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Data Visualization and Decision Support Analysis Based on Tableau

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Abstract: With the rapid development of big data technology, data visualization technology has gradually become a key tool for decision support. This article relies on the Tableau platform to conduct in-depth research on the application and specific implementation of data visualization in the field of decision support. The article elaborates on the core features of Tableau and its powerful capabilities in data processing, and analyzes its advantages in data integration, analysis, and presentation. Through specific cases, this article provides a detailed introduction on how to use Tableau to complete the entire process from data preprocessing to final visualization display, and explores the applicability and effects of different charts. The article further analyzes how to combine data visualization with improving decision-making efficiency and reducing decision-making risks, and proposes coping strategies for enterprises that may encounter difficulties in adopting data to guide decision-making processes. Research has found that using Tableau for data visualization can enhance the effectiveness and ease of understanding of data transmission, providing more accurate and timely support for enterprise decision-making.

Introduction

In the era of big data, massive amounts of data information pose unprecedented challenges to traditional decision-making systems. The issue of how to quickly and accurately extract key information from massive datasets and present it in a clear and intuitive graphical format to assist businesses in making informed decisions has become a hot topic in current research. Data visualization technology, as a technique for transforming complex data information into easily grasped knowledge, has been widely promoted in many fields. Tableau, as a leader in the industry, is highly favored by data analysts and decision-makers for its outstanding data processing capabilities and interactive display effects. This article explores the application of Tableau in data visualization in decision support systems. By analyzing its key functions and specific application examples, it reveals its critical role in decision optimization and the potential for future development.

1. Introduction to Tableau

Tableau is an American company founded in 2003, and its innovative technology originated from Stanford University's data visualization research project. This project aims to optimize the presentation format of data to enhance the readability and efficiency of data analysis [1]. The enterprise has utilized the Visual Query Language (VizQL) technology to transform the complex database query process into visual images, achieving dynamic display of data. In 2004, Tableau launched its first desktop product, which had a convenient drag and drop interface and diverse chart options, greatly facilitating users. Subsequently, Tableau gradually expanded its product range, covering multiple versions such as Server, Online, Public, and Prep, to meet the diverse needs of enterprises and individual users of different sizes. In 2019, Salesforce incorporated Tableau into its portfolio, further consolidating and enhancing its position in the enterprise market. After years of technological innovation and product refinement, Tableau has firmly established a leading position in the global data visualization industry and occupies an important position in enterprise data analysis and business intelligence.

2. Building a data visualization platform based on Tableau

2.1 Integration and Processing of Data Sources

In building a data visualization system with Tableau as the core, integrating and processing data sources is the core. Efficient data integration can ensure high consistency and accuracy of data, laying a solid foundation for future data mining and visual presentation [2]. In the data integration stage, it is necessary to screen and access various relevant data resources. The supply chain related information of general enterprises is scattered among numerous independent systems, such as ERP systems, SCM systems, WMS systems, and logistics management platforms. The data in these systems is stored in different database formats, and the types and dimensions of the data are also different. During the integration process, it is necessary to pay attention to the inherent connections between various data sources and implement unified format adjustments and field correspondences. The integration process is shown in Figure 1.

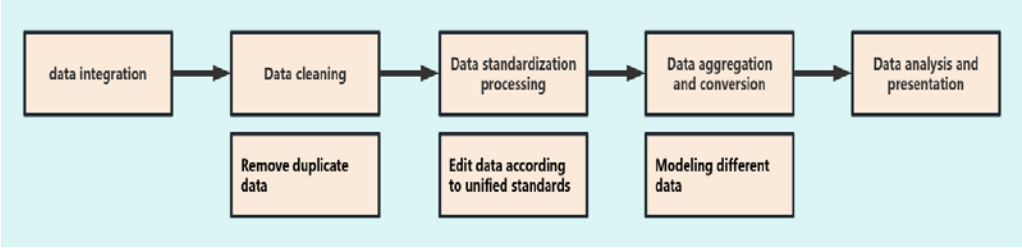

Figure 1. Data integration process.

Firstly, it is necessary to perform cleaning operations on numerous data sources to eliminate redundant and irrelevant information. When dealing with missing values, filling or excluding measures should be taken according to the specific situation to prevent interference with subsequent analysis. Subsequently, the data is standardized, such as unifying date formats, amount units, etc., to ensure the uniformity of the data on a unified platform. For some complex data items, such as product codes, order numbers, etc., dimension tables (such as product catalogs, customer directories) can be used to

achieve data interconnection and maintain data integrity. After completing data cleaning and standardization work, the data is summarized and transformed, and Tableau's data connection function is used to associate various data tables to construct a data model. The data integration has come to an end, followed by the stage of data analysis and presentation.

2.2 Visual Component Design and Development

When building a data visualization platform based on Tableau, designing and developing visualization components is a key step in transforming data into meaningful information. In the conceptual stage, designers need to comprehensively consider the essence of data, the actual needs of users, and the interactive characteristics of the platform [3]. The selection of appropriate data visualization methods is crucial. For example, when revealing the development of a time series, a line chart is an ideal choice. When comparing different types of data, bar charts or their variants - stacked bar charts - are more suitable. As for displaying the distribution characteristics of data in multiple dimensions, scatter plots or heat maps can provide clear visual displays. Through Tableau, users can easily build diverse charts by dragging and dropping dimensions and measurement fields. The convenience and efficiency of this operation have improved the speed of data processing visualization. When developing visual components, dynamic interaction functionality is a key element that allows users to filter and analyze data as needed. This interactivity enhances the user experience and helps users gain deeper insights into the patterns and connections behind data. In the specific process of data visualization creation, advanced calculations need to be performed on the data to reveal its deep connotations from different perspectives. For example, the relationship between sales revenue and advertising investment can be expressed through a complex mathematical formula:

$$S(t) = S_0 \times (1 + r)^t \times \left(1 + \frac{A(t)}{C}\right) \tag{1}$$

In formula (1), S (t) represents the sales revenue at time t, S0 is the initial sales revenue, r is the annual growth rate, A (t) is the advertising investment at time t, and C is the threshold for advertising investment, reflecting the growth effect of advertising on sales. By utilizing Tableau's calculation field function, the formula can be processed and its various elements can be projected onto a multidimensional data level. Line charts or other forms of data visualization can be used to display the calculation results. This approach enables Tableau to convert data into chart format and helps analysts gain insights into how different factors specifically affect sales performance, providing strong data support for decision-making processes[4].

2.3 Implementation of Data Analysis and Modeling Functions

Building a data visualization system based on Tableau, data analysis and model construction are key, and they are the direct driving force for data value-added and deep insights. Tableau is an excellent data visualization software that integrates a variety of data analysis tools, covering data modeling, prediction, and complex statistical analysis, helping users explore the inherent rules and trends of data from multiple perspectives. Data analysis first involves sorting and pre-processing the data. Tableau utilizes its data connection and custom field functions to aggregate data from different channels (such as Excel documents, databases, cloud services, etc.) into a single worksheet, laying the foundation for subsequent analysis and model construction. For example, when predicting and analyzing demand in

the supply chain, regression analysis can be conducted by combining historical sales data with product influencing factors (seasonal changes, promotional activities, etc.). In Tableau, new variables can be created through built-in calculation fields, such as constructing a linear regression model using the following formula:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + ... + \beta_n X_n + \varepsilon \quad (2)$$

In formula (2), Y represents demand, X1, X2,..., Xn are various factors that affect demand (such as product prices, advertising expenses, seasonal factors, etc.), β0, β1,..., βn are model coefficients, and ϵ is the error term. Tableau can set unique weight values for various influencing factors, and then use its trend analysis or prediction tools to automatically construct regression analysis models and estimate future demand[5]. In addition, Tableau also has the ability to perform advanced data analysis techniques such as time series analysis and clustering analysis. Users can use the analysis dashboard and built-in calculation methods such as moving averages and year-on-year growth to quickly reveal the development trends and cyclical characteristics of data. When faced with numerous complex data analysis tasks, Tableau provides integrated support for R language and Python code. Users can implement more in-depth statistical analysis or machine learning programs in the system, import externally constructed model results into a visual operation interface, and improve the quality and accuracy of analysis. With these advanced features, Tableau has successfully integrated sophisticated mathematical models with data analysis techniques, helping users quickly understand the essential laws of data and providing solid scientific support for decision-making.

3. Application of Tableau in Decision Support

3.1 Macro strategic formulation of enterprises

In the stage of formulating macro strategic plans for enterprises, the use of data analysis and visualization software such as Tableau has improved the speed and accuracy of decision-making. The strategic positioning of an enterprise needs to be comprehensively considered from multiple dimensions, including market dynamics, competitor situation, resource allocation, risk prediction, and many other factors. By using Tableau, enterprises can transform complex data information into concise and easy to understand graphical representations, assisting senior management in making more reasonable and accurate decisions when making strategic choices[6]. For example, for a manufacturing company planning to formulate a development strategy for the next three years, its primary task is to analyze the degree of adaptation between market demand fluctuations and production capacity. With the help of Tableau tools, the enterprise can consolidate various data including past sales performance, market growth rate, and changes in raw material supply chain prices into a visual data display system, and create three-dimensional data analysis charts. The management can utilize the interactive function of the system to screen different market indicators, time spans, and influencing factors, and gain deeper insights into the interactions between various variables. Here are some of the data analysis results obtained through Tableau:

After analyzing the data shown in Table 1, enterprises can more flexibly optimize resource allocation, increase capital investment in regions with high growth potential, and implement cost management strategies to enhance comprehensive benefits when formulating overall strategies. Tableau's real-time data refresh feature enables enterprises to keep up with market trends, quickly adjust strategic deployments, and ensure continuous optimization of decision-making.

Table 1. Strategic Development Forecast Table.

Region	Sales revenue (10000 yuan)	Market growth rate (%)	Raw material cost (10000 yuan)	Sales growth forecast (%)
East	1500	5	300	7
south	1300	3	250	5
North	1000	4	200	6
southwest	800	6	150	8

3.2 Development of Risk Prevention and Control Strategies and Emergency Plans

In modern enterprise management, building a comprehensive risk prevention mechanism and emergency response plan is particularly important to ensure the sustained and stable development of enterprise business. With the widespread application of data analysis technology, Tableau, as an excellent data visualization tool, has played an important role in various aspects of risk management. Enterprises can use it to conduct detailed analysis of historical data, market dynamics, and various potential risk factors, timely discover and predict possible risk points, and formulate more reasonable and efficient prevention and control measures [7]. For example, a manufacturing enterprise may encounter various types of risks, including supply chain disruptions, fluctuations in raw material costs, and production machinery failures. Enterprises can use Tableau to aggregate data information from different departments, such as sales data, inventory status, production records, etc., and use techniques such as time series analysis and regression analysis to predict the likelihood of risk occurrence in different scenarios. With this data-driven decision-making model, enterprises can more accurately identify the source of risks and develop appropriate emergency plans accordingly. Among the various methods of risk assessment, calculating "risk exposure" is a commonly used one, and its calculation formula is:

$$RE = P \times I \tag{3}$$

In formula (3), RE represents risk exposure, P represents the probability of risk occurrence, and I represents the degree of impact at the time of risk occurrence. Through Tableau Enterprise, historical data and market data can be combined to calculate exposure to different risk events. Faced with the risk of price instability in raw material costs for enterprises, past records show that the probability of such changes occurring is 30% (P=0.3), and once a change occurs, it may cause a loss of up to 1 million (I=1000000). Calculate the risk exposure using this formula as $RE = 0.3 \times 1000000 = 300000$ Through this, enterprises can identify potential high-risk areas and concentrate resources on these key areas to implement effective risk control strategies. In addition, Tableau software can instantly refresh risk data, creating a monitoring platform for enterprises that can dynamically track risks and facilitate timely adjustment of emergency plans to respond to unexpected situations. Therefore, Tableau is not only a simple data visualization tool, but also a powerful auxiliary platform that plays an important role in risk management decision-making.

3.3 Support for Product Development Decisions

Cost control plays a crucial role in the product development process, and with the help of data visualization technology Tableau, R&D decisions can be made more efficiently and accurately[8]. The

decision-making process in product development covers a wide range of dimensions, including but not limited to market trend analysis, technology feasibility exploration, cost budgeting, and management of the entire product lifecycle. Tableau has the ability to gather data resources across departments and systems, helping management to comprehensively grasp various issues and challenges that may arise during the R&D phase and make more informed choices. Taking the development cycle of innovative products as an example, enterprises must comprehensively consider multiple factors such as research and development progress, cost investment, and resource allocation when developing innovative products. By using Tableau, developers can track the trend of key indicators in real-time, making it easier to identify potential risks and make timely adjustments. There exists a fundamental production and R&D progress model that elucidates the interrelationship between product R&D cycles and resource requirements. It can be represented by the following formula:

$$P(t) = P0 + R \cdot \int_0^t e^{-\alpha \cdot (t-T)} dT \tag{4}$$

In formula (4), P(t) represents the product development progress at time t, P0 is the initial progress, R is the amount of resources invested, and α is a decay coefficient representing the change in development efficiency over time (which may decrease due to technical difficulty or other external factors). This formula reflects the impact of continuous resource investment on research and development progress by integrating time. By utilizing Tableau Enterprise, real-time monitoring and dynamic adjustment of various parameter values in formulas can be achieved, and the promotion effect of various resource allocation schemes on product development speed can be analyzed. For example, when Tableau's visualization tools show slow progress in the development of a certain technology, and the resources invested do not significantly promote an increase in development speed, management can adjust resource allocation plans or improve research and development methods accordingly.

3.4 Practice in the field of enterprise operation decision-making

In the strategic decision-making process of enterprises, utilizing Tableau tools can enhance the speed and accuracy of data processing. By comparing the changes in data before and after adjustment, companies can have a clearer understanding of the specific effects of improvement measures. The following is a comparative analysis of data before and after applying Tableau for optimization in enterprise operation decision-making.

Table 2. Comparison before and after optimization.

Index	Before optimization (2023 Q1)	Optimized(2023 Q2)	Improvement range
Average order processing time	48hour	36hour	-25%
Customer complaint rate	8%	5%	-37.5%
Supply chain inventory turnover rate	5Times/year	6.5Times/year	+30%
transportation cost	1 million yuan	850000yuan	-15%
Sales order fulfillment accuracy	92%	98%	+6.5%

With Tableau's visual analysis tools, enterprises can quickly capture the changing trends of various key indicators and develop more clear improvement strategies based on data display. After improvement, the business operation efficiency of the enterprise has been enhanced, the time for processing orders has been shortened, customer complaints have decreased, the speed of inventory circulation and the accuracy of sales order execution have been improved, and logistics costs have also been reduced. This comparative analysis reveals the effectiveness of improvements and provides strong data basis for future business decisions. Tableau enables senior managers to quickly identify issues and make corresponding adjustments through its dynamic data refreshing and graphical presentation, accelerating the efficiency of the decision-making process.

4. Conclusion

With the rapid development of information technology and the continuous expansion of data scale, data visualization technology has gradually become a key assistant for enterprises and institutions to formulate strategies. This study uses Tableau as a tool to deeply analyze the positive role of data visualization in improving the efficiency and accuracy of decision support systems. Thanks to Tableau's high interactivity and ease of operation, complex business data can be simplified into intuitive images, helping decision-makers obtain clear information to optimize decision-making processes and enhance the market competitiveness of enterprises. Looking ahead, with the continuous upgrading of data analysis technology, visual data processing methods will play an important role in more industries and become the core means to promote data-driven decision-making. We hope that the results of this study can provide some reference significance for the practical application and future development direction of data visualization, and lay a solid foundation for discussions in the same industry.

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