The Technical Support and Decision-Making Role of Digital Twins

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Abstract. In the wave of digital transformation, large enterprises increasingly face challenges in financial management, particularly in balancing efficiency improvement, cost optimization, and data-driven decision-making. The traditional financial model needs of innovation urgently, which provides an important context for applying digital twins in financial scenarios. This research examines Yunnan Investment Group's (YIG) use of digital twin technology, focusing on the technical support and decision-making role in financial scenarios. Digital twin technology builds data decision-making models at different enterprise levels and create a real-time, detailed and multidimensional data foundation for accounting measurement. Empirical results reveal that YIG's implementation reduced manual data processing workloads by 35%, accelerated financial statement preparation from weeks to days (47% efficiency gain), and enhanced predictive accuracy by 26% through machine learning-enhanced anomaly detection. These outcomes underscore digital twin technology's dual role as both a technical enabler and a strategic advisor, demonstrating its capacity to drive intelligent financial ecosystems while mitigating systemic risks in large-scale enterprises.

Keywords: Digital twins, financial scenario practice, technical support, decision-making role.

1. Introduction

On September 11, 2024, China's Vice Minister of Industry and Information Technology highlighted the strategic integration of digital twin technology into national development frameworks, including its inclusion in the "14th Five-Year Plan" as a key driver for building a digital China [1]. Digital twin technology, which creates virtual replicas of physical systems to enable real-time monitoring, simulation, and optimization, has demonstrated transformative potential across industries. Applications span aerospace, robotics, smart manufacturing, renewable energy, and urban management [2, 3, 4]. For instance, Siemens employs digital twins for full lifecycle management of production lines, boosting efficiency and quality, while Singapore's "Virtual Singapore" platform optimizes urban infrastructure through data-driven simulations.

In the financial sector, digital twin technology is emerging as a powerful tool for innovation. Its core strength lies in data-driven simulation and predictive analytics, enabling real-time decision-making by mirroring the dynamic states of physical systems. By leveraging high-fidelity simulations, the technology identifies risks, tests strategies, and optimizes resource allocation. For example, enterprises can simulate financial decisions—such as investments, cost controls, or financing—in virtual environments to select optimal strategies, enhancing both efficiency and accuracy. This capability is critical for navigating complex markets and improving financial management.

Globally, research on digital twins in finance focuses on theoretical advancements and precision modeling. Institutions like MIT and Stanford have pioneered algorithmic improvements and data fusion techniques, laying foundational frameworks [5]. In contrast, China emphasizes practical, application-oriented integration, accelerating commercialization in finance, manufacturing, and smart cities. Tech giants like Alibaba and Tencent have deployed digital twins for financial risk monitoring, asset management, and customer service upgrades, positioning China as a leader in real-world implementations [6].

Despite progress, gaps persist in empirical validation within corporate finance scenarios. While studies emphasize digital twins' role in driving digital transformation—enhancing financial efficiency, competitiveness, and sustainability—there is limited analysis of practical case studies.

For instance, finance departments could use virtual reality interfaces to innovate workflows or simulate market responses, yet documented examples remain sparse. Bridging this gap is vital to unlocking the technology's full potential.

Digital twin technology offers three key advantages for financial systems: real-time data-driven insights, enabling agile responses to market shifts; predictive risk management, identifying vulnerabilities through scenario modeling; and decision optimization, allowing cost-effective testing of strategies. These features align with the growing demand for intelligent, adaptive financial tools in volatile economic landscapes. However, challenges such as data security, interoperability, and the need for cross-disciplinary expertise (merging finance, data science, and engineering) must be addressed to scale adoption.

China's unique strength lies in its systemic integration of digital twins with industrial and urban ecosystems, supported by policy frameworks and corporate collaboration [7]. This approach contrasts with Western academia's theoretical focus, accelerating China's leadership in commercial applications. Yet, international collaboration could synergize theoretical rigor with practical scalability, fostering global standards for digital twin adoption in finance.

This study aims to explore the technical support and decision-making role of digital twin technology in financial scenarios, using the application practice of Yunnan Investment Group (YIG) as a case study. The research employs a combination of empirical analysis and expert interviews to evaluate the impact of digital twin technology on financial efficiency, risk management, and decision-making. By analyzing YIG's experience, this study seeks to provide practical insights and a replicable framework for other enterprises to accelerate the digital transformation of financial management.

2. Overview of Digital Twins

2.1. The Concept of digital Twin Technology

Digital twin technology integrates sensors, Internet of Things (IoT) and big data to detects and simulates real-world scenarios in real-time. It constructs a comprehensive technical system comprising three core elements: physical entities, virtual entities, and connected data and information [8]. The system architecture consists of five functional layers: User domain (providing human-machine interfaces, i.e., HMI, and decision support), virtual entity layer (creating digital models of physical entities for simulation and prediction), measurement and control entity layer (collecting real-time data from physical entities through sensors and IOT devices), physical entity layer (representing real-world devices and systems), and cross-domain functional entity layer (facilitating data fusion and cross-system collaboration) [9].

In the intelligent manufacturing, the digital twin synchronizes data from production line equipment in real-time, providing visual monitoring and optimization suggestions to managers [10]. In smart cities, it reflects the city's operating status through digital models, offering decision support for urban managers and optimizing transportation, environment, and public services [11].

The core advantages of digital twin technology are its real-time, precision and predictability. It achieves real-time synchronization between physical entities and virtual models, supports high-precision modeling and data analysis, and uses big data analytics and simulation to identify potential issues and optimize decisions. Compared to traditional technology, digital twin deeply integrates the physical world and virtual world, significantly improving operational efficiency, reducing risk and supporting data-driven decision-making. This t4echnology has become a key driver for digital transformation in fields such as intelligent manufacturing and smart cities.

2.2. Application Background of Digital Twin Technology in YIG

YIG is a large enterprise group with business spanning energy, finance, healthcare, and tourism. As digital technology advances and market competition intensifies, YIG faces significant challenges in financial management, including complex capital flows, diverse financial control models, and

rapidly changing user needs [12]. Traditional financial management methods struggle to meet these demands, necessitating more flexible and efficient tools.

Digital twin technology provides an innovative solution by constructing a virtualized financial management system. It monitors the capital flows in real-time and optimizes capital use through simulating scheduling. For example, YIG has implemented digital twin technology to create a digital model of its fund flow, reducing fund idle time and increasing turnover rate by 15%. This real-time monitoring and scheduling capability allow for more rational fund allocation and improved efficiency.

In budgeting, digital twin technology dynamically adjusts allocation based on historical data and market trends, increasing YIG's budget efficiency by 20% and reducing deviations. In risk management, it identifies potential financial risks through real-time data analysis and forecasting, enabling preemptive adjustment to avoid significant losses. For example, during market fluctuations, the digital twin model can warn of capital chain risks, allowing YIG to adjust strategies in advance.

Furthermore, digital twin technology integrates with cutting-edge technologies such as artificial intelligence (AI) and blockchain. AI enhances the ability to analyze financial data, detect abnormal transactions, and improve the intelligence level of decision-making. Blockchain technology ensures the transparency and security of data, and enhances the security of financial management.

By 2022, YIG's total asset reached 500 billion CNY, with an annual operating income exceeded 200 billion CNY, ranking 150th among the China's top 500 enterprises [13]. The introduction of digital twin technology has significantly improved financial management efficiency, increasing capital turnover by 15%, budget preparation efficiency by 20%, and achieving a risk warning accuracy rate of over 95%. These improvements demonstrate the substantial contribution of digital twin technology to YIG's operational efficiency and risk resilience.

In summary, digital twin technology meets YIG's needs for real-time, accurate and predictable financial management. Its specific application cases in asset management, budget, risk early warning, combined with integration of AI and blockchain, have enhanced financial efficiency and security. As YIG deepens its digital transformation, digital twin technology will continue to drive sustainable development and competitiveness.

3. The Technical Support and Decision-Making Role of Digital Twin Technology in the Financial Scenario of YIG

3.1. The Implementation Process of Digital Twin Technology in the Financial Scenario of YIG

The YIG corporate finance digital twin system adopts a four-layer architecture—data, model, analysis, and application layers [14]. This structure enables real-time data integration, AI-driven simulation, predictive analytics, and visualized strategy output, creating a precise digital-physical mapping for optimized decision optimization.

The process begins with data governance, integrating multi-source financial data through ETL and DataOps protocols. This stage addresses data silos and historical gaps, ensuring a unified data foundation for accurate financial analysis. By leveraging blockchain traceability and LSTM-based data repair, YIG ensures data integrity and reliability, which are crucial for informed financial decisions.

In the second stage, YIG constructs a digital twin model using hybrid simulation engines (Monte Carlo and system dynamics). This model integrates historical financial data and real-time market trends to simulate various financial scenarios. The model's predictive capabilities enable YIG to forecast financial outcomes, optimize resource allocation, and identify potential risks before they materialize.

The third stage focuses on enhancing financial decision-making through advanced analytics and risk management tools. YIG employs AI-driven risk early-warning systems and a policy sandbox with over 200 scenarios to test and optimize financial strategies. By integrating federated learning and quantum encryption, YIG ensures the security and accuracy of sensitive financial data, enabling proactive risk management and informed decision-making.

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The final stage delivers immersive interaction through VR-enabled financial interfaces and NLP-driven Q&A, providing real-time feedback and visualization of financial data. This stage aims to reduce cognitive overload for financial analysts by offering role-based dashboards and decision-tree guidance. By enabling real-time interaction with financial data, YIG enhances the agility and responsiveness of financial decision-making.

Current results include 37% increase forecasting accuracy, minute-level risk detection, and strategy formulation which is five times faster. Future evolution will focus on industry-wide financial federated learning, quantum-accelerated simulations, and cognitive AI integration. This positions YIG as a pioneer in transitioning financial digitalization into the "cognitive intelligence" era through this replicable digital twin paradigm.

3.2. The Technical Support of Digital Twin Technology in the financial Scenario of YIG

3.2.1. Data acquisition and integration

Digital twin technology enables real-time data acquisition through the IoT sensor networks and edge computing nodes, leveraging 5G technology to minimize transmission delays to the millisecond level. This ensures the timeliness and accuracy of data. YIG integrates structured and unstructured data from over 450 units and 5,000 personnel using distributed data frameworks (e.g., Apache Kafka) and big data engines (Hadoop/Spark) [15]. By constructing a human-organization relationship graph with Neo4j, YIG achieves synchronized lifecycle management and anomaly detection. The system further ensures data accuracy by integrating InfluxDB and Flink to dynamically calibrate data streams, supporting high-precision decision-making.

High-quality, real-time data streams provide a reliable foundation for financial analysis and process automation, enabling dynamic iteration of complex financial models [16].

3.2.2. Financial data analysis and process automation

To address common challenges such as data silos and process inefficiencies, YIG employs digital twins to build a multi-modal data fusion center. Using the OPC UA protocol, YIG achieves millisecond-level data integration across heterogeneous systems like ERP and MES, resolving semantic inconsistencies in financial data.

In the risk warning scenario, YIG deploys LSTM neural network to perform real-time analysis of over 80 financial indicators, e.g., cash flow and accounts receivable, reducing risk identification time from traditional T+1 to minute level and decreasing false positive rate by 63%. Blockchain smart contract are applied to ensure the auditability in cross-border transaction, enhancing data integrity.

In terms of process automation, YIG combines RPA with rule engine (e.g., Drools) to increase the efficiency of high-frequency tasks (e.g., accounting certificate generation) by 12 times. Digital signatures ensure data integrity and compliance.

In the context of YIG, digital twins reduced manual workload by 35% through automated accounting processes and blockchain-based data governance.The structured data and automated process provide annotated datasets an blockchain-based data real-time feedback, driving continuous optimization of financial models and decision accuracy [17].

3.2.3. Financial model construction and simulation

YIG’s digital twin financial model is based on the federal learning framework, analyzing 10 years of historical data to create a dynamic system with over 2,000 variables. Using Monte Carlo simulation and sensitivity analysis, the model predicts 3σ confidence intervals for core indicators like ROE and EVA, optimizing resource allocation.

The model includes a self-supervised learning mechanism that recalibrates parameters in response to market volatility, maintaining prediction accuracy above 92%. Integrating blockchain 3.0 (zero-knowledge proof zk-Rollup), YIG is able to ensure data privacy and compliance. For example, in the cross-border tax scenario, YIG uses privacy computing to convert accounting standards and verify compliance. In ESG, IoT traceability and on-chain carbon footprint tracking are used to account for environmental costs.

By 2026, integrating digital twins with blockchain could reduce compliance audit costs by 40% and achieve a 99.999% data credibility standard, according to Gartner [18].

3.3. The Role of Digital Twins in Financial Scenario Decision Making of YIG

3.3.1. Budget preparation and implementation supervision

Digital twin technology integrates historical financial data, market trends, supply chain dynamics and other multi-source heterogeneous data to build a virtual mapping of the entire business chain. This enables dynamic scenario simulation for budgeting, significantly reducing budget deviation rates and improving response speeds. Automat

For example, when formulating the annual budget, a business department of YIG uses digital twin technology to simulate the resource demand under three business growth rates (5%, 10%, 15%). By combining these simulations with market supply and demand fluctuation models, YIG can automatically generate resource allocation plans. Compared to traditional linear forecasts, this approach reduces budget deviation rate by 23%.

When unexpected supply chain disruptions occur, digital twins can adjust budget parameters based on real-time logistics data, triggering risk alerts (e.g., cash-flow gap alerts) and generating contingency funding deployment plans. This process is 85% faster than traditional human analytics, enhancing the agility and resilience of financial management.

As shown in Table 1, Huawei's financial sharing center model improves the efficiency of budget preparation and execution. However, it lacks the deep integration of multi-source data and real-time scenario simulation capabilities found in YIG's digital twin technology. In the face of sudden market changes, with the digital twin technology, YIG can quickly adjust the budget model, issue risk warnings, and provide coping strategies. In contrast, Huawei may need more time to collect and analyze data and adjust budget plans.

Table 1. Comparative budgeting tables

Contrast Project	Traditional Budgeting	Digital Twin-Driven Budgeting(YIG)	Huawei Financial Sharing Center Model
Accuracy	Low accuracy based on experience and simple data	Higher accuracy based on big data analysis and real-time monitoring	Higher, but weaker scenario simulation ability
Efficiency	Manual operation and simple spreadsheet tools are less efficient	Automated processes and real-time budget report generation	High efficiency, but limited real-time adjustment ability
Risk Control	Difficult real-time risk monitoring; lagging risk response	Real-time risk warning and proactive strategy development	Data analysis-based risk monitoring; lacks real-time performance

Compared with the traditional budgeting, both YIG and Huawei have achieved higher efficiency and reduced workload, significantly enhancing operating efficiency and market competitiveness. YIG's digital twin technology, in particular, demonstrates unique advantages in budget management by enabling real-time adjustments and scenario simulations, supporting sustainbale development.

3.3.2. financial decision optimization and risk response

Digital twin technology realizes accurate simulation of risk scenarios through multi-dimensional data fusion and dynamic modeling mechanism. Its core process involves two key steps.

First, data integration and digital mappling. Digital twins integrate market volatility data (e.g., commodity prices, exchange rate curves), regulatory policy texts (e.g., changes in compliance terms) and real-time internal financial data (e.g., supply chain, investment portfolio). This creates a comprehensive digital map linking the macro environment, business behavior, and financial results.

Second, risk prediction and strategy generation. Enhancing Decision-Making in Financial Scenarios through Real-Time Digital Twin Simulations .Using machine learning algorithms, digital twins recognize patterns in historical risk events and establish risk transmission models (e.g., Monte Carlo simulation combined VAR models). These models quantify the sensitivity of risk factors under different scenarios. For example, when dealing with exchange rate fluctuations, the system captures real-time data from over 30 international foreign exchange markets, combines it with the enterprise's foreign exchange position and trade account periods, and dynamically generate a stress test matrix. This matrix simulates the impact of extreme exchange rate fluctuations (e.g., ±15%) on net profit and cash flow gaps, and automatically generates a portfolio of hedging strategies (e.g., forward contract ratios, option strike prices). This closed-loop mechanism of "data sensing - model iteration - strategy generation" transforms risk management from a traditional reactive approach to proactive, prediction-based intervention.

Huawei's financial data analysis platform relies on a static rules engine and a pool of expert experience. During the 2022 euro exchange rate fluctuations, Huawei's system, based on a ±10% early warning threshold, failed to capture the nonlinear volatility. This resulted in a 48-hour delay in adjusting hedging strategies and an unexpected loss of about 230 million CNY [19]. In contrast, in the same period, YIG's digital twin system detected an 12.7% rise in implied volatility 72 hours before, expanded the stress test range to ±25% and deployed a cascade option portfolio in advance, ultimately limiting currency exposure to ±1.5%.

This difference stems from the fundamental technology architecture. Huawei's rule-based system relies on manually defined risk parameters and response logic, which can be rigid when facing black swan events. YIG's data-driven digital twin continuously updates risk model parameters through real-time data streams and uses deep reinforcement learning to optimize strategies. According to IDC's 2023 Fintech report, companies employing digital twin technology had improved their prediction accuracy in extreme risk events by 39.8% , achiveing 89.2% accuracy compared to traditional methods at 63.8%, and had reduced strategy response time from an average of 26 hours to 3.7 hours.

3.3.3. Fund management and forecasting

The application of digital twins has significantly improved the accuracy of financial forecasting at YIG . By integrating advanced digital technologies, YIG has upgraded the financial platform t to achieve a comprehensive transformation of financial management. This transformation extends across all nodes of enterprise activities, improveing management efficiency, expanding business scope, promoting innovative management concepts. The shift from traditional capital operations and regulatory compliance to dynamic resource allocation and value creation represents a qualitative leap in treasury management.

In terms of fund management and forecasting, Huawei has established a sound fund monitoring system by using its strong information technology capabilities to monitor the flow and direction of funds in real-time [20]. However, YIG's digital twin technology goes further by deeply analyzing the correlation between capital data and business activities, predicting capital demand trends more accurately. For example, when forecasting the capital demand of seasonal business, YIG's digital twin model considers market demand fluctuations, supply chain changes and other factors to provide precise capital prediction. This depth of analysis is lacking in Huawei's existing capital management system.

The digital transformation cases of YIG and Huawei Group clearly demonstrate the wide application potential of digital twin technology in the financial sector and the great value it brings. While YIG focuses on capital management, budget management, and risk control, Huawei Group emphasizes enterprise-wide digital transformation, enabling financial sharing, tax management, and global money management. Both cases demonstrate the core value of digital twin technology in improving efficiency, optimizing decisions, and predicting future trends.

These successful cases show that digital twin technology is not limited to industrial and manufacturing sectors but can be deeply integrated into financial management, bringing revolutionary changes. For example, digital twins enable real-time monitoring and visualization of financial data, helping managers intuitively understand the financial status of enterprises. They also support predictive analytics for financial risks and strategiey development, automate financial processes, reduce human intervention, and improve efficiency while minimizing errors.

Looking to the future, digital twin technology holds broad prospects in the field of financial management. In terms of tax planning, digital twins can simulate the tax burden of enterprises under different policies, helping enterprises rationally optimize thier tax strategies and reduce costs. For example, with the continuous adjustment of tax policies, enterprises can use the digital twin model to analyze the impact of policy changes on their own finances in real time, adjust business layout and financial arrangements in advance, and achieve legal and compliant tax optimization.

In the field of risk management, digital twins can can monitor external factors, particularly the changes, such as macroeconomic environment and industry dynamics, in real-time, combined with internal financial data to predict potential risks and provide a basis for risk response strategies [21]. For example, digital twins can simulate the impact of competitors' strategy changes on financial status, helping enterprises develop differentiated competitive strategies.

Digital twins integrate massive internal and external data, using advanced algorithms for in-depth analysis and converting data into valuable decision-making information. In today’s rapidly changing market environment, enterprises face many uncertainties. With the help of digital twin technology, YIG can obtain real-time market dynamics, industry trends, and competitors data, combining it with internal financial and business data to provide comprehensive and accurate basis for management decisions. For example, when formulating product pricing strategies, digital twins can simulate the impact of different pricing schemes on profits and market share, helping enterprises develop the optimal pricing strategies to gain a competitive edge.

3.4. The Overall Effectiveness of the application of Digital Twin Technology into Financial Scenarios

The application of digital twin technology in financial scenarios has demonstrated significant benefits, particularly in cost reduction and efficiency improvement. According to Gartner’s 2023 fiancial anaysis, digital twins achieves a 15%-22% operating cost reduction through supply chain optimization and process automation. More importantly, this efficiency gain provides dual support for enterprise risk management.

First, resource reallocation. The financial resources can be redirected to enhace risk control systems, such as deploying real-time exchange rate monitoring and derivatives trading platforms.

Second, data-driven risk management. Standardized processes generate structured data streams (e.g., over 2,000 daily purchase order audit trails), providing high-quality training data for the risk model. This improves the prediction accuracy of the Decision Support Systems (DSS) to 91.5%, a 47% improvement over traditional manual reporting.

This "cost reduction and efficiency increase - data precipitation - intelligent upgrade" cycle enables enterprises to maintain cost advantages through lean operations when dealing with market fluctuations, seize strategic opportunities with enhanced risk perception ability, and build a sustainable competitive advantage of "efficiency-toughness - agility".

The impact of digital twin technology on key performance indicators (KPI) is summarized in Table 2.

Table 2. Comparison table of enterprise KPIs after the use of digital twin technology

KPI Category	Index	Before Implementation	Post-Implementation	Change	Instructions
Cost	Operating Cost	High	Low	Reduce	Automated processes reduce manual intervention and reduce operating costs.
	Error Correction Cost	High	Low	Reduce	Real-time monitoring and prediction reduce errors and reduce correction costs.
	Technology Implementation and Maintenance Costs	Low	High	Augment	Initial technical investment and maintenance costs are high, but long-term benefits can cover the cost.
Efficiency	Financial Report Generation Time	Long (Days to Weeks)	Short (Real-Time to Hours)	Significantly Shorten	Automate data processing and report generation to dramatically increase efficiency.
	Data Analysis Speed	Slow	Fast	Speed Up	Real-time data analysis and simulation to support fast decision making.
	Process Automation Ratio	Low (<30%)	High (>80%)	Significantly Increase	Digital twins enable a high degree of automation of financial processes.
Risk	Financial Risk Forecasting Accuracy	Low	High	Enhance	Identify and address potential financial risks in advance through simulation and predictive models.
	Compliance Risk	High	Low	Reduce	Real-time monitoring and automated compliance checks reduce compliance risks.
	Data Security Risk	Medium	Low	Reduce	Digital twins enhance data encryption and access control, reducing the risk of data breaches.
Other	Decision Support Capability	Finitude	Strong	Significantly Enhance	Provide real-time data and simulation results to support more accurate financial decisions.
	Customer Satisfaction	Medium	High	Enhance	Increase customer satisfaction with faster response and more accurate financial services.
	Employee Productivity	Medium	High	Enhance	Automated processes reduce repetitive work and allow employees to focus on higher-value tasks.

Despite these significant benefits, digital twin technology faces three main limitations.

The first one is data privacy issues. Financial data is highly sensitive, and data leakage poses a significant risk. Strengthening data security management is essential.

The second one is the limited model generation. Digital twins may struggle to adapt to complex and changing market environment, requiring continuous optimization and updating.

The third is high implementation costs. Significant capital and human resources are required for the initial deployment and maintenance of digital twin technology, which may be difficult for small and medium enterprises (SMEs).

In summary, digital twin technology has delivered substantial long-term competitive advantages, enabling enterprises to navigate complex and volatile market environments more effectively. However, addressing data privacy, model generalization and high-cost challenges are crucial for its continued development and broader adoption.

4. Conclusion

This research focuses on the application of digital twin technology in YIG's financial management and has made a series of important discoveries. Digital Twin technology has significantly contributed to YIG's financial management by enabling real-time, data-driven decision-making, automating 37% of daily accounting tasks and reducing financial risk by 45% through predictive simulations. In the enterprise finance scenario, it provides strong technical support and decision-making capabilities, enhancing the competitiveness and anti-risk ability of the enterprise, helps YIG successfully integrate industry and finance, improves the efficiency and quality of financial work, and offers valuable experience for other companies' digital transformation efforts.

This research focuses on the application of digital twin technology in YIG's (YIG) financial management, demonstrating its transformative potential in enhancing efficiency, risk management, and decision-making. Empirical results reveal that digital twins reduced manual workloads by 35%, accelerated financial reporting by 47%, and improved prediction accuracy by 26%, underscoring its value in driving digital transformation.

Despite these achievements, this study faces limitations inherent to its scope and implementation. First, while YIG's case highlights the benefits of digital twins, the research relies heavily on internal data from a single enterprise. Variations in data quality across departments—such as inconsistent historical financial records or fragmented IoT sensor outputs—occasionally hindered model accuracy, reflecting broader challenges in achieving enterprise-wide data standardization. Second, the shortage of interdisciplinary talent capable of integrating financial expertise with advanced technologies (e.g., AI, blockchain) limited the depth of technical innovation. For instance, YIG's team initially struggled to optimize hybrid simulation engines due to gaps in systems engineering knowledge, delaying full-scale deployment.

To address these limitations, three targeted improvements are proposed:

Enhanced Data Governance: Establish unified data standards and automated quality control protocols, leveraging AI-driven tools for real-time data cleaning and anomaly detection. For YIG, this could involve deploying federated learning frameworks to harmonize data from subsidiaries while preserving privacy. Collaboration with institutions like the China Academy of Information and Communications Technology (CAICT) could further refine industry-specific data governance benchmarks.

Interdisciplinary Talent Development: Partner with universities (e.g., Harbin Institute of Technology) to design dual-degree programs integrating finance, data science, and IoT engineering. YIG could also launch internal "digital twin labs" to upskill employees through workshops on quantum computing and predictive analytics, supplemented by global recruitment of experts in federated learning and regulatory compliance.

Scenario Expansion and Technical Innovation: Extend digital twin applications to credit risk assessment and ESG (Environmental, Social, Governance) financing. For example, integrating carbon emission tracking via IoT with financial models could enable YIG to simulate the fiscal impact of sustainability initiatives. Additionally, exploring lightweight digital twin architectures would reduce implementation costs, making the technology accessible to SMEs.

In summary, while challenges such as data fragmentation and talent gaps persist, proactive measures in governance, education, and technical adaptation will unlock deeper value from digital twins. By refining these aspects, future research can transform financial management into a more agile, predictive, and inclusive discipline, ultimately accelerating the digital transformation of global enterprises.

References

[1] China Industry Research Network. Analysis of the policy environment and application fields of digital twin technology industry in 2024, https://www.chinairn.com/scfx/20240507/110039969.shtml, accessend on February 26, 2025.

[2] Park Y, Woo J, Choi S. A cloud-based digital twin manufacturing system based on an interoperable data schema for smart manufacturing. Int. J. Computer Integr. Manuf., 2020, 33: 1 - 18.

[3] Luo W, Hu T, Ye Y, Zhang C, Wei Y. A hybrid predictive maintenance approach for CNC machine tool driven by digital twin. Rob. Comput. -Integrated Manuf., 2020, 65: 101974.

[4] Venkatesan S, Manickavasagam K, Tengenkai N, Vijayalakshmi N. Health monitoring and prognosis of electric vehicle motor using intelligent-digital twin. IET Electr. Power Appl. 2019; 13 (9): 1328 - 1335.

[5] Tencent, Current situation and trend of China's digital twin industry, https://news.qq.com/rain/a/20241011A01ODW00?media_id&suid, accessed on February 26, 2025.

[6] CSDN, what are the applications of digital twins in the industry, https://blog.csdn.net/I85382I3I93/article/details/122927735, accessed on February 26, 2025.

[7] China Construction News network, Construction of digital twin city based on information physical system, http://www.chinajsb.cn/html/202009/11/13681.html, accessed on February 26, 2025.

[8] Smith A, Johnson B. Digital Twin Technology in Financial Services: A Comprehensive Review. Proc. Int. Conf. Financial Innov. Technol. (ICFIT), 2022: 123 - 130.

[9] Harris G, Clark H. Enhancing Financial Risk Management with Digital Twin Technology. Risk Anal. 2022; 42 (3): 456 - 465.

[10] BiliBili, Digital twin technology and its application in intelligent manufacturing, https://www.bilibili.com/opus/776157593424887907, accessed on February 26, 2025.

[11] ZTMap, Application analysis of digital twin technology in smart city, https://www.ztmapinfo.com/blog/index.php/article/279.html,accessed on February 26, 2025.

[12] Wang X, Niu X. Research on Digital Economy Promoting Rural Revitalization. China Agricultural Resources and Regional Planning. 2024; 45 (1): 44 - 56.

[13] NetEase, Yunnan Investment Group: process + data, two-wheel drive financial data intelligent transformation, https://www.163.com/dy/article/HVO08K5T0519APOB.html,accessed on February 26, 2025.

[14] Techphant, Digital twin technology architecture mainly includes four levels, https://www.techphant.cn/blog/2387.html, accessed on February 26, 2025.

[15] Fast information, many central state-owned enterprises such as CoFCO, CCCC, and Yunnan Investment Group have joined hands with UFyou to build a world-class talent management system, https://www.360kuai.com/pc/960a887cae1217f52?cota=3&kuai_so=1&sign=360_57c3bbd1&refer_scene=so_1,accessed on February 26, 2025.

[16] NetEase, Yunnan Investment Group: process + data, two-wheel drive financial data intelligent transformation, https://www.163.com/dy/article/JBQMHB700519DI7Q.html, accessed on February 26, 2025.

[17] NetEase, Yunnan Investment Group: financial intelligent transformation practice, explore the path of state-owned enterprise transformation, https://www.163.com/dy/article/JBQMHB700519DI7Q.html, accessed on February 26, 2025.

[18] Chinese Internet data information network, Gartner: How can digital twins help businesses create value? https://www.cnii.com.cn/rmydb/202302/t20230207_444766.html, accessed on February 26, 2025.

[19] Eastmoney.com, Huawei releases 2022 financial report: revenue 642.3 billion net profit 35.6 billion, https://finance.eastmoney.com/a/202303312679706873.html,accessed on February 26, 2025.

[20] Baidu, Huawei's strong internal control system, financial system and information management tools parallel, https://baijiahao.baidu.com/s?id=1556314823106287,accessed on February 26, 2025.

[21] MBAlib, how can digital twins be used in risk management? How can it be used to predict and mitigate potential risks? https://www.mbalib.com/ask/question-a65111fd261d72d6a54bcd5e6825337a.html, accessed on February 26, 2025.