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Business Administration Decision Support System Based on Big Data

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Abstract: This article aims to discuss the construction and application of business management decision support system (DSS) based on big data. This article adopts a systematic approach, analyzes the application status and challenges of big data in business management decision-making, and puts forward the construction scheme of business management DSS based on big data. The model design of this article follows the design principles of systematicness, flexibility and user-friendliness, and defines the system goals of improving decision-making efficiency and promoting data-driven cultural transformation. By constructing a system architecture including data acquisition layer, storage and processing layer, analysis and mining layer and decision support layer, it provides a comprehensive solution for enterprise decision support. The results show that the business management DSS based on big data can significantly improve the efficiency and accuracy of enterprise decision-making, reduce the risk of decision-making, and promote the transformation of data-driven culture within enterprises. Through the implementation of the system, enterprises can make better use of big data resources and optimize management processes.

1. Introduction

In the current information age, data has become the core element of enterprise operation [1]. The rapid progress of information technology, especially the popularity of technologies such as cloud computing and Internet of Things, has given birth to the explosive growth of data volume and announced the arrival of the era of big data [2]. As a key link in economic activities, enterprise management is facing unprecedented transformation challenges [3]. The traditional decision-making model is often based on limited information and empirical judgment, which has been difficult to meet the current complex and changeable market demand [4]. Therefore, it is of great significance to explore how to make effective use of big data technology and build an intelligent and accurate DSS for enhancing the competitiveness of enterprises, optimizing resource allocation and realizing sustainable development [5].

Building a business management DSS based on big data is inseparable from solid theoretical support [6]. Big data theory, as a new branch of information technology, its core concepts, characteristics and technical system provide the basic framework for this study [7]. At the same time, DSS, as a tool to assist decision makers to analyze and make decisions on complex problems,

its development history, structural design and functional realization are also indispensable theoretical basis for this study [8]. Business management theory, including strategic management, marketing and operation management, provides theoretical guidance and practical path for the specific application of big data in enterprise management [9]. This article synthesizes these theories, and discusses how they can integrate with each other to support the effective application of big data in business management decision-making. Its purpose is to explore the construction and application of business management DSS based on big data.

2. Application of big data in business administration decision-making

In recent years, big data technology has been widely used in business administration and has become a key driving force for enterprise transformation [10]. In the retail field, big data analysis helps businesses accurately capture consumer demand and optimize product display and marketing strategies; The financial sector uses big data to assess risks, accelerate credit approval, and strengthen financial risk prevention and control; The manufacturing industry realizes production intelligence through big data, improving efficiency and product quality. These examples prove that big data not only brings economic benefits to enterprises, but also promotes management innovation and enhances comprehensive competitiveness. However, when applying big data, enterprises face different characteristics and challenges due to differences in industry and scale, so it is necessary to make targeted analysis and adopt differentiated strategies.

Although big data shows great potential in business management decision-making, it still faces many challenges in its application process [11]. These include data acquisition and processing, data privacy protection, talent shortage, and rapid technology update. Faced with these challenges, enterprises need to take effective measures to overcome obstacles and promote the in-depth application of big data in business management decisions.

3. Construction of business management DSS based on big data

3.1. Principles and objectives of system design

When building a business management DSS based on big data, following scientific design principles is the key to ensure the effectiveness and practicability of the system. In the design process of this article, the principles followed include user orientation, data driving, flexibility, expansibility, security, real-time, visualization, interactivity, stability and cost-effectiveness.

Defining system objectives is the core of building DSS. This system aims to significantly improve the decision-making efficiency of enterprises and shorten the decision-making cycle through the application of big data technology, so that enterprises can respond to market changes more quickly. At the same time, the system reduces the risk of decision-making through accurate data analysis and prediction, and avoids the losses caused by blind decision-making. The system is also committed to promoting the transformation of data-driven culture within the enterprise, encouraging employees to make decisions and management based on data, and improving the overall operation level of the enterprise.

3.2. System architecture and functional modules

The overall architecture of the system is the cornerstone of building DSS. The system adopts hierarchical architecture design, including data acquisition layer, storage and processing layer, analysis and mining layer and decision support layer. The data acquisition layer is responsible for collecting data from various data sources and carrying out preliminary cleaning and sorting. The

storage processing layer is responsible for the storage and management of data to ensure the security and availability of data. The analysis and mining layer is the core of the system, and the data is deeply analyzed and mined through the algorithm model to extract valuable information and knowledge. The decision support layer presents the analysis results to the decision makers in an intuitive way to support their decision-making.

In the analysis and mining layer, this article adopts cluster analysis algorithm as the main algorithm. Cluster analysis is an unsupervised learning algorithm, whose goal is to group the objects in the data set, so that the objects in the same group have high similarity in some measure, while the objects in different groups are quite different. Through cluster analysis, we can find hidden patterns and structures in data, such as identifying customer groups or market segments with similar characteristics. In this system, clustering analysis algorithm is used to group a large number of business management data, thus helping enterprises to better understand their customers and markets and provide support for formulating accurate marketing strategies and decisions. In this article, the K- means clustering algorithm is used, and its goal is to minimize the sum of the distances from each point to its clustering center. The algorithm formula is as follows:

$$J = \sum_{i=1}^{k} \sum_{x \in S_i} \left\| x - \mu_i \right\|^2 \tag{1}$$

Where J is the objective function, which represents the sum of the distances from all points to its cluster center; k is the number of clustering centers; S_i is the set of data points contained in the i cluster; x is a single data point in the data set; μ_i is the coordinate of the i cluster center; $\left\| x - \mu_i \right\|^2$ is the square of Euclidean distance from data point x to cluster center μ_i.

The system also contains several functional modules to meet different decision-making needs. The data preprocessing module is responsible for cleaning, transforming and integrating the original data, providing a high-quality data base for subsequent analysis. The intelligent analysis module uses machine learning and data mining technology to deeply analyze the data and find the correlation and law between the data. The visual display module visually displays the analysis results to decision makers through charts, reports and other forms, which is convenient for their understanding and application. According to historical data and current trends, the early warning and prediction module predicts and warns the possible future situation, and provides forward-looking support for enterprise decision-making.

3.3. System test

In order to ensure the stability and reliability of business administration DSS based on big data, a series of system tests were carried out. The purpose of the test is to verify whether the system can meet the expected design requirements, including functional integrity, performance, data accuracy and user interface friendliness.

In the process of testing, various testing methods are adopted, including unit testing, integration testing, system testing and user acceptance testing. Unit testing is mainly to independently test each functional module of the system to ensure that each module can work normally; Integration testing is to integrate all modules and test their cooperative working ability. The results of unit test and integration test are shown in Table 1:

Table 1: Unit Testing and Integration Testing Results

Test Type	Test Module/Integration Point	Number of Test Cases	Passed	Failed	Pass Rate
Unit Testing	Data Acquisition Module	50	50	0	100%
	Storage & Processing Module	45	45	0	100%
	Analysis & Mining Module	60	58	2	96.7%
	Decision Support Module	35	35	0	100%
Integration Testing	Interface A between Modules	20	20	0	100%
	Interface B between Modules	15	14	1	93.3%
	Interface C between Modules	10	10	0	100%

System testing is a comprehensive test of the whole system to verify the overall performance and stability of the system. The result is shown in Figure 1:

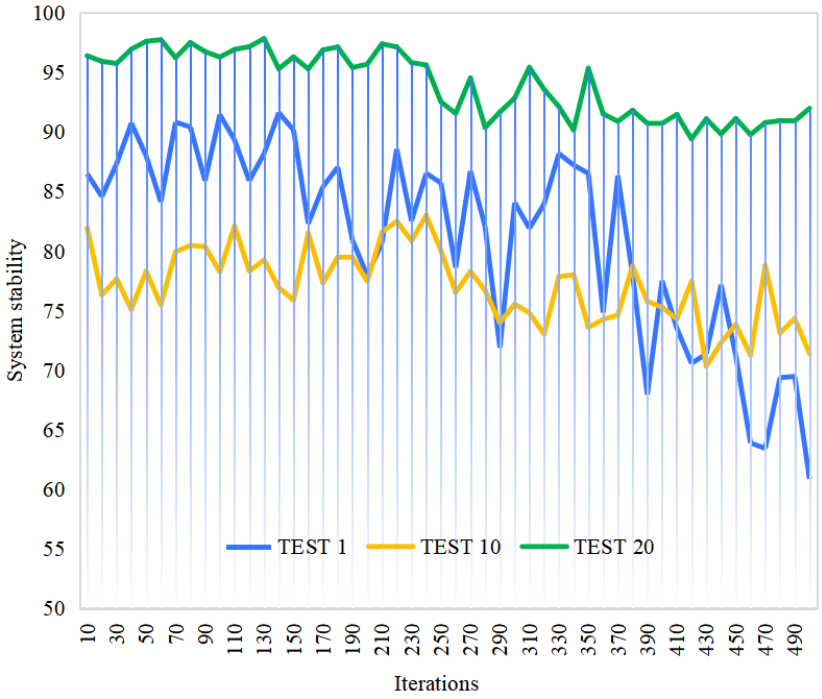

Figure 1: System stability test

User acceptance test is to invite actual users to participate in the test and collect their feedback so as to further optimize and improve the system. The results are shown in Table 2:

The test results show that the business management DSS based on big data has reached the expected design requirements in terms of functional integrity, performance, data accuracy and user-friendly interface. The system can stably process and analyze a large amount of data and provide accurate decision support information. At the same time, the user interface of the system is

reasonable in design and easy to operate, and users can get started quickly and skillfully using the system.

Table 2: User Acceptance Testing Results

Testing Indicator	Test Result (Max Score 5)	Summary of User Feedback
Functional Completeness	4.8	System features are comprehensive, meeting business administration decision-making needs, with only a few auxiliary functions to be improved
Performance	4.6	System processes quickly, strong in big data analysis, with occasional minor delays under high load
Data Accuracy	4.9	Data analysis results are accurate, decision support information is reliable, no significant data errors found
User Interface Friendliness	4.7	Interface design is simple and clear, easy to operate, users can quickly get started and use the system proficiently
Overall Satisfaction	4.75	Users are satisfied with the overall performance of the system, believing it significantly improves decision-making efficiency, and suggest continuous optimization

In the analysis stage of test results, the problems found in the test process are recorded and analyzed in detail. Aiming at these problems, the corresponding solutions are formulated, and the system is optimized and improved. Through continuous testing and optimization, the stability and reliability of business administration DSS based on big data are ensured.

4. Conclusions

After analysis and discussion, the business administration DSS based on big data is comprehensively expounded. This article clarifies the important position of big data in business management decision-making, and sorts out the relevant theoretical system. Then, the application status of big data in business management decision-making is analyzed, and its great potential in promoting enterprise transformation and upgrading and enhancing competitiveness is revealed. At the same time, it also points out some problems such as data acquisition, processing, privacy protection, technology update and talent shortage. On this basis, the construction scheme of business management DSS based on big data is put forward, including system design principles and objectives, system architecture and functional modules, implementation strategies and safeguard measures, which provides specific guidance and reference for the practical application of enterprises. The research shows that business management DSS based on big data can significantly improve the efficiency and accuracy of enterprise decision-making, reduce decision-making risks and promote the transformation of data-driven culture within enterprises. Through the construction and implementation of the system, enterprises can make better use of big data resources and optimize management processes, thus occupying a favorable position in the fierce market competition.

Business administration DSS based on big data is a field full of challenges and opportunities. Future work will continue to pay attention to the development of this field, explore new technologies and methods in depth, and provide more comprehensive and in-depth support and help for enterprise decision support.。

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