Application of Big Data Analysis in Product R & D Design Decision

Yongdong Song1,*

1Dalian University of Science and Technology, 999-26 Bingang Road, Lvshun Economic Development Zone, Dalian, Liaoning

*Corresponding author e-mail: youngdee@126.com

Abstract. In the era of big data, individual small data is aggregated into big data through various network interconnections. Big data has the characteristics of large volume, many types, and fast speed. More and more information is contained in it. Massive data resources and mature The data value mined by the big data analysis method can provide more powerful decision support for enterprises in the product development and design process. Based on this, this paper analyses the application of big data analysis in product R & D design decision. This paper conducts research through a combination of literature review method and experimental comparison method, and summarizes relevant domestic and foreign literature data. It is found that big data analysis solves product development. For user needs and experience, data sources are more accurate and convenient. Through the comparison of the experiments of two companies in a certain area, it is concluded that companies that use big data analysis for product R & D and design have more advantages. Their advantages are as follows: the systemization of R & D and design has increased by 70.0%, and the efficiency has increased by 93.3%. Collaboration The aspect has increased by 55.4%, and the cost has been reduced by 58.3%. The research results of this paper show that big data analysis has played an important role in product R & D and design decisions.

Keywords: Big Data Analysis, Product Development Design, Decision Analysis, Enterprise Decision

1. Introduction

In ancient times, knotting opened the history of human recorded data, and since then, people began to explore how to use data to represent nature and society. With the development of social economy and culture, the amount of data keeps increasing and the quality keeps improving. Especially in recent years, due to the rapid development of the Internet, in the fields of economic culture, scientific
research, national defense, Internet applications, etc., the Internet is becoming more and more widely used in e-commerce, etc., the data scale and data types are growing rapidly, the era of big data Comes quietly.

This paper analyzes the application of big data analysis in product R & D design decisions to help companies achieve multi-point collaboration, information sharing and hierarchical management in the overall product design and development process, improve the efficiency and effectiveness of the design and development system, and have Important guiding role.

This article first introduces the big data analysis, analyzes the research status of the data analysis and the technical methods used in the big data analysis, then explains the product development and design process, and then starts the analysis through the literature review method and the experimental comparison method. , Analyze the role of big data analysis in product R & D design decisions, and the benefits of specific implementation applications, and finally summarize the significance of big data analysis in product R & D design decisions.

2. Proposed Method

2.1. Big Data Analysis

(1) Introduction to big data analysis

With the continuous development of big data related technologies and the popularization of the mobile Internet, some behaviors and ideas of individuals can be recorded and analyzed in real time and effectively. These data are called "electronic behavior traces" of people, such as individuals and various social A large amount of data generated by the interaction between media, websites, apps and other media. Compared with traditional small sample research data, the above interactive data has the following advantages: first, from the sample size, the data is larger and more complete; second, from the ecological validity, these data are actively generated by people under natural scenarios It is more authentic and representative. In addition, from the perspective of the research process, the development of big data and machine learning related technologies has greatly improved the ability of researchers to process information. The characteristics of big data are the comprehensiveness, richness, depth and connection of data. Through the data insights between the data of various vertical industries, the correlation behind the data is predicted to predict the future development[11].

(2) Research status of big data analysis

At present, the related researches on big data analysis at home and abroad can be roughly divided into four aspects, namely data visualization, data mining algorithms, AI artificial intelligence and data distributed processing. The ultimate goal of big data analysis is to obtain the hidden value in the data, and the analysis results or data features we get are often not intuitively explained in language. The data visualization technology can clearly analyze the data through charts, animations, and even videos. The process and the final conclusions are vividly and vividly displayed, which is convenient for analysts to show, and makes the viewer more clear.

1) Data visualization:
The research directions of data visualization mainly include:

Text visualization: optimization in the form of a tree, display of text structure in the form of radial hierarchical rings, and projection method based on Hipp hierarchical projection. Monorail text information is displayed in two-dimensional space and grouped. Network optimization: such as data display of node-based imaging methods, space filling methods and imaging methods combined with multi-dimensional technology[2].

2) Data mining algorithm

Data mining algorithms are the core of big data analysis. From a technical point of view, data mining is to obtain hidden, undiscovered, and potentially valuable from a large amount of complex, irregular, random, and fuzzy data. Process of information and knowledge.

Today's commonly used data mining analysis methods mainly include cluster analysis, classification and regression prediction, and association analysis[3].

Cluster analysis: the process of aggregating a large number of data objects into several clusters or classes, and making the objects in the same cluster as similar as possible and the objects between different clusters as different as possible[4]. Since cluster analysis itself does not directly represent a certain feature of a category, cluster analysis is a learning process of unsupervised learning. Existing clustering algorithms can be roughly divided into five categories, which are partition-based methods, layer-based methods, density-based methods, grid-based methods and model-based methods.

Classification and regression prediction: are the two main types of problem prediction. Classification prediction is to predict the classification (discrete, disordered) label, while regression prediction is to establish a continuous value function model to predict the exact value of a variable. Classification and regression are the characteristics of known training data sets. Obtaining the description of each category or the relationship between a certain variable and other variables is a supervised learning process.

AI artificial intelligence technology: AI artificial intelligence technology level research is currently concentrated in three aspects, namely computer vision, speech recognition and natural language processing. In recent years, due to the continuous enhancement of various algorithms such as machine learning and deep learning, AI artificial intelligence technology has continued to break through, and many branch fields have gradually matured and have been put into practical production applications. At the same time, artificial intelligence is also facing many problems, for example, how to obtain high-quality large data sets in a certain field, how to improve and innovate algorithms to obtain higher accuracy, how to put academic research results into industrial production, and how Innovating in application scenarios, these are the problems or development directions that the artificial intelligence needs to solve in the future.

Distributed processing of data: Many scholars have conducted research as early as the era of big data, but the real start of widespread application must be counted from the MapReduce parallel computing framework proposed by Google in 2004. The main reason is that the development of big data makes it difficult or even impossible to directly store and calculate the full amount of data. Using distributed processing can not only reduce the pressure of data storage, but also improve the speed and
quality of calculation through parallel computing.

2.2. Product R & D and Design

Product R & D and design is a gradual and iterative process, which is mainly divided into five stages\(^5\): user research, demand analysis, design scheme, scheme development, and product launch. This is a nonlinear cycle process. For product design, every design node and iteration requires decision-making behavior. The design decision of each stage is both the end of this stage and the beginning of the next stage. Objective and rational big data can ensure the scientificity of decision-making and promote the design step by step. Reaching the goal is divided into the following five decision-making steps\(^6\).

(1) User portrait decision

Fully understanding user data is a prerequisite for user-centered Internet product design. By filtering and aggregating user data, the decision maker finalizes a user portrait that represents the characteristics of the target user group. Big data is a connection of multi-source data, with very rich and detailed data dimensions. Big data analysis can efficiently and accurately complete user portrait decisions. The specific steps are as follows: through repeated cross-combination of demographic feature dimensions, the most significant features can be found. The combination of dimensions and the types of users who find the highest demand for the product in this combination of dimensions are the target user, analyzing the behavior data of the target group, mining user preferences and completing user portrait decisions by abstracting user characteristics.

(2) Demand decision

User needs are composed of explicit needs expressed by users themselves and implicit needs based on user profile insights, and demand collection should be comprehensive and meticulous. According to the importance of user needs, the types of user needs are divided into five categories: essential needs, expected needs, charming needs, indifferent needs and negative needs. The decision-maker completes the demand screening, classification and prioritization through the research data, demand investment return ratio and their own understanding of the target users.

(3) Design scheme decision

By using the test data obtained by big data analysis to evaluate the design plan, the decision maker can determine the most suitable product form, information architecture, operation process, information layout, visual style, color matching, and form a set of design plans that are finally put into development and implementation. According to the scene data and competition data of the target user group, the typical use scenarios of the target user using this type of Internet product can be determined, and then one or more product forms can be determined, and the target user’s behavior can be analyzed based on the large amount of behavior data left by the user on the Internet. The behavior law further predicts the user's behavior, combined with the test data, to determine the information architecture, operation process and information layout that best meets the user's cognitive and operating habits and can guide the user to complete the task.

(4) Product release decision
Before the product is officially launched, the decision maker needs to decide the product launch time and promotion strategy to obtain as many target users as possible with the highest matching cost at the minimum cost. Through real-time big data analysis, it can be judged that a user's stickiness to the existing product has not faded, but the user's demand level has the best time node to improve the trend, which assists in the decision of new product release time.

(5) Iterative optimization decision

After the product goes online, users can touch and use the product, which will generate a large amount of operation behavior data. One of the types of data is quantitative data in the product. Typically, there are traffic (the number of visits in a certain period of time), conversion rate (the ratio of completing the target task to the total number of visits), and bounce rate (the left after browsing a page and the total visit Quantitative ratio). Another type of data is the browsing behavior data left by the user's browsing logs between interfaces and the user's click behavior to form the user's click behavior data. Quantitative data can reflect whether the product's positioning, content, and delivery channels meet the current needs of users, and can be used as a basis for decision-making for new needs or subversion of existing designs. The user's browsing and clicking behavior data reflect the user's operation mode, and can be used as the decision basis for product information organization optimization.

3. Experiments

(1) Literature review method

In this paper, by consulting domestic relevant papers, magazines, and other relevant materials, the basic needs of this article are sorted and finally summarized to get big data analysis, which mainly affects product development and design from user needs, user experience, and data convenience and accuracy.

(2) Contrast experiment method

In this paper, through the experiment of two companies in a region, the experimental group uses big data analysis for product R & D and design, and the control group uses traditional methods for product R & D and design, and analyzes the system, efficiency, collaboration, and cost reduction to obtain big data. The conclusion that analysis plays an important role in product R & D design decisions.

4. Discussion

4.1. The Impact of Big Data Analysis on Product R & D Design Decisions

This article refers to relevant domestic and foreign literatures and summarizes the aspects of big data analysis that affect product development and design. The results are shown in Table 1.
Table 1. The Influence of Big Data Analysis in Product R & D Design Decision

| Effect                        | Object of Action     | Proportion |
|-------------------------------|----------------------|------------|
| Analysis Needs                | Enterprise, Designer | 35%        |
| Focus on Experience           | User                 | 40%        |
| Convenient and Accurate Data | Designer             | 25%        |

It can be seen from Table 1 that big data analysis mainly affects product development and design in terms of user needs, user experience, and data convenience and accuracy.

(1) Analysis needs

Numerous potentials and undeveloped data provide the first step in the product development process for new needs. It is also a very important step in the concept development and product planning phase. At this stage, designers need to analyze requirements and define product functions, which is the basis of the entire design process.

(2) Focus on experience

With the gradual improvement of living standards, people's first level (physiological needs) and second level (security needs) have been fully satisfied, so more and more people are beginning to pursue emotions and belonging Need (third level). This requires designers not only to consider the function of the product, but also to consider the user experience, conforming to the current trend of user-centered R & D and design. At the same time, these changes have promoted user research to a very important position in the product development process, and designers will devote more energy to this stage.

(3) The data is convenient and accurate

The developed Internet has brought designers closer to users, more accurate and convenient access to user behavior data, and various information transmission and data analysis has become very convenient, especially Internet products, through some simple script implantation, or use some third parties The platform can easily realize the record analysis of user operation behavior to obtain user
feedback.

4.2. Application of Big Data Analysis Technology to Product R & D Design Decision

In this paper, through the experiment of two companies in a certain area, the experimental group uses big data analysis for product development and design, and the control group uses traditional methods for product development and design. The results are analyzed in terms of system, efficiency, collaboration and cost reduction. 1 shown.

![Figure 1. The Application of Big Data Analysis Technology in Product R & D Design Decision](image)

As can be seen from Figure 1, companies that use big data analysis for product R & D and design have more advantages. Their advantages are as follows: systemization in R & D design has increased by 70.0%, efficiency has increased by 93.3%, collaboration has increased by 55.4%, and cost Reduced by 58.3%, so big data analysis has played a significant role in product R & D design decisions.

"System, efficiency, collaboration, cost reduction"-the eight-characteristic policy that represents the core elements of the new design thinking model will bring a new breakthrough to product design and development thinking, and will effectively help tens of thousands of Chinese companies to truly transform design To build core competitiveness for productivity and ultimately, improve the brand system and comprehensively enhance brand value.

Collect and organize product market data, and use big data analysis technology to find relevant information with the highest reference value for enterprise product design and development. Unlike the subjective and decentralized traditional design models, the new generation of design thinking needs to adjust resources and information, Forming a supporting system, realizing multi-point cooperation, information exchange and hierarchical management in the entire process of business planning and development, greatly improving the efficiency of the process, reducing the operational risks caused by misjudgment of market orientation, and saving time in planning and development And cost, at the same time, the new design ideas will strengthen the evaluation of the work indicators of each link, so as to achieve an effective and benign management mechanism.
5. Conclusion

The research of big data analysis is in full swing and developing rapidly. In this paper, through the study of the application of big data analysis in product R & D and design decisions, it is found that big data analysis will bring a new development path for enterprises and help enterprises in an increasingly competitive market environment. Quickly develop the situation and comprehensively enhance the core value of products and brands.

References

[1] Stieb D M, Boot C R, Turner M C. Promise and pitfalls in the application of big data to, occupational and environmental health[J]. Bmc Public Health, 2017, 17(1):372.

[2] Pahalvan R, Omid M, Akram A. Application of Data Envelopment Analysis for Performance Assessment and Energy Efficiency Improvement Opportunities in Greenhouses Cucumber Production[J]. Journal of Agricultural Science & Technology, 2018, 14(3):1465-1475.

[3] D. Cui, R. Han, Q. Ma. Thermal analysis and application of 5 in automotive high luminance module[J]. Chinese Journal of Liquid Crystals & Displays, 2017, 32(10):765-771.

[4] Robert Thorstad, Phillip Wolff. A big data analysis of the relationship between future thinking and decision-making[J]. Proceedings of the National Academy of Sciences of the United States of America, 2018, 115(8):201706589.

[5] Hongwei Li, Rongxing Lu, Jelena Misic. Guest Editorial Big Security Challenges in Big Data Era[J]. IEEE Internet of Things Journal, 2017, 4(2):521-523.

[6] Deepak Puthal, Xindong Wu, Surya Nepal. SEEN: A Selective Encryption Method to Ensure Confidentiality for Big Sensing Data Streams[J]. IEEE Transactions on Big Data, 2017, PP(99):1-1.