Investigation on Evaluation and Optimization of Intelligent Business Statistical Models

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Abstract: In network management, especially when a large amount of business data is accumulated in daily operations, the application effect of Business Intelligence (BI) technology in network management is particularly significant. Based on the business analysis process involved in the data analysis of Company A's data center, this article summarized the problems existing in the existing data analysis system, drew inspiration from the principles and processes of BI technology, and used BI technology to rebuild the business analysis system solution for Company A's data center. A business analysis system model based on metadata management was proposed, which could provide analysis results and visual reports for business decision makers and business analysis teams. It focused more on effectively explaining the current business situation and providing valuable information or knowledge for enterprise decision-making. According to the analysis of the distribution proportion of visiting regions, it could be found that South China accounted for 23.25% and North China accounted for 12%. The South China region had a strong interest in Company A's business. By utilizing intelligent business statistical models, the potential value contained in enterprise data could be better excavated, thereby providing guidance for the operation and decision-making of enterprises.

Keywords: Intelligent Business Statistical Model, Business Intelligence Technology, Data Center, Data Analysis, Enterprise Management

1. Introduction

With the rapid development of network technology, competition between network companies is becoming increasingly fierce. In order to stand out and gain an advantage in the fierce market competition, enterprises must more accurately grasp the needs of users and be able to make timely and correct decisions and business adjustments. Therefore, how to extract useful information from massive commercial activity data and provide strong data support for analysts and decision-makers is an urgent problem to be solved.

In enterprises, the job of a data warehouse is to unify and effectively manage massive amounts of data, and to clean, summarize, and store effective data, providing convenience for querying daily business data and historical data of the enterprise. The relevant developers of digital warehouses would conduct data governance in the data

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warehouse, such as data cleaning and dimensional model construction, and provide important data support for the BI system's data display system. In response to the demand for intelligent manufacturing in the automotive stamping industry, Tang Mingqing adopted the partial least squares method to construct the mapping relationship between products and constructed a BI analysis model for the stamping industry based on the "process-quality" correlation, in order to achieve deep mining of the "process-quality" correlation and identify key factors affecting product quality. In practice, this model could effectively construct one-to-many and many-to-many mapping relationships for different types of parts, thereby achieving the goal of early control of products [1]. Zhang Wei established a visual medical insurance payment intelligent analysis system based on BI technology. This could effectively control medical costs, improve medical efficiency, optimize disease structure, and help hospitals make scientific decisions conveniently and effectively in the process of medical insurance payment reform and medical management, thereby improving the overall operational efficiency of the hospital [2]. Cui Jia believed that in the era of big data, enterprises needed to explore and showcase the value of business data more, which further promoted the development of BI. After several years of development, traditional BI was no longer able to meet its needs. Therefore, in future development, a self-service BI would emerge [3]. Their research only explored the application of intelligent business statistical models without further optimization.

The research object of this article was the practical needs of e-commerce enterprises. This article was based on the needs of frontline personnel, data analysts, and managers in the company's business, and combined with the technical architecture and development status of enterprise data warehouses, so as to help the company build a BI data display platform that is consistent with the actual needs of the company, thus meeting the complex data needs of enterprise business operations. Based on the BI analysis system, this article integrated multiple business source data and external data within the enterprise. By utilizing online analysis processes and data mining tools, data was randomly extracted and analyzed from a data warehouse, and combined with the interpretation of data analysts to form a visual presentation of information results, providing comprehensive decision-making information for enterprises.

2. Establishment of Business Statistics Model Based on BI

With the continuous development of society and economy and the continuous improvement of modern enterprise management, data visualization analysis has become a research hotspot. In the future, data would become the most valuable asset for enterprises. Building a commercial BI system requires unified integration and integration of existing operational data, investment data, and other data from major shopping malls through data processing and analysis techniques [4-5].

The profitability Y_N of enterprises in BI is as follows [6]:

$$Y_N = S * N - X * (-r * T) * N \quad (1)$$

The business growth trend Y_Q is as follows:

$$Y_Q = X * (-r * T) * N(-d) - S * N(-d1) \quad (2)$$

In a business analysis system, a carefully planned data warehouse is a high-quality, fully documented, multiple application system, practical, historical, and real dataset with multiple application systems. Integrating these basic data and constructing a standardized basic data platform and indicator system is helpful for the integrated information management of Company A and improving its decision-making ability [7-8]. At the same time, emphasizing the maintenance and utilization of BI data and strengthening the value mining of data are also important symbols of the transformation of data centers from traditional data and information processing departments to corporate strategic planning and leadership decision-making support departments [9].

The implementation of BI applications is a decision-making process of data information, which serves as the driving force for business analysis systems and is mainly manifested in three aspects [10]:

The data source is extracted from various applications in the enterprise system and integrated;

Business modeling and quantitative analysis indicators are carried out to provide solutions to core issues within the enterprise. Appropriate online analysis process tools and data mining tools are used to process this data and transform it into knowledge to assist decision-making;

The data sources of various application systems, combined with BI, form a cycle of process and decision information, thus presenting knowledge to users, thereby helping enterprises detect enterprise operations and making it easier and more timely to make correct decisions.

When implementing BI in enterprises, it is necessary to conduct business analysis on it. The research in this article would provide a new approach for the construction of enterprise business data analysis systems, and also provide a new approach for the construction of enterprise business data processing systems [11-12]. The information demand flow starts at the business requirement layer (business department/business driven environment) and flows to the technical support layer (technology department/technology driven environment). The information supply process starts from the level of technical support to the level of business requirements.

Business analysis activities involve many people, resources, and business processes. This includes research content from top to bottom, including decision-making layer, management layer, analysis layer, data warehouse, and operating application system from top to bottom:

The decision-making level is based on the management level, integrating various indicators of enterprise operation to form an overall enterprise management strategy, and deriving a series of key performance indicators to evaluate the implementation and effectiveness of the enterprise management strategy. Strategic decisions are usually made jointly by senior management, business or functional department managers.

The management team describes various types of problems in the business process and provides a basis for decision-making [13]. It can often be expressed through a set of business processes and metrics.

The analysis layer refers to the level of reporting and analysis reports. Analysts provide specific data requirements based on the comprehensive issues of management

level, which is the level of information and knowledge generation. Usually, the data in the data warehouse is processed using pre established analysis and statistical models to generate information and knowledge. This level also includes front-end applications, reporting, and other distribution capabilities to meet the needs of business decisions and management models. This layer is in the transitional area between business requirements and technical execution, so the execution team must have both business awareness and technical execution, which is the issue to be explored in this article.

The data warehouse is designed to enable analysts to use application systems or other external data sources. Data warehouses typically receive data transfer requests from the analysis level before performing data access.

Operating application systems, also known as data source systems in enterprise operation systems, provide the basis for business analysis activities and mainly meet the data delivery requirements between data warehouses and business systems.

In the five tier model of business analysis system, the top level is the decision-making level. If the decision-making level does not have an overall strategy, managers would lose their goals. Therefore, the analysis system should be centralized from top to bottom and from decision-making to avoid the chaotic execution of BI.

The application of BI mainly involves the application of BI technology in the process of data analysis. Its core technology consists of three key parts, namely: data warehouse, data mining, and online analytical processing. With the continuous maturity of BI technology, the role of BI technology in maintaining or improving its competitiveness is also recognized by more and more enterprises [14-15]. So far, many companies or institutions have successfully applied BI in other countries. However, China's BI is still in its early stages. Compared to other countries, its application scope is not wide enough and research is not in-depth enough. There is still a significant gap in its application level and actual effectiveness compared to enterprises or institutions in other countries [16]. However, whether in some countries, a large number of BI solution providers, experts from higher education institutions, and relevant scholars have conducted in-depth and extensive basic theoretical and applied research on it [17-18]. With the continuous deepening of the application of BI technology, many scholars have not only conducted in-depth research on the application of BI in enterprises such as finance and sales, but also conducted application research in other fields. Among them, the medical information management system based on BI is one of the important application research fields of BI [19].

3. Intelligent Business Statistics Model Exploration Experiment

3.1 Current Status of A Company's Data Center Evaluation System

The data center of Company A collects nearly 30 types of data every day, including the backend management systems of various websites, unified message platforms, online consultation systems, direct call systems, various promotion data, management data, and so on. These data are all very large [20]. In Company A, the analysis system of the data center is used to support departmental level decision-making. That is to say, the functions of the data center business analysis team often assume the responsibility of implementation supervision. In the process of monitoring the completion of goals for

various business departments, the main operation to be completed is to receive a large number of data sources, integrate them, and form a near line analysis report. These data would be fed back to the business decision-making layer to monitor the achievement of performance goals, and the business decision-making layer would adjust strategies based on the completion of performance.

Currently, Company A lacks business information resources and needs to further strengthen the integration and management of business information [21-22]. There is no unified management of data or precipitation of digital assets, and the available data is very limited. At present, the accumulation of various data is not sufficient, and the statistical data cannot be accurately obtained, such as sales data and passenger flow data, and there is very little drilling data available. There are significant differences in data between different systems, and data sharing is also quite difficult. Company A's business has some difficulties in data collection, storage, update, and application research. The construction and management of enterprise databases still need further improvement. The business scope and responsibilities undertaken by various functional departments of Company A vary. On the basis of overall planning, on the one hand, it is necessary to preserve the unique characteristics of different business data between different departments, and on the other hand, it is necessary to link the business processes and related operations between Company A's Chamber of Commerce headquarters and regional engineering companies, and build a business database that can simultaneously meet the requirements of both aspects.

3.2 Problems in the Data of Company A

The exploration process, data collection process, and data storage management process are shown in Table 1. The diversity of heterogeneous data sources leads to low efficiency in data collection and processing; Due to the overly rigid storage method of raw data, enterprises cannot conduct integrated analysis and mining; Due to the differences between the analysis indices, there is incompatibility between the analysis results. In BI, each technology can be addressed separately [23]. The correspondence between system problems, corresponding optimization strategies, and expected goals is analyzed.

Table 1. Exploration process, data collection process, and data storage management process

Serial number	Exploring the process	Data collection process	Data storage management process
1	Analysis system issues	The diversification of heterogeneous data sources leads to	The solidification and storage of raw data makes it impossible to conduct business integration analysis and mining
2	Corresponding optimization strategies	Low efficiency of data collection and processing process	Design of Data Warehouse Structure
3	Expected goals	Design of extraction, conversion, and loading processes	Data structure optimization metadata management

3.3 Bi Based Data Warehouse Technology for Integrating Raw Data and Evaluation Indicators

The data in Company A's data center covers the entire enterprise. During the process of enterprise development, due to the rapid development and change of business and data,

the design strategy of the data warehouse is not a top-down approach, but a bottom-up approach. On this basis, this article adopts a data warehouse design method based on data mining technology. This requires the integration of existing application system databases and external data resources, including marketing data, website platform data, customer relationship management data, financial data, etc.; It is necessary to achieve unified data specifications, unified system indicators, unified code, and achieve data centralization. Under the data warehouse of the data center, there are three types of data marts, which can be divided into: enterprise to enterprise e-commerce model dataset, enterprise to user e-commerce model dataset, and member service dataset based on the company's business processes and main data sources [24].

4. Evaluation Results of Intelligent Business Statistical Models

The comparison of website visits, clicks, and costs is shown in Figure 1. Analysts can immediately obtain the previous month's visits, clicks, and costs on the first day of the new moon. It can be seen that the overall number of webpage views and clicks has increased, indicating that webpage browsing and click through rates are to some extent consistent. In communication with the business department, analysts learned that the company has made adjustments to its promotion strategy, and the promotion methods of search engine optimization have also undergone changes. The conclusion drawn from this is that the changes in search engine optimization promotion methods have not brought more natural traffic to users, and the change in promotion focus of marketing personnel has led to an increase in click through costs.

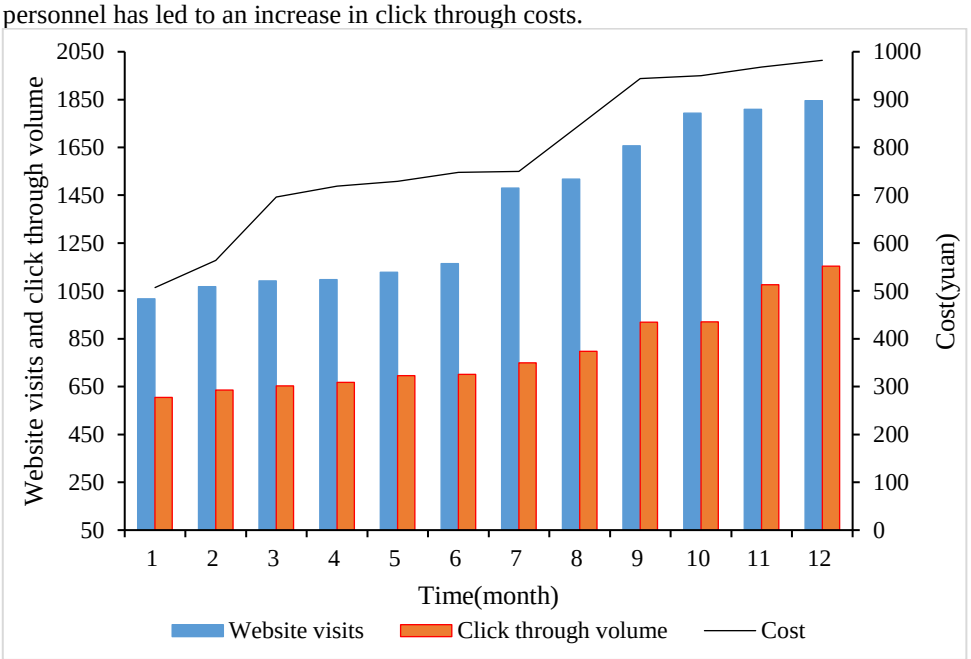

Fig 1. Comparison of website visits, clicks, and costs

The distribution of access regions is shown in Figure 2. In this region, marketers can view the selected region at any time, which is the region assigned to that region. It can be observed that South China accounts for 23.25% and North China accounts for 12%, indicating a strong interest in Company A's business in the South China region. Therefore, when conducting promotional campaigns, more resources should be allocated to this key area.

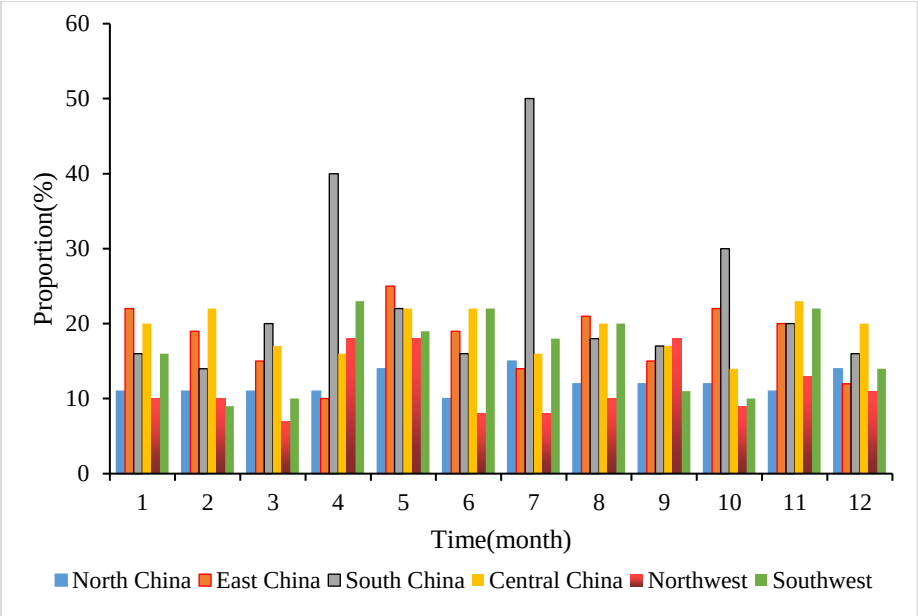

Fig 2. Distribution proportion of access areas

The information on novelty and food and beverage industries can account for 55%, indicating that enterprises in these two industries attach greater importance to their own business development. In the marketing process, targeted marketing plans should be formulated based on different industries. The levels and proportions of different business models are shown in Table 2.

Table 2. Grades and proportions of different business models

Serial number	Management model	Grade	Proportion(%)
1	Novel features	A	30
2	Food and beverage	A	25
3	Home building materials	B	16
4	Beauty and health preservation	C	8
5	Real estate park	C	7
6	Engineering agency	D	5
7	Chinese and western Catering	D	4
8	Education and training	C	5

The pressure test results of the system are shown in Table 3. The average transaction response time is 2 seconds for single sign on and 0.2 seconds for report

queries. The mixed scene takes 0.6 seconds. The CPU (Central Processing Unit) single sign on of the report server is 8%.

Table 3. System stress test results

Test scenario	Average transaction response time (seconds)	Report server CPU (%)	Database server CPU (%)
Single sign-on	2	8	40
Report query	0.2	9	30
Mixed scenarios	0.6	10	60

5. Conclusions

This article analyzed the problems in enterprise information systems based on their characteristics and provided corresponding solutions. At the same time, the concept and model of business analysis systems were also introduced. The value of business analysis lies in its ability to combine the results of information analysis with the business process of the enterprise. To achieve this goal, an ideal method is to use service intelligence technology to build a service analysis system. Currently, BI data display platforms based on multiple data sources can effectively support user needs. However, with the continuous increase in enterprise data volume, especially for real-time data sources, it cannot pre aggregate detailed data. When the amount of data is too large, querying report data can cause significant pressure on the database, resulting in long response times and affecting the user experience. In future plans, the method of obtaining user request lists can be used to analyze user behavior data, and corresponding caching operations can be carried out in advance for the report data queried by common user operations. For example, caching operations can be carried out in advance for the data queried during weekly or monthly time periods, which can enable the system to better respond to user needs and reduce database pressure.

References

[1] Tang Mingqing, Guo Gang, Chen Qinhe, et al. Business Intelligence Analysis of Automotive Stamping "Process Quality" [J]. Computer Integrated Manufacturing Systems, 2021, 27(4):1120-1127.

[2] Zhang Wei, Chen Dengju, Yang Qiao, et al. Construction and Practice of DRG Analysis System Based on Business Intelligence Technology [J]. China Digital Medicine, 2023, 18(2):16-20.

[3] Cui Jia. Business Intelligence in the Era of Big Data - Self Service BI [J]. Mobile Information, 2023, 45(1):117-119.

[4] Qin Chao, Sun Yun, Jin Tianyu, et al. Technical Implementation of Business Intelligence BI for Shale Gas Business Data Visualization Application [J]. China Management Informationization, 2023, 26(5):168-174.

[5] Liao Heng. Research on Business Intelligence Applications Based on Big Data Analysis Technology [J]. China New Telecommunications, 2022, 24(19):86-88.

[6] Bharadiya J P. Driving Business Growth with Artificial Intelligence and Business Intelligence[J]. INTERNATIONAL JOURNAL OF COMPUTER SCIENCE AND TECHNOLOGY, 2022, 6(4): 28-44.

[7] Canhoto A I, Clear F. Artificial intelligence and machine learning as business tools: A

framework for diagnosing value destruction potential[J]. Business Horizons, 2020, 63(2): 183-193.
[8] Caseiro N, Coelho A. The influence of Business Intelligence capacity, network learning and innovativeness on startups performance[J]. Journal of Innovation & Knowledge, 2019, 4(3): 139-145.
[9] Clark A , Zhuravleva N A , Siekelova A ,et al.Industrial Artificial Intelligence, Business Process Optimization, and Big Data-driven Decision-Making Processes in Cyber-Physical System-based Smart Factories[J].Journal of Self-Governance and Management Economics, 2020, 8(2):28-34.
[10] Duan Y, Cao G, Edwards J S. Understanding the impact of business analytics on innovation[J]. European Journal of Operational Research, 2020, 281(3): 673-686.
[11] Garbuio M, Lin N. Artificial intelligence as a growth engine for health care startups: Emerging business models[J]. California Management Review, 2019, 61(2): 59-83.
[12] Grover V, Chiang R H L, Liang T P, et al. Creating strategic business value from big data analytics: A research framework[J]. Journal of management information systems, 2018, 35(2): 388-423.
[13] Gupta K, Jiwani N. A systematic Overview of Fundamentals and Methods of Business Intelligence[J]. International Journal of Sustainable Development in Computing Science, 2021, 3(3): 31-46.
[14] Khan W A , Chung S H , Awan M U ,et al.Machine learning facilitated business intelligence (Part II): Neural networks optimization techniques and applications[J].Industrial Management & Data Systems, 2019, 120(1):128-163.
[15] Kiani Mavi R, Standing C. Cause and effect analysis of business intelligence (BI) benefits with fuzzy DEMATEL[J]. Knowledge Management Research & Practice, 2018, 16(2): 245-257.
[16] Li H Y .Research on Business Model Optimization of Artificial Intelligence Garbage Classification[J].Transactions on Computer Science and Technology, 2022, 9(1):20-25.
[17] Mariani M, Baggio R, Fuchs M, et al. Business intelligence and big data in hospitality and tourism: a systematic literature review[J]. International Journal of Contemporary Hospitality Management, 2018, 30(12): 3514-3554.
[18] Mishan M T , Fadzil A F A , Samah K A F A ,et al.Business Intelligence for Paintball Tournament Matchmaking Using Particle Swarm Optimization[J].Indonesian Journal of Electrical Engineering and Computer Science, 2018, 11(2):599-606.
[19] Rane S B, Narvel Y A M, Bhandarkar B M. Developing strategies to improve agility in the project procurement management (PPM) process: Perspective of business intelligence (BI)[J]. Business Process Management Journal, 2020, 26(1): 257-286.
[20] Rao S K M S V .A Novel Integrated Machine&Business Intelligence Framework for Sensor Data Analysis[J]. Internet of Things Magazine (English), 2021, 3(1):27-38.
[21] Richards G, Yeoh W, Chong A Y L, et al. Business intelligence effectiveness and corporate performance management: an empirical analysis[J]. Journal of Computer Information Systems, 2019, 59(2): 188-196.
[22] Sun Z, Sun L, Strang K. Big data analytics services for enhancing business intelligence[J]. Journal of Computer Information Systems, 2018, 58(2): 162-169.
[23] Williams A , Suler P , Vrbka J .Business process optimization, cognitive decision-making algorithms, and artificial intelligence data-driven internet of things systems in sustainable smart manufacturing[J].Journal of Self-Governance and Management Economics, 2020, 8(4):39-48.
[24] Zhang C, Chen Y. A review of research relevant to the emerging industry trends: Industry 4.0, IoT, blockchain, and business analytics[J]. Journal of Industrial Integration and Management, 2020, 5(01): 165-180.