Optimisation of Big Data and Artificial Intelligence Driven Digital Intelligence in Manufacturing Budget Management

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Abstract. With the advancement of manufacturing industry's transformation to digital intelligence, budget management, as an important part of corporate financial management, is gradually integrated into big data and artificial intelligence technology, ushering in new opportunities for digital intelligence transformation. This essay discusses the challenges and opportunities faced by manufacturing budget management in the process of digital and intellectual transformation, focusing on how big data and artificial intelligence technology drive the optimisation of budget management. In the budgeting process, dynamic budgeting and rolling budget mechanisms combined with real-time data and AI forecasts are used to achieve flexible budget adjustments and improve the ability to respond to market changes. In budget enforcement, the use of BI systems and visual dashboards as well as real-time deviation analysis, timely detection of budget deviations and provision of adjustment recommendations, significantly improving the efficiency and transparency of execution. In budget evaluation, introduce a multi-dimensional evaluation framework that combines financial, non-financial and external environmental factors, and dynamically adjust evaluation weights through artificial intelligence to make the evaluation more comprehensive and accurate. Through these optimisation strategies, the manufacturing industry can achieve more efficient and accurate budget management, and promote the improvement of overall operational efficiency and sustainable development.

Keywords: Budget management, Digital transformation, Big data

1 Introduction

In July 2024, the Decision of the Central Committee of the Communist Party of China on Further Comprehensively Deepening Reform and Promoting Chinese-style Modernisation of the Third Plenary Session of the 20th CPC Central Committee proposed to accelerate the promotion of new-type industrialisation, cultivate and grow advanced manufacturing clusters, and promote the development of manufacturing industries in a high-end, intelligent and green way. It is necessary to lead the optimisation and upgrading of traditional industries with the upgrading of national standards,

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and to support enterprises in upgrading traditional industries with digital intelligence and green technology[1]. This is the first time that the government has used the term ‘digital intelligence’ in an important policy document, and the decision has put forward directional requirements for the digital and intellectual transformation of the high-quality development of manufacturing enterprises. In 2022, the SASAC issued the ‘Guidelines for Building World-Class Financial Management’, which also proposed to improve the comprehensive budget management system, co-ordinate intelligent and forward-looking financial digitalisation planning, and establish intelligent, agile, systematic, in-depth and forward-looking digital and intelligent financial[2]. In 2024, the Ministry of Finance issued the ‘Guidelines on Comprehensively Deepening the Application of Management Accounting’, pointing out that the optimisation and updating of management accounting tools and methods should further reflect the application of new technologies such as digitalisation and intelligence, and new concepts such as sustainable development in management accounting[3]. This intelligent transformation promotes the manufacturing industry to change from the traditional static budget to the dynamic and efficient intelligent budget mode, which enhances the industry's market adaptability and risk resistance. The digital-intelligent transformation of budget management not only enhances the financial management efficiency of enterprises, but also provides them with strong market adaptability and risk resistance.

Cheng P., Chen R. (2023) constructed a comprehensive budget management framework model based on ChatGPT on the basis of the fit between ChatGPT and enterprise comprehensive budget management. Meanwhile, the application concerns of ChatGPT-based comprehensive budget management model, such as budget management information security and data preparation, human-computer intelligent interaction and collaboration, are also proposed[4]. Combined with the actual situation of C colleges and universities, Miao Y. (2024), by analysing the challenges faced by the budget management integration construction of colleges and universities through the transformation of digital intelligence, put forward the specific path for colleges and universities to achieve the budget management integration construction in the context of the transformation of digital intelligence, in terms of the construction of the standardized system of college budget management, and the construction of the budget management information system of colleges and universities[5]. Wang T. (2024) takes the digital intelligent financial management system constructed by Shanxi State-owned Capital Operation Co., Ltd. as an example, introduces its framework design and BI application, and puts forward the direction of future improvement in combination with the shortcomings of the current system operation[6]. Around the digital transformation of budget management, Cheng H., Liu H., Li N. (2024) to complex product manufacturing enterprises as the object, pointed out that the comprehensive budget management to the intelligent, digital transformation has become possible and put forward the digital platform, order budget management system, “visual” display, intelligent dynamic analysis and organisational protection of the digital transformation path, in order to achieve the complex product manufacturing enterprises[7]. The digital transformation path to achieve the complex manufacturing business and value management synergy. With the rapid development of China's

economy, digital intelligent transformation has become an inevitable trend in the development of all industries, manufacturing is no exception. The digital transformation of budget management is an important way to achieve high-quality development of enterprises, and digital transformation can not only improve the level of enterprise financial management, but is also an inevitable choice for enterprises to meet the challenges of the digital era. However, looking at the existing literature, the digital transformation of budget management often focuses on a specific issue and fails to analyse systematically from the perspective of the whole life cycle. Therefore, this paper will analyse the main pain points and limitations in each step of manufacturing budget management, and further propose the optimisation paths and optimisation guarantees of big data and AI technologies in different aspects of budget management.

2 Analysis of Traditional Budget Management in the Manufacturing Industry

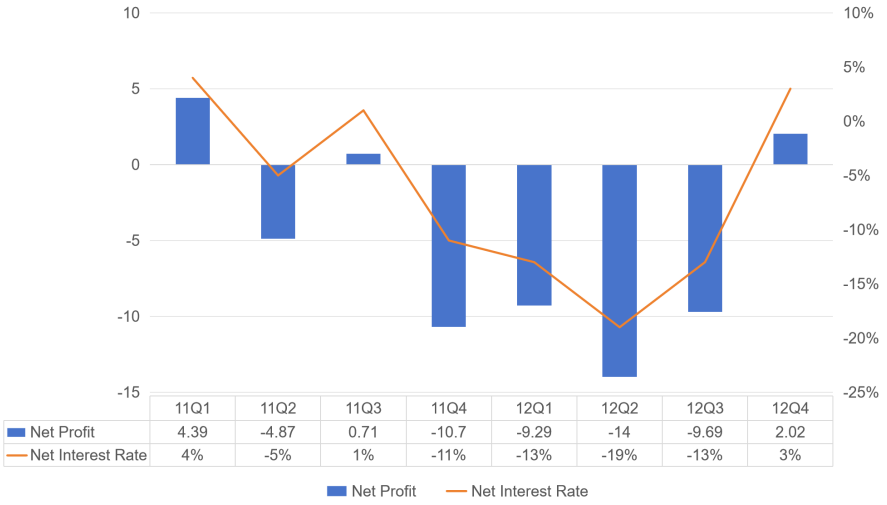
The traditional budget management in manufacturing industry is a kind of budget preparation and execution mode centred on cost control and based on fixed cycle and manual operation. Although it has adapted to the needs of manufacturing production management for a certain period of time, its limitations have gradually emerged with the rapid changes in the market environment and the expansion of enterprise scale.

2.1 Characteristics and Limitations of Traditional Budgeting in the Manufacturing Industry

Traditional manufacturing budgeting usually takes a top-down approach, with top management setting budget targets and then cascading them down to individual departments. First, the budgeting cycle is fixed. Usually an annual budget, the budget content is relatively fixed, focusing on cost control and revenue forecasting, and emphasising the reliance on historical data. Based on historical data, statistics and analyses of past data are used to forecast future financial needs. Second, the traditional budgeting process focuses on rigid control. Once a budget is set, it is usually difficult to adjust it, which helps companies maintain financial discipline and stability.

The advantage of this approach is ease of operation, but there are some limitations. First, slow response to environmental changes transmission. The reason why the traditional budget is often unable to accurately predict is that it relies too much on historical data and static assumptions, and is unable to fully consider market changes and external uncertainties. Traditional budgets often ignore the impact of external factors such as new technologies and policy changes, which may have a significant impact on business operations, leading to biased and inaccurate budget forecasts. For example, Nokia was the world's largest mobile phone manufacturer in the mid-2000s, and much of its budgeting and strategic planning relied on market trends and historical data at the time. However, Nokia failed to anticipate the rise of Apple and Android smartphones in time, and its budget forecasts were still based on the traditional fea-

ture phone market. in 2007, Nokia's global market share was 49%, but by 2012, it had rapidly dropped to 20% and continued to decline. Nokia reported a billion dollar loss in 2011 after failing to adapt to the smartphone trend in time. Figure 1 shows that Nokia's net profit in 2011 and 2012 showed a very downward trend.



	11Q1	11Q2	11Q3	11Q4	12Q1	12Q2	12Q3	12Q4
Net Profit	4.39	-4.87	0.71	-10.7	-9.29	-14	-9.69	2.02
Net Interest Rate	4%	-5%	1%	-11%	-13%	-19%	-13%	3%

Fig. 1. Nokia's quarterly profit and loss for 2011 and 2012

Second, it lacks flexibility. Traditional budgeting, with its fixed annual cycle and incremental adjustments based on historical data, leads to a lack of flexibility in a rapidly changing market environment. Once a budget is set, the cost of adjusting it is high and the process is cumbersome, making it difficult for companies to respond in a timely manner to unforeseen events, changes in market demand or new opportunities.

2.2 Characteristics and Limitations of Traditional Budget Execution in the Manufacturing Industry

The characteristics of traditional budget execution in the manufacturing industry are mainly reflected in the control and supervision in strict accordance with the budget plan. Budget execution is usually centred on controlling costs and ensuring that budget targets are achieved, with an emphasis on comparisons and variance analyses between budgets and actual expenditures. Management will regularly check budget execution to ensure that production and operations are not overspent, and identify problems and adjust strategies through variance analysis. The advantage of this approach is that it provides clear financial targets and control mechanisms, which help to ensure the rational allocation of resources and the effective management of costs.

However, traditional budget execution also suffers from departmental nativism and inefficient synergy. Traditional budget execution in the manufacturing industry divides budget objectives by department, and each department independently formulates and manages budgets, which leads to concern for self-interests among departments and a lack of a global perspective. Moreover, the information transfer in the

budget execution process is poor and the communication between departments is insufficient, and the data and information relied on in each link are often scattered in different systems or departments, lacking effective integration and sharing, resulting in the data not being able to form a global view, which is prone to the phenomenon of "data islands". For example, in the budgeting process of Ford Motor Company in 2007, the production department and the sales department set their own independent goals. The production department set vehicle production based on past sales data, while the sales department failed to fully anticipate the impact of the global recession on market demand. As a result, Ford's production division continued to mass-produce vehicles according to traditional budgets, particularly by overinvesting in models with high fuel consumption.Ford reported a loss of $1.46 billion in 2008, with a significant disconnect between the production division's goals and actual market demand, resulting in a significant financial loss.

2.3 Characteristics and Limitations of Traditional Budget Evaluation in the Manufacturing Industry

Traditional budget evaluation in the manufacturing industry usually focuses on static budget management, emphasises cost control and the achievement of financial goals, and focuses on the deviation of cost control and budget execution. The evaluation index is generally based on the financial data such as cost, revenue and profit set in the budget, and is analysed by comparing the budget with the actual performance. The advantage of this type of assessment is that it can effectively identify resource wastage and cost overruns, ensure that the enterprise performs according to the budget and control financial risks.

Nevertheless, the design of assessment indicators for traditional budget assessment in the manufacturing industry lacks dynamism. Traditional assessment is usually based on annual budgets, and the indicators are mostly centred on financial data (e.g. cost, profit, etc.), ignoring the dynamic changes of non-financial factors (e.g. production efficiency, customer satisfaction, innovation ability). This fixed model leads to the assessment results can not fully reflect the actual operating conditions of the company, and it is difficult to incentivise departments to flexibly adjust their strategies to cope with market fluctuations. In addition, it is easy to ignore the strategic orientation. Traditional budget evaluation focuses too much on short-term financial indicators, such as profit, cost control and financial budget achievement, which may lead to the neglect of non-financial factors such as quality management, customer satisfaction and innovation. This type of assessment makes management and employees focus more on the completion of budget execution than on the core strategic objectives of the company. As a result, companies may neglect important areas such as long-term strategic investment, R&D and innovation, thus losing the initiative in market competition and affecting its future growth and innovation capability. For instance, part of Kodak's failure can be attributed to the neglect of strategic orientation in its budget evaluation. As a leader in the film manufacturing industry, Kodak had long focused its budget assessment on optimising film production costs and short-term profitability, while neglecting strategic investment in digital photography

technology, and ultimately falling behind competitors such as Sony and Canon in the digital photography market.

In view of the lack of flexibility, the existence of "data islands" and the neglect of strategic orientation of the traditional budget management in the manufacturing industry, the problems of budget management will be improved through the digital transformation of big data and artificial intelligence.

3 Optimisation Strategies for Manufacturing Budget Management Based on Big Data and Artificial Intelligence

In manufacturing budget management, traditional budget systems often struggle to meet the challenges of a dynamic environment, and the introduction of big data and artificial intelligence can significantly improve the efficiency and accuracy of budget management. The following will be optimised according to each step of the budget pipeline.

3.1 Characteristics and Limitations of Traditional Budgeting in the Manufacturing Industry

Dynamic budgeting is a new type of budget management method based on big data and artificial intelligence technology, which breaks the static and fixed limitations of traditional budget management through real-time data collection and analysis, enabling enterprises to flexibly respond to market changes and fluctuations in the internal and external environment. Traditional budgeting methods are usually based on historical data and preset targets, ignoring possible changes in the actual operation process, so it is often difficult to effectively respond to unexpected events or market changes. Dynamic budgeting, on the other hand, is centred on high-frequency adjustment and real-time response, and is able to make timely adjustments to budget targets based on changes in internal operational data (e.g., production efficiency, inventory levels, sales performance) and the external environment (e.g., market demand, supply chain dynamics, policy changes). Big data technology plays an integrating and analysing role in dynamic budgeting, by helping enterprises collect data from production, sales, supply chain and other aspects in real time, and transform these data into actionable budget proposals. At the same time, dynamic budgeting incorporates a rolling budget mechanism that regularly updates the budget cycle, such as quarterly, monthly, or even real-time adjustments, so that the budget is always aligned with the actual needs of the enterprise and market changes. For example, the Water System Management Department under China Petroleum & Chemical Corporation Tianjin Branch uses ERP system to implement dynamic budgeting. When preparing a comprehensive budget based on cost control, the Water Department makes full use of the comprehensive budget data provided by the company's ERP system to achieve a seamless connection between the grassroots budget and the company's comprehensive budget. The budget is reconciled according to different conditions.

In addition, the rolling budget mechanism is a management method for dynamically adjusting the budget, which enables the budget to adapt to the dynamic changes in the enterprise's internal needs and external environment through regular (e.g., monthly and quarterly) reassessment and updating of the budget targets. Unlike traditional annual fixed budgets, the rolling budget mechanism emphasises continuous optimisation and flexibility, and ensures the real-time and scientific nature of the budget by shortening the budget adjustment cycle from one year to more frequent time periods and dynamically revising the original targets. The rolling budget mechanism is supported by big data and artificial intelligence technology at its core, making full use of dynamic data (e.g., production costs, market demand, supply chain fluctuations, etc.) from both inside and outside the enterprise. The big data platform integrates real-time data from the Internet of Things (IoT), Enterprise Resource Planning (ERP) system and Customer Relationship Management (CRM) system to provide accurate basic information for budget adjustment. Meanwhile, artificial intelligence technology can analyse historical trends and real-time data to predict future revenue, costs and resource requirements, making budget adjustments more forward-looking. Through scenario simulation and risk analysis, enterprises can also assess the impact of different adjustment options on budget targets in advance, providing management with scientific decision-making support.

3.2 Monitoring of Budget Execution and Real-time Management of Exceptions

In the manufacturing industry, BI systems can automatically generate detailed budget execution reports through real-time data collection and processing, and carry out cross-departmental data comparison and analysis.BI systems help managers visualise the differences between various costs and budgets through real-time tracking of multiple budget items, such as production costs, equipment maintenance costs, and raw material purchasing expenditures. If there is overspending or deviation in a budget item, the BI system can automatically issue an early warning notice to remind the relevant departments to make timely adjustments. As part of the BI system, the visual dashboard transforms complex data into easy-to-understand information through various visualisation tools, making budget execution clear at a glance. For the manufacturing industry, real-time monitoring of production line expenses, material consumption, production and other key indicators is crucial. Visual dashboards can present these key data in a graphical format, helping management to quickly identify where budget deviations are occurring, where expenditures are too high, or where production schedules are not being met. In addition, BI and visualisation dashboards support multi-level decision making. For top management, the dashboard can provide macro budget execution and key financial indicators; for specific department managers, the system can customise personalised budget views based on permissions, enabling managers at different levels to grasp the progress of budget execution and potential problems in real time within their own areas of responsibility. For example, Sunrise Oriental launched its first BI project in 2013. The daily market price and actual purchase price of bulk materials is achieved by filling in reports, and the market trend table and actual purchase strategy table of bulk materials can be automatically gener-

ated, which makes it easy to analyse the price trend of bulk materials and make adjustments to the purchase plan according to the actual inventory and purchase situation. The following Figures 2 and 3 show Sunrise's FineReport Process Efficiency Kanban, as well as the bulk material market trend table and actual purchasing strategy table.

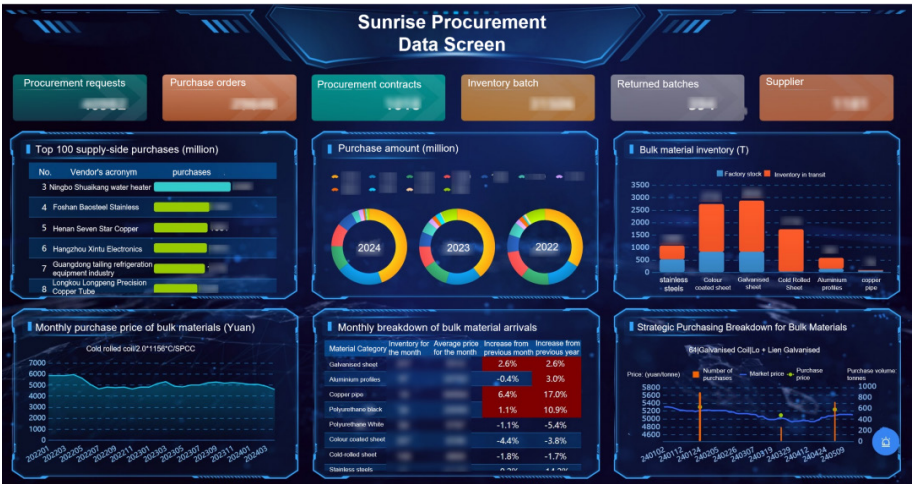


Fig. 2. Sunrise Purchasing Data Screen[8]

Bulk Materials Market Price Trend Table

Note: This table price for the official website market guide price, does not include freight, warehousing fees, financial costs, etc., not the actual purchase price, for reference only!

(29 May 2024)

Brand name	Norm	Unit	Average price last month	Beginning of month price	Yesterday's prices	Today's Prices	Day's rise and fall	Monthly Cumulative Gains and Losses	Official website
Copper	1#	Yuan/tonne	77126.5	80870	84590	84470	-120	+3600	Cheung Kong Non-Ferrous Metals Network
Aluminium	A00	Yuan/tonne	20235	20540	21040	21070	+30	+530	Cheung Kong Non-Ferrous Metals Network
Nickel	1#	Yuan/tonne	139722.5	144100	156550	155400	-1150	+11300	Cheung Kong Non-Ferrous Metals Network
Magnesium	1#	Yuan/tonne	20020	19900	20300	20300	0	+400	Cheung Kong Non-Ferrous Metals Network
Ore	PB(P) (61.5%)	Yuan/tonne	842	875	890	870	-20	-5	China United Steel
Stainless Steel Coil	0.4*1219 SUS304/2B/Bao	Yuan/tonne	15505	15750	15850	15850	0	+100	51 stainless steel
	0.6*1219 SUS430/2B/ JISCO	Yuan/tonne	8785	8800	8800	8800	0	0	51 stainless steel
	0.6*1240 SUS201/2B/ HongWang	Yuan/tonne	9365	9400	9600	9600	0	+200	51 stainless steel
Galvanised Coil	1.2*1250 DX51D+Z/ WISCO	Yuan/tonne	4983.5	5090	5160	5160	0	+70	China United Steel
Cold-rolled coil	1.2*1250 SPCC/Han	Yuan/tonne	4262.5	4240	4180	4170	-10	-70	China United Steel
Colour coated coil	0.5*1000 TDC51D+Z/Bao	Yuan/tonne	6517.5	6550	6650	6650	0	+100	China United Steel
Enamelled steel coil	1.8*1156 BTC340R/Mei	Yuan/tonne	5850	5850	5850	5850	0	0	Baosteel Online
Petroleum	Brent Crude Oil	USD/barrel	84.24	78.37	78.89	80.07	+1.18	+1.7	Zhongyu Information
Exchange rates	Offshore Chinese yuan (CNY)	USD/CNH	7.255	7.2186	7.2584	7.265	+0.0066	+0.0464	finance website

Fig. 3. Price Trends in Bulk Material Markets[8]

Real-time deviation analysis is an important means of real-time management of budget execution anomalies, dynamically monitoring budget deviation through real-time comparison of actual budget execution data with target budget data and quickly analysing the reasons for the deviation in order to provide accurate adjust-

ment suggestions. The core of real-time deviation analysis lies in combining big data and artificial intelligence technology, capturing deviation information in budget execution in real time through efficient data processing and analysis tools, and ensuring the flexibility and timeliness of budget management. Real-time deviation analysis starts from data collection, obtains dynamic data related to budget execution such as production costs, sales revenue, inventory changes, etc., and compares these data with the established budget targets to identify the point and scope of deviation. Combined with AI algorithms, the system can quickly assess the extent and trend of deviations. For example, when a department overspends its budget, the real-time deviation analysis system can immediately flag and quantify the amount and time point of the overspend. In addition, real-time deviation analysis includes in-depth analysis of the causes of deviation. By cross-analysing multi-dimensional data, AI can reveal the specific causes of deviation, such as increased procurement costs due to supply chain delays, or reduced sales revenue due to lower market demand. This root cause analysis not only helps enterprises understand the surface of budget execution deviations, but also provides decision support for management to formulate scientific adjustment plans.

3.3 Construction of an Intelligent Decision Support System in Budget Appraisal

The multidimensional evaluation framework is a system that integrates financial, non-financial and external environment factors into the budget evaluation system in order to comprehensively and dynamically assess the performance of an enterprise. The framework is designed to integrate data from financial, non-financial and external environments in order to comprehensively and dynamically assess the performance of an enterprise's budget and the degree of achievement of its strategic objectives. Unlike the traditional single financial indicator assessment, the multi-dimensional assessment framework uses big data technology to collect, clean and analyse multiple sources of data from both internal and external sources of the enterprise in real time, and divides the key indicators into three core dimensions: financial indicators (e.g., cost control, profitability), non-financial indicators (e.g., production efficiency, equipment utilisation, innovation, employee satisfaction) and external environment indicators (e.g., market share, industry trends, supply chain fluctuations). Through artificial intelligence technology, the framework is able to analyse historical data, predict future trends and dynamically adjust the weights of each indicator, making the assessment system more flexible and adaptable. For instance, when an enterprise faces fluctuations in market demand, the framework will prioritise increasing the weighting of market-related appraisals, such as sales growth rate and customer satisfaction; and highlighting productivity and cost-control indicators when cost pressures increase. Moreover, it is based on the combination of automated adjustment mechanism, so as to realise the dynamic update and real-time feedback of assessment indicators. For example, when there are significant changes in the external market, the system will automatically identify the changes and suggest optimisation options. Through the multi-dimensional appraisal framework, manufacturing companies can not only assess operational performance more comprehensively, but also improve the scientific and

strategic matching of budget management, providing data-driven decision support for long-term sustainable development.

In budget evaluation, intelligent decision support is to improve the efficiency and accuracy of decision-making for enterprises. Traditional budget execution usually relies on manual experience and static data analysis, which has the problems of long decision-making cycle, data lag, and lack of flexibility, making it difficult to adapt to the rapidly changing market environment. And through the introduction of artificial intelligence technology and big data analysis, intelligent decision support can provide enterprises with dynamic, real-time budget optimisation solutions. The core of intelligent decision support lies in scenario simulation and optimisation analysis. Through multiple scenario modelling, the system can predict the impact of different budget adjustment options on resource allocation and enterprise performance, and help management choose the optimal decision. For example, when the market demand for a certain product line grows, the system will suggest an increase in the relevant budget based on real-time data, and at the same time cut funding support for low-priority projects to ensure efficient resource allocation. In addition, the intelligent decision support system can also automatically analyse abnormal budget execution data (e.g. cost overruns or revenue shortfalls) and propose countermeasures in combination with the positioning of the cause of deviation (e.g. fluctuations in the price of raw materials or declines in production efficiency), thus enabling rapid adjustments to be made. For example, General Electric's (GE) AI system helps GE formulate more accurate equipment maintenance budgets by predicting equipment maintenance needs, avoiding unnecessary maintenance expenditures.GE combines big data analytics and an AI recommendation system to create an intelligent budget management decision support platform. The platform reduced decision-making time for management by 30 per cent and improved overall budget management responsiveness.

4 Challenges and Countermeasures under the Digital Intelligence Transformation Strategy of Manufacturing Budget Management

In the process of promoting the digital transformation of budget management in the manufacturing industry, big data and artificial intelligence can be used to achieve a comprehensive upgrade of budget preparation, implementation, monitoring and evaluation. However, this process also faces many challenges that require targeted countermeasures to deal with.

4.1 Challenges and Responses to Budgeting under Digital Intelligence Transformation

Data quality assurance is crucial in the process of digital transformation. Data in an organisation may come from different devices, sensors, manual inputs, etc., and there are quality issues such as duplicate, missing and incorrect data. These problems directly affect budgeting, leading to inaccurate forecasts or poor decision-making.

Therefore, enterprises need to ensure the accuracy and completeness of data by establishing a data cleaning mechanism and regularly cleaning, de-duplicating and filling the collected data. At the same time, in the data collection process, unified standards and specifications are adopted to ensure uniformity in data format and quality and to reduce human error and system compatibility problems.

Second, data security and privacy breaches. Due to the centralised storage and sharing of large amounts of financial, production and supply chain data, manufacturing enterprises face the threat of data leakage. The budget management process involves a large amount of sensitive information, and once these data are inappropriately accessed or leaked, it may lead to competitors gaining access to the core secrets of the enterprise, affecting the market competitiveness of the enterprise, and even causing financial losses. Therefore, enterprises must strengthen the application of data encryption technology to ensure that all sensitive data can be effectively encrypted and protected from hackers and unauthorised access during storage and transmission. At the same time, implement a strict rights management system to manage the access rights of employees, suppliers and partners at all levels in a detailed manner to ensure that only authorised personnel can access critical data. At the same time, security measures such as multi-factor authentication are used to further enhance the security of the system.

4.2 Challenges and Responses to Digital Intelligent Budget Monitoring and Execution

Insufficient technology adaptability makes it difficult for budget management systems to fully meet the complex and changing needs of the manufacturing industry. Manufacturing budget management involves production, procurement, inventory, sales and other links, the traditional ERP system or a single budget tool may not be able to flexibly adapt to different business scenarios, resulting in data fragmentation, missing functions or insufficient scalability. And the existing hardware and software infrastructure of enterprises is often difficult to support advanced digital intelligence solutions, some old equipment can not be docked with the Internet of Things technology, data collection capabilities are insufficient, resulting in a weak data base in the budgeting process, the basis for decision-making is not comprehensive. Enterprises can take systematic introduction and integration support measures. In the introduction stage, priority should be given to selecting system solutions that can adapt to the needs of manufacturing budget management, and pay attention to its overall functional performance in budget preparation, approval, adjustment and monitoring. At the same time, ensure that the system has good scalability and compatibility, and can be seamlessly connected with existing systems to reduce the complexity of data migration and integration.

In addition, the lack of technological awareness makes employees less receptive to digital intelligence tools and less motivated to apply them. Employees in the traditional manufacturing industry are used to manual or semi-automated budget management, and there is a certain degree of resistance to the emerging digital intelligence technology, fearing that technological change will increase the workload or replace

some positions. Therefore, enterprises should adjust their recruitment strategy when introducing talents, give priority to talents with data analysis, artificial intelligence or budget management composite background, and widely recruit high-end talents with advanced budget management experience through industry forums and headhunting services to provide cutting-edge knowledge and technical support for enterprises. Enterprises should also focus on building a continuous learning and development mechanism. On the one hand, it can provide systematic training for the existing budget management personnel, on the other hand, the enterprise can implement the 'mentor system', inviting internal or external experts to provide personalised guidance for the staff to help them quickly improve their skills.

4.3 Challenges and Responses to digitised budget appraisal

The application of digital intelligence technology in budget assessment has greatly improved efficiency, but it also brings the challenge of complexity in interpreting the results of data analysis. First, the diversity and dispersion of data sources make data integration difficult, and the inconsistency of data formats and standards between different systems further increases the difficulty of interpretation; second, the results generated by advanced analytical models may have high dimensionality and depth dependence, which are difficult to be understood and applied by non-technical backgrounds, and at the same time, decision makers often need to extract key information within a limited time, which puts more demands on the efficiency and accuracy of data interpretation. This places higher demands on the efficiency and accuracy of data interpretation. To solve this problem, companies can combine visualisation tools, automated report generation and artificial intelligence to assist in the interpretation, making the results more intuitive and easy to understand. At the same time, the synergy between the finance and business departments should be strengthened, and the business logic behind key indicators should be explained by professionals, so as to ensure the operability and decision support capability of the data results.

In addition to this, poor feedback mechanisms are also important in the evaluation of digital budgets. It is mainly manifested in the untimely transmission of evaluation results, insufficient information sharing and lack of implementation of improvement measures. Such problems will lead to the assessment results can not effectively guide business optimisation, weakening the role of budget assessment to support the strategic objectives of the enterprise. The assessment results often remain at the level of data analysis, but fail to form concrete improvement plans through efficient communication and collaboration, making it difficult to close the loop. In order to solve the problem of imperfect feedback mechanism at the stage of digital budget evaluation, it is necessary to use intelligent tools to generate analysis reports in real time, and automatically push the results to the relevant departments through the digital platform to ensure the timeliness and accuracy of information transmission. The introduction of a collaborative management system promotes efficient communication between finance, operations and management, and the joint development of targeted improvement programmes. Meanwhile, the feedback results are combined with budget ad-

justment, performance appraisal and resource allocation to form a clear action plan and track its implementation.

5 Summary

This essay provides an in-depth discussion of the digital and intellectual transformation of budget management in the manufacturing industry, focusing on the analysis of the path and practice of big data and artificial intelligence in the process of optimising budget management. As the market environment faced by the manufacturing industry becomes more and more complex, the traditional budget management model has been difficult to meet the needs of high efficiency and flexibility. These problems can be well improved and optimised under the digital intelligence transformation of the manufacturing industry based on big data and artificial intelligence. In terms of budgeting, dynamic budgeting and rolling budget mechanisms are used to flexibly adjust budget targets to market changes through real-time data collection and AI forecasts, such as the dynamic budget application case of Sinopec Tianjin Branch. Secondly, in budget execution, real-time monitoring and anomaly management are achieved through BI system and visual dashboard to detect and adjust budget deviations in a timely manner, which significantly improves efficiency and transparency, such as the BI project application of Sunrise Orient. Finally, in budget evaluation, a multi-dimensional evaluation framework is constructed, combining financial, non-financial and external environment indicators, and the evaluation weights are dynamically adjusted through artificial intelligence to enhance the flexibility and accuracy of evaluation, such as the application of General Electric's intelligent decision support system. Although the transformation of digital intelligence faces challenges in data quality, technology adaptability and feedback mechanisms, these issues can be effectively resolved by strengthening data governance, system integration and talent training. In summary, the application of big data and artificial intelligence in manufacturing budget management not only improves the efficiency, flexibility and precision of budget management, but also endows enterprises with stronger market adaptability and competitiveness. In the future, with the further development of technology, digital and intelligent budget management will continue to provide solid support for the high-quality development of the manufacturing industry and become an important driving force to promote enterprises to achieve long-term sustainable development.

References

1. Decision of the Central Committee of the Communist Party of China on Further Comprehensively Deepening Reform and Promoting Chinese-style Modernisation. 2024. https://www.gov.cn/zhengce/202407/content_6963770.htm
2. Guiding Opinions on Central Enterprises Accelerating the Construction of a World-Class Financial Management System: No. 23 of SASDF's Financial Assessment Regulation [2022]. https://www.gov.cn/zhengce/zhengceku/2022-03/02/content_5676491.htm

3. Guidance on deepening the application of management accounting in a comprehensive manner.2024. https://www.gov.cn/zhengce/zhengceku/202412/content_6993093.htm
4. Cheng Ping,Chen Rui. Research on comprehensive budget management based on ChatGPT[J]. Finance and Accounting Monthly,2023,44(18):60-64.
5. Miao Yitian. Research on the integration of budget management in universities under the background of digital intelligent transformation[J]. Finance and accounting newsletter,2024,(20):168-171.
6. Wang Tao.BI analysis to help Shanxi state-owned financial digital intelligence innovation and practice[J]. Finance and Accounting,2024,(18):65-69+73
7. Cheng Huijie,Liu Hui,Li Nan. Research on the digital transformation path of enterprise comprehensive budget management[J]. China CPA, 2024,(03):102-105.
8. Sunrise Oriental:Unlocking Data Potential by Unleashing Manpower, Sunrise Oriental Moves from Traditional Manufacturing to Data Driven. 2024. https://www.fanruan.com/cases/view/?cid=526