stickiness and promote the transformation of enterprise value creation mode from product to service [11].

Big data and manufacturing. The integration of big data and production line is to transform the digital of physical form into that of virtual form, which is conducive to the realization of real-time, efficient flow and sharing of data, the creation of intelligent production line, the networking of internal supply chain and the improvement of production efficiency. The specific performance is to formulate scientific and reasonable production plan and element allocation based on Internet of things and intelligent algorithm, monitor the flow of materials and resources in real time, establish process simulation and product quality control model, monitor process and quality, optimize process parameters and ensure product quality; By using big data algorithms such as decision tree and neural network, the abnormal alarm model of production workshop is established to improve the operation efficiency of equipment; the intelligent equipment maintenance is carried out by using the big data analysis and prediction function to prolong the equipment life and reduce the maintenance cost; the multi-dimensional energy consumption analysis model and big data mining model are established to improve the energy utilization efficiency [9].

Big data and product marketing. The penetration of big data in various industries makes the pattern of collaborative innovation more and more obvious. Big data is the link of deep integration and development of manufacturing and retail industry. The essence of "new retail" is to realize the in-depth integration of "Online + offline + logistics", using data technology to drive, provide consumers with all-round services, and achieve C2B sales without inventory. Manufacturing enterprises use big data to make the whole sales chain more efficient and promote the upgrading of new material enterprises into more efficient and accurate suppliers through comprehensive and real-time warehousing tracking, logistics distribution, channel planning and marketing promotion.

Big data and organizational innovation. On the one hand, big data has changed the internal information transmission and management mode of enterprises. Enterprises pay more attention to the flexible management of system management and business process, and horizontal organization replaces the previous vertical organizational structure. The flattening of organizational structure effectively improves the efficiency of information transmission and timely and effective response to market dynamics. On the other hand, the deep integration of big data and various industries blurs the boundaries of enterprises. Enterprises extend the industrial chain and form a pan platform interactive mode with network virtual agglomeration mode, which promotes the transformation of industrial organizations from vertical structure to network collaborative structure, and forms a new competitive coordination relationship. We should establish a digital ecology with user value as the link and multi-party cooperation to realize the common value proposition, and realize the effective combination of resources and collaborative innovation [8].

Big data and business model innovation. The instrumentalization of big data resources and technologies has brought about the innovation of business model elements; the commercialization of big data resources and technology has given rise to different positioning and value creation modes of enterprises in the "big data" industrial chain; the industry expansion and extension based on big data has produced business model innovation characterized by connection, integration and cross-border. Platform economy and cross-border integration are two typical models of business model innovation in the era of big data. The pan flattening of the interaction among the market entities is conducive to easing the friction in the transaction, promoting the coordinated and orderly updating among business units, reducing transaction costs and improving the efficiency of resource allocation [10].

4.2. The influence of DMAIC model on the decision of new material enterprises
At the macro level, big data is mainly applied to the overall planning of the new material industry, the company's innovation management and various major decisions of the company. D is define, which means transforming the business problems of an enterprise into the data mining problem of an enterprise; m is measure, which means understanding and mastering data, collecting and processing data, and preparing for the application of big data; a is analyze, which refers to the process of constructing and analyzing the model; I is improve, which refers to solving practical problems through the deployment of the model; C is measure Control means to start to evaluate the results again and continuously improve the analysis results[6].

Today's data is more complex, most of the data are not integrated, and the state of data island, the main characteristics are large data capacity, wide sources, many types, and data is divided into structured data and unstructured data, unstructured data is more and more. For the current data processing, we must apply advanced big data analysis technology for processing operations, including data cleaning, and high-quality data management. In order to successfully realize the big data solution proposed by the relevant industry managers, the basic part is a better understanding of the logarithms, and the output of the results should be of high quality, which depends on big data technology Through the establishment of a standard process and analysis tools on the enterprise's relevant data in advance, we can get the data warehouse [7].

### 4.3. Data value added and business reconstruction

The business operation analysis of big data has derived a large number of data analysis results and value-added products, such as market trend analysis and user habit analysis in business operation. The results of data analysis can be further applied to the innovation of business model of enterprises, which can better design the business model of enterprises and open up new markets. In the final analysis, the development of enterprises is still the number of spectators. With the rapid development of big data technology, enterprises can obtain more detailed user information data in the market. After the analysis of big data technology, enterprises can grasp the market information in real time, so as to find some information or development trend favorable to the development of enterprises, and then make accurate marketing strategies, in this way, more users can be obtained, and the revenue of enterprises will be greatly increased [4].

According to the different participants, there are five modes of technological innovation in new materials enterprises: industry university research cooperation, enterprise alliance, government led, military civilian integration and platform sharing [3].

| Model name                        | Participants                                                                 | Main methods                                                                                      |
|-----------------------------------|------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------|
| Industry university research      | Universities, scientific research institutions and enterprises               | Intermediary organizations build bridges to promote technological innovation through "contract research and development" |
| cooperation                       |                                                                              | The upstream and downstream enterprises build cooperation alliance, and the upstream enterprises carry out research and development around the downstream demand |
| Enterprise alliance type          | Upstream and downstream enterprises                                         | In the form of government procurement, relevant enterprises are entrusted to carry out research and development |
| Government led                    | Government, enterprises                                                     | Military procurement forms to promote enterprises to tackle key technical problems                 |
| Civil military integration        | Military, enterprises                                                       | Through computational materials science and sharing platform, online collaboration of simulation, design, R & D, manufacturing and feedback of new materials is realized |
| Platform sharing                  | All sectors of society                                                      |                                                                                                |

5. Conclusions

In today's development, new material enterprises are constantly creating big data and constantly understanding and digesting big data. They need continuous innovation in the creation method and analysis of big data. Big data can effectively promote the upgrading and rationalization of the structure
of new materials enterprises, and big data has an impact on the optimization of the structure of new materials enterprises mainly through labor productivity and resource allocation efficiency. In the new generation of industrial revolution, how to promote the deep integration of big data and new material enterprises, promote the coordinated development of various industries in the new material industry, coordinate the regional development, and give full play to the "multiplication" effect of big data on new material enterprises rather than simple "aggregation", which is an important challenge for the structural optimization and high-quality development of China's new material enterprises.

More and more countries attach great importance to big data analysis technology. It will bring great changes to the decision-making of high-tech industry of new materials and various business processes. At present, there are many problems in the field of new materials in China that need to be solved urgently. Such as low level of science and technology, high energy consumption, technological innovation and the upgrading of the new materials industry etc., can be solved by using big data analysis technology.

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