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Research on the Application of Data Visualization in Management Accounting Decision-Making

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Abstract. In the era of digital economy, enterprise financial management is faced with the dilemma of data overload and lack of information, and data visualization has become an important tool to connect data and management accounting decision-making. This paper studies the application areas and implementation effects of data visualization in management accounting decision-making, aiming to provide a reference for the digital transformation of enterprise finance. This study adopted the literature review method and conducted an inductive analysis based on the relevant theme literature included in CNKI. Through the literature review, it is found that data visualization can improve the readability and interactivity of financial information, and help management accounting not only to output information, but also to participate more in the business decision-making of enterprises. Sound data governance, suitable analysis tools and interdisciplinary professionals are an important basis for the application of visualization technology. This study also discusses the challenges in practice and provides suggestions for future research.

Keywords: Data Visualization, Management Accounting, Decision Support, Business Analysis

1. Introduction

With the continuous influx of various business data into the financial system, many enterprises have the problem of a large amount of data but difficulty in extracting effective information [1]. As a technical means to transform complex data into intuitive visual information, data visualization helps users quickly extract valuable information relying on the characteristics of visual perception [2]. However, traditional management accounting relies on static statements to carry out accounting analysis, which is difficult to adapt to the real-time and multi-dimensional business decision-making needs of management [1].

Most of the existing studies focus on the technology itself or individual business scenarios, and few fully review how data visualization affects management accounting decisions as a whole, which also leaves room for discussion in this study [3].

This paper discusses the application of data visualization in financial reporting, budget management, performance evaluation and risk early warning. The research adopts the literature review method and conducts an inductive analysis based on 10 academic literature included in CNKI [4]. Theoretically, it helps to improve the theoretical system of data visualization enabling

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management accounting decision-making, and in practice, it can provide a reference for the digital transformation of enterprise finance.

2. Data visualization and the theoretical basis of management accounting

Data visualization can convert complex original data into intuitive graphics, thus reducing the difficulty of understanding and improving the efficiency of information transmission [2]. The complete visualization process includes two main stages: data conversion and graphic rendering. In management accounting, visualization serves as an important bridge between original business data and business decisions [2]. Compared with traditional reports, visualization can reduce cognitive load and help managers quickly identify business characteristics and anomalies [5]. Visualization can also be iteratively integrated with automatic data analysis to improve decision response efficiency [2].

3. Core application areas of data visualization in management accounting

3.1. Visualization of financial reporting and operational analysis

Traditional financial reports mostly adopt the form of static tables, and there is significant delay in data update, which makes it difficult to carry the huge volume and complex structure of business data, thus affecting the timeliness of management decisions [5, 6]. For enterprises with continuous business expansion, the scale of financial data expands rapidly, and the shortcomings of traditional reports are further highlighted: timely information update, single analysis dimension, and lack of interaction ability. Managers need to independently screen effective information from massive numbers, which has a heavy cognitive burden and is difficult to support dynamic and real-time business decisions [5].

The application of visualization technology effectively makes up for the defects of static reports. With the help of interactive dashboards, managers can track core indicators in real time and receive abnormal alerts, Multi-dimensional cross data analysis is carried out by using chart drilling and slice screening functions to break the information limitation of traditional reports [5, 6]. Visualization converts boring values into intuitive graphs, reduces the time required for information interpretation, facilitates users to capture business rules from complex data, and improves the efficiency of financial analysis [6].

Visualization has been applied in a number of practice scenarios of management accounting. In cost analysis, the cost structure of each department and product line can be intuitively split, and the cost change link can be quickly identified, Compare budget objectives with actual implementation results in budget management, and efficiently trace the causes of differences, Cash flow analysis relies on dynamic charts to present the time sequence and flow path of capital income and expenditure, detect capital gap in time, and provide a decision-making basis for cost control, budget correction and capital coordination [5].

3.2. Visualization of budget management and cost analysis

Traditional budget management relies on static statement accounting, lag update, deviation identification depends on manual labor, cost data is scattered, and it is difficult to track the progress in real time [7]. In many enterprises, budget preparation and execution monitoring are still carried out on a monthly or quarterly basis. When managers receive the budget execution report, the best

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time for adjustment has often passed. At the same time, cost data are scattered across different business links and systems, and it is difficult to form a unified and intuitive cost structure view. Manual comparison of budget and actual data is not only time-consuming but also prone to omission and error, which weakens the ability to warn of cost anomalies [7].

Relying on the financial sharing platform, visualization technology captures the budget and actual differences through a real-time dashboard to support pre-warning and in-process control [6, 7]. The system collects business data according to standardized accounting rules, and captures the difference between budget and actual performance through a real-time indicator dashboard. With the help of an intelligent analysis module, it mines the law of cost changes, integrates the scattered business data at the city and county levels, and supports pre-warning and in-process control, thus improving the response efficiency of budget correction and cost control [6, 7].

The visualization tool presents cost fluctuations with the help of heat maps [8], displays cost composition with hierarchical charts, and realizes cross-dimensional cross-comparison by using slicing and drilling functions [6]. Through these functions, managers can not only observe the overall budget execution at the macro level, but also drill down to specific business documents at the micro level, so as to realize cross-dimensional comparative analysis and provide intuitive data support for budget adjustment and cost optimization [6].

3.3. Visualization of performance evaluation and risk warning

In performance evaluation visualization, Business Intelligence (BI) tools are used to build a cash flow comparison view, realize horizontal benchmarking between group subjects and vertical comparison of operation stages, and highlight abnormal performance nodes [9]. Risk early warning visualization integrates topological network and hierarchical early warning system, and describes the diffusion path of risks among organizations through three elements: nodes, transmission relationship and influence strength [9]. Based on BI technology, an enterprise risk profile is constructed to determine risk levels from multiple dimensions and divide high, medium and low warning levels [10]. Some studies have proposed a full-chain visualization framework covering data collection, risk mapping and decision support [9]. There are also studies taking Shanxi state-owned capital operating companies as samples to build an early warning system including index design and risk classification [10].

3.4. Synergy of inferential statistics and visualization

Inferential statistics provide quantitative support for management accounting and are widely used in business forecasting, program decision-making and performance evaluation scenarios [2]. Visualization technology can transform abstract indicators such as confidence intervals and significance levels into intuitive graphs and reduce the cognitive difficulty of statistical conclusions [2]. Interpretable visual analysis can trace the data context formed by the conclusion, avoiding only observing the results and ignoring the internal logic of statistical inference [2]. The two jointly build a decision-making chain from "seeing" to "judgment": visualization undertakes the output of statistical models, and users rely on visual interaction to transform statistical evidence into management judgment and improve the quality of decision-making [5].

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4. Typical application cases in enterprise practice

4.1. Visualization scheme of intelligent financial analysis of G Enterprise

G Enterprise has multiple shortcomings in traditional financial management: lengthy manual document processing and a serious backlog, Data rely on manual verification, and cost accounting is easy to mismatch, Budget control adopts static statements, and capital monitoring lags behind, making it difficult to timely respond to project overruns and sudden capital needs [8]. In peak settlement periods, the daily processing volume of documents can reach thousands, and the backlog rate remains high, which not only extends the reimbursement cycle for employees but also delays payments to suppliers. Manual verification of large-scale data also leads to repeated entry and cross-system inconsistency, further increasing the risk of cost accounting errors. In addition, the static budget reporting mode makes it difficult to detect project overspending in time, and emergency capital needs often cannot be responded to quickly [8].

The enterprise builds a three-layer intelligent financial visualization scheme: At the bottom, Enterprise Resource Planning (ERP), Office Automation (OA) and production system data are connected, and automatic document identification and hierarchical approval are realized by relying on an intelligent audit engine. The middle layer deploys a dynamic budget model to continuously update expenditure forecasts, A visual monitoring platform was built at the top level to focus on displaying core indicators such as capital flow trajectory and aging of accounts receivable [8]. Through this architecture, the system realizes the automatic circulation of documents, real-time monitoring of budget execution and visual tracking of capital flow, which effectively reduces manual intervention and improves the accuracy and timeliness of financial data [8].

After the implementation of the scheme, the timeliness of document processing was greatly reduced from the original 3 working days to less than 4 hours, the efficiency was improved by about 85%, the error rate of cost accounting was reduced to less than 0.3%, and the budget management changed from periodic adjustment to real-time dynamic response [8]. These improvements significantly enhance the intelligent and refined level of enterprise financial management, and provide strong support for the sustainable expansion of the enterprise in emerging markets [8].

4.2. BI analysis practice of Shanxi state assets

Before the launch of BI tools, there were some problems in Shanxi state-owned assets, such as the mutual independence of industry and finance data, difficulty in benchmarking analysis of subordinate enterprises, and inability of supervision to sink to grass-roots subjects [10]. The enterprise under its jurisdiction has complex levels and diversified industrial layout, and its business and financial data are scattered in different information systems, making it difficult to carry out cross-subject and multi-dimensional benchmarking work. The original supervision mode is difficult to penetrate into subordinate units, and there are governance problems such as low work efficiency and delayed risk discovery [10].

In view of the above problems, Shanxi state-owned assets have built a financial BI system oriented by the integration of industry and finance, aiming at penetrating analysis, dynamic supervision and management efficiency improvement, and setting up functional modules such as operation analysis, risk early warning, enterprise benchmarking, approval and assessment, and comprehensive budget management. Through data collection and model operation, the system supports multi-level data penetration query, automatic warning of changing financial indicators, and

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realizes multi-subject and multi-industry benchmarking research and judgment, so as to build a complete decision support chain [10].

In terms of governance effectiveness, this practice has outstanding value. The system broadens data collection channels, lays a solid foundation for data governance, quickly locks risks with the help of visual means, explores hidden risks that are not easily detected by traditional supervision, and effectively improves supervision efficiency. This digital supervision system can provide a reliable basis for the operation and management of state-owned enterprises and help provincial state-owned enterprises achieve high-quality development [10].

4.3. The commonality and enlightenment of practical cases

Several common trends can be summarized from the practical cases of G Enterprise and Shanxi state-owned assets: the data analysis mode changes from static post-accounting to dynamic real-time monitoring, the index dimension changes from single financial index to multi-dimensional integration analysis of industry and finance, and the risk control changes from passive investigation to active early warning and prediction [8, 10]. The successful implementation of the two cases depends on three key factors: data quality control is the foundation, and data standardization governance directly determines the accuracy and reliability of intelligent analysis, Tool adaptation is the key, enterprises need to choose the right visual analysis tools according to their own scale and industry characteristics, Interdisciplinary talents are the guarantee, and cross-field talents can effectively break through the information barrier between business and finance [1, 10]. These experiences provide a reference for enterprises' digital transformation. Enterprises should give priority to improving data governance mechanism, matching visual analysis tools, and cultivating interdisciplinary professionals with both financial knowledge and data analysis ability [1].

5. Conclusion

This paper mainly discusses the application areas and implementation effects of data visualization in management accounting decision-making, and analyzes the four scenarios of financial reporting, budget management, performance evaluation and risk early warning. By reviewing the literature, this study finds that data visualization can effectively improve the problem of static lag of traditional financial information, transform abstract data into intuitive information, and promote management accounting from information provider to decision-making participant. Data governance, tool adaptation and interdisciplinary professionals are the key foundations of visualization.

This paper has not conducted quantitative empirical testing and lacks quantitative evaluation of the decision gain effect of visualization. Subsequent studies can use questionnaires or comparison of multiple cases to quantitatively evaluate the actual impact of visualization on decision-making efficiency and quality.

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